BOOK OF
PROCEEDINGS

Fifth International Scientific Agricultural Symposium

"Agrosym 2014"

AGROSYM 2014

Jahorina, October 23 - 26, 2014

Impressum

Fifth International Scientific Agricultural Symposium „Agrosym 2014"

Book of Proceedings

Published by
University of East Sarajevo, Faculty of Agriculture, Republic of Srpska, Bosnia
University of Belgrade, Faculty of Agriculture, Serbia
Mediterranean Agronomic Institute of Bari (CIHEAM - IAMB) Italy
International Society of Environment and Rural Development, Japan
Balkan Environmental Association, B.EN.A, Greece
Academy of Engineering Sciences of Serbia, Serbia
Maize Research Institute „Zemun Polje" Serbia
Biotehnical Faculty, University of Montenegro, Montenegro
Balkan Scientific Association of Agricultural Economics, Serbia
Institute of Agricultural Economics, Serbia
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http://www.agrosym.rs.ba

Fifth International Scientific Agricultural Symposium "Agrosym 2014"
Jahorina, October 23-26, 2014, Bosnia and Herzegovina

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Foreword

The current agro-food system failed to feed the world population and to eradicate rural poverty. The environmental and social problems caused by such an agricultural production model are well known and widespread. The most dramatic environmental damage is caused by climate change, loss of biodiversity and ecosystem functions, soil erosion and degradation, and pollution from fertilizers and pesticides.

Climate change, population growth and competing demands for land and resources are putting great pressure on the world's food systems. The world's population is set to reach nine billion by 2050. To feed them it is needed to produce 70% more food, and do so without destroying our environment. The successful management of agricultural resources for meeting the changing human needs, while maintaining or enhancing the quality of the environment and conserving natural resources, is imperative for a stable food production.

Agriculture is at the core of sustainable development. Ecological agriculture, agroecological practices and sustainable agricultural production are alternative farming methods to address the environmental consequences of conventional agriculture dependent on intensive chemical inputs. Sustainable agriculture is not only a technological solution but also an approach that embodies a shift in agricultural paradigms. Sustainable food systems should integrate the economic, social and environmental dimensions of sustainable development.

Appropriate agricultural and rural development strategies in the Balkan area and beyond should ensure food and nutrition security - through the sustainable and eco-functional intensification of crop and animal production systems - while conserving the natural resource base. They should also contribute to the eradication of rural poverty and improvement of livelihoods and quality of life of rural populations.
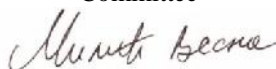
Innovative and responsible measures - based on sound and accurate scientific knowledge - are required to respond to the multiple food-related challenges of the New Millennium in a resource-constrained world. During four days; October 23-26, 2014; the 5th International Scientific Agricultural Symposium "AGROSYM 2014" made an important contribution to the improvement of knowledge in agriculture, environment and rural development fields. In fact, 430 contributions were presented by scientists from 56 countries (Albania, Algeria, Australia, Austria, Azerbaijan, Belarus, Belgium, Benin, Bosnia and Herzegovina, Bulgaria, Burundi, Burkina Faso, Cameroon, Croatia, Czech Republic, Egypt, Germany, Ghana, Hungary, Greece, India, Indonesia, Iran, Iraq, Italy, Japan, Kazakhstan, Latvia, Lithuania, Republic of Macedonia, Mauritania, Montenegro, Morocco, Nepal, Niger, Nigeria, Norway, Pakistan, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Serbia, Slovenia, South Africa, Spain, Syria, Sweden, Switzerland, Tajikistan, Thailand, The Netherland, Tunisia, Turkey, Vietnam). This publication comprises 180 accepted full papers while selected papers will be published in the International Journal "Agriculture and Forestry".

The success of the symposium was made possible thanks to the unconditional commitment and invaluable contributions of a wide range of partners and sponsors. Much appreciation is due to the authors of all papers submitted to and presented at the symposium, the reviewers for their sound comments and feedback as well as to all the symposium participants for ideas, insights and contributions.

Academician Dusan Kovacevic	Prof. Vesna Milic	Mr. Cosimo Lacirignola
President of the Scientific Committee	President of the Organization Committee	Director, MAIB Secretary General, CIHEAM

KEYNOTE PAPERS

THE WATER- ENERGY-FOOD SECURITY NEXUS IN THE MEDITERRANEAN: CHALLENGES AND OPPORTUNITIES

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Abstract

The water-energy-food security nexus is now receiving consensus and attention of both political and technical experts. Indeed, the World Water Day 2014 was mainly on this topic. Although, some of the biggest challenges the world is facing hinge on the growing scarcity and allocation of resources vital to sustaining life-water energy and food. Food, water and energy security are finally being recognized as the most important national and international security issues. Understanding the complex relationship between water, energy and food systems has become critically important to the development of a sustainable and secure future for all nations and regions. This was clearly highlighted at the Bonn 2011 nexus conference held in the preparation for the United Nations (UN) Rio +20 Conference which brought to light the need to address sustainability issues in the closely related sectors of water, energy and food security. In this regards, the question to be raised concerning water-energy-food nexus is where are we now? This will bring us to several crucial questions which technically and politically are wide bargaining and serious discussion including the following: (i) Nexus thinking has been around for a while now, but is it really joined up enough yet? (ii) Do we have enough data points to catalyze action? (iii) How are organizations tackling interconnected resources challenges and what are the concrete examples of scenario planning collaboration or programmes in place? (iv) Could the move towards valuing natural capital help accelerate nexus thinking and policy making?
In this paper evidence will be given that if the food, water and energy connection remain unaddressed, global food security will not be achieved increasing poverty and environmental degradation.

Key words: *Water-Energy-food nexus, Security, Sustainable development, Mediterranean*

Introduction

Global trends such as population growth and rising economic prosperity are expected to increase demand for energy, food and water which will compromise the sustainable use of national resources. Besides positive effects, this pressure on resources could finally result in shortage which may put water, energy and food security for the people at risk, hamper economic development, lead to social and geopolitical tensions and cause lasting irreparable environmental damage.

Bonn (2011) conference considers that achieving water energy and food security and consequently reducing hunger and eradication poverty, is a central future challenge that is possible even under difficult and challenging global economic conditions. This has opened up a global debate on the importance of the nexus on water, energy and food security and the need for interlinked thinking and action fields for sustainable development including the following three dimensions (Hoff, 2011):

- The social dimension- accelerating access, integrating the bottom of the pyramid.
- The economic dimension- creating more with less
- The ecological dimension- investing to sustain ecosystem services.

By the year 2050 with the expected global population 9.2 billion demands for water, energy and food will increase exponentially. Therefore projections of a 70% increase in agricultural demand by 2050 and energy demand of 40% by 2030, water needs to satisfy agriculture and energy production is projected to be the double of what is available now. In the meantime, the world is reaching, and in some cases had already exceeded the sustainable limit of resource availability and is at risk. The global demand and supply assessments predict significant shortfalls in water and food in future. Those are the nexus challenge. The raised question do we have the integrated solutions to satisfy the tremendous future demands of water, food and energy. This cannot be easily done without having the appropriate enabling conditions which needs major work towards finding the solutions to the existing problems mainly related to weak governance systems, limited awareness, and distortions from perverse subsidies and unsustainable investments. Those factors and others related to the non efficient use and mismanagement of the resources can exacerbate a set of unintended consequences and contradictory outcomes. The current situation shows the need to build on more innovative solutions to achieve water, energy and food security.

The nexus

- Water-energy-food nexus

The nexus has emerged as a key concept to describe the complex and interrelated of our global resource systems, on which we depend to achieve different, often competing development goals. In practical terms, it presents a conceptual approach to better understand the interactions between the natural environment and human activities and to work towards a more coherent approach to natural resources management vis-à-vis our social, economic and environmental goals. This can help us to identify and manage trade-offs and to build synergies through our response options, allowing for more integrated and cost-effective planning, decision-making, implementing, monitoring and evaluating (McCornick *et al.*, 2008; OECD, 2011).

It is important to note that there are different conceptualizations of the nexus that vary in their scope, objectives and understanding of divers. Several concepts, frameworks and methodologies have looked at the inter-linkages between water, energy and food (Mohtar and Daher, 2012; ADB, 2013; Bizikova *et al.*, 2013; UN-ESCAP, 2013).

The case of nexus thinking has been around for a while now, but is it really joined up enough yet? Do we have enough data points to catalyze action? How are organizations talking recommended resource challenges and what are the concrete examples of scenario planning, collaboration, or programmes in place? Could the move towards valuing natural capital help accelerate nexus thinking and policy making?

- Nexus approach

It is a holistic vision of sustainability that tries to balance different development goals by managing trade-offs and exploring opportunities for synergies in light of growing demand for resources and other key drivers. It recognizes the incremental value of natural environment to humans. Improved water, energy and food security on a global level can be achieved through a nexus approach- an approach that integrates management and governance across sectors and scales. It highlights the interdependence of water, energy and food security and the natural resources that underpin that security-water, soil and land (figure 1).
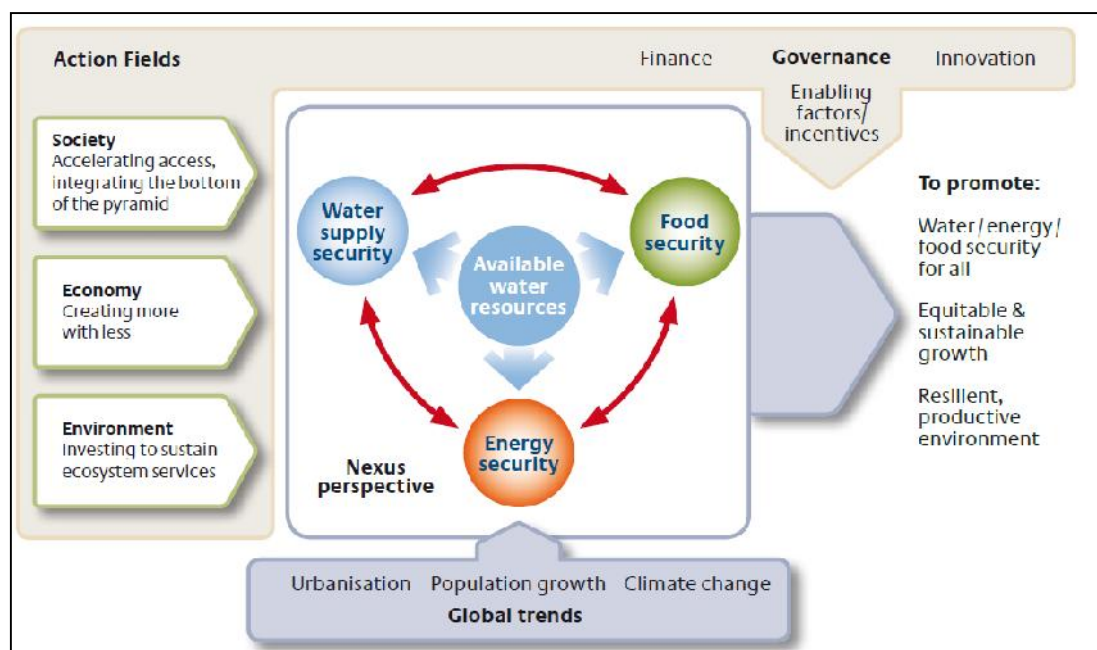
Figure 1: The water, energy and food security nexus (*Source: Bonn, 2011*)

A nexus approach can support the transition to a green economy which aims among other things, at resource use efficiency and greater policy coherence. Indeed, the green economy itself is the nexus approach par excellence. To succeed a green economy must go beyond sectorial solutions and actively address the water, energy and food security in line with human rights-based approaches.

Given the increasing interconnectedness across sectors and in space and time, a reduction of negative economic, social and environmental externalities can increase overall resource use efficiency, provide additional benefits and secure the human rights to water and food. Conventional policy and decision making therefore needs to give way to an approach that reduces trade-offs and builds synergies across sectors- a nexus approach. Business as usual is no longer an option. Based on better understanding of independence of water, energy and climate policy, this new approach identities naturally beneficial responses and provides an informed and transparent framework for determining trade-offs and synergies that meet demand without compromising sustainability. The following guiding principles are central to the nexus approach:

- Investing to sustain ecosystem services
- Creating more with less
- Accelerating access, integrating the poorest

The nexus approach will also allow decision-makers to develop appropriate policies, strategies and investments, to explore and exploit synergies, and to identify and mitigate trade-offs among the development goals related to water, energy and food security. Furthermore, through a nexus approach as it integrates management and governance across sectors and scales improved water, energy and food security can be achieved. A nexus approach can also support the transition to green economy which aims among other things, at resource use efficiency and greater policy coherence. In addition it can also help to avoid "sunk costs" i.e investments that lock development into non sustainable pathways. Active participation and among government agencies, the private sector and civil society is critical for avoiding unintended adverse consequences. A true nexus approach can only be achieved

through close collaboration of all actors from all sectors (Hellegers *et al.*, 2008; Karlberg and Hoff, 2013; Stein, 2013).

Why do we need nexus approach?

- Accelerating development

Development has rapidly accelerated over the half past century, but the benefits of development and progress on water, energy and food security (e.g. per capita calorie production has increased from 2280 to 2800 kcal/per day) have been unequally distributed between and within countries. A range of pressures from global and regional changes, such as population growth, economic development and changing lifestyles, are growing simultaneously and sometimes amplifying each other. In most developing countries, there is a rapidly expanding affluent middle class which is nearly tripled in size particularly in developing Asia between 1990 and 2005 (The-Economist, 2011). The consumption pattern diets and resource use of this class are quickly approaching those of developed countries (FAO, 2013). In the meantime there must be additional resources available to meet the food and energy needs of the poorest.

- Urbanization

Continuing urbanization, often driven by deteriorating rural living conditions and a quest for a better life. City dwellers now account for 50% of the total global population which is projected to reach 70% by 2050 (UNDP, 2011). There are currently one billion slums dwellers (UN-HABITAT, 2003) projected to increase to two billion by 2030 who are especially food insecure and disconnected from water and energy services. This is the reason behind having a nexus approach for cities. However, such nexus approach should include integrated planning of infrastructure for water, wastewater and energy. In the meantime cities have to build synergies with their hinterlands and water sheds, by providing markets for agricultural production, by recycling waste products into and out of cities through cascading water uses and by promoting nexus approaches through peri-urban agriculture and landscaping.

- Climate change

Climate change is mostly driven by energy use and changes in land use. Climatic variability adds further pressures such as accelerating drying of dry lands, reducing glacier water storage, as well as having more frequent and intense extreme events such as droughts or floods and less reliable water supplies and agricultural productivity. At the same time change mitigation places new demands and water and land resources and biodiversity. Climate adaptation measures such as intensified irrigation or additional water desalination are often energy intensive. Thus climate policies can impact on water, energy and food security and adaptation action can in fact be maladapted if not well aligned in a nexus approach and implemented by appropriately interlinked institutions (IPCC, 2007; Smith and Barchiesi, 2009; FAO, 2011; IPCC, 2011).

- Degradation of the resource base

Growing demand and non-sustainable management have increased human's ecological footprint and caused degradation of the natural resource base in many regions including severe modification of ecosystems. This has resulted in a notable reduction in the land primary productivity primarily for food production (MA, 2005; Haberl *et al.*, 2007; Ellis, 2011). Desertification and soil degradation have reduced water and land productivity, water and carbon storage biodiversity and a wide range of ecosystem services. Regarding the water while it is a renewable resource, pollution and over use can still have long lasting impacts such as degraded and depleted aquifers and loss of aquatic ecosystems and wet lands.

Water energy and food security

Food water and energy are finally being recognized as most important national and international security issues. However, we are long away from achieving water energy and food security for the entire world's people. Water energy and food security have so far been mainly constrained by unequal access, but mainly is now also approaching limits of global resource availability.

Food security refers to both physical and economical access to food and food supplies. The current food crisis in most developing arid and semi arid countries cannot be understood unless located in the broader nexus that encompasses food, water and energy.

According to FAO (1996), as illustrated in figure 2, the concept of food security has four components, namely food availability, access, stability of supply and utilization. They reflect different social, cultural, political aspects as well as biophysical and socio economic conditions (Clark et al, 2013). Food security is determined by FAO as "availability and access to sufficient, safe and nutritious food to meet the dietary and food preferences for an active and healthy life. Adequate food has also been defined as a human right.
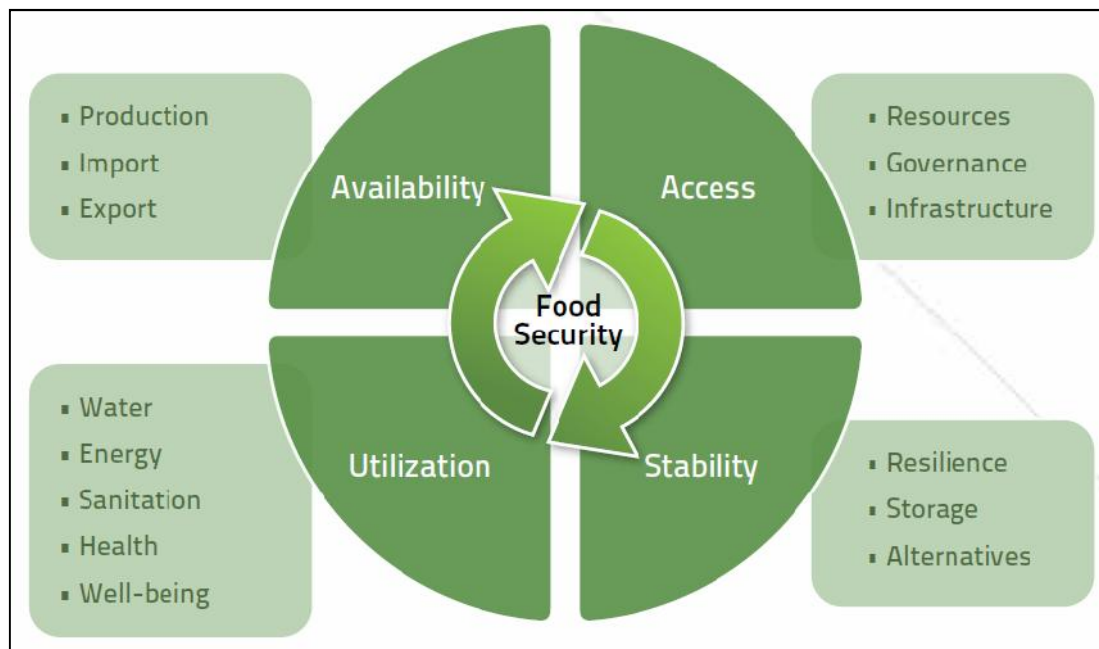
Figure 2: The components of Food Security (*Source: Clark et al, 2013*)

Food security alone does not ensure economic social and environmental sustainability. There is need to a nexus approach as it is a holistic vision of sustainability that tries to balance different development goals by managing trade-offs and exploring opportunities for synergies in light of growing demand for resource and other key drivers. Water security, energy security and food security are inextricably linked and these linkages have always been present.

Interactions take place within the context of globally relevant drivers, such as demographic change, urbanization, industrial development, agricultural modernization, international and regional trade, markets and prices, technological advancements, diversification of diets, and climate change as well as more site-specific drivers, like governance structures and processes, vested interests, cultural and social beliefs and behaviors (Figure 3) (FAO, 2014)
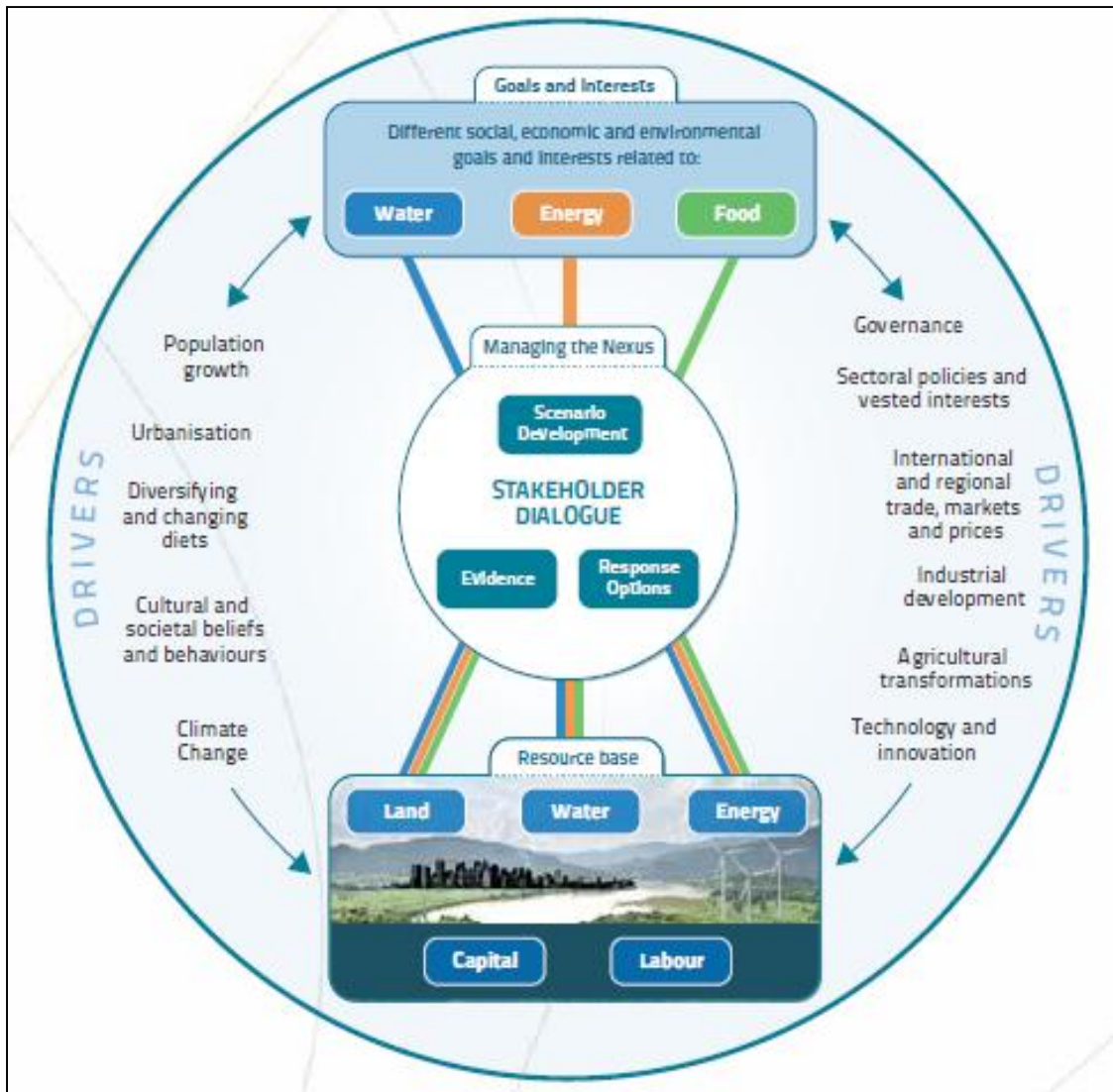
Figure 3: The FAO approach to the Water-Energy-Food Nexus (*Source: FAO, 2014*)

Indeed water, energy and food sectors are connected in important ways and each sector has its potential to either help or harm the other two. Interrelationships between water food energy and environment are both facing challenges and opportunities (McCornick *et al.*, 2008). Water security, food security and energy security are chronic impediments to economic growth and social stability. Food security in particular can be threatened by water and energy shortages. The availability of water for agriculture directly determines the availability of food. Higher energy prices increase the price of agricultural inputs and reduce the availability of land and water for food production due to competition from expanded biofuel production. This dampens food demand as a result of higher food prices.

The nexus perspective

A nexus perspective increases the understanding of the interdependencies across water, energy, food and other policies such as climate and biodiversity. The nexus perspective thus helps to move beyond silos and ivory towers that preclude interdisciplinary solutions, these increasing opportunities for mutually beneficial responses and enhancing the potential for the cooperation between and among all sectors. Everyone in all disciplines need to think and act from the perspective of being interlinked in order to realize the full impact of both direct and indirect synergies that can result in this context, it is to be emphasized that the opportunities

provided by the nexus perspective and consequent social, environmental and economic benefits to be realized, implementation requires the right policies, incentives and encouragement, and institutions and leaders that are up to the task as well as frame works that encourage empowerment, research, information and education. Capacity development programme should be well developed and tailored to meet the know-how required for the implementation of the various nexus approach steps (UN-WWDR, 2014).

The nexus opportunity areas

The areas of energy water and food policy have numerous interwoven concerns ranging from ensuring access to services, to environmental impacts to price volatility. These issues manifest in very different ways in each of the three spheres but often the impacts are closely related. Identifying these interrelationships a priori is of great importance to help target synergies and avoid potential tensions. The fact that environmental issues are normally the 'cohesive' principle from which the three areas are considered jointly, the enormous inequalities arising from a lack of access suggest that economical and security related issues may be stronger motivators of change.

They support sustainable growth and achievement of water energy and food security by cutting across interlinked decision spaces and identifying win-win solutions. Such nexus opportunity areas are:

- Increase policy coherence by ensuring that synergies and trade-offs among water, energy and food are identified both in design and implementation policies, plans and investments.

- Create more with less by increasing productivity establishing mechanisms to identify the optimal allocation of scarce resource for productive process and sustainable intensifying the use of land and water to achieve equitable social, economic and environmentally sound development.

- Accelerate access by progressively realizing in a more coordinated way- the human rights obligations related to water, sanitation, energy and food to reap the resulting health, productivity and development benefits.

- Value natural infrastructure by investing to secure, improve and restore the considerable multi-functional value of biodiversity and ecosystems to provide food and energy, conserve water, sustain livelihoods.

- End waste and minimize losses by reducing waste and losses along supply chains to capture significant economic and environmental gains within and across sectors and reduce demands on water, land and energy.

Here, it should be quite clear that for each of the nexus opportunity areas there is a set of policy recommendation that provide the basis to build momentum for a more coherent approach, develop enabling policy frameworks, provide economic incentives and establish market instruments; re-orient regulatory, planning and institutional set up; stimulate good governance; and build capacity.

Opportunities to improve water energy and food security

A nexus approach can support a transition to sustainability, by reducing trade-offs and generating additional benefits that outweigh the transition costs associated with stronger integration across sectors.

A number of opportunities can be outlined in the followings:

- Increased productivity resources. Sustainable and inclusive intensification and decoupling of economic development from resource use both fundamental to a green economy can be achieved through technological innovation, recycling wastage. The nexus focus is on system efficiency rather than on the productivity of isolated sectors.
- Simulating development through economic incentives. Innovation to improve resource use efficiency requires investments and reduction in economic distortions. Economic instruments for stimulating investments included for example pricing of resource and ecosystem services, water markets and tradable rights and payments for ecosystem services. A nexus approach can also help to avoid sunk costs, i.e. investments that lock development into non-sustainable pathways.
- Governance, institutions and policy coherence. Regulation and collective action can help to guide investments and innovation to minimize negative externalities and share benefits equitably enabling conditions for horizontal and vertical policy coherence include institutional capacity building political will, change agents and awareness raising. Additional opportunities can be realized if the nexus is addressed coherently across all scales through multi-level governance.

Concluding remarks and recommendations

Some of the biggest challenges the world is facing things on the growing scarcity and allocation of resource vital to sustainable life water energy and food. To make enough food to support a growing population we need more water and energy. Producing energy requires water to cool power plants and produce biofuel, while making water accessible and clean for human consumption demands energy. According to UN estimates by 2030 we will need 30% more water, 45 more energy and 50% more food.

For most countries around the world there is a need for a new nexus oriented approach to address sustainable parameters of growth and impeding resource constraints promote security of access to basic services. It is an approach that better understands the interlinkages between water, energy and food sectors as well as the influence of trade, investments and climate policies. A nexus that helps to identify mutually beneficial responses and provides an informed and transparent frame work for determining trade-offs to meet demand without compromising sustainability and exceeding environmental tipping points as well as bringing economic benefits through more efficient use and management of the resources, productivity gains and reduced waste.

Central to a human rights approach is the achievement of water, energy and food security for the poorest of the poor. Many programmes and activities have been made to contribute to this objective including the millennium development goals complemented by a drive towards renewable energy sources, adoption the concept of integrated water resources management and moves taken towards more sustainable and efficient agricultural practices. Great efforts and much work is also being done by governments, communities, private agencies to achieve more productive resource efficient equitable and sustainable outcomes. However, in spite of this significant progress security of water, energy and food supplies are still remaining far from being achieved work on what is being termed the water-food-energy nexus is starting, but, much still needs to be learned and accomplished on increasing efficiency, reducing trade-offs and building synergies across sectors.

To achieve water energy and food nexus goals there is need for a coordinated harmonized nexus knowledge-base and database indicators and metrics that cover all relevant spatial and temporal scales and planning horizons. Full life cycle analysis across the nexus is also needed.

Such an improved nexus understanding could underpin new decision and policy making in a green economy framework.

Despite the strong, food, water and energy linkages practitioners and policy maker continue to approach developing programme and policies in the 'silos' of their respective ministers. To maximize food, energy and water security, mechanisms must be created to raise the policy makers' awareness of these issues and promote greater collaboration among ministers as well as communities, civil societies and the private sector in policy design and implementation. Research too needs to address the linkages across these sectors, and provide the evidence of the strategies, investment and policy action needed to consider all three sectors. If the food, water and energy connections remain unaddressed, global food security will not be achieved, increasing poverty and environmental degradation.

The increased demand of energy worldwide will reflect directly and indirectly on water-dependent systems. Rising fuel cost and increasing concerns over the effects of climate change are reinvigorating policy makers' interest in renewable energy sources such as hydropower and bioenergy- both from biofuels as well as biomass. Development of any of these sources has the potential to generate positive economic and environmental benefits, yet, at the same time they can cause negative food and equity impacts. This obviously entails major trade-offs between, the food, energy and environmental goals of water and energy development, allocation and management. Increasingly complex energy-agriculture relationships require in-depth understanding of water and energy trade-offs. Choosing biofuels for energy production should require a careful balancing of priorities, since water that has been used to grow feedstock for biofuels could also have been used to grow food.

For water, energy and food security nexus the resource limitations in all sectors require a shift towards resource use efficiency, demand management and more sustainable consumption patterns. Without such changes current development trajectories threaten to drive social-ecological systems at all scales towards critical thresholds. Crossing critical thresholds at any scale could result in possibly irreversible system.

To avoid such negative impacts new approaches are needed; institutions need to be flexible, adaptive and enabled to cooperate with institutions representing other sectors and in some cases new institutions may be required (UNECE, 2014). Stronger institutions that are better interlinked are a key to a nexus approach and may be more important than additional institutions.

Manuscript analysis (raised items for oral discussion)

Deep analysis of this manuscript and others cited in this paper could be conclusively highlighting the following:

- Many governments have separate agencies to oversee water, energy and food production, and they set policies and plans for each sector separately. The same is true of research on these issues; expertise on energy, water and use is clustered in separate groups, with limited interaction.
- Nexus analyses need to go beyond human systems, and look at resources within ecosystems. Impacts on ecosystems, in turn, affect human livelihoods and wellbeing by eroding vital ecosystem service. Experiences gained and lessons learned indicate that an ecosystem-based approach can find ways to avoid negative impacts and actually strengthen ecosystems and the services they provide.

- Along with cross-sectoral interactions, nexus analysis need to examine how systems interact across scales, and the role of factors such as political and social structures, governance and trade.
- If nexus research is to make an impact on policy and practice, it must connect with stakeholders and their terms. To operationalize the nexus, it is needed to understand conditions on the ground including the perspectives of different institutions and stakeholders groups, at all relevant scales. In this regard, participatory processes are thus crucial and are playing an important essential role. Participatory processes can also help ensure that vulnerable stakeholders have the information and access they need to advocate for themselves, and can foster dialogue across sectors and scales.

Many nexus problems have win-win solutions, but some do not. For many places there is great potential for efficiency improvement and waste reduction and thereby producing more food with fewer resources. For example, nexus analysis of proposed sustainable development goals targets, found numerous synergies and potential win-win. However, this could not be the same in some cases especially when resources are very scarce, a nexus analysis may not find win-win option, but just difficult trade-offs (Weitz *et al.*, 2014).

Nexus approach implementation, an outlook on the future, clearly identify that there is several pathways needed including: building scientific knowledge, well tested methodologies, transparent well designed integrated models. Equally, there is need to expand nexus perspectives focusing more on integrating socio-economic and bio-physical perspectives, and looking across scales, from the local to the global.

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ORGANIC AGRICULTURE IN TERMS OF SUSTAINABLE DEVELOPMENT OF SERBIA

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Abstract

Achieving sustainability gives an answer on question what is a sustainable agroecosystem? Sustainability has been the background context of nearly every topic addressed so far. This paper proposes a framework for setting the parameters for sustainability, outlines indicators that can tell us if we are moving in the necessary directions, and sets criteria for the research needed to fashion a more sustainable path in agriculture. The concept of sustainable development and the complex analysis of the state of the environment require from agriculture to produce enough food in a manner that does not endanger the environment. Due to the significant percentage of the population living in rural areas, because of the high percentage of gross domestic product, as well as the growing adverse impact that agriculture has on the environment, our country needs a strategy of sustainable development in agriculture. One of the goals of the sustainable agriculture is to create farming systems that mitigate or eliminate environmental harms associated with industrial agriculture. That aim can be realized only in flexible cultural practices in real agroecological conditions (different regional characteristics, soil types, adapted cultivars for low-input or organic production). The transformation from conventional to sustainable organic field crop technology production requires changes and adaptation of many cultural practices. Organic farming is one of the most interesting current trends in agriculture entirely based on ecological principles and the absence of agricultural chemicals use (pesticides, fertilizers, antibiotics, hormones, GMOs, etc. The Republic of Serbia has significant natural resources and favorable conditions for agricultural production, which can meet the basic requirements for the establishment of organic farming, due to less contamination of soil and water, and to less use of pesticides and other chemicals.

Key words: *organic agriculture, sustainable development, environmental protection*

Introduction

The development of agriculture enabled the development of the human population, but directly and indirectly affecting the environment. On the other hand, agriculture creates the basic resources for human survival – food on only 10% of arable land on Earth. The concept of sustainable development and the complex analysis of the state of the environment require from agriculture to produce enough food in a manner that does not endanger the environment. Due to the significant percentage of the population living in rural areas, because of the high percentage of gross domestic product, as well as the growing adverse impact that agriculture has on the environment, our country needs a strategy of sustainable development in agriculture. Sustainable agriculture is an exact example of anticipated concept of future development of agriculture in general. Term "sustainable agriculture" could be defined as a direction of agricultural development. It needs to secure satisfaction stability of food production and plant production used in other technical purposes, with respect to basic natural

resources, energy, ecology, economical efficiency and profitability in the same time. The most important thing regarding a global sustainable system is to avoid conflict between economy and ecology as two opposite goals. Global considerations about this problem lead to first concrete results. These results guide unloading of world's conventional (industrial) production. Industrial agriculture depends on expensive inputs from off the farm (e.g., pesticides and fertilizer), many of which generate wastes that harm the environment; it uses large quantities of nonrenewable fossil fuels and it tends toward concentration of production, driving out small producers and undermining rural communities. Resource-intensive agricultural practices are considered unsustainable for two reasons: much of the consumption is of nonrenewable resources, in particular, fossil fuels and consumption of some renewable resources is occurring faster than the rate of regeneration. The bad characteristics of that kind of development may be slowly directed to the alternate directions of development, based on biological foundations. The proliferation of industrial animal agriculture creates environmental and public health concerns, including pollution from the high concentration of animal wastes and the extensive use of antibiotics, which may compromise their effectiveness in medical use. Transition from industrial agriculture (intensive cultural practices, feedlot farming etc.) with intensive technologies of crop production (conventional tillage, usage of huge amounts of fertilizers and pesticides, GMO, hormones and antibiotics), to sustainable systems takes over low-input technologies (Kovacevic, 2004a; Kovacevic et al., 2004b) as result of domination of ecological paradigm.

Currently, different directions in which agriculture is conceived are existing, weather it is represented as industrial, so called very intense, or conventional one followed also by many environmental trends based on strict principles of environmental inputs. Conventional agriculture has a duty to ensure maximum production in terms of quantity and quality at the lowest cost. For these purposes, a variety of agro/cultural practices are available, sometimes with many negative long-term effects in agro/ecosystems, in addition to the expected positive effects (Kovacevic et al., 2010).

One of the national priorities for achieving sustainable development in the Republic of Serbia refers to the protection and enhancement of the environment and rational use of natural resources (Official gazette, 2008). One of the priorities of the National Strategy for Sustainable Development of the Republic of Serbia (priority 5) is the protection and enhancement of the environment and rational use of natural resources. Preservation and improvement of the system of environmental protection, pollution reduction and environmental pressures, the use of natural resources in a manner to ensure their availability for future generations through: the establishment of the protection and sustainable use of natural resources (air, water, soil, mineral resources, forests, fish, wildlife and plant species); strengthening interaction and achievement of significant effects between environmental protection and economic growth, integrating environmental concerns into development policies of other sectors; investing in reducing environmental pollution and the development of cleaner technologies; reducing the high energy intensity of the economy of the Republic of Serbia and the efficient use of fossil fuels; promoting the use of renewable energy sources; planning of sustainable production and consumption and reducing waste per unit of product; protection and conservation of biodiversity.

Organic farming has a positive effect on the stability of a specific geographic area. This opens possibilities for the development of the concept of multifunctional agriculture, reducing migration of rural population to the cities, contributing to the development of local communities, strengthening and expanding the market, particularly in the areas of protected nature in which sustainable development from agriculture system is imperative, because of the wider public interest in the preservation of natural resources the production of which is relied upon (Olja a, 2003; 2005).

However, when it comes to organic field production it is necessary to choose field types of plants without normal use (alternative), suitable for this type of production (Pearson et al., 2004; Bavec and Bavec, 2007). The highest yielding cultivars with best quality in conventional systems are not the highest yielding cultivars with the best quality in organic systems, would suggest the need for breeding and selection under organic conditions (Murphy et al., 2007). Some of these grains may be of local significance or of limited markets, and some are interesting on the so oriented farms (Kovacevic et al., 2011).

Organic agriculture in the world

Organic food production is the only way of agricultural production, which, at the same time, provides an opportunity to integrate environmental conservation and improvement of quality of life with economic and social aspects (Olja a, 2004). Although, organic farming as a concept, exist more than 80 years, until the mid -1980s became the spotlight of consumers, producers, environmentalists and policy-makers across Europe. Customer requirements for products from organic agriculture were beginning to grow rapidly, which leads to active participation of traders in this sector and an increase in the price of these products. Support for organic production is tight these days in Europe, because they recognize its benefits and contribute to the objectives of rural development and environmental improvement. The last ten years the production and processing of organic products is becoming increasingly popular and economically significant. Organic farming is now practiced in more than 160 countries worldwide. According to the latest data, under cultivation is 37 million hectares to 1,8 million registered farms. This accounts for 0,9% of agricultural land in the world (Willer and Kilcher, 2012). Organic products occupy only about 1-2% of the world food market, and the potential is huge. The demand for these products in recent years has been growing because of growing awareness of environmentally concerned consumers. The prices of organic products exceed the price of the products of conventional agriculture by 10-40% on average. Economically developed countries of EU, USA, Canada and Australia already have a developed awareness of the benefits of the organic products. In Western countries, the average index of growing demand for organic food is around 8-10 % per annum which means that soon the turnover share of certified food will be around 5 %, which means that turnover is about $ 60 billion on a global level (FIBL-AMI, 2012). It is necessary to emphasize that climate, historical heritage and public sector support organic production make some countries the leaders in a given type of organic production (Pereira, 2003). Organic agriculture is more energy efficient with smaller carbon footprint compared to conventional one (less harmful gases). It uses alternative energy sources very frequently. It produces 28% more carbon, and it is estimated that during one year it can fix, in this production type, 1000 kg of C per ha of soil.

Organic agriculture obtains its full value by multifunctionality - production of agricultural and non-agricultural products and services by preserving agricultural landscape. It creates conditions for better quality and richer touristic offer and contributes to integral rural development (Lazic, 2010).

Organic agriculture in Serbia

Organic farming is one of the most interesting current trends in agriculture entirely based on ecological principles and the absence of agricultural chemicals use (pesticides, fertilizers, antibiotics, hormones, GMOs, etc. The Republic of Serbia has significant natural resources and favorable conditions for agricultural production, which can meet the basic requirements for the establishment of organic farming, due to less contamination of soil and water, and to less use of pesticides and other chemicals. Organic production is characterized by a certain transition period of conversion, greater biodiversity, changed agricultural practices and the necessary certification. (Kovacevic and Lazic, 2012).

There are 11099 ha of arable land under the certification in Serbia in 2012, according to the study of GIZ (Martz et al., 2013). The fruits dominate with nearly 5145 ha, mostly apples and plums. According to these data, about 829000 ha are certified for collection from the wild (wild fruits, herbs, and mushrooms). The most important resources are the areas around the protected natural resources especially those with high natural values. At least 4000 farms practice organic farming, and 60 % of them have less than 6 ha and 25% of them have 10-20 ha of land. Most of these farms are in Vojvodina then, in west and south of Serbia. The total value of organic production is estimated at around € 25 million, and most of these products are exported, due to poorly developed domestic market. It was also stressed that around 25 companies successfully engaged in the processing and production of finished organic products. Organic food market in Serbia is underdeveloped because of the lack of demand, consumers have not sufficiently developed awareness on the consumption of such foods, the underdeveloped distribution channels, specialized shops for this type of food is small, the higher the price of these products, as well as underdeveloped and widespread production.

Important methods for achieving sustainability in agriculture

One of the goals of the sustainable agriculture movement is to create farming systems that mitigate or eliminate environmental harms associated with industrial agriculture. That aim can be realized only in flexible cultural practices in real agroecological conditions (different regional characteristics, soil types, adapted cultivars for low-input or organic production). The transformation from conventional to sustainable organic field crop technology production requires changes and adaptation of many cultural practices (Kovacevic et al., 2000). Organic production is very specific in this respect must be for alternative small grains crops to develop appropriate supporting technology based on respect for ecological principles (Pearson et al., 2004). Republic Serbia has significant heterogeneous natural resources and favorable conditions for agricultural production that can meet the basic requirements for the establishment of organic agricultural production, due to lower land and water pollution due to less application of pesticides and other chemicals. This production, under our conditions in Serbia, is still modest due to the existing market restrictions. However, when it comes to organic production of cultivated and it is necessary to choose the type of field crops that do not have normal use (alternative) that would be suitable for such production (Sinebo et al, 2002; Kovacevic et al., 2007). Each of these crops has the botanical characteristics, needs for different growing factors and more like any other commercial crop. Some of these crops can be with local significance or in limited markets, and some may be of interest and on farms that are so oriented.

Intercropping

Intercropping is a type of mixed cropping and defined as the agricultural practice of cultivating two or more crops in the same space at the same time. The important reason to grow two or more crops together is the increase in productivity per unit of land (Olja a and Dolijanovi , 2013). All the environment resources utilized to maximize crop production per unit area per unit time and risk may be minimized in intercropping system. Biological efficiency of intercropping can be better due to exploration of large soil mass compared to monocropping. This advaced agrotechnique has been practiced in past decades and achieved the goal in agriculture. There are some socio-economic, biological and ecological advantages in intercropping over monocropping (Dolijanovi et al., 2005).

Successful intercropping needs several considerations before and during cultivation: intercropping afects vegetative growth of component crops, therefore have to consider the spatial, temporal and physical resources. Economically viable intercropping system largely depends on adaptation of planting pattern and selection of compatible crops. Cereal-legume intercropping system have potential to provide nitrogen depends of crop densities, light interception, crop species and nutrients (Olja a et al., 2000). Compatible crop selection is vital in intercropping practices. The choice of compatible crops depends on plant growth habitat, soil, light, water and fertilizer utilization. Cereal-legume intercropping increase the fixation of nitrogen by legumes, than different crop species in mixtures increase capture of growth limiting resources and different planting time of component crops can improve the resource utilization and reduce competition (Table 1).

Table 1. Grain yield (kg ha^{-1}) and LER of maize and beans in relation to different plant arrangement pattern and water regime (Olja a et al., 2000)

Year	Plant arrangement	Maize		Beans		LER	
		Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
	1/3:2/3	5602	4578	1252	876	1.17	0.80
1994	1/2:1/2	8421	6037	1140	914	1.30	0.94
	2/3:1/3	8572	7706	633	434	1.01	1.11
	Sole crop	15060	13552	1472	1772	-	-
	S.E.	963.2		198.0		0.085	
	1/3:2/3	3943	3681	940	656	1.21	1.02
1995	1/2:1/2	7285	5999	938	494	1.54	1.06
	2/3:1/3	7428	6785	473	322	1.14	0.88
	Sole crop	10175	11375	1144	930	-	-
	S.E.	782.1		68.2		0.083	
	1/3:2/3	2089	1855	851	879	0.86	0.98
1996	1/2:1/2	3608	3339	734	436	0.97	0.85
	2/3:1/3	3738	4172	408	419	0.81	0.96
	Sole crop	6315	6647	1816	1258	-	-
	S.E.	329.8		160.6		0.045	
	1/3:2/3	3878	3371	1014	804	1.08	0.93
Mean	1/2:1/2	6438	5125	937	614	1.21	0.95
1994-	2/3:1/3	6579	6221	505	392	0.98	0.99
1996	Sole crop	10516	10524	1477	1320	-	-

S.E.-standard error; D.F.=24

This system also allowed the cereal grain yield in intercropping to exceed that in monoculture as has been the case for maize in our experiment. The average LER (Table 1) was higher than 1 only in 1/2:1/2 mixture (LER=1.21) on irrigated plot. The most productive

maize-beans intercrop was on irrigated plot in 1/2:1/2 mixture (LER=1.54). Other mixtures (1/3:2/3 and 2/3:1/3) showed advantage over sole crops under irrigation (LER=1.21, 1.14). The optimal spatial arrangement in our experiment was a single row of maize and two rows of beans (1/2:1/2 mixture). Under favorable conditions (irrigated plots or wet season) intraspecific competition appears to be more intense than interspecific competition in maize-beans intercropping system. The culture of beans in mixture with maize probably costs a small farmer very little more effort, than the production of a sole stand of maize.

Cover crops

Modern society, as mach as it could must be related to sustainable management of renewable natural resources trough ecologicaly based agricultural development. An ecological production management system that promotes and enhances biodiversity, biological cycles, and soil biological activity should be based on minimal use of „off-farm" inputs and on management practices that restore, maintain, or enhance ecological harmony (Dolijanovi et al., 2013). Increasing environmental problems and big concern on health issues has driven to development of new techniques and systems to deal with weeds, pests and diseases. Cover crops being often used to design new strategy that preserves farm natural resources while remaining it's cost-effectivity.

Cover crops are very important, especially with regards to the sustainability of agricultural production, and the term cover crops involves a number of different measures of soil under vegetation (winter cover crops, green manure flies, living mulches (cover crops), sowing of fodder crops after the main crop (subsequent crops, etc..), as the intention of maintaining or increasing the organic matter in soil, improve soil physical properties (structure, water regime, etc..), accumulation of nitrogen legumes, improved microbial activity in soil, suppress weeds, and generally raising soil fertility.

The term "cover-crop," which, until 1893, was not distinguished from "catch-crop," or from "green-manure crop," is now applied to a crop grown to prevent injury and losses to soils, and either directly or indirectly to improve them, and often to afford protection to trees or other plants, rather than to secure the proceeds or products of the crop itself. Cover crops can have numerous other benefits including improvement of soil quality, pest management, fertility management, water availability, landscape diversification, and wildlife habitat. Cover crops are of interest in sustainable agriculture as many of them improve the sustainability of agroecosystem attributes and may also indirectly improve qualities of neighboring natural ecosystems. Cover crops can also improve soil quality by increasing soil organic matter levels through the input of cover crop biomass over time. By reducing soil erosion, cover crops often also reduce both the rate and quantity of water that drains off the field, which would normally pose environmental risks to waterways and ecosystems downstream.

Cover crops can play an important role in managing weeds by shading and interfering with weed germination and establishment. Among cereals, it is known that rye produces allelochemicals, naturally occurring compounds that can control or suppress weeds.

Once researchers find the appropriate combination of maize and ground cover, they believe yields will not be impacted, and soil quality will be maintained. Nevertheless, cover crops can also become weeds and must be carefully managed to prevent it's competitivity toward main crops regarding soil moisture, nutrients etc. The possibility to reduce weediness on the basis of the increased crop competitive abilities by growing high yielding hybrids that "tolerate" a higher plant density depends on traits of each hybrid and climatic conditions in the specific growing region (Williams et al., 2007).

Growing cover crops is one extremely important tool for the appropriate management of weeds in long-term weed control under sustainable and organic agricultural systems. Perceived benefits of the alternative technology over conventional one should considered

mostly in terms of grain yield of the main crop. Currently, living mulch in spring-sown cover crops has had positive impact on lower weediness, and oppositely, negative impacts on sweet maize yield. The main crop of sweet maize was not competitive enough with ground cover, mainly because of limited soil moisture and nutrients, especially between the rows of sweet maize being possessed by living mulch (Table 2).

Weeds species were weaker competitor in this situation. The highest total fresh weight was 834. 1 g m^{-2} (conventional system) in 2011 and 728.8 g m^{-2} in 2012 while the lowest fresh weight was measured in hairy vetch (winter cover crops) and common vetch (spring cover crops) in both years. By covering bare soil with straw (organic mulch) weediness becoming somewhat higher comparing plots among winter and spring cover crops, even though sweet maize yield significantly was higher using this system of growing. In addition, cost inputs were reduced, but no other common benefits in the long term were found on winter and spring cover crops (increase of organic matter, increase of biodiversity, etc.). Among all variants with winter and especially with spring cover crops, plot weediness of main crop was lower comparing to control variants in both years of investigation.

Weeds represent one of the major threats to crop production in sustainable and organic farming systems. The risk of high weed infestations is not only yield reduction of the main crop but also the decrease of the commercial quality and the feeding palatability of main crops (Rahman et al., 2006) and enrichment of the soil seed bank of weeds (Buhler, 1999), which may cause severe weed infestation in subsequent crop production (Uchino et al., 2009).

Table 2. The growing season (A) and cropping system (B) effects on weed infestation and grain yield of sweet maize (Dolijanovic et al., 2013)

Cropping system (B)		Fresh biomass (g m^{-2})		Air dried biomass (g m^{-2})		Yield (t ha^{-1})
		2011	2012	2011	2012	2011
Winter cover crops and mixtures (dead mulch)	Common vetch	291,4	255,1	70,2	79,3	8,84
	Hairy vetch	288,6	262,1	69,7	74,2	9,98
	Oats	311,6	302,3	78,8	80,7	9,07
	Fodder kale	301,0	296,5	80,2	78,7	8,32
	Common vetch+oats	310,1	307,4	90,6	91,1	8,72
	Hairy vetch+oats	304,5	303,9	94,2	101,8	8,61
	Average	301,2	287,9	80,6	84,3	8,92
Control treatment	Organic mulch	381,1	326,7	102,3	85,4	10,00
	Conventional system	834,1	728,8	121,1	132,6	8,09
	Average	607,6	527,7	111,7	109,0	9,05
Spring cover crops and mixtures (living mulch)	Common vetch	212,6	198,4	56,9	59,8	7,61
	Oats	304,8	299,7	65,2	61,8	7,49
	Common vetch+oats	291,3	289,7	70,2	55,6	6,21
	Average	269,6	262,6	64,1	59,1	7,10
	Average	392,8	359,4	85,5	84,1	8,36

Fresh biomass LSD A	B	AB	Air dried biomass LSD A	B	AB	Yield of grain LSD	
0,05 0,52	1,21	1,71	0,69	1,42	2,04	0,05	0,41
0,01 0,71	1,66	2,35	0,91	1,83	2,63	0,01	0,57

The highest yield of sweet maize was obtained in the variant with dead organic mulch (10.00 t ha^{-1}), primarily due to the fact that for its decomposition was significantly more time alone and the planting of corn was thus greatly facilitated. The lowest yield was obtained following the conventional system (8.09 t ha^{-1}) as well spring cover crops. Yield of sweet maize in this study was below average yields in similar experiments (Dolijanovi et al., 2012), and the main reason was the way of growing. The variants covered by dead mulch, and

especially variants being covered by living mulch mixtures gave higher yields of biomass and consequently lower grain yield of sweet maize as a main crop.

Challenges for plant breeders

Breeding programs dedicated to organic agriculture would focus on traits including improved nitrogen and nutrient efficiency, adaption to soil microbes, improved competitiveness against weeds and resistance to insects and diseases currently controlled with chemical pesticides with the incorporation of these traits into high yielding cultivars, organic agriculture will be better equipped to realize its full potential as a viable alternative to conventional agriculture (Murphy et.al., 2007; Przystalski et al., 2008). The transition to new technologies with lower investments, as the case in the organic production of winter wheat and other grain alternative is unthinkable without the new varieties. The initial approach and criteria in the ideo/types varieties design for such a change to the conditions must be different from the present.

New varieties must have a greater resistance to abiotic and biotic stress conditions, more efficient uptake of mineral nutrients and better exploit of the existing environmental conditions. Since the problems of weeds in organic crop production are more pronounced if it is the initial criteria, it is certain that sorts incurred by this means should be selected, based on other grounds (Kovacevic et al., 2007; Kovacevic et al., 2009; Berenji, 2009).

Many alternative grains may well be successful in our environmental conditions as indicated by our research (Kovacevic et al., 2014). Each genotype has a morphological characteristic, the need for different vegetation factors, usage, etc. like any other commercial crop. Placing the individual genotypes in terms of organic cultivation technology, we have examined their response through measurement of morphological and productive traits. Test results of grain yield of different wheat genotypes alternative small grains are shown in Table 3.

Table 3. The effect of fertilizer on Grain yield of small grain genotype in relation with different fertilizers, t ha^{-1}

Year/ Genotype	2006/07			Average G	2007/08			Average G	Average
	F_0	F_1	F_2		F_0	F_1	F_2		
G_1	3.13	3.91	3.38	3.47[a]	4.63	6.53	5.65	5.60[a]	4.54
G_2	2.25	2.59	2.96	2.60[b]	3.49	5.40	4.44	4.44[b]	3.52
G_3	3.47	4.33	2.81	3.54[a]	3.75	6.10	4.84	4.89[c]	4.22
G_4	2.52	3.35	2.62	2.83[b]	3.78	5.22	3.97	4.32[b]	3.57
Average F	2.84[b]	3.55[a]	2.94[b]	3.11	3.91[b]	5.81[a]	4.73[c]	4.81	3.96

G-genotypes (G_1_NS 40 s, G_2 -Bambi, G_3 -Nirvana, G_4 -Durumko); F-fertilizers (F_0 control, F_1 organic + microbiological fertilizer, F_2 microbiological fertilizer); Means that columns followed by the same letter are not significantly different according to Fisher's protected LSD values (P=0.05)

Factorial analysis of variance has showed that grain yields significantly depend on the chosen fertilizer. Combined application of organic fertilizer in the fall and microbial in the spring, the highest average yields of alternative wheat were obtained regularly. The yield obtained by this variant, compared to the other two variants of fertilization were highly significant.

From the genotypes, the highest yields were obtained by growing commercial varieties NS-40S, especially in terms of combined application of organic and microbial fertilizers in

the second, a better year of study. Spelt wheat is second genotype by its yield, with a note that the yield of this genotype in the control plots was always the lowest.

Future directions

Sustainability is a test of time: an agroecosystem that has continued to be productive for a long period of time without degrading its resource base - can be said to be sustainable. How can a sustainable system be designed when the proof of its sustainability remains always in the future? Generating the knowledge and expertise for doing so is one of the main tasks facing the science of agroecology today, and is the subject to which this chapter is devoted.

Serbia as a country has variety of geographic, climate, natural and cultural heritage. Mountains of Serbia are part of one of 6 biodiversity centers of temperate climate. Extremely in danger, these vulnerable areas require special treatment that would provide whole network of life protection, instead conventional protection of nature. Optimal model of community development for these territories is in the framework of integral rural development strategy and organic agricultural production which is part of this concept. Absolutely essential condition for starting of organic production is obeying the low and other legal acts, which provide in details selection of plots and other conditions. Organic agriculture is very suitable for natural resources and protected areas management: in national parks, nature reserves, water supply zones and other endangered and sensitive parts of the country. Modern cities will have the need for using different ecological trends in architecture, touristic attractions, permaculture - modern landscape design, where the multifunctionality of agriculture will be seen in the best way.

Ministry of Agriculture with serious extension service, cooperatives and different specialized associations should help our agricultural producers to solve many problems that they face in their production on the field. They have to provide necessary prosperity and economic security for life on the land.

Acknowledgement

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MAIZE HYBRIDS AS RAW MATERIAL FOR BIOETHANOL PRODUCTION

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Abstract

Last decades, the importance of alternative energy source has become more necessery due to the continous depletion of limited fossil fuel stock and their negative enviromental impact. Bioethanol produced from renewable biomass such as sugars, starch or lignocelluloses could be one of alternatives. The maize is one of the best renewable raw material for ethanol production, due to the high content of starch in grain. Ten maize hybrids of differnt genetic background created in Maize Research Institute Zemun Polje, were investigated for bioethanol production. The highest ethanol yield, 87.84% of theoretical content, as well as the highest bioethanol yield per arable land (5783,4 kg ha-1) had hybrid ZP434. Energy effectivnes of hybrids was from 8,35MJ(ZP341) to 9,47MJ (ZP434). Since that production of one liter of ethanol requires on average 2,5 kg of maize grain, it can be calculated that production of maize grain per hectare of arable land would be more profitable. Identification of maize hybrids with high potential for ethanol yield could significantly rise efficiency of ethanol production from maize.

Key words: *bioethanol, maize grain, starch, production*

Introduction

With the depletion of fossil fuel resources, as well as the increase in environmental pollution, interest in various agricultural crops as renewable and biodegradable feedstock's for biofuel production are growing (Agarwal, 2007). Bioethanol is a liquid biofuel which can be produced from several different biomass feed stocks and conversion technologies. It can be made from many agricultural products and food wastes if they contain sugar (sugar cane, sugar beet, sweet sorghum and fruits), starch (maize, wheat, triticale, rice, potatoes, cassava, Jerusalem artichoke, sweet potatoes and barley), or cellulose (wood, straw and grasses), which can further be fermented and distilled into ethanol.

Maize, the dominant feedstock in the starch-to-ethanol industry worldwide, is composed of 60 to 70% of starch. There are two major traditional industrial processes for producing ethanol: wet and dry milling. In the dry-milling process, the grain is ground to a powder, which is then hydrolyzed and the sugar contained in the hydrolysate is converted to ethanol while the remaining flow containing fiber, oil, and protein is converted into a co-product known as distillers grains (DG) used as animal feed.

The use of ethanol as a fuel has a long history, starting in 1826 when Samuel Morey used it with the first American prototype of the internal combustion engine. At the beginning of 20th century, Henry Ford built a vehicle that could run either on gasoline or alcohol (Freudenberger, 2009). Nevertheless, ethanol failed to be used as a common fuel at that time because of the abundant and cheap supply of petroleum and natural gas. In Brazil, the commercial use of bioethanol produced from sugar cane, started back in 1925. The first bioethanol plant in the United States was built in the forties of the twentieth century to supply

the U.S. military with fuel. The disruption of oil supply from the Middle East in 1970s, however, re-boosted the production of ethanol (Bothast and Schleicher, 2005).

According to the World Association for Renewable Fuels (GRFA) in cooperation with Licht, world production of bioethanol is 23.4 billion gallons during 2013 (RFA 2013), Table 1. Brazil and the USA are the world leaders, which together accounted for about 60% of the world ethanol production exploiting sugarcane and maize respectively. In Europe, the production of bioethanol constantly increases, with 1371 million gallons during 2013.

Table 1. World fuel ethanol production by countries (mil gallons)

	2007	2008	2009	2010	2011	2012	2013
USA	6521.00	9309.00	10938.00	13298.00	13948.00	13300.00	13000.00
Brasil	5019.20	6472.20	6578.00	6921.54	5573.24	5577.00	6267.00
Europe	570.30	733.60	1040.00	1208.58	1167.64	1179.00	1371.00
China	486.00	501.90	542.00	541.55	554.76	555.00	696.00
Canada	211.30	237.70	291.00	356.63	462.30	449.00	523.00
Rest of world	315.30	359.40	914.00	984.61	698.51	752.00	1272.00
World	13123.10	17643.80	20303.00	23310.00	22404.09	21812.00	23429.00

Ethanol production process only uses energy from renewable energy sources. Hence no net carbon dioxide is added to the atmosphere, making ethanol an environmentally beneficial energy source. What bioethanol placed in front of other renewable energy sources at the moment is the fact that the entire existing oil infrastructure can be used for the distribution of biofuels without problems (or with minor modifications) that burns in petrol or diesel engines. Fuel ethanol is used in several manners in internal combustion engines: as 5% to 25% anhydrous ethanol blends with gasoline (5% maximum in Europe and India, 10% in the United States and China, 20 to 25% mandatory blends in Brazil), as pure fuel (100% of hydrated ethanol) in dedicated vehicles, or up to 85% in FFVs (Gnansounou, 2009). When anhydrous bioethanol is blended with gasoline in small proportion (up to 15%), the influence of the lower heating value has no significant effect. For higher blend levels, the fuel economy is reduced compared to that with conventional gasoline.

Current production of bioethanol in Serbia is based on molasses (50%) and cereals (50%) (Mojovic *et al.*, 2012). The average annual maize yield is approximately 40% higher than the calculated domestic needs in last few years This means that there is enough maize for other purposes besides the food, therefore significant amounts can be used for the bioethanol production.

The feedstock for bioethanol production is currently based mostly on agricultural crops, which can be devoted to both food and ethanol markets or dedicated solely to ethanol. In case of a high world production of bioethanol, the correlation between food and ethanol markets may generate a high volatility of agricultural crops with regard to fluctuations in energy prices.

The aim of our study was to analyze suitability of selected ZP maize hybrids for the bioethanol production.

Material and methods

Ten maize hybrids of different genetic background and maturity produced in Maize Research Institute Zemun Polje: ZP341 (FAO300), ZP 434 (FAO400), ZP 505, ZP548 (FAO500), ZP 600, ZP606, ZP666 (FAO 600), ZP704wx, ZP747 (FAO 700), ZP808, ZP877 (FAO 800) were investigated for bioethanol production.

Before ethanol fermentation two-step enzymatic hydrolysis of maize meal by commercially

available -amylase (from *Bacillus licheniformis*, Termamyl® SC, Novozymes, Denmark) and glucoamylase (SAN Extra® L, Novozymes, Denmark, from *Aspergillus niger*) was done (Nikoli *et al.*, 2009). Starch hydrolysates were subjected to fermentation by *Saccharomyces cerevisiae* (collection of BIB-TMF, Belgrade) yeast. The ethanol concentration was determined based on the density of alcohol distillate at 20ºC and expressed in weight % (w/w), (Official Methods, 2000). The starch content was determined by Ewers polarimetric method (ISO, 1997), protein content by Kjeldahl metod and oil content by Soxhlet method (Oficial method of analysis, 2000).

The average bioethanol yield per arable area for each hybrid was calculated on the basis of percentage of theoretical bioethanol yield obtained in fermentation and average yield potential of the hybrid per arable area. The calculation of the cost of production of maize per hectare of arable land based on the prices of certain operations, the cost of fuel and the price of maize seeds, fertilizers and herbicides used. In the calculation of production costs of bioethanol used data on costs of production plants in the United States (Mousdale, 2008). The budget is approximated to the ideal case that Serbia has a production facility which is currently operational.

Results and discussion

Characteristics regarding chemical composition of the hybrids are shown in Table 2. Starch, protein and oil content differ between analyzed hybrids. Hybrid ZP 877 had the highest starch content of 74.68% and ZP341 the lowest, only 70.40%. Hybrid ZP877 has the highest soluble carbohydrate content and hybrid ZP434 the lowest one. All hybrids containing proportion of starch in the grain, more than 70%, which is one of the main prerequisites for the achievement of high yields of bioethanol in the process of dual-enzymatic hydrolysis and fermentation. According to Gulati *et al.* (1996) from one kg maize with the 15.5% moisture, containing an average of 0.61kg starch and 0.022kg of carbohydrates, theoretically 0.50l of ethanol could produce. In this case, 0.44l of ethanol originating from starch, 0.14l from soluble carbohydrates, 0.034l from cellulose and 0.015l from hemicelluloses. This means that soluble carbohydrates found in maize affect the yield of bioethanol (approximately 2.8% of the total yield). Protein content ranged from 8.86% (ZP808) to 10.30% (ZP704wx). Oil content ranged from 5.06 (ZP600) to 7.18% (ZP747).

Table 2. Chemical composition of ten maize hybrids

Genotype	Dry matter content %	Moisture content %	Starch content %	Soluble carbohydrates content %	Protein content %	Oil content, %
ZP 341	88.04	11.96	70.40	0.20	9.75	6.28
ZP 434	88.44	11.56	72.04	0.10	10.15	6.02
ZP 505	88.86	11.14	73.38	0.40	9.88	6.38
ZP 548	90.19	9.81	72.04	0.40	9.19	6.08
ZP 600	86.78	13.22	74.42	0.35	10.19	5.06
ZP 606	87.26	12.74	73.16	0.25	10.22	5.45
ZP 666	87.90	12.10	74.26	0.16	9.42	5.55
ZP 704wx	89.13	10.87	74.13	0.37	10.30	5.71
ZP 747	86.92	13.08	74.08	0.21	9.31	7.18
ZP 808	88.12	11.88	74.55	0.16	8.86	5.24
ZP 877	88.52	11.48	74.68	0.41	9.77	5.26

Values of the parameters important for bioethanol production determined after 48h of fermentation of maize flour hydrolysates of investigated hybrids are presented in Table 3.

Table 3. Bioethanol content, percentage of the theoretical yield, volumetric productivity and energy value in SSF

Genotype	Bioethanol content % (w/w)	% of theoretical yield %	Volumetric productivity (gl^{-1} h^{-1})	Energy value MJ after 24h	Energy value MJ, after 48h
ZP 341	7.97	79,94	1.66	6.27	8,35
ZP 434	8.96	87.84	1.87	6.39	9.43
ZP 505	8.01	77.02	1.67	5.66	8.46
ZP 548	8.83	86.57	1.84	6.24	9.47
ZP 600	8.33	79.03	1.74	5.59	8.60
ZP 606	8.46	81.66	1.76	5.50	8.78
ZP 666	8.61	81.84	1.79	6.07	9.00
ZP 704wx	8.07	76.86	1.68	5.50	8.55
ZP 747	8.75	83.41	1.82	5.45	9.05
ZP 808	8.20	80.68	1.78	5.60	8.93
ZP 877	8.41	79.49	1.75	5.84	8.85

The highest bioethanol content after 48h of fermentation had hybrids ZP434, ZP 548, ZP 747, ZP 666, ZP 808, ZP 606 (8.96%, 8.83%, 8.75%, 8.61% 8.52% and 8.46, respectively). The similar ethanol yield (approximately 79%) was detected in the hybrids ZP 877 and ZP 341. These two hybrids significantly differ in starch content. The relationship between grain starch and ethanol yield is not complete understood. The highest starch producing hybrid was not the highest ethanol producer. Volumetric productivity varied from 1.66 gl^{-1} h^{-1} (ZP341) to 1.87 gl^{-1} h^{-1} (ZP434). The hybrid ZP434 had the highest bioethanol content, volumetric productivity, a percentage of theoretical ethanol yield and bioethanol yield. If compared ethanol yield of ZP 434 with ethanol yield of another hybrids (Drini *et al.*, 2011; Seme enko 2013), it can be concluded that ZP434 is very suitable for bioethanol production. The lowest yield detected in ZP704wx can be attributed to the high percentage of hard endosperm. The hybrid ZP434 has the highest amount of soft endosperm. Seme enko *et al.* (2013) found a very good association between bioethanol yield and amount of soft endosperm. Srcichuwong *et al.* (2010) concluded that the hybrid with the highest starch content and the lowest content of lipids and proteins achieve the best yield of ethanol.

During the production of bioethanol, starch is removed from the grain and converted to alcohol and carbon dioxide. As a result of starch removal, the concentration of the remaining nutrients in the grain increases approximately three-fold. Valuable by-product dried distillers grains with soluble (DDGS) contains high percentages of protein, fiber and lipid can be used as a substitute for traditional feedstuff. Energetic value of bioethanol, which can be obtained from one kg of maize, expressed in MJ is calculated. After 24 hours of fermentation the most effective hybrid was ZP 434 (6.39 MJ) and the lowest one ZP737 (5.45 MJ). After 48 hours of fermentation the most effective hybrid was ZP 548 (9.47 MJ), following by ZP 434 (9.43 MJ) and the lowest one ZP737 (5.45 MJ).

Beside the fermentation efficiency, an important issue in the maize evaluation for bioethanol production is land requirement, e.g. bioethanol yield per land area. Hybrid ZP434 gives the highest yield per area, 5783.4tha^{-1}, followed by ZP704wx (4646.5tha^{-1}). The average bioethanol yield per arable area for each hybrid was calculated on the basis of percentage of theoretical bioethanol yield obtained in fermentation and average yield potential of the hybrid per arable area. It is also important to note that the best bioethanol producer, hybrid ZP 434, can be successfully cultivated on a poor land quality.

According to Mousdale (2008) 1GJ production of ethanol from starch or sugar feedstock in the European Union and the United States costs between €16.2 to 23 or from €0.29 to 0.41l^{-}

[1]. This means that 17.82 to 17.90 MJ is consumed to produce one liter of ethanol or about 5.5 MJ less energy than the energy value of one liter of ethanol. One liter of ethanol achieves higher profit than selling one kilogram of maize grain, but the production of one liter of ethanol requires on the average 2.5 kg of maize grain so the production of maize grain per hectare of arable land would be more profitable.

Conclusion

Identification of maize hybrids with higher bioethanol yield potential could significantly increase production efficiency of this biofuel from maize. The hybrid ZP434 is the most promising ethanol producer. High yield potential per hectare makes it the best candidate for the commercial bioethanol production. This hybrid is also extremely tolerant to drought and stalk lodging.

Acknowledgments

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IMPACT OF CLIMATE CHANGE ON CROP EVAPOTRANSPIRATION AND IRRIGATION REQUIREMENTS IN THE MEDITERRANEAN WITH A SPECIAL FOCUS ON THE COUNTRIES OF FORMER YUGOSLAVIA

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Abstract

High resolution climate database developed within the WASSERMed (EU-FP7-ENV) project, are used to estimate the expected changes in agricultural water requirements in the countries of former Yugoslavia. The climate data, based on A1B SRES scenario, referred to the actual situation (year 2000) and the future climate (year 2050). The results indicated that the air temperature increase could go from 1.3°C in Slovenia to 1.7°C in FYROM, while the precipitation is expected to decrease from 30-40 mm year^{-1} in Bosnia and Herzegovina and Serbia to about 80 mm year^{-1} in Montenegro and FYROM. The precipitation could remain unchained in Croatia, while in Slovenia a slight increase of 10 mm year^{-1} is expected. Evapotranspirative demand is foreseen to increase from 35 mm year^{-1} in Slovenia to 84 mm year^{-1} in FYROM.

By the mid of this century, the increase of air temperature could contribute to the anticipation and shortening of crop growing cycle for most crops. Hence, crop evapotranspiration and irrigation requirements could decrease especially for the winter-spring crops. However, the perennial crops water requirements could remain the same or even increase due to reduction of precipitation. Overall water requirements of agricultural sector could be slightly lower or remain almost the same as today because the shortening of the growing cycle could counterbalance the increase of evaporative demand and decrease of precipitation in the region. In any case, the impact of climate change could be distributed in a dissimilar way throughout the region due to spatial and temporal variation of future precipitation pattern and air temperature trend.

Keywords: *Air temperature, precipitation, water balance, evapotranspiration; irrigation; A1B SRES scenario.*

Introduction

Climate change studies have been getting major scientific interest in the last decades. This is due to numerous facts confirming the negative climate change trend which affects the functioning of bio-physical system and almost all sectors of economy (IPCC, 2014). This has recognized recently also on the World Climate Summit, convened at the UN Headquarters in New York (USA) on 23rd September 2014. The Summit brought together more than 100 Heads of State, ministers and leaders from international organizations, business, finance, civil society and local communities, who strengthened a treaty to mobilize the political support and momentum necessary to reach urgently a global agreement on climate change and galvanize action on the ground across all sectors.

Impacts of climate change on agricultural sector could be particularly relevant especially when linked to a number of factors such as population growth, socio-political issues, inadequate agricultural infrastructures, land degradation, heavy disease burden, poor soils and unfavourable climate (Todorovic et al., 2014). Numerous studies reported that the rising of air temperatures, changing of precipitation regimes, and increased atmospheric carbon dioxide levels will largely affected agricultural production (Linderholm, 2006; Fisher et al., 2007; Pereira and de Melo-Abreu, 2009; Lovelli et al., 2010). Biophysical effects of climate change on agricultural production could be positive in some agricultural systems and regions, and negative in others, and these effects will likely vary in seasons and time. For that reason, one of main challenges is to guarantee satisfactory food supply in the future knowing that within the 50-year span (2000-2050) world population would increase by 42%, food demand by 60% (30% of that due to changes in diets) (FAO, 2011), and that water for agricultural sector could be likely reduced by 18% (Strzepek and Boehlert, 2010). Hence, the studies investigating the impact of climate change on agricultural production and water requirements are of great importance to identify the capacity of agricultural systems to act and react to the changes in progress.

Recent studies pointed out that the Mediterranean region is potentially very vulnerable to climatic changes: large climate shifts were observed in the past (Luterbacher et al., 2006) while the climate projection studies have identified the region as one of the top "Hot-Spots" (Giorgi, 2006; IPCC, 2007). In fact, according to the A1B scenario of the Special Report on Emissions Scenarios (SRES), for the period of 100 years (from the end of 20th to the end of 21st Century), the following changes of climate are foreseen for the Mediterranean region (IPCC, 2007; Giorgi and Lionello, 2008; Hertig and Jacobeit, 2008): i) increase of CO_2 concentration in the atmosphere in a range from 45 to 90%; ii) annual mean warming from 2.2°C to 5.1°C, with the largest warming in summer months; iii) decrease of annual mean precipitation from 4 to 27%, with the largest decrease occurring in summer period; iv) decrease of annual number of precipitation days and increase of frequency of high intensity rainfalls. Accordingly, the increase of frequency and intensity of drought events and heat waves could be expected along with the increasing evapotranspirative demand and reduced precipitation. Hence, it is foreseen that the agricultural production in the future could rely strongly on irrigation. It will create an increasing competition for water resources between agricultural, domestic, industrial and tourism sectors especially in the areas characterized by scarce water availability.

The impact of climate change on the Mediterranean agricultural systems have been studied in the last years, among others, within the frame of WasserMed project (EC-FP7-ENV) funded by the European Commission. The studies focussed on both the regional (Mediterranean) scale and selected case-study areas and pointed out that the effects of climate change on agricultural production will be positive in some agricultural systems and regions, and negative in others (Saadi et al., 2014; Tanasijevic et al., 2014). However, no particular reference has been done on the impact of climate change in the Balkan Peninsula and countries of former Yugoslavia. Accordingly, this work focussed on the area of former Yugoslavian republics since it could be particularly vulnerable to climate change. This is mainly due to the fact that Balkan Peninsula represents a transient zone between the temperate continental climate in the North-Western parts and semi-arid Mediterranean climate, along the coast and in the South. Climate change was considered mainly through the changes of air temperature and precipitation with the objective to estimate the impact on crop water requirements and irrigation over the 50-year period (2000-2050). The analysis has been done for the whole Mediterranean region while the results focused on a comparison of the foreseen regional impact with it expected in the countries of former Yugoslavia.

Materials and methods

The climate data set was derived from from the ENSEMBLES project data (EC-FP6-ENV) and consecutive elaborations within the Wassermed project. RACMO2 Regional Circulation Model (RCM), driven by ECHAM5 Global Circulation Model (GCM) was selected as the most suitable model for this analysis. Data used in the analysis referred to the A1B SRES emission scenario which is one of the most likely to occur (IPCC, 2007). Data included the monthly values of precipitation, air temperature, air relative humidity, solar radiation and wind speed over the whole Mediterranean and former Yugoslavian republics. Data were arranged to represent year 2000 (given through the average of the period 1991-2010) and year 2050 (the average of data generated for the period 2035-2065).

The methodology adopted for data elaboration (Fig. 1) was based on the use of Geographical Information System (GIS). High resolution of input climate data (0.25° x 0.25° latitude by longitude) allowed the mapping of results to provide the spatial patterns of impacts over the whole region and to identify hot spots where changes could be particularly relevant.

It was assumed that the changes of air temperature will modify the starting date of growing season and will determine the extension of the areas suitable for cultivation. The thermal time concept was used to predict the crop development as a function of temperature (Monteith, 1977). The summation of temperatures above a threshold, called base temperature, was considered to simulate crop development and growing season length. Then, the crop evapotranspiration and irrigation requirements were estimated for the years 2000 and 2050 through a simplified water balance considering the changes in precipitation regimes and the variations of evapotranspirative demand of the atmosphere over the 50-year distance.
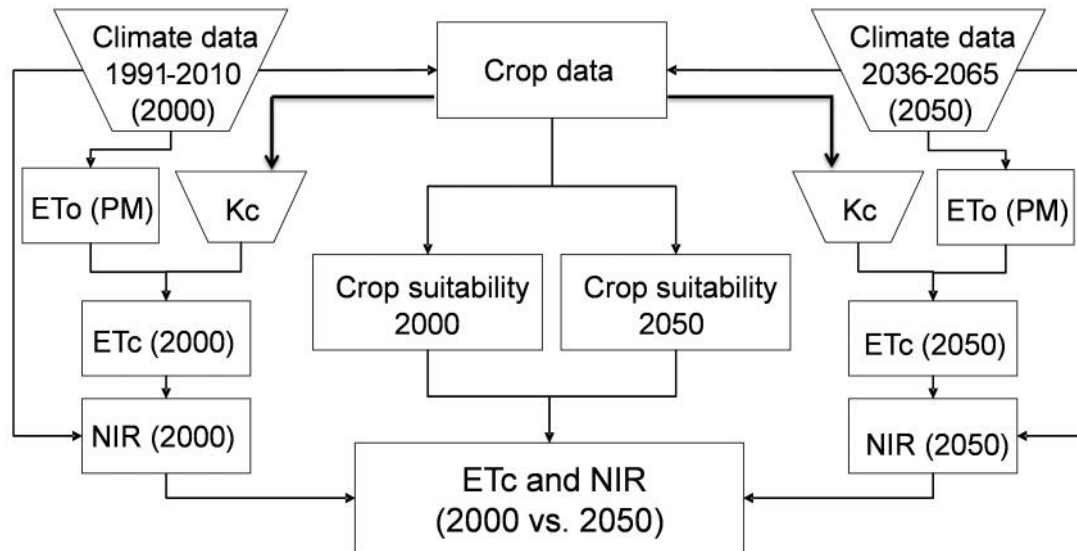
Fig. 1. A simplified scheme of the methodology used for estimation of crop evapotranspiration (ETc) and net irrigation requirements (NIR)

Reference evapotranspiration (ETo) was estimated from full weather data sets using the FAO Penman-Monteith equation (Allen et al., 1998) as:

$$ET_o = \frac{0.408 \cdot \Delta \cdot (Rn - G) + \gamma \cdot \dfrac{900}{T + 273} \cdot U_2 \cdot (e_s - e_a)}{\Delta + \gamma \cdot (1 + 0.34 \cdot U_2)} \tag{1}$$

where R_n is the net radiation available at the canopy surface (MJ m^{-2} d^{-1}), G is the soil heat flux density (MJ m^{-2} d^{-1}), T is mean air temperature at 2 m height (°C), U_2 is wind speed at 2 m height (m s^{-1}), (e_a–e_s) is vapour pressure deficit at 2 m height (kPa), Δ is the slope of the

vapour pressure curve (kPa ^{o}C^{-1}) and γ is the psychometric constant (kPa °C^{-1}). All parameters were estimated following the standard FAO procedure described in Allen et al. (1998).

Crop evapotranspiration (ET$_c$), corresponding to crop water requirements, was estimated using the single crop coefficient K$_c$ approach as:

$$ET_c = K_c ET_o \tag{2}$$

The K$_c$ values were taken from the literature for the Mediterranean growing conditions (Allen et al., 1998; Pastor and Orgaz, 1994; Er-Raki et al., 2008) and the net irrigation requirements (NIR) were computed as:

$$NIR = K_c ET_o - P_{eff} = ET_c - P_{eff} \tag{3}$$

P$_{eff}$ is the effective rainfall assumed to be 80% of total monthly precipitation.

The analysis has been done for a typical winter-spring crop (winter wheat), a typical spring-summer crops (tomato, sunflower and maize), and olive trees which growing season covers the whole year. A more detailed explanation of methodology in given in Saadi et al. (2014) and Tanasijevic et al. (2014).

Results and Discussion

The results of elaboration of climatic data indicated that the air temperature will increase over the whole study area in a range from 1.35°C in Slovenia to 1.67°C in FYROM, therefore, being lower in the North-West areas and increasing gradually towards South-East (Fig. 2). In general, the temperature increase is in the middle of range observed for the whole Mediterranean (from 0.84 to 2.31°C) by Saadi et al. (2014). On the seasonal basis, the temperature increase could be greater in winter (above 1.5° for all regions) and in summer months. Particularly hot summer season could be expected in Serbia (+1.89°C) and FYROM (+2.1°C) increasing the risk of heat stress.
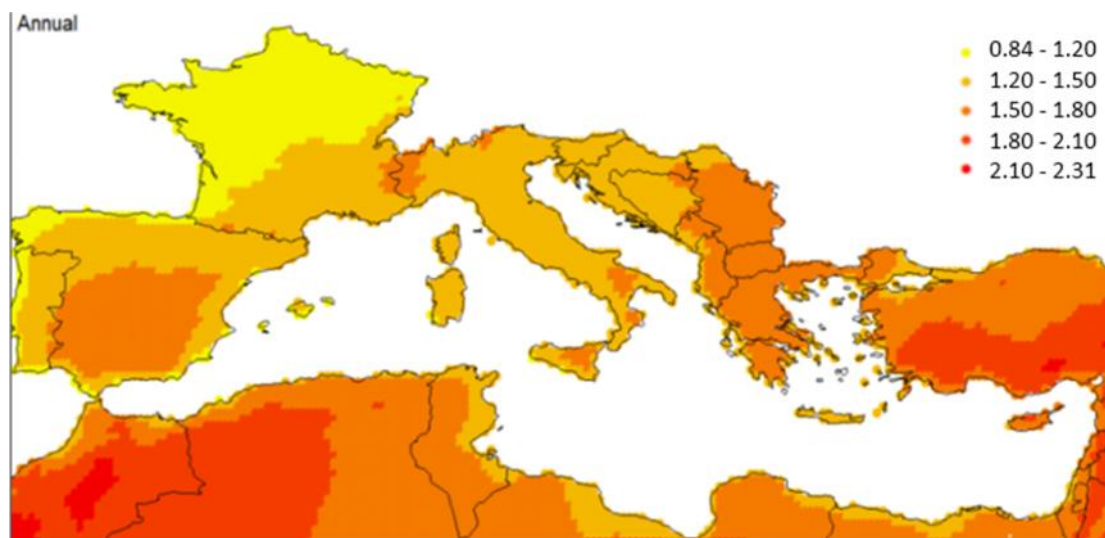
Fig. 2. Expected variation (increase) of average annual air temperature (in °C) over the Mediterranean for the period 2000-2050 (adapted from Saadi et al., 2014)

The precipitation trend could be twofold and depends on the geographic location (Fig. 3). Hence, precipitation is expected to decrease from 30.4±18.9 mm year^{-1} in Bosnia and Herzegovina and 38.5±22.2 mm year^{-1} in Serbia to about 77.1±35.7 mm year^{-1} in Montenegro and 82.4±26 mm year^{-1} in FYROM. On the contrary, the precipitation could remain at the same levels as today in Croatia (-0.6±16.9 mm year^{-1}), while in Slovenia an average increase

of 9.6 ± 17.5 mm year^{-1} is predicted. In general, the increase of precipitation is foreseen for the North-western parts of Slovenia and coastal areas of Croatia. A particular decrease of precipitation (more than 100 mm year^{-1}) could be expected in some areas of Montenegro and Macedonia (Fig. 3). These areas, together with the western parts of Greece and Iberian Peninsula and northern Morocco, could have the greatest reduction of precipitation in the region.
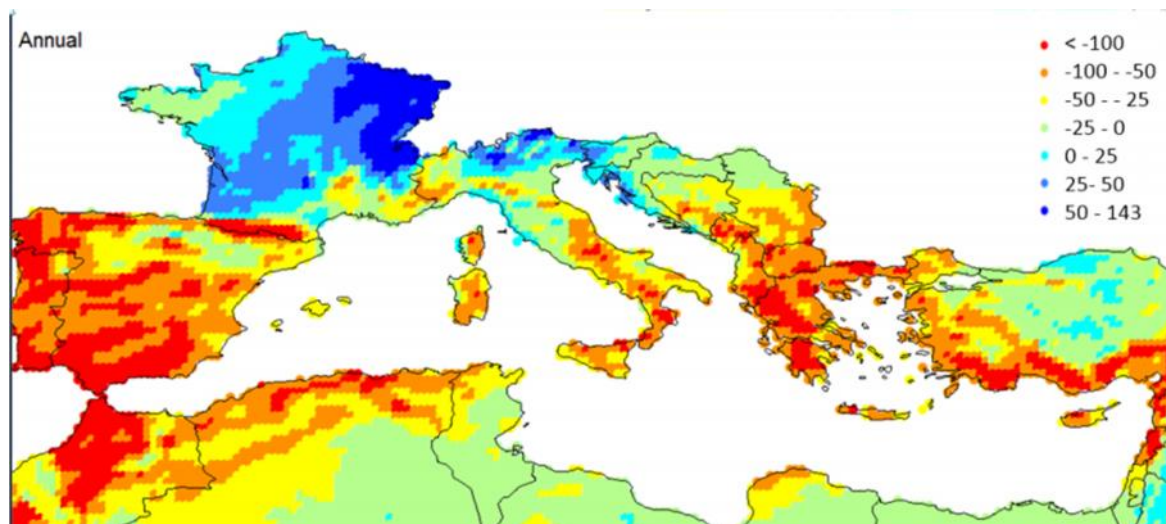
Fig. 3. Expected variation of annual precipitation (in mm year^{-1}) over the Mediterranean for the period 2000-2050 (adapted from Saadi et al., 2014)

Evapotranspirative demand of the atmosphere, expressed through the reference evapotranspiration term, is foreseen to increase over the whole region from 35 ± 3.5 mm year^{-1} in Slovenia to 84 ± 7.7 mm/year in FYROM (Fig. 4). The expected increase of reference evapotranspiration in Croatia, Bosnia and Herzegovina, Montenegro and Serbia is 48.6 ± 7.4, 54.4 ± 4.9, 59.6 ± 2 and 65.7 ± 7.9 mm year^{-1}, respectively. The foreseen change of reference evapotranspiration over the Balkan Peninsula could be similar to France and most of Apennine Peninsula and lower than the average increase over the whole Mediterranean (92.3 ± 42.1 mm year^{-1}). Furthermore, the peak values are much lower than the similar data in some areas Spain, Morocco, Greece and Turkey. In fact, reference evapotranspiration does not follow only the trend of temperature increase (Fig. 2) which means that the expected changes of other climate variables (wind speed, relative humidity and solar radiation) could be relevant and different than that of air temperature in some areas under study.

Olive trees are actually growing only along the Adriatic coast in Slovenia, Croatia, Bosnia and Herzegovina and Montenegro. Due to expected temperature increase, especially during the winter months, the areas suitable for olive trees cultivation could be extended over the continental part of Balkan Peninsula and included many new areas. This is particularly true for Serbia where, by 2050, almost 50% of territory could have a limited suitability for olives growing. Most of these areas are located in the Northern part of country (Vojvodina). Similar situation could occur also in the Northern part of Croatia (Eastern Slavonia) and in the Southern part of FYROM (Tanasijevic et al., 2014). These results, emphasizing the extension of the areas suitable for olive growing, are in agreement with the other studies (Bindi et al., 1992; Gutierrez et al., 2009; Ponti et al., 2013).
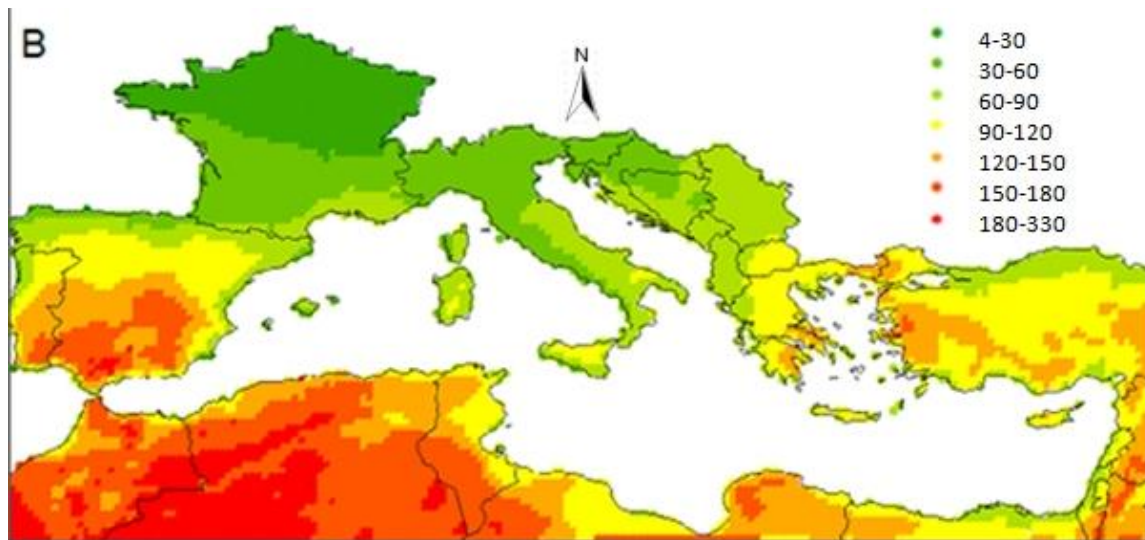
Fig. 4. Expected variation (increase) of evaporative demand of the atmosphere (in mm year^{-1}) over the Mediterranean for the period 2000-2050 (adapted from Saadi et al., 2014)

Olives flowering dates could be likely anticipated in the future, in average over the whole Mediterranean by 11 days. The anticipation of olive flowering in the areas of former Yugoslavia, where the olives are actually grown, could be between 10 and 12 days. This could have a minimum impact on the crop water requirements of olive trees but could affect the harvesting time and yield.

Olive trees ETc and irrigation requirements are expected to increase almost everywhere in the Mediterranean region. The first is due to ETo increase while the second is due to negative water balance and increased water deficit estimated by Eq. 3. Considering the whole Mediterranean region and only the areas where olive trees are actually growing, crop evapotranspiration is expected to increase in average by 8% (51±17 mm season[-1]) whereas the net irrigation requirements may increase in average by 18.5% (70±28 mm season[-1]) (Tanasijevic et al., 2014). The expected increase of olive crop evapotranspiration in the Balkan countries is much lower and it is in the range between 20 mm season[-1] in Slovenia and 31 mm season[-1] in Bosnia and Herzegovina. Similarly, NIR could increase from 18 mm season[-1] in Slovenia to 29 mm season[-1] in Bosnia and Herzegovina which is much less than expected increase over the whole Mediterranean.

In the case of winter wheat, crop water requirements could remain the same as they are today in Montenegro and they could decrease in other countries, from 8%, in FYROM and Slovenia, to 10% (43 mm season[-1]) in Serbia and 13% (53 mm season[-1]) in Croatia. This reduction of ETc is greater than the average reduction foreseen for the whole Mediterranean (8% or 33 mm season[-1]). In general and for the whole Mediterranean, it is worthwhile to point out that the foreseen reduction of winter wheat evapotranspiration was in agreement with other studies (Supit et al., 2010; Ventrella et al., 2012). Irrigation requirements of winter wheat could decrease by 2% in Montenegro and from 14%, in FYROM, to 33% in Croatia. Similarly to the ETc, the reduction of NIR in the future could be greater in the Balkan countries than over the rest of Mediterranean region (an average reduction of 12% is expected).

Maize crop evapotranspiration could be reduced from 1% in Montenegro to 5% in Slovenia (Fig. 5) whereas net irrigation requirements could diminish from 2%, in FYROM and Serbia, to 6% in Slovenia. These variations are in the range of those predicted for the whole Mediterranean (average reduction of 4% could be expected for both ETc and irrigation requirements).
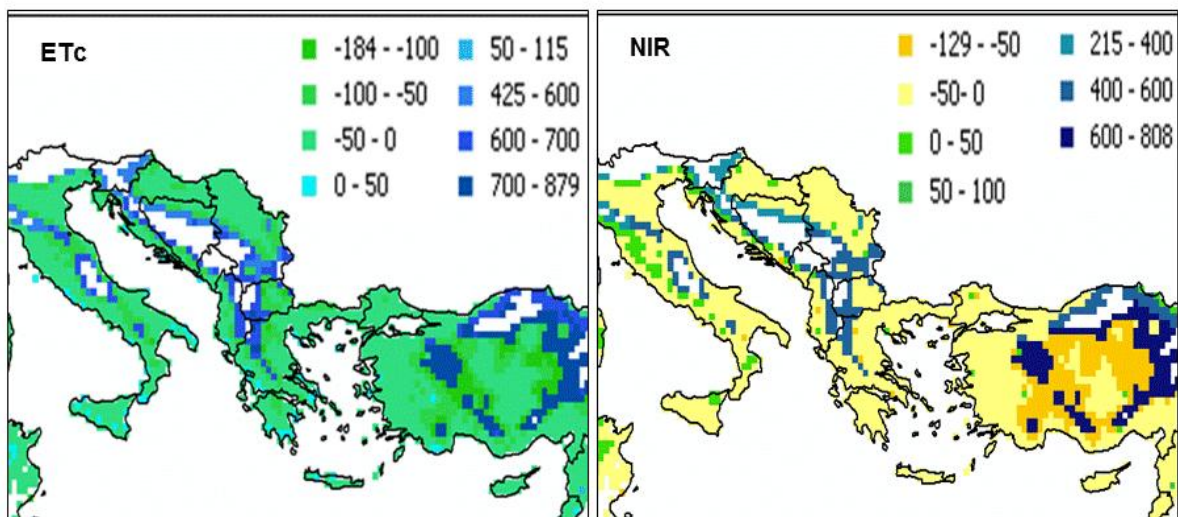
Fig. 5. Expected variation of maize crop evapotranspiration (ETc) and net irrigation requirements (NIR) over the countries of former Yugoslavia and one part of the Mediterranean region for the period 2000-2050 (the reduction of ETc is expected in all areas actually suitable for cultivation while the positive values - blue coloured areas – indicate the zones which could be suitable for the cultivation in the future)

The results of elaborations for sunflower indicated that crop evapotranspiration could likely decrease from 1% in Montenegro to 5% in FYROM and Serbia (Fig. 6). These changes are always lower than expected average crop evapotranspiration reduction over the Mediterranean (5%). In 2050, NIR of sunflower could: a) remain at the actual level in Bosnia and Herzegovina and Montenegro, b) decrease by 1, 2 and 8% in Croatia, FYROM and Slovenia, respectively, and c) increase by 3% in Serbia. This can be explained by the expected variation of precipitation during the spring-summer season which could penalize some areas in respect to the others.
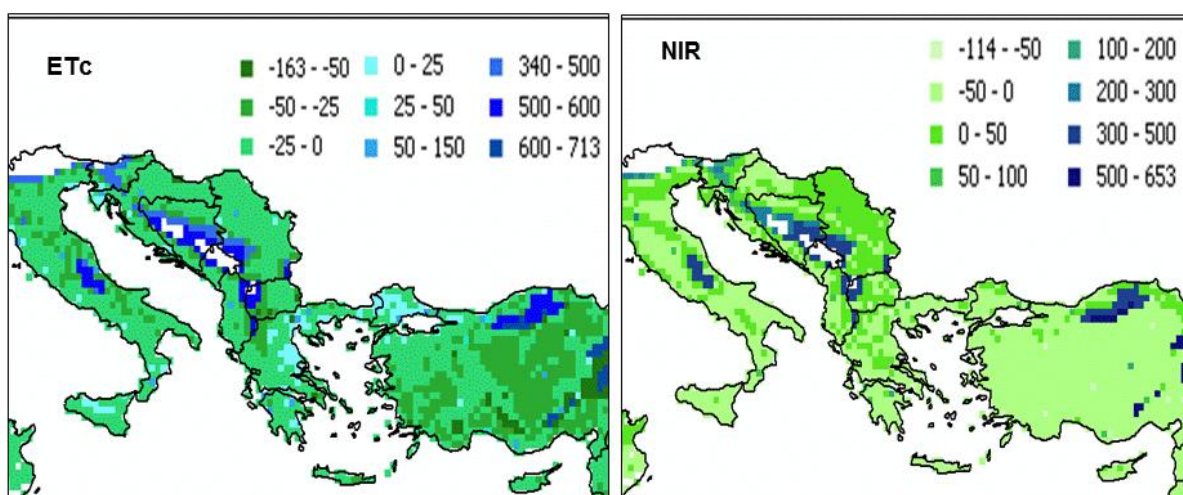
Fig. 6. Expected variation of sunflower crop evapotranspiration (ETc) and net irrigation requirements (NIR) over the countries of former Yugoslavia and one part of the Mediterranean region for the period 2000-2050 (the reduction of ETc is expected in all areas actually suitable for cultivation while the positive values - blue coloured areas – indicate the zones which could be suitable for the cultivation in the future)

Finally, in the case of tomato, crop evapotranspiration is expected to decrease from 2% in Bosnia and Herzegovina to 6% in Croatia and Slovenia, whereas irrigation requirements could be reduced from 1% in Serbia to 7% in Slovenia. The foreseen ETc variation is in the range of expected average variation for the whole Mediterranean (5%) while NIR reduction could be likely lower in respect to the average foreseen reduction for the Mediterranean (7%). The results were in agreement with those obtained by other authors for other areas of the Mediterranean (Lovelli et al., 2010; Ventrella et al., 2012).

Conclusions

The impact of climate change of agricultural water requirements in the Balkan area is in agreement with the overall expectations for the Mediterranean region. The main effects of temperature rise would be: i) the expansion of cultivable land toward the Northern latitudes and higher altitudes; and ii) the extension of the season suitable for cultivation. This study pointed out that the increase of air temperature could contribute to a substantial shifting (anticipation) and shortening of crop growing cycle for most crops by the mid of this century. Hence, crop evapotranspiration and irrigation requirements could decrease especially for the winter-spring crops. This reduction of agricultural water needs could be greater for the countries of former Yugoslavia than for other areas of the Mediterranean. However, the perennial crops water requirements could remain the same or even increase due to reduction of precipitation. Consequently, the average water requirements of agricultural sector could be slightly lower or remain almost the same as today because it is expected that the shortening of the growing cycle could counterbalance the increase of evaporative demand and decrease of precipitation in the region. In any case, the impact of climate change could be distributed in a dissimilar way throughout the region due to spatial and temporal variation of future precipitation pattern and air temperature trend. As a result, the impact of climate change could increase gradually from the north-western areas of Slovenia towards southern Serbia and Macedonia.

Spontaneous adaptation to climate change through the anticipation of the sowing/planting dates for spring- summer crops is already adopted in many areas. On one side, it could keep almost unchanged ETc and NIR. However, on another, the anticipation of growing season increases the frost risk and reduces the intercepted photosynthetic active radiation (IPAR) with the negative effects on yield.

Overall effects of climate change on water productivity could be positive whereas the effects on yield could be seen within a complex interaction of different strategies including the starting of growing season, the selection of most adequate varieties (short/long maturing), and adopted locally-tailored (water, land and nutrient) management practices. Overall adaptive capacity of agriculture will depend also on a mutual link between the bio-physical factors and socio-economic and policy impacts including the changes in land, water, energy and food availability, population growth, migration and habits, market fluctuations, as well as the consideration of environmental services (FAO, 2012). The effect of adaptation measure should consider the adaptation capacity of each specific area and could have greater success where water (and economic) resources are plenty available. In fact, the availability of water resources represents one of the main advantages of the Balkan countries in respect to the rest of Mediterranean. Therefore, the adoption of sustainable site-specific agronomic practices and introduction of modern and efficient irrigation distribution systems should be a priority in order to reduce the risks of yield reduction in the future. This could be achieved only through the strong socio-economic and institutional setting, the accessible funding based on well-designed operative irrigation programs, the on-ground demonstration actions and the implementation irrigation projects especially in the most vulnerable areas of important agricultural regions.

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1. PLANT PRODUCTION

A TRANSPIRATION MODEL TO SCREEN LOCAL FRUIT TREE GENOTYPES FOR DROUGHT TOLERANCE

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Abstract

Temperature increases associated with climate changes has already affected the agricultural production in Mediterranean countries, in particular, due to temperature increases. Under such scenario, selections of drought tolerance traits are imperative. Among the rich apple germplasm of Albania it is possible to find resistant genotypes but their screening requires a fast method. Given that transpiration of tree crops is mainly modulated by canopy conductance and vapour pressure deficits, we developed a functional model of tree transpiration, based on sap flow which was measured using stem heat balance sap flow sensors. Using a fast modeling approach based on parameterized Penman – Monteith equation we calculated the daily transpiration dynamics in real – time. The model was tested using various apple selections as candidate rootstocks showing a good fitting between measured and modeled values ($R^2 = 0.91$). This transpiration model can be effectively used to screen a large number of genotypes or even seedling from a cross in fruit tree species. The structure of the model being based on sap flow together with an assessment of intercepted radiation, allow the computation of transpiration in the main fruit tree species under different climates with a degree of precision that should be greater than the standard engineering methodology which uses a single crop coefficient regardless of climate.

Keywords: *screening, drought resistance, transpiration, modelling*

Introduction

The risks of climate change for the Albanian agricultural sector are a particularly immediate and important problem because the majority of the rural population depends either directly or indirectly on agriculture for their livelihoods (Sutton et al., 2013). Improving current approaches to quantify the transpiration of fruit trees is needed for water allocation purposes and to enhance the precision of water applications under full and deficit irrigation (Villalobos et al., 2013). Furthermore, temperature increases by 1.5°C in the next decades forecasted for Albania constitute a challenge to sustainable fruit production, which considers also water usage. Under such scenario, selections of drought tolerance traits are imperative.

Models of transpiration have been developed for many species with a wide variation of physiological detail (Dekker et al., 2000). In general they are based on the calculation of canopy conductance which is often done by applying empirical models of leaf conductance (e.g. Jarvis, 1976) to canopies (Stewart, 1988). Another approach links leaf conductance to CO_2 assimilation using semi-empirical equations (e.g. Ball et al., 1987; Leuning, 1995). Overall, the complexity of many assimilation models (e.g. Farquhar et al., 1980) needed to calculate conductance preclude the wide use of approaches linking conductance to assimilation outside the academic environment (Villalobos et al. 2013). However, the development of transpiration or canopy conductance models has been hindered by the lack of accurate, long-term transpiration data at the orchard scale. In trees it is often based on

determining sap velocity using heat as a tracer. Records of sap velocity of different fruit tree species under a variety of conditions, are a prerequisite for the estimation of transpiration with sufficient accuracy as an input needed for the parameterization and experimental validation of transpiration models (Villalobos et al., 2013).

The research presented here describes a generalized, model of transpiration based on sap flow, as a potential method for fast screening of drought tolerance among the rich apple germplasm of Albania (Kullaj, 2006).

Material and Methods

For the purposes of testing the model, four local apple genotypes, the 'Zheji' (Sl#01), 'Gjeçe'(Sl#02), 'Bardhe' (Sl#03), and 'Kumardha' (Sl#04) were collected from the Fruit Germplasm Collection at the Agricultural University of Tirana. These local varieties have been phenotypically described knowing to have a different degree of drought sensitivity (Kullaj, unpublished). For the drought tolerance experiments, 20 young trees (~1 m tall) propagated by shoot proliferation were grown for several weeks. To a simulated moderate-severe drought genotypes were imposed by withholding water until the pots reached 40% of full saturation and maintained for 2 weeks at this level. Using a fast modeling approach based on parameterized Penman – Monteith (PM) equation we calculated the daily transpiration dynamics in real–time. The details of the modelling procedure and equations have been already described (Kullaj et al. 2014b). The method is based on diurnal courses of variables instead of commonly used daily means (Kullaj, et al. 2014a) and a different evapotranspiration formula describing the influence of vapour pressure deficit (D) to stomata closure and the parameterization process is performed as a direct non–linear multi–regression analysis of P–M equation (Kullaj 2013a, b) to radiation (R) and D. This was enabled by the use of sap flow (SF) was measured using sap flow sensors EMS 62 (EMS Brno), based on SHB (stem heat balance) method (Lindroth et al. 1995; ermak et al. 2004). Sensors were installed on shoots (12 mm thick) on the stem of 9 saplings, 3 for each genotype. The measuring interval was every minute with 1 s warm-up and storing interval every 15 minutes during the hottest period. A portable meteorological station Minikin RTHi (EMS Brno, CZ) measured the radiation (R), air temperature (Ta) and humidity of air (RH). D was calculated from vapour pressure and relative humidity. Plants were subject to water stress, beside others (high R and Ta). Using a nonlinear multiregression analysis we obtained the measured canopy transpiration and the one calculated by P-M equation. Plants were subjected to a dry period followed by full irrigation to evaluate their ability to recover.

$$E = \frac{\left(\Delta.(R_n - G) + \rho c_p D g_a\right)/\lambda}{\Delta + \gamma.(1 + \frac{g_a}{\frac{R_g}{R_g + R_a} \cdot g_{\lim}(0.5 - \frac{1}{\pi} arctg(\frac{D}{a} - b) + g_{\min}})}$$

where:

E = transpiration [mm]; – slope of saturation water vapour pressure deficit [Pa/K]; Rn – net radiation [W/m^2]; G – soil heat flux [W/m^2]; – density of dry air [kg/m^3]; c_p – specific heat of air [J/m^3]; D – vapor pressure deficit [Pa]; g_a – aerodynamic conductance [s/m]; – water heat capacity[J/kg]; - psychrometric constant [Pa/K]; a, b – empirical parameters; g_s – canopy (stomatal) conductance [s/m]

Results and Discussions

Based on sap flow diurnal dynamic and using the model described, we calculated the actual (measured) diurnal transpiration of four apple selections for the entire period of measurement. The graph ilustrates the diurnal dynamics of sap flow for the entire period of measurments which was characterized by a relatively stable evapotranspiration demand. To enable a comparison both as daily maximum rates as well as a total transpiration for the entire measurement period, selected statistics are reported in Table 1. The diurnal dynamics shows clearly that Sl#02 had the highest transpiration rates (0.0153 mm), whilst the other three selections have similar rates.

Table 1. Comparison of transpiration values (mm) between the four apple selections

Selections	Min	Max	Average	Total	Std. Dev.	Records
Sl#01	0	0.01018210	0.002408901	7.166481	0.00241891	2975
Sl#02	0	0.01533009	0.004116965	12.247970	0.00398802	2975
Sl#03	0	0.01178653	0.003021107	8.987795	0.00303455	2975
Sl#04	0	0.01274005	0.003287117	9.779174	0.00325232	2975

Transpiration is driven mainly by vapour pressure deficit (D). Figure 1 shows the dependency of transpiration to D as well as the modelled potential evapotranspiration (PET) calculated from meteorological sensors. Figure 2 shows the comparison of diurnal cycles of measured versus modelled transpiration. A short period was selected for better comparison of the fluctuations. Further more, a regression analysis (Figure 3) explained in more details elsewhere (Kullaj et al. 2013a,b) gives a good regression coefficient between measured and modelled data. The sensitivity analysis demonstrates that the model fits with the actual transpiration data and can be used to simulate various abiotic stresses.
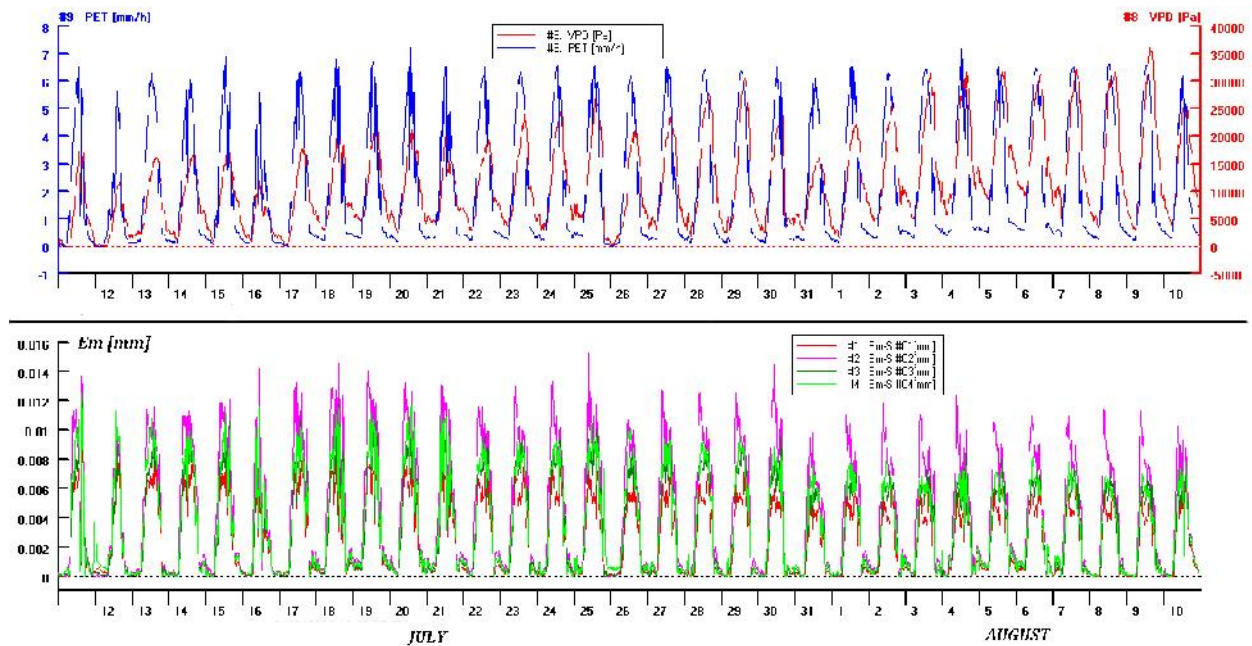
Figure 1. Dependence of transpiration values to VPD. The upper window shows also potential evapotranspiration dynamics

The model responds to the main changes on the crop-climate binomial, thus is a step forward with respect to the simpler approaches currently used for the calculation of crop water requirements. This modelling methodology is adapted for fruit trees in which E responds to the g_s, contrary to short, dense field crops or grasses, in which whole–crop E is dependent on stomatal aperture when g_s is low but as stomata begin to open, whole–canopy E soon becomes relatively insensitive to changes in g_s (Lakso, 1994). This is related to changes between the two types of crops in terms of tree boundary layer resistance, with apples having small boundary layers due to their stature and roughness of the canopy, changing the transfer rate of water vapour between the crop and the air above.
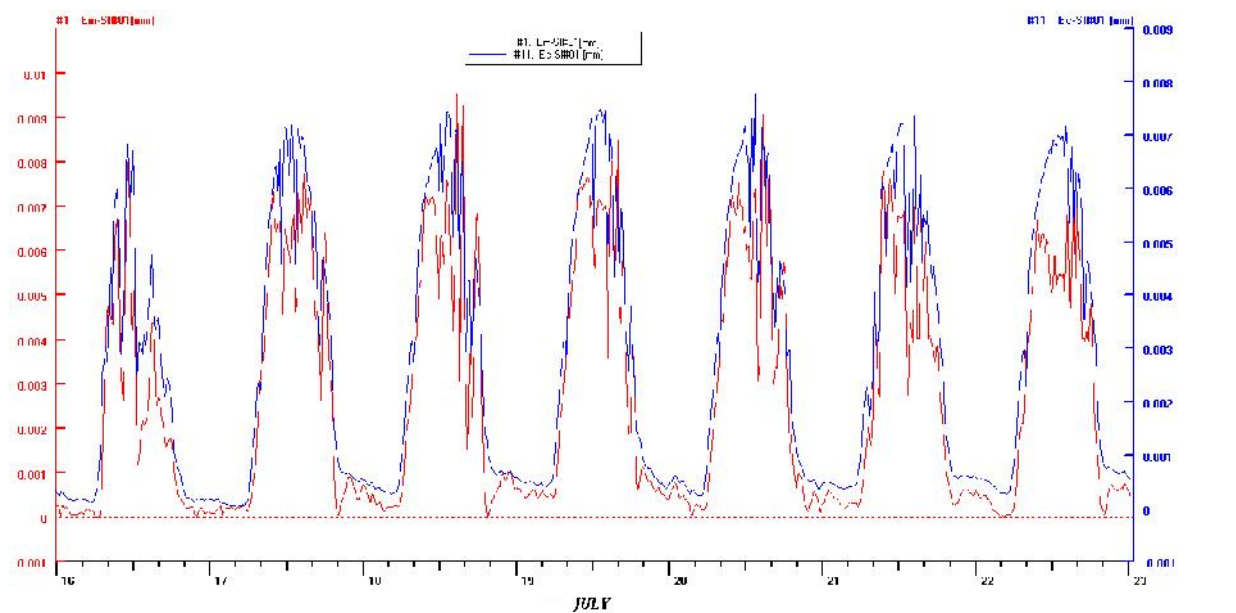
Figure 2. Comparison of modelled (Ec) and measured (Em) transpiration values for a selected period of measurement. It seems that the model fits with measured variables. However, in

particular cases we see a higher or lower prediction values, especially in days where there is a high fluctuation in meteorological variables dring sap flow.

Calculation of modelled E values in PrgmClc module is approachable directly from the fit module. The fit module estimates the time lag between radiation (VPD) and sap flow using a cross-correlation analysis. The programming code is created automatically although an editing is advisable. During the calculation, a new file with calculated canopy transpiration variable is created.

The main advantages over the standard FAO method (Allen et al., 1998) of using this model of canopy conductance to calculate transpiration are a more mechanistic approach that increases the precision of the estimate and the reduced data requirements relative to the FAO method. Solar radiation and vapour pressure deficit may also be estimated from maximum and minimum air temperature using the Hargreaves method (Hargreaves and Samani, 1985) for solar radiation and taking minimum temperature as a surrogate for dew point temperature (Villalobos et al. 2013). The model proposed here could account for the changes in canopy conductance by modifying the coefficients a and b of Eq. in proportion to atmospheric CO_2 concentration and expected changes in radiation use efficiency.

The model presented here predicts that the increase in transpiration slows down as vapour pressure deficit (D) increases which confirms the findings of Dragoni et al. (2005) in apple.
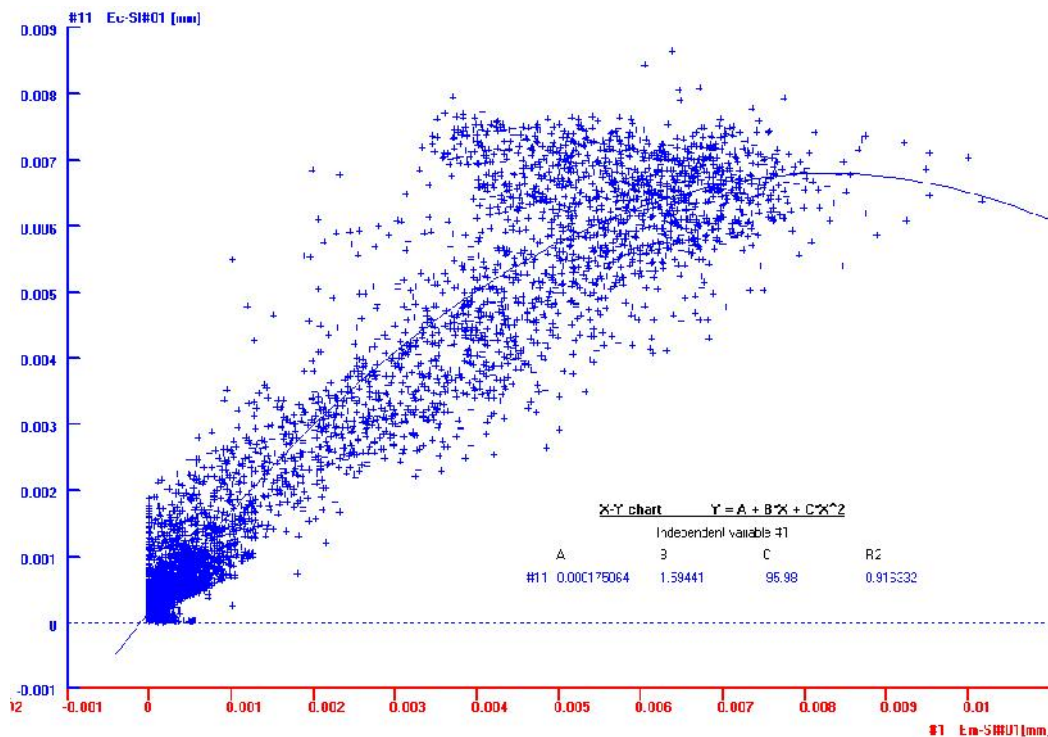
Figure 3. Regression analysis between calculated (modelled) (Ec) and measured (Em) transpiration values for a selected period of measurement. The graphs includes all the measurements, including a considerable zero values shown in the left part of the graph since the diurnal course was used.

Conclusions

We have demonstrated that this transpiration model can predict the actual transpiration of these young apple selections as candidate rootstocks. Rather than identifying the most appropriate rootstock for drought resistance, the main purpose of this paper was to test a transpiration model to be effectively used to screen a large number of genotypes or even seedling from a cross in fruit tree species. Although it was tested on apples, the structure of the model being based on sap flow together with an assessment of intercepted radiation, allow the computation of transpiration in the main fruit tree species under different climates with a degree of precision that should be greater than the standard engineering methodology which uses a single crop coefficient regardless of climate. For the first time in literature, we have shown real–time, dynamic transpiration measurement.

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PRODUCTION CAPABILITIES AND NUTRITIVE VALUE OF FODDER FOR ANIMAL NUTRITION IN MOUNTAINOUS AREA OF REPUBLIC OF SRPSKA

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Abstract

There is lack of feed in the mountainous region of the Republic of Srpska despite the large agricultural area. The main source of feed is natural grasslands of low productivity and low energy value. In this paper we determined the yield and nutritional value of the natural grasslands using agricultural practices of fertilization and sowing. Also, a number of production technologies on plowed land with annual legumes and grass-legumes mixture were designed. The aim of this work was to increase the yield and quality of forage on natural grassland and on plowed land. It was determined the forage yields per unit area as well as the nutritional value of the air-dry hay. According to the results of chemical analysis, low protein content in natural grasslands was found (8.96 to 9.59%), regardless of the agro-technical measures application. It was identified a high protein content sowing grass-legume mixtures, especially in the second cut (from 17.31 to 21.77%). The digestibility of nutrients from green feed depends on the plant growing stage and species of animal consuming such feed. The digestibility of this feed for ruminants is 75-80%, for horses 60%, and 50% for pigs. Applied agro-technical measures show that the production of high-quality nutrients can be increased in this region.

Key words: *mountainous area, natural grasslands, plowed land, yield, nutritional value.*

Introduction

Of the total agricultural area 350 000 ha land are under natural meadows and pastures in Republika Srpska. Arable land cover an average of 586 000 ha, fallow and uncultivated land 240 000 ha. Accorfing to a multi-year average, forage crops on arable land is planted on 75 000 ha. Most of this area is located in the hilly-mountainous region. The characteristic of production in these areas are low yields and poor quality. The reason for the low and unstable yields and poor quality of forage is the lack of agro technical measures (*Dubljevi* , 2007). Natural grasslands belong to the most widespread meadow-pasture communities in the mountainous region of Serbia (*Lazarevi et al*., 2009). Several authors (*Stevanovi et al.,* 2004; *Neši et al*., 2004; *Vu kovi et al*., 2004; *Alibegovi et al.*, 2004) found that the proper fertilization of meadows and pastures with mineral and organic fertilizers, the rational exploitation, under the same conditions can provide of several times increasing of hay yield (up to 20 t ha-1), and at the same time improving the quality of forage. One of the most important nutrients for achieving high yields of natural grassland is nitrogen. *Vitousek and Howarth (1991), Frink et al. (1999), LeBauer and Treseder (2008)* point out that the nitrogen is usually the limiting factor for high production of natural grasslands. Different species of perennial grasses and legumes can be combined into the mixtures that are suitable for a specific production area, the purpose of use and duration of exploitation *(Lazarevic et al., 2006). Kessler and Lehman (1998)* concluded that sown grasslands had a higher yield and quality of the biomass as compared to natural grasslands. Increasing of legumes in the mixtures reduces the need for nitrogen fertilizer and in that way reduces the cost of fodder production per unit area (*Vu kovi* , 2004). The number of species that can be breeded for

fodder production is limited because of short growth season in the mountainous region. In the research of Gatari et al., (2009) it was concluded that excellent results can be achieved by breeding fast growing perennial legume of forage pea and vetch.

The aim of this study was to determine forage yield and its quality, and based on these results to obtain the proposed measures for the repair of natural meadows and recommendations for planting species that will increase the production of good quality forage.

Materials and Methods

The research was conducted on agricultural land in the village Mrkalji, in the municipality of Han Pijesak, during the growing season in 2013 (44 ° 01 '30 "N, 18 ° 56 '10" E, 1111 altitude). Arable land has a shallow layer on dolomite. It has acid reaction and very poor content of available P_2O_5, medium content of humus and rich content of K_2O. Meteorological parameters of the study area during the vegetation period in 2013 are shown in Table 1

Table 1. The average monthly temperature and the amount of monthly precipitation in the growing season

Month	III	IV	V	VI	VII	VIII	IX	X
Temperature $°C$	0.6	8.2	11.4	14.4	17.0	17.6	11.3	9.6
Precipitation lm^{-1}		94.1	53.0	201.3	75.3	69.6	75.7	105.5	93.3

The experiment on a natural meadow, type Agrostietum vulgaris, was placed in four variants: 1.control, 2.fertilization with 200 kg ha^{-1} NPK (15:15:15), 3.fertilization with 300 kg ha^{-1} NPK (15:15:15) and 4. sowing off 20 kg ha^{-1} of red clover + 20 kg ha^{-1} + Italian ryegrass fertilization with 200 kg ha^{-1} NPK (15:15:15). Agro technical measures were not used in the control group. All variants are mowed at the same time.

The experiment on arable land included planting legume-grass mixtures and planting perennial fast-growing legumes. Three variations were used in legume-grass mixtures: red clover + Italian ryegrass, white clover + ryegrass and red fescue + Birdsfoot trefoil. Sowing was manually from sowing rate 20 kg ha^{-1} legumes +20 kg ha^{-1}grass. The joint crops were used from the fast-growing legume: field pea (120 kg ha-1) + oats (40 kg ha-1) and vetch (80 kg ha-1) + oats (40 kg ha-1). Before sowing the soil was fertilized with 300 kg ha^{-1} NPK (15:15:15). After sowing the soil was rolled. The experimental unit was 0.1 ha. Samples were collected at an optimal growth phase, i.e. the flowering phenophase. Four samples per 10m^2 were taken from each experimental unit, and thereafter the green mass was weighed. Samples were taken from the diagonal of the four variants of each. The green mass was determined, dried, prepared and analyzed in the Laboratory of feed quality control. The chemical composition was determined and calculated protein production for all variants. Quality of dry matter was determined after analyzing the chemical composition. Chemical analyzes were performed according to the following methodology: protein micro-Kjeldahl method, modification by Bremner (1960) and crude protein by multiplying by a factor of 6.25; crude fat in plant material, using the Soxhlet; crude fiber content of the plant material, the method by Henneberg - Stohman; crude ash content in the plant material, burning at 550°C until constant weight. The share of nitrogen-free extracts (NFE) was calculated based on the chemical composition of the dry matter. Forage measurement was performed on the experimental plot and the analysis was performed in the Laboratory of feed quality control of Banja Luka Faculty of Agriculture. Biometric measurements were processed by PC applications for Windows: Statistical Package for Social Sciences and Excel.

Results and Discussion

Results of testing forage yield in natural meadows and arable land are presented in Figure 1. Based on the data it can be concluded that the treatment application on the natural meadows was an increase yield compared to the control group. On the arable land forage production was significantly higher than in the natural grasslands. The lowest yield of 5.53 t ha^{-1} was achieved on the natural meadows, on the control plot, with no argo technical measures. The yield was significantly increased on the natural meadow with applied treatments as compared to control; for a variant of fertilization 200 kg ha^{-1} of 27.1%, for the variant of fertilization 300 kg ha^{-1} of 37.4%, and sowing off of 43.8%.

Vuckovic et al., (2004) reported that application of 160 kg N ha^{-1} showed an increase of biomass yield of grassland for 153% compared to control. According to Dubljevic (2007), natural grassland fertilization with nitrogen is very important because its application increased forage yield and crude protein, potentiates growth and tillering grass, increasing the density of grass cover, extending the vegetation and slows down aging plants. Djuric et al. (2007) noted that the fertilizing natural grasslands increasing the proportion of high-quality plants on the lawn, which results in greater production of proteins. The highest biomass production was achieved in the arable land of vetch + oat (27.30 t ha^{-1}) and a mixture of white clover + ryegrass in two cuts (26.38 t ha^{-1}). The production of biomass in a growing season is 2-5 times higher than the natural grasslands. For perennial mixture since it was the first year of establishing the crop can be expected that in the coming year's production will be even greater.
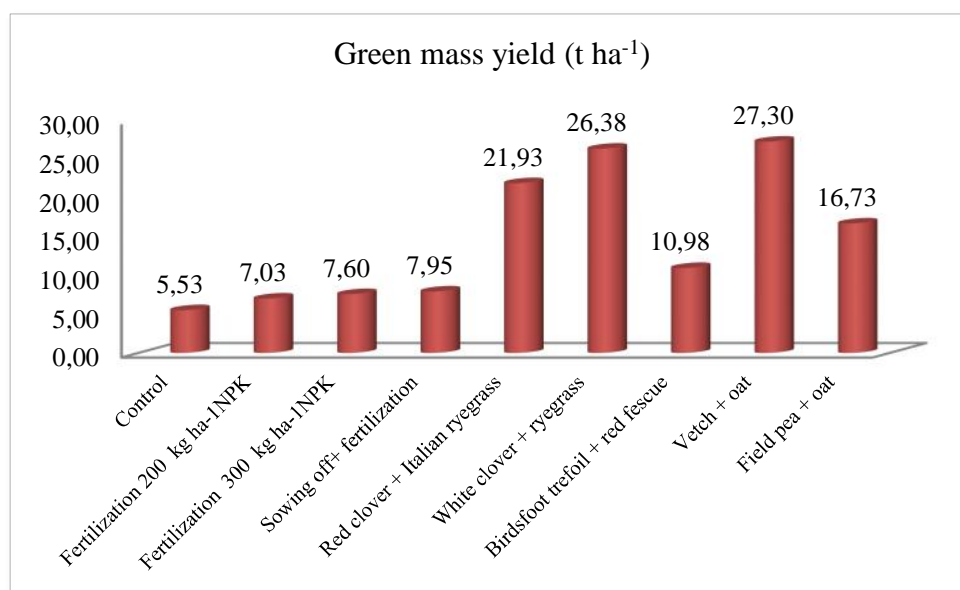
Figure 1. Green mass yield

Green feed, produced on grasslands or arable land, has a high water content, which may range from 60 and even more than 80%, and primarily depends on the stage of the plant maturity. The results of the chemical composition of plant dry matter are shown in Table 2. The percentage of protein from natural grasslands ranged from 7.10 to 10.14%, while the fiber content was 29.6 to 32.60%. The differences in the chemical composition on natural grasslands were created largely because of differences in the floristic composition on micro-locations, and due to the heterogeneity of the land, rather than as a result of the applied treatment.

A higher content of nutrients was observed in all tested variants on arable land compared to natural grasslands. Variant of white clover and perennial ryegrass in the second cut had the

highest crude protein content (21.87%) and crude fat (2.91%) and the lowest content of crude fiber (20.96%). By analyzing the chemical composition of first cut of this mixture was found high nutritional value. Higher protein content was determined in the second cut compared to the first cut in all tested legume-grass mixtures. One year fast-growing legumes with supporting crops (oats) had a high nutritional value. The crop of vetch and oats in addition to high yield of green mass showed a favorable ratio of crude protein and crude fiber. Of the total amount of crude protein, true protein is represented 45-85% and the rest are amides. However, ruminants can use amide well due to microorganisms which are found in the rumen. (Grubi and Adamovic, 2003).

Table 2. Chemical composition of feed dry matter

		Variant	Crude protein (%)	Crude fat (%)	Crude fiber (%)	Crude ash (%)	Nitrogen-free extracts (NFE) (%)
Natural grassland		Control	8.14	1.81	31.33	6.88	51.84
		Fertilization 200 $kg\ ha^{-1}$NPK	10.14	2.13	29.60	7.35	50.78
		Fertilization 300 $kg\ ha^{-1}$NPK	8.13	1.92	31.10	6.08	52.77
		Sowing off+fertilization	7.10	1.84	32.60	6.29	52.17
Legume-grass mixtures	First cut	Red clover + Italian ryegrass	13.34	2.10	29.90	8.34	46.32
		White clover + ryegrass	18.96	2.39	22.80	9.07	46.78
		Birdsfoot trefoil + red fescue	17.47	1.96	23.30	8.18	49.09
	Second cut	Red clover + Italian ryegrass	17.31	2.43	27.20	8.66	44.40
		White clover + ryegrass	21.87	2.91	20.96	11.25	43.01
		Birdsfoot trefoil + red fescue	21.77	2.01	21.47	11.64	41.01
Legumes		Vetch + oat	20.55	2.05	21.80	13.03	42.57
		Field pea + oat	16.46	1.92	25.96	6.34	49.32

Economic significance of natural grasslands is determined by two main factors, vegetation cover quality and yield of fodder *(Kojic et al., 2001).* The chemical composition of dry matter of natural grasslands is of crucial significant for the quality of animal feed, and is highly dependent on environmental factors, floristic composition and developmental stages of plants *(Ivanovski et al., 2004).* The digestibility of the organic matter of green plants depends on the plant growing stage and animal species consuming such feed. The digestibility of this feed for ruminants is 75-80%, for horses 60%, and 50% for pigs.

Conclusions

Based on a survey of forage yield and quality in agricultural areas in the mountainous region of the Han Pijesak municipality can be drawn the following conclusions:
Forage production on natural grassland with agro technical measures: fertilization and sowing off + fertilization can be increased from 5.53 t ha^{-1} on 7-8 t ha^{-1}.
There were no significant differences in the level of protein, but it can be expected in the coming period due to changes in the floristic composition.

However, the total production of protein per unit area was significantly greater with agro technical measures.

Very good production results and quality of feed were obtained by sowing the joint crops of vetch and oat, on arable land in the mountainous area, in a very short growing season of 80 days.

The yield was 27.30 t ha^{-1}. This feed had high nutritional value, with 20.55% crude protein, 2.05% crude fat and 21.80% crude fiber.

Production and quality of perennial legume-grass mixtures in a growing season is 2-5 times higher than the natural grasslands.

Out of all tested feed the best quality showed legume-grass mixtures, white clover + ryegrass with a high content of crude protein in the first cut (18.96%) and second (21.87%) and total production of green mass of 26.38 t ha^{-1}.

The digestibility of the organic matter of green plants depends on the plant growing stage and animal species consuming such feed. The digestibility of this feed for ruminants is 75-80%, for horses 60%, and 50% for pigs.

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INFLUENCE OF SUBSTRATE AND CELL VOLUME OF CONTAINERS ON THE QUALITY OF BASIL

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Abstract

The system of polystyrene and polypropylene containers "speedling system" with different volumes of cells proved to be a rational and practical system of container seedling production. The aim of this study was to examine the use and analyzes of advantageous properties of different substrates in the production of basil grown in containers with the different volumes of cells (7,30, 20, 33.5, 80 cm^3). Reseachers analyzed the main indicators of basil seedlings quality: mass of seedlings, seedling height and number of basil leaves. The best basil is produced on Klasman substrate in containers with a maximum volume of 80 cm^3.

Keywords: *basil, seedlings, substrates, cell volume containers.*

Introduction

Basil *(Ocimum basilicum)* is an annual herbaceous plant. Provenance of basil is India. Basil is known as a spice and is now spread over a large area of the Mediterranean, which is unavoidable in Mediterranean cuisine. It has an important ecological function as attracts insects which use it for grazing *(Lesinger and Vicar, 2006).* It is grown as a medicinal plant as well as plant for extracting the essential oils recently *(Jev ovi et al., 2011)*. The essential oil of basil is used in the pharmaceutical industries and lately occupies an important role in the protection of plants *(Keita at all., 2001)*. Basil oil has an antibacterial, antiviral and antiseptic effects, but recent studies confirm anticancer effects also *(Gajula et al., 2009).* The interest for basil rises the need for improving transplant technology especially from the different aspects of its use,.*(Beatovi i sar., 2009).* The modern technologies of production of seedlings of basil *(Ocimum basilicum)* (speedling and cut system) according to the protected root system are conducted using different types of substrates *(Hani 2000; Jelacic et al., 2005; Beatovi et al., 2006, 2008).*

Materials and methods

The two-year experiment was conducted in 2013/14 in the laboratory of the Faculty of Agriculture, University of East Sarajevo. In the two factorial study, set in a randomized block design with four replications it has been investigated the effect of substrate (A) and volume of container cells (B) on the quality of basil seedlings. Researchers used the following substrate: Klasman Deliman-potgrond H (a mixture of frozen red sphagnum peat and fine white sphagnum peat), Plantel ideal (a mix of 70% black peat, white peat 28% and 2% clay), Domestic substrate (substrate is composed of black, white and more decomposed less decomposed peat 65-85% clay and 10%). The basil seedlings was produced in containers with the following cell volume ((7,30; 20; 33,5;80 cm^3). For sowing the basil seeds we used varieties"Basilica". Planted were two seeds in each cell, and immediately after the eruption, we left the most advanced plant to grow. Sowing was conducted in the first decade of March.

During the experiment, the measures common for the seedlings were applied (shading, watering, ventilation). The seedlings had adequate conditions in the laboratory. Daily air temperature was in the range of 22-25^{0}C, while the humidity of the substrate is maintained within the optimal range (60-70%). We selected 20 plants of each combination (substrats volume of container cells) using the method of random sampling. We analyzed the following parameters of quality seedling: plant height, number of leaves per plant, weight of above-ground parts of the plant. Results were analyzed using analysis of variance (ANOVA) and tested with LSD test.

Results and Discussion

Basil seedlings quality is reflected in the weight of the aerial parts. The results of the effects of substrate type and volume of container cells to the mass of seedlings showed that the best version was with the capacity of 80 cm^3 in all of three tested substrates. Influence of substrate type and volume of container cells was confirmed in research *(Ilin et al., 2003)*. The results indicate that the substrate Klasman Deilman potgrond-H showed as the best where the avarege determined mass of seedlings was 4.12 g. In the local substrate we have found significantly less weight (2.56 g). The statistically significant differences among the domestic and Plantel substrate were not observed . Size of container volume cells significantly affect the mass of plants. The difference in weight of seedlings produced in containers with a maximum (80cm^3) and the lowest (7.3 cm^3) volume was 1.10 g (29% increase). The highest average value of the mass of seedlings (3.82 g) was obtained in the production of containers with the highest volume of cells (b4). The statistically significant differences in average plant mass analysis between variants were obtained. According to *Rapaji et al., (2010)* studies based on experiments with other plant species,it was confirmed the influence of the size of the volume of container cells on the plant mass.

Table 1. Effect of the volume and supstrate type on the basil seedling weight (g)

Supstrat type	2013.year				2014.year				Average
	Supstrat volume (cm^3)				Supstrat volume (cm^3)				
	b$_1$ (7,3)	b$_2$ (20)	b$_3$ (33,5)	b$_4$ (80)	b$_1$ (7,3)	b$_2$ (20)	b$_3$ (33,5)	b$_4$ (80)	
Klasman Deilman	1,71	1,95	3,20	2,46	5,10	5,74	6,30	6,55	4,12
Plantee substrate	1,28	1,46	1,65	2,80	2,17	3,41	4,20	4,45	2,67
Domestic substrate	1,53	1,91	1,38	1,86	4,53	4,91	4,38	4,86	3,17
Average	1,50	1,77	2,08	2,37	3,93	4,69	4,96	5,28	3,32

LSD	A		B		AxB	A		B		AxB	
5%	0,33		0,38		0,67	0,44		0,36		0,63	
1%	0,45		0,52		0,90	0,60		0,49		0,85	

The analysis results of the influence of substrate type and volume of container cells to the amount of basil seedlings (Table 2) shows that the best variant of the cell is volume 80 cm3 and 33.5 cm^3. By examining the influence of substrate type on height of basil stalk, the best shown substrate Klasman Deilman-potgrond where H is determined by the height of seedlings at the two-year average was 7.98 cm, with a much shorter stalk on Plantel ideal and the local substrate. Rapaji (2010) and Miškovi (2006) in their experiments on other plant species have shown that the production of high-quality seedlings obtained in containers with a volume of 80 cm^3 cell. Similar results got Beatovi (2006) who tested the basil seedlings in 7 different containers. The highest average height basil seedlings obtained in the production of containers with the highest volume (76cm^3).

Table 2. Effect of the volume and substrate type on the basil seedling height (cm)

Supstrat type	2013.year				2014.year				Average
	Supstrat volume (cm^3)				Supstrat volume (cm^3)				
	b_1 (7,3)	b_2 (20)	b_3 (33,5)	b_4 (80)	b_1 (7,3)	b_2 (20)	b_3 (33,5)	b_4 (80)	
Klasman Deilman	7,99	8,43	8,80	9,68	7,02	7,1	7,35	7,47	7,98
Plantee substrate	5,39	6,7	6,53	6,05	6,10	6,15	6,15	6,25	6,16
Domestic substrate	6,10	6,12	6,05	5,32	5,80	5,95	5,75	6,02	5,88
Average	6,49	7,08	7,12	7,01	6,30	6,40	6,41	6,58	6,67

LSD	A		B		AxB	A		B		AxB
5%	0,72		0,83		1,44	0,23		0.26		0,46
1%	0,97		1,12		1,95	0,31		0,36		0,62

The analysis results of the influence of substrate type and volume of container cells to the number of leaves shows that the best was variant with the greatest volume of 80 cm^3 for all three substrates in container production basil seedlings. Romano (2003) shows that the number of leaves rise significantly with the volume of cells, which ranged from 15.6 to 99.2 cm^3. The effect of substrate type on the number of leaves proved to be the best Klasman Deilman-potgrond substrate where 5,87 leaves per plant was found.

Table 3. Effect of the volume and supstrate type on the number of leaves

Supstrat type	2013.year				2014.year				Average
	Supstrat volume (cm^3)				Supstrat volume (cm^3)				
	b_1 (7,3)	b_2 (20)	b_3 (33,5)	b_4 (80)	b_1 (7,3)	b_2 (20)	b_3 (33,5)	b_4 (80)	
Klasman Deilman	4,32	4,50	4,68	4,41	7,17	7,10	7,35	7,47	5,87
Plantee substrate	2,58	3,50	2,94	5,28	6,10	6,15	6,15	6,25	4,86
Domestic substrate	2,84	3,37	3,15	3,70	5,80	5,95	5,75	6,02	4,57
Average	3,24	3,79	3,59	4,46	6,35	6,40	6,41	6,58	5,10

LSD	A		B		AxB	A		B		AxB
5%	0,48		0,56		0,97	0,34		0,39		0,69
1%	0,65		0,75		1,31	0,46		0,53		0,93

Conclusion

Based on two-year study on the effects of substrate type and volume of container cells on the quality of basil, it can be concluded the following:
Volume of container cells significantly affects the quality of basil. The highest quality basil seedlings obtained in containers with the volume of 80 cm^3 cell.
The Klasman Deilman potgrond-H and Plantel ideal substrates are suitable for the production of container seedlings of basil. Poorer results are determined by the local substrate.

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LEVELS OF POTENTIALLY TOXIC HEAVY METALS IN BULBS OF DIFFERENT VARIETIES OF ONION

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Abstract

The presence of toxic heavy metals in food is regulated by legal acts and limited to the permissible contents because the consumption of contaminated food over a long period of time is dangerous for health.

Tests for the presence of heavy metals in bulbs of onion variety Stuttgarter (standard) and new varieties Konjicki and Zenicki were conducted in 2012 and 2013 by performing experiments on the site of Butmir, Sarajevo. Even though none of the test samples contained heavy metals above the prescribed amount, as per detected presence of lead, arsenic and cadmium, there are indications of present differences related to the examined varieties of onions or even year of breeding. In 2013 detected content of lead increased by 0.0090 mg/kg, 0.0074 mg/kg of arsenic and 0.0033 mg /kg of cadmium, comparing to 2012. Among the examined varieties of onion, a variety Stuttgarter in 2012 had the highest contents of all studied toxic heavy metals, while such properties in 2013 had variety Zenicki. The results indicate that only the amount of the bulb yield that is significantly higher for the variety Konjicki (34%) in 2012, and 30% for the variety Konjicki and 27% for Zenicki in 2013, comparing to standard, is not enough to accept a new line of onion as fit for human consumption.

Key words: *heavy metals, onion, varieties, bulbs.*

Introduction

Some heavy metals are in the form of elements in trace necessary – essential for a number of functions in the human body, and its deficiency results in the appearance of symptoms of diseases and serious defects in the metabolism. Increased concentration in the body is undesirable and dangerous. Most often it is a question of toxicity of quantity, and this range varies with each individual element.

Heavy metals can be in the form of fine particles of dust released into the atmosphere, where they deposit in the water and soil. In waters, they quickly dilute and deposit on the bottom as insoluble carbonates, sulfates or sulfides.

Circulation of heavy metals in the nature highly depends of the changes which these metals are subject to. The concentration of these compounds in adverse conditions (out of mineral soil) is of anthropological origin and is the result of industrial pollution. Mentioned concentrations occur in industrial products (detergents, batteries, food additives, etc.) or as a result of technological processes (combustion, smelting, electroplating, etc.).

Contamination of soil, surface and groundwater with nitrates, heavy metals and remains of active ingredients of pesticides occurs occasionally in environmental conditions of uncontrolled extensive and intensive agricultural production. In the soil-water-plant system the more actual is problem of heavy metals that do not belong to the biogenic elements, but

act solely toxically as e.g. cadmium and lead. However, the sources of contamination of soil and water are not always nor exclusively from agriculture (Vida ek et al., 1999).

The content of available forms of inorganic and organic pollutants in soil is variable and depends primarily on the parent material, pH (greater mobility in acidic soils), the content of organic matter in the soil, $CaCO_3$, textural and others. (Teodorovi et al., 2009). The acidic environment causes the appearance of ionic forms of metals in the soil, which are mobile and available to plants.

Adoption of heavy metals in plants is primarily carried out by the roots from the soil solvate, and to a lesser extent through above ground organs from the atmosphere. Because of its durability, heavy metals accumulate in the soil where plants can adopt them through the roots. Part of the heavy metals, which is deposited on the leaves, is absorbed, and other part can be washed by precipitation. Rinsing depends on the degree of dissolubility.

The occurrence of possible contamination of food by heavy metals in primary agricultural production is very significant problem that creates confusion among consumers, so the researches related to the presence of potentially toxic heavy metals in bulbs of different varieties of onion in the framework of this paper, the contribution of the production of safe food.

Materials and methods

The experiments were carried out at the site Butmir (Sarajevo) during two years (2012, 2013) with new varieties of onions, variety Zenicki and Konjicki. For standard is used Stuttgarter variety, which is widespread in production in Bosnia and Herzegovina. Experiments have been conducted on a randomized block design with five replications. The main parcel size was 4.5 m^2 (5x 0.9 m), with three rows of the parcel (30 x 10 cm), or 150 plants per parcel (330 thousand plants / ha).

Planting of onion was done manually, on 18th of March 2012 and 6th of March 2013. During the growing season were administered all necessary measures of care in the production of onion. During fertilization it was taken into account the preceding crop and soil type. It was sought to provide plants with such conditions which will allow expression of the maximum capacity of yielding of variety. In the soil were added fertilizers in the following quantities of pure nutrients: 56 kg / ha N, 112 kg/ha P_2O_5 and 294 kg/ha K_2O. In early spring NPK fertilizers were added. Fertilization was carried out before the first hoeing.

The content of heavy metals were detected: EN 13805:2002, 15763:2009 ITD and EN, by ITD method on the instrument Inductively coupled plasma with mass spectrometry, with the previous preparation of plant material in a microwave for digestion. Samples of plant material (bulbs at the stage of full maturity without outer sheath, only edible part) were destroyed with nitric acid HNO_3 and 65% hydrogen peroxide.

All analyzes were performed in the laboratory of the Federal Institute for Agriculture, Sarajevo.

Environmental conditions in the course of performing experiments:

On the site Butmir where experiments were carried out, the soil is brown valley, and the composition of the feed is moderately supplied with phosphorus and potassium (Table 1).

For view of the climatic conditions during the vegetation period, data from meteorological stations Sarajevo (Site Butmir) was used. The average monthly temperatures and rainfall for the growing season onion were showed (Graph 1 and 2).

Climatic conditions vary from year to year. Butmir has harsh winters and moderately warm summers. In the years of testing temperature ranged within the multi-year average.

Table1.Chemical habits of soil

Year	Reaction pH		Content %			mg of soil contains phisiologially	
	H_2O	KCl	Total N	$CaCO_3$	Humus	P_2O_5	K_2O
2012.	5,89	-	0,09	-	1,80	12,50	10,9
2013.	6,02	-	0,08	-	1,80	8,45	14,20
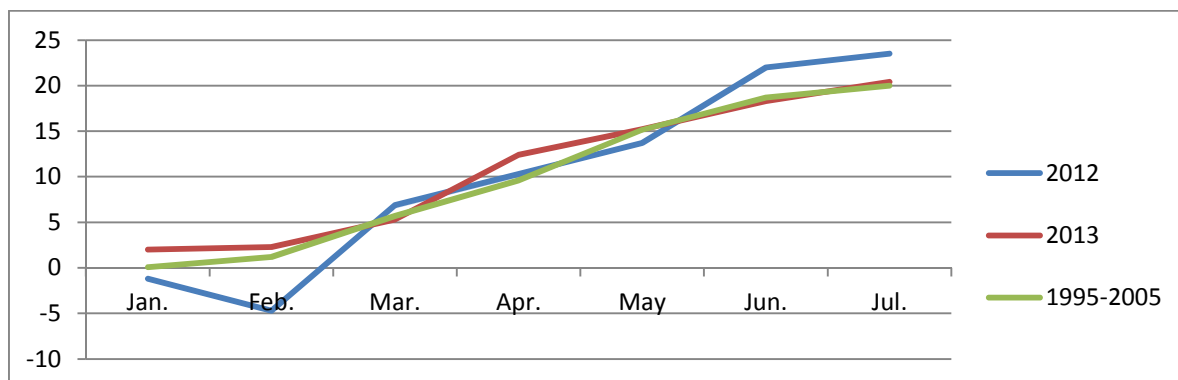
Graph 1.Middle average air temperatures (ºC)
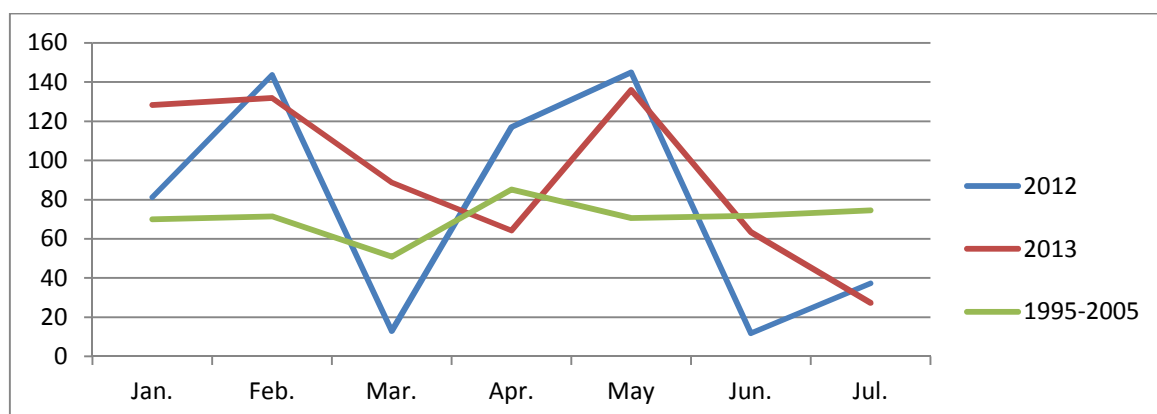
Graph 2.Monthly precipitation (l/m^2)

If we analyze the temperature data, it can be seen that the temperatures in the period of performing experiment with varieties of onion (2012, 2013) were satisfactory comparing to the perennial average. Higher mean monthly temperatures were in the III, IV, VI and VIII month (2012), and II, IV and VII month (2013) in relation to a multi-year average. Maximum temperatures were higher in the sixth month (2012) and IV and VI month (2013), while minimum temperatures were slightly higher except in V month (2012) in relation to a multi-year average. The lack of rainfall during the growing season was in III, VI and VII month (2012) and IV, VI and VII month (2013), which did not significantly affect the germination of onion because the land had sufficient accumulated moisture. In this paper, data on the climate conditions in the years of testing should be an indication of the possible impacts on the mobility of heavy metals.

Results and discussion

It is known that plants acquire large amounts of metals in their vegetative parts (root, stem, leaf) rather than in fruit and seed. In particular, the attention should be paid to the cultivation of green leafy vegetables such as cabbage, which adopt a significant amount of pollutants in their edible parts. Also, growing forage crops and by pasture, heavy metals can enter the food chain via cattles consuming contaminated forage, and then by using the meat, milk, or other products to the man. Therefore, it is important to dynamically observe and monitor the occurrence of not only the soil but also the plant material, whereby a relatively small amount of pollutants in the soil of the plants may accumulate in large quantities in their organs (Masih and Bhadauria, 2010).

Starting from these statements, the results of examination of potentially toxic heavy metals in onion, are represented by the varieties and years of study.

Results of heavy metals detected in samples of onion on average for all three varieties (Graph 3) indicate that this is not about amounts that exceed the threshold amount. Regulations on maximum permitted amounts for certain contaminants in food (Official Gazette of BiH, No. 37/09) restricts the presence of lead and cadmium on 0.10 mg/kg, and arsenic at 0.3 mg/kg) as contaminants in food. Onion bulbs contained the highest amount of cadmium (0.0143 mg/kg), and lead (0.0081 mg/kg), and minimum of arsenic (0.0043 mg/kg).

Heavy metals in plants affect many physiological and biochemical processes such as photosynthesis, nitrogen assimilation, adoption and metabolism of essential elements, enzyme activity, respiration and water regime, and in addition they affect the growth and development of plants. In the period of performance of experiment no symptoms were reflected of influence of heavy metals such as necrosis and chlorosis on the oldest, and later on other leaves, and especially what was not observed is phenomenon of extinction of old leaves and stunted growth. Could detectable amounts of heavy metals in conditions of performing experiments cause such disorders, a more detailed examination are necessary that could provide answers about the effect of heavy metals depending on the type of plants, the way in which are adopted by the plants, and the effects of the adoption and distribution of the elements that are necessary for the plant and the water regime of plants.
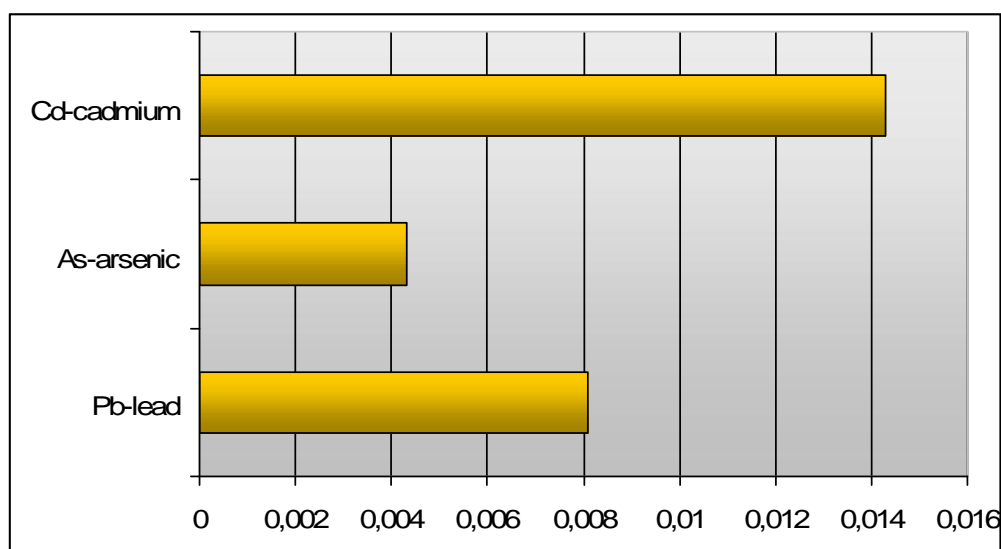
Graph 3.Average values of heavy metals detected in bulbs of onion

Regardless of the detected average amounts of heavy metals in onion bulbs, the fact of the presence of potentially toxic elements, impose a need for better understanding of results and from aspect of impact of variety and year of examination (Table 2). Even more there are

results of such researches in other production conditions. Particularly are interesting impacts of soil and water contamination by heavy metals, and contamination of soil, surface water and groundwater with nitrates, heavy metals and residues of pesticide active substances occur occasionally in uncontrolled environmental conditions of extensive and intensive agricultural production (Vida ek et al., 1999). Without going into such considerations of possible impacts of soil and water at the site of the experimental field Butmir (we leave this to experts of that field) we point out that the pH is from 5.89 to 6.02, and the humus content is 1.80% (Table1). Research results in this paper indicate that the highest content of lead (0.0060 mg / kg), arsenic (0.0010 mg / kg) and cadmium (0.0300 mg / kg) were detected in the variety Stuttgarter in 2012, and in 2013 that were bulbs of variety Zenicki with 0.0180 mg/kg of lead, 0.0090 mg/kg of arsenic and 0.0220 mg/kg of cadmium.

As indicators of possible increases in the accumulation of potentially toxic heavy metals in onion bulbs, can be used results shown through the differences of their presence in the 2013 as compared to 2012. All the studied species of bulbs of onion on average, in 2013 there is more all investigated heavy metals: lead 0.0090 mg/kg, arsenic 0.0074 mg/kg and cadmium 0.0033 mg/kg. Only the bulb Stuttgarter had a lower content of cadmium in 2013 for 0.0140 mg/kg, while the lead content was increased for 0.0010 and arsenic for 0.0070 mg/kg.

Varieties Konjicki and Zenicki, increased detected amounts of lead were much higher than the standard variety: Konjicki for 0.0100 mg/kg, and Zenicki for 0.0160 mg/kg. Variety Zenicki had greater increase in arsenic (up to 0.0086 mg/kg in 2013), and cadmium in bulbs (to 0.0150 mg/kg) compared to the Konjicki onion and variety Stutgartner.

Table 2. Detected amounts of heavy metals in bulbs of onion (mg/kg) by variety and year of examination

Year	Heavy metals	Sort/variety			Average
		Stuttgarter	Konjicki	Zenicki	
2012.	Pb-lead	0.0060	0.0030	0.0020	0.0055
	As-Arsenic	0,.0010	0.0004	0.0004	0.0006
	Cd-Cadmium	0,.0300	0,.0070	0,.0070	0.0105.
2013.	Pb-lead	0.0070	0.0130	0.0180	0.0127
	As-Arsenic	0.0080	0.0070	0.0090	0.0080
	Cd- Cadmium	0.0160	0.0160	0.0220	0.0180
Differences in 2013 in compare to 2012	Pb-Lead	+ 0.0010	+ 0.0100	+ 0.0160	+ 0.0090
	As-Arsenic	+ 0.0070	+ 0.0066	+ 0.0086	+ 0.0074
	Cd-Cadmium	- 0.0140	+ 0.0090	+ 0.0150	+ 0.0033

The results indicate that only the level of the bulb yield that is significantly higher (for 34%) for variety Konjicki in 2012, and 30% for variety Konjicki in 2013 and 27% for variety Zenicki comparing to the standard, is not the only parameter to a accept a new sort of onion as fit for human consumption (ota et al., 2014). Farming area in relation to soil habits,

expressed mobility of heavy metals (Teodorovi et al., 2009), possibility of larger accumulation in parts of cultivated plants which are used as food (Maksimovi et al., 2012), should be and remain the main indicator of successful production of safe food.

Conclusion

Tests for the presence of heavy metals in bulbs of onion variety Stuttgarter (standard) and new varieties Konjicki and Zenicki were conducted in the period of 2012 and 2013 by performing experiments on the site of Butmir, Sarajevo. The results indicate that:

the quantity of heavy metals detected in the samples of onions on the average for all three are not in amounts that exceed the threshold amounts

that the highest contents of lead (0.0060 mg/kg), arsenic (0.0010 mg/kg) and cadmium (0.0300 mg/kg) were detected in the variety Stuttgarter in 2012, and in 2013 that were bulbs of variety Zenicki with 0.0180 mg/kg of lead, 0.0090 mg/kg of arsenic and 0.0220 mg/kg of cadmium.

Varieties Konjicki and Zenicki onion, increase of the detected amount of lead (in 2013) was significantly higher than those of the standard variety: Konjicki for 0.0100 mg/kg, and Zenicki for 0.0160 mg/kg.

Line of Zenicki onion had greater increase in arsenic (in 2013 for 0.0086 mg/kg), and cadmium in bulbs (for 0.0150 mg/kg) compared to Konjicki onion and variety Stuttgarter.

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SANA – NEW VARIETY OF SPRING OAT

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Abstract

New variety of spring oat is the first registered variety of oat in the Agricultural Institute of Republic of Srpska (RS), Banja Luka. It is an early variety, plant height is 110 cm and has excellent resistance to lodging. It has large, well-filled grain, 1000 kernel weight is about 33 g, a hectoliter mass 50 kg, the grain color is golden yellow. Protein content in the grain is about 14,5%, oil 4,3%, mineral matter 2,77% and 11,3% cellulose. In 2011 and 2012 are conducted the trials of Varietal commission at six locations. Variety Sana achieved higher grain yield and higher protein content than the standard variety Slavuj. Variety Sana achieved maximum yield of 9.412 kg/ha at the site of Sremska Mitrovica and the average yield for two years and locations was 6.725 kg/ha.

Key words: *oat (Avena sativa L.), yield, variety, breeding, quality.*

Introduction

Oat originated from Europe, Asia and Africa, but it is imported in Europe as cultivated species and is considered the European corn (Jevti , 1992). It belongs to the botanical family *Poaceae*, genus *Avena* with about 70 systematized species. Cultivated species *Avena sativa cv. diffusae* belongs to a group of hexaploid with 2n=42 chromosomes. For its ancestors wild forms *Avena fatua* L. and *Avena byzantina* L. are considered. Oat is an old crop, which has multiple purposes as other grain crops. It is used as a grain, green food and as silage for feed about 60%, for industry processing about 30% and for human consumption about 5%. Oat grain is one of the best concentrated food for all kinds of animals, especially horses and the development of young cattle. Dairy cows fed with oat increase milk yield, reduces mortality in poultry and stimulate carrying eggs in laying hens by Rosi *et al.* (1989). Oat has fine and soft straw and husk. It is used as a pure or joint crop, which has the function as supporting crop sowed with peas and beans. With industrial processing of oat following products could be obtained: oat flour, meal, flakes, and various jellies. Nutritional value of these products is large and with easy digestibility. Oat grain has soluble and digestible proteins, rich in vitamins B_1 and B_2, amino acids lysine and tryptophan, the oil contains mostly unsaturated fatty acids (Maksimovi *et al.,* 1998.). Oat grain contains 385 calories. For example, in the United Kingdom (UK) oat grain is used as oatmeal or cereal for breakfast with milk. It is especially important for growing in mountainous regions where other crops grow weaker. It has modest requirements in terms of mineral nutrition and soil quality. In crop rotation, oat comes behind other crops or as the last crop.

In recent years, the areas under this crop range from 6,5 to 11 hectares in RS. We are proud that 2004 was especially successful in scientific research on oat, two master's theses and a dissertation were defended, which in some way marks a milestone in the work with this very important crop for RS and Bosnia and Herzegovina (BiH). In the last two decades, oat is increasingly used in human nutrition, pharmacy, medicine and cosmetics in the developed world.

Material and method

At the beginning of 2011, seed and required documentation for a line of spring oat under the symbol BL Z - 101 were submitted to the Department for the recognition and protection of varieties for testing in microtrials in multiple locations and DUS test.

VCU and DUS trials were performed by a unique methodology that is inherent to the plant species at the plots of 5 m^2 in five repetitions. Variety Slavuj was used as a standard, which is one of the most common varieties in production in the Republic of Serbia, and it can be found in sale or in the production in RS.

Oat line BL Z – 101 is created by crossing the varieties Kondor and Astor and bred by pedigree method of selection.

By the Decision No. 320-04-00216/2011-11 from 07.09.2012, the Department for the recognition and protection of varieties, Ministry of agriculture of the Republic of Serbia, introduced this variety named Sana, *Avena sativa cv. diffusae* in the the Register of recognized varieties. New varieties are the basis of production, because the ultimate goal of their own creation can be achieved only through production, and it is a complete expression of their potential for yield and quality.

Results and discussion

New varieties are the basis of production, because the ultimate goal of their own creation can be achieved only through production, and it is a complete expression of their potential for yield and quality (Den i , 2012).

The primary objective and task of breeding was the creation of the first national oat variety with high genetic yield potential, and preferably good quality, because it is known that it is very difficult to combine the two most important characteristics and one genotype. It was achieved in this variety. In addition to these two features, this variety has other excellent agronomic traits, primarily earliness and resistance to lodging.

There are very favorable environmental conditions for the cultivation of oat in the largest part of BiH, and RS. When it comes to the requirements of oats to the soil, climate and mineral nutrition, this is very grateful and modest crop. According to Okiljevi (1996) in the first production area in RS (Banja Luka region, Posavina, Semberija, Bira) up to 63% of the land has acidic to very acidic reaction. The most economical way to use these soils is through sowing acidophilic plants, like oats. This plant species is tolerant to excess manganese and aluminum in the soil (Ubavi , 1996).

For most grain crops including oats, it is important to have the gene for earliness, in addition to other important agronomic traits. It was shown that early-maturing varieties of oat avoid temperature and drought stress. Earliness is closely linked with the sowing dates, so varieties planted in the early sowing dates provide safe and quality yield. Resistance to lodging is also one of the important features that the newer varieties should have, and this trait is closely related to production technology, primarily the amount of nitrogen fertilizers and quantity of seed for sowing. Resistance to lodging is a quantitative trait that depends on the environmental conditions, soil and applied agricultural technology. Resistance to lodging depends on the anatomical structure of the stem, conductive and mechanical tissues, thickness of the lower internodes, the development of foliage, root system, resistance to agents of several diseases that attack the stem and root, as well as the accumulation of some mineral elements, particularly calcium in stalk.

Oat grain quality is measured by the amount of nutrients, particularly proteins, which are contained in the core. According to Moule (1964) grain shell contains 30% cellulose and about 40% pentosans. According to the same author, the percentage of the core varies from 65 to 70% at the finest varieties of oat. This is a quantitative trait, and can range from 3 to 4% depending on the environmental factors. The largest part of the oat proteins belong to the

globulin 55%, glutelins about 21 – 27% and albumin around 9 – 20%. Oat oil contains plenty of linoleic acid, which is essential in the human diet (Pržulj *et al.* 2011). Soluble oat dietary fibers are beta glucans, which content varies from 25 - 70 g/kg. The level of beta glucans can be increased by breeding to this characteristic, and the use of appropriate agricultural technology (Peterson, 1991). According to the results of the Commission for registration of varieties (Table 1) the grain of variety Sana contains about 14,52% of crude proteins, which is significantly higher compared to the standard variety with 11,69%.

Table 1. Physical, chemical and technological characteristics of Sana variety compared to standard Slavuj

Characteristic		Novi Sad	
		Sana	Slavuj
Chemical characteristics			
1.	Dry matter content (%)	89.41	89.53
2.	The content of organic matter	86.64	86.84
3.	The content of nitrogen-free extracts (NFE)	56.5	56.9
4.	Crude protein content	14.52	11.69
5.	The content of crude fat	4.32	5.54
6.	The content of crude fiber	11.31	12.73
7.	Ash content	2.77	2.69

An important feature, since the yield is largely dependent on it, is the resistance to lodging. This is a quantitative trait that depends on the environmental conditions, soil and applied agricultural technology. Resistance to lodging depends on the anatomical structure of the stem, conductive and mechanical tissues, thickness of the lower internodes, the development of foliage, root system, resistance to agents of several diseases that attack the stem and root, as well as the accumulation of some mineral elements, particularly calcium in stalk. During the tests (Table 2) variety Sana had an average stem height 98,5 cm and resistance to lodging with grade 1, meaning resistant to lodging.

Table 2. Heading date, plant height and lodging

Place	Year	Heading		Plant height (cm)		Lodging (grade 1 – 9)	
		Sana (date)	+/- days of standard	Sana	Slavuj	Sana	Slavuj
Novi Sad	2011.	30.05.	- 4	103.1	99.2	1	1
	2012.	25.05.	- 2	95.4	92.8	1	1
		-	- 3	99.25	96	1	1
Kikinda	2011.	28.05.	- 8	120	124	1	1
	2012.	29.05.	0	107	112	1	1
		-	- 4	113.5	118	1	1
Kruševac	2011.	27.05.	- 8	113	94.8	7	7
	2012.	05.05.	4	110	95	1	1
		-	- 2	111.5	94.9	4	4
Pan evo	2011.	02.06.	0	84	96	4	3
	2012.	01.06.	0	101	107	1	1
		-	0	92.5	101.5	2.5	2
Sremska	2011.	28.05.	- 8	102	106	1	1

Mitrovica							
	2012.	30.05.	- 3	104	98	1	1
		-	- 5.5	1'3	102	1	1
Sombor	2011.	25.05.	- 2	80	85	1	1
	2012.	21.05.	- 6	69	72	1	1
		-	- 4	74.5	78.5	1	1
	2011.	-	- 5.0	100.4	100.8	2.5	2.3
	2012.	-	- 1.2	97.7	96.1	1.0	1.0
2011 – 2012.	-	-3.1	99.0	98.5	1.8	1.7	

1000 kernel weight is variety trait, that is caused by genetic factors. It varies widely by climate, soil and agro-technical conditions of production. Based on the results of several authors 1000 kernel weight ranged from 22 g to 33 g (varieties with very coarse-grain). The best indicator of fertility is the number of grains per panicle, where it is established a positive correlation coefficient of $r = 0,67$ (Moule, 1964). Sana variety had in average 55 seeds per panicle, which is in accordance with the values that have other varieties of oats. According to research (Nožini , 2008), seven varieties of oats (Željka, Lov en, Slavuj, Rajac, Flemingsregent, NS golozrni and Vesna) average 1000 kernel weight was 28,3 g in the three-year average, and also the average value for the same characteristic in mentioned varieties grown at three different locations (Banja Luka, Drini and Novi Sad) was 28,1 g. The modern type of oat variety is a shorter stem in the range 70 – 110 cm, with lower tillering, a large number of grains per panicle, with thicker internodes. The number of grains per panicle varies under the influence or environmental factors, and sowing date has a crucial role for this feature. The highest number of seeds in spring oats was achieved by sowing in the second half of February, which means that oats can be sown earlier if weather and soil conditions permit. Later sowing gives more sterile spikelets at the base of the wiper or the smaller total number of grains per panicle.

In agricultural production, variety is a basic mean for the production of organic matter, which is used in human and animal nutrition. Creation of high-yielding, adaptive and stable varieties intended for production is one of the important tasks in scientific and research work in agriculture.

Tab. 3. Grain yield (kg/ha) of new variety Sana according to the results of the Commission for varieties from Belgrade in 2011

No.	Variety	Localities						x
		Kikinda	Kruševac	Novi Sad	Pan evo	Sremska Mitrovica	Sombor	
6507	Slavuj	8108	6787	7240	-	8840	7534	
6725	Sana	8247	6454	9273	-	8270	7709	

Tab. 4. Grain yield (kg/ha) of new variety Sana according to the results of the Commission for varieties from Belgrade in 2012

No.	Variety	Localities						x
		Kikinda	Kruševac	Novi Sad	Pan evo	Sremska Mitrovica	Sombor	
6507	Slavuj	8108	6787	7240	-	8840	7534	7702
6725	Sana	8267	6706	8299	-	9412	7930	8123

Tab. 5. Average grain yield (kg/ha) of new variety of spring oat Sana according to the results of the Commission for varieties from Belgrade in 2011/12

| No. | Variety | Localities | | | | | | x |
		Kikinda	Kruševac	Novi Sad	Pan evo	Sremska Mitrovica	Sombor	
6507	Slavuj	7360	6787	7086	3367	7336	5677	6507
6725	Sana	7772	6454	8022	3158	7474	5551	6725

For all localities and years of testing, variety Sana had higher yield in average than standard variety Slavuj for 0,218 t/ha. The highest average yield for the two years of researching this variety had in the locality of Novi Sad from 8022 kg/ha and the lowest at the locality of Pan evo from 3,158 kg/ha. Based on only these two data we can conclude that this variety, as well as others, can achieve a high genetic potential only in good ecological conditions, particularly soil. According to our two-year research at the locality of the Agricultural Institute, this variety has achieved yield of over 7 t/ha.

Conclusion

Based on two years results related to the amount of grain yield and other important agronomic traits of variety Sana and standard variety Slavuj, we can derive the following conclusions: Sana is a variety of spring oats intended for grain production, tolerant to lodging and high yielding potential. Compared with the standard variety, during the two years of testing at six locations Sana gave significantly higher grain yields of excellent quality, so that the average content of crude protein was 14,52%, 1000 grain weight about 33 g. This variety is early-maturing, according to the average location/year three days earlier than standard varieties. It possesses good flexibility, because it shows little variation in terms of some morphological and agronomic traits in breeding at different locations.

It is reasonable to expect that this variety enter into seed production and occupy an important place in the production of feed in order to better and on poorer quality soils.

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AFLATOXIN B1 CONTAMINATION OF CORN IN REPUBLIC OF SRPSKA

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Abstract

The natural occurrence of fungal contamination was evaluated in samples of corn (*Zea mays* L.) grains. Mycological survey was carried out by direct plating method on PDA and focusing on the mycotoxigenic fungi *Aspergillus* because of the ability of this genus to produce mycotoxin. A total of 83 samples of corn grains from domestic production were analyzed. The most frequent isolated fungi were *Aspergillus* spp. and *Fusarium* spp. while *Penicillium* spp. and *Alternaria* spp. were less frequently isolated genera. Samples are also analyzed for aflatoxin B1 contamination and only two samples were contaminated and had aflatoxin B1 content higher than defined by regulations. The composition of mycotoxigenic fungi in corn grain showed also the presence of other toxigenic fungi and these results indicate possible health hazards for human and animal consumption of such contaminated food grain by mycotoxigenic fungi.

Key words: *mycotoxigenic fungi, Aspergillus, aflatoxin B1, Republic of Srpska*

Introduction

The increasing worldwide concern about food has enhanced interest in fungal contamination and subsequent production of mycotoxins in food products. In this regard, attention is continuously focused on corn (*Zea mays* L.) because it is one of the most important food and feed in different regions of the world (Anon, 2004). Corn is the world's third most important crop after rice and wheat and in Republic of Srpska corn grown for grain accounts for almost one quarter of the harvested crop hectares in the country. Mycotoxins and mycotoxicises have been problems of the past and the present, but scientific attention for mycotoxins did not start until the early 1960's. Nowadays, many mycotoxins are known, and their occurrence in food and feed may cause various adverse effects on human and animal health, including carcinogenic, hepatotoxic, immunotoxic, nephrotoxic, neurotoxic, oestrogenic and teratogenic effects (Egmond, 2013). Mycotoxins are secondary metabolic products from fungi which can grow on the plant either in the field or during storage and are potentially toxic for humans and animals. More than 300 secondary metabolites have been identified although only around 30 have true toxic properties which raise concerns. These toxins are found as natural contaminants in many foodstuffs of plant origin, particularly cereals but also fruits, hazelnuts, almonds, seeds, fodder and foods consisting of or manufactured from these products and intended for human or animal consumption (Anon, 2006).

Mycotoxins are secondary metabolites produced by toxigenic fungi that contaminate food, feed chain, and represent a risk for human and animal health (Bennett *et al.*, 2003). They are responsible for many different toxic effects including the induction of cancer, and digestive, blood, kidney and nerve defects. The mycotoxin problem is particularly relevant for human health in tropical areas, such as Sub-Saharan Africa, where crops are quite susceptible to contamination by the carcinogenic aflatoxins and fumonisins. In Europe, the main concern is related to *Fusarium* and *Aspergillus* diseases that have assumed a great relevance for both

health and economic implications (Battilani *et al*., 2006; Magan, 2006; Logrieco, 2001; Logrieco *et al*., 2002; loc. cit. Fanelli & Logrieco, 2012). Aflatoxin B1 is produced by many species of *Aspergillus*, most notably *A. flavus*, *A. parasiticus* and *A. nomius*; it is a proven carcinogen for humans (Castegnaro and Wild, 1995), immunotoxic, and it causes stunted growth in children and growth retardation in animals. High-level of aflatoxin exposure produces acute hepatic necrosis and later it can result in cirrhosis, and/or carcinoma of the liver.

The presence of aflatoxin affects grain quality and marketability, as well as livestock health if the grain is consumed. *Aspergillus* ear rot is commonly observed during hot, dry years on stressed plants (such as those exhibiting symptoms of nutrient deficiency or drought stress). Feeding damage from ear-invading insects also contributes to disease development and aflatoxin contamination. In these cases, accurate mold identification is critical for making the right feeding and management decisions.

Attention of the scientific and professional community was drawn to very intensive appearance of *Aspergillus* ear rot in 2012 in Republic of Srpska, as well as in the region. Specific environmental conditions, especially drought and high temperatures during the period from fertilisation to harvest favored the intensive development of the genus *Aspergillus* on corn ear and grain. In addition, ear damage caused by the larvae of the second generation of European corn borer (*Ostrinia nubilalis* Hbn.) that appeared in 2012 in extremely high intensity is another factor that caused intensive emergence of olive-green powdery mold. The result of intensive development of the disease in 2012 was unusually high contamination of corn grain with aflatoxin B1, that is produced by species of the genus *Aspergillus* (mostly *A. flavus* Link and *A. parasiticus* Speare). Therefore, there was the question of the use of such corn for food and feed, and a consequence were also large economic losses in the production of milk and dairy products so many producers had to spill milk contaminated with aflatoxin M1, which led to huge losses in the economy. Above-mentioned draw a great deal of public attention and caused major concern to consumers and producers.

Considering the situation from previous year as well as extreme drought in July and August 2013, the Ministry of Agriculture, Forestry and Water Management of the Republic of Srpska appointed expert team tasked to continuously monitor the impact of drought on plants yield and quality with special reference to the possible production of mycotoxins. This expert team has assessed the risk of re-occurrence of aflatoxin and proposed a survey that is "Monitoring of the presence of aflatoxin B1 in corn in the Republic of Srpska". Samples were taken by the representatives of the Agricultural Extension Service of Republic of Srpska in regions of Banja Luka, Prijedor, Doboj, Bijeljina and Gradiška, where corn is mostly grown.

Material and Methods

Prior to isolation of toxigenic fungi samples were pre-treated, that is sterilized and dried. Sterilization is done in order to destroy saprophytic micropopulations on sample surface. Surface sterilization of the samples was carried out by immersing the grains in 1% sodium hypochlorite solution (1 part NaOCl: 3 parts of distilled water) and after that grains were rinsed three times in sterile distilled water. Sterilized grains were dried between two layers of paper towels to remove excess water. 50 grains of each sample (10 grains in a Petri dish) were plated on potato dextrose agar (PDA) media with streptomycin sulfate in order to prevent growth of bacteria. Inoculated plates were incubated for seven days at 25°C prior to visual differentiation and counting of colonies. The different fungal colonies on the plates were subcultured on PDA media for identification of species. In order to determine if *Aspergillus flavus* isolates are toxigenic or atoxigenic, isolates were incubated at 30°C in order to form sclerotia, and then based on the size of sclerotia determined whether it is toxigenic or atoxigenic strain.

Furthermore, 250 g of each sample were dried at 60°C for 72 h and in that way prepared for analysis for aflatoxin B1 contamination. Approximately 50-100 gram of sample is ground and pulverised into a fine homogenous compound. After that, to 3 gram of ground sample 9 ml of 80% methanol is added and shook thoroughly at room temperature for 10 minutes. Samples are than centrifuged for 10 minutes at 2000 x g. An aliquot of 50 μl of the supernatant obtained after centrifugation is diluted with 150 μl of dilution buffer to obtain a solution containing 20% methanol. Contamination of corn samples with aflatoxin B1 is done by competitive enzyme immunoassay (ELISA) using a kit from EuroProxima, the Netherlands. ELISA test is highly specific and sensitive immunological reaction that allows detection and quantification of aflatoxin B1 in very low concentrations. The test is based on antibodies against aflatoxin B1. The microtiter plate based ELISA kit consists of 12 strips, each 8 wells, precoated with rabbit antibodies to mouse IgG. In one incubation step, specific antibodies (mouse anti-aflatoxin), enzyme labelled aflatoxin (enzyme conjugate) and aflatoxin B1 standards or sample are added to the precoated wells. The specific antibodies are bound by the immobilised rabbit antibodies and at the same time free aflatoxins (in the standard solution or in the sample) and enzyme labelled aflatoxin compete for the specific antibody binding sites (competitive enzyme immunoassay). After an incubation time of one hour, the non-bound (enzyme labelled) reagents are removed in a washing step. The amount of bound enzyme conjugate is visualised by the addition of chromogen substrate (tetramethylbenzidine, TMB). Bound enzyme transforms the chromogen into a coloured product. The substrate reaction is stopped by the addition of sulfuric acid. The colour intensity (O.D.) is measured photometrically at 450 nm and is inversely proportional to the aflatoxin B1 concentration in the sample. Photometric measurement is performed on Thermo Scientific™ Multiskan™ FC Microplate Photometer. The mean optical density (O.D.) of the blank well is subtracted from the individual O.D. of the wells containing the standards and the samples. The O.D. values of the six standards and the samples (mean values of the duplicates) are divided by the mean O.D. value of the zero standard and multiplied by 100. The zero standard is thus made equal to 100% (maximal absorbance) and the other O.D. values are quoted in percentages of the maximal absorbance. The values (% maximal absorbance) calculated for the standards are plotted (on the Y-axis) versus the aflatoxin B1 equivalent concentration (ng/ml) on a logarithmic X axis. The amount of aflatoxin in the samples is expressed as aflatoxin B1 equivalents. Calculated aflatoxin B1 equivalents are then multiplied by a factor 16. All these calculations are done by Thermo Scientific™ SkanIt™ Software.

Results and Discussion

Eighty three samples of maize grain intended for human or animal consumption and sampled before harvest from domestic production were analyzed for fungal and aflatoxin B1 contamination. Identification of fungal strains revealed that *Aspergillus* was the most frequent genus, found in almost all maize samples. In *Aspergillus* genus (fig. 1), two species were identified, *A. flavus* and *A. parasiticus*, but *A. flavus* was the most frequent contaminant, observed in more than 80% of the samples. Most *A. flavus* isolates were atoxigenic, that is they formed sclerotia bigger than 400 μm in size (fig. 2). Other fungal strains found in maize samples belonged to *Fusarium, Penicillium* and *Alternaria* species and were found in up to 33, 23 and 18% of the samples, respectively. The frequencies of four fungi genera differed from sample to sample. The general means of fungi showed that *Aspergillus* spp. and *Fusarium* spp., were the most frequently isolated genera; while *Penicillium* spp. and *Alternaria* spp. were less frequently isolated genera. Only two maize samples from Doboj and Gradiška were contaminated with aflatoxin B1 at a level of 3,24 and 7,29 ppb, respectively. Other 81 samples had aflatoxin B1 content below the limits defined by the "Regulation on

undesirable substances in feed" (Official Gazette No. 72/11) and the "Regulation on the maximum allowable amount for certain contaminants in food "(Official Gazette, No. 37/09). These results indicate that the type of fungal contamination of the corn grains in Republic of Srpska was qualitatively similar to that found in other corn producing countries such as the United States (Wu *et al*., 2011), Italy (Covarelli *et al*., 2011), Switzerland (Dorn *et al*., 2011), Malaysia (Reddy & Sallah, 2011), Pakistan (Saleem *et al*., 2012) and Saudi Arabia (Mahmoud *et al.*, 2013).

Fig. 1. *Aspergillus* spp. isolated from corn grains.

Fig. 1. *Aspergillus flavus* sclerotia on PDA media.

Mycotoxins are among the food-borne risks that are dependent upon climatic conditions. Indeed, the ability of fungi to produce mycotoxins is largely influenced by temperature, relative humidity, insect attack, and stress conditions of the plants (Miraglia *et al*., 2009). Therefore studies on frequency and relative percentage of mycotoxigenic fungi are highly useful and required for further studies on toxin producing fungi and their epidemiological significance in corn crops. *Aspergillus*, *Fusarium, Penicillium* and *Alternaria* genera are mycotoxigenic fungi responsible for the majority of agricultural mycotoxin contamination.

These fungi are common components of the microbial flora associated with many agronomic crops, including corn (Palumbo *et al.*, 2008). Previous studies identified genus *Fusarium, Aspergillus, Penicillium* and *Alternaria* as mycotoxigenic fungi that are a natural contaminant in corn crops and also in many other agricultural commodities (Lino *et al.*, 2007; Logrieco *et al.*, 2007, Pacin *et al.*, 2009; Cunha *et al.*, 2009) and all these were isolated from the samples in this study.

The use of good agricultural practices that would discourage fungal growth and mycotoxin production would be necessary to reduce mycotoxin levels in the corn and corn products. Contact of the corn with the soil should be avoided during harvest and drying to avoid contamination with the fungal inoculum present in the soil. Drying of corn to safe moisture levels of less than 13% and cleaning of stores at the end of each season would reduce chances of infection and mould growth. If the earth's surface temperatures continue in a warming trend, and other associated climate patterns may be changing, then farmers, food industries, and policymakers should be concerned about changing mycotoxin risks both in the short term and in the long term. In the short term, from year to year, temperature and precipitation may favour or discourage growth of mycotoxigenic fungi and mycotoxin contamination of agricultural products. In the long term, climatic trends may pose longer-term impacts on distribution of fungi, their mycotoxins, and host crop plants (Wu *et al.*, 2011).

Conclusions

Based on the results, we can conclude that in this phase of the survey there was no excessive production of aflatoxin B1 in tested corn samples. However, these fungi do not always produce mycotoxin but only under certain circumstances, such as when exposed to adverse environmental conditions, competition with other species of fungi, etc., and amount of produced mycotoxins depends on the environmental conditions, storage conditions, air humidity and other factors. Because of all that facts it should be taken into consideration that there is a possibility of mycotoxins production in later stages, so these analysis should also be perfomed in other phases of corn production, drying, storage and handling.

Also, the composition of mycotoxigenic fungi in corn grain showed the presence of other toxigenic fungi. These results indicate possible health hazards for humans and animals consumption of such contaminated food grain by mycotoxigenic fungi so these analysis should include other mycotoxins such are zearalenone and deoxynivalenol. This study should also include certain number of samples of wheat, barley and other cereals in order to analyze other food and feed components. Besides, it is necessary to carry out permanent control of feed and feed components from import.

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GENOTYPE SPECIFICITY OF THE ORGANOGENESIS OF FRUIT-BEARING PEAR TREE (II THE ANALYSIS OF TWO-YEAR-OLD OUTSPREAD BRANCH)

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Abstract

The two-year-old outspread branch (the last year outspread shoot) is the key for defining pomotechnical operations in a genotypically defined fruit tree pruning. Certain pear cultivars has a distinctive branching pattern of the last year shoot; according to branching pattern, all pear cultivars are classified into 5 ideotypes. Based on the analysis of the two-year-old outspread branch, the cultivars can be classified into the corresponding groups, while the type of the organogenesis of fruit-bearing pear trees can be determined, which represents the cultivar specificity as the base for defining pomotechnical treatments, i.e., we obtain the information how much time it takes lateral vegetative buds form a new growth which bears the generative bud at its top. This paper presents the results of the analysis of the two-year-old outspread branch in three vegetations of 6 pear cultivars as follows: 'Trevuška', 'Santa Maria', 'Williams', 'Abate Fetel', 'Kalu erka' and 'Krasanka'. The interaction effects per cultivars and years have been analyzed, as well.

Key words: *pear, cultivar, organogenesis, fruit-bearing tree*

Introduction

Growing points are a basic prerequisite for determining genotype specificity in the formation, growth and development of all categories of growths, and in this way in the organogenesis of a fruit-bearing tree, as well. (Mi i , 1992). All the growing points of a tree can originate from vegetative cones; then we call them normal growing points. However, they may be formed by the differentiation of parenchyma cells into the meristematic ones; then we call them incidental or adventious growing points (uri and Mi i , 1988; Lu i et al., 1996). Depending on how much time it takes to get the lateral vegetative buds form a mixed terminal (generative) bud on the shoot, we may consider the type of organogenesis of fruit-bearing pear tree, i.e., the genotype specificity of this process in pear (Gvozdenovi , 2008). The two-year-old outspread branch is the basis of the fruit-bearing potential of the most pome fruit species (Mi i et al., 1998). Nevertheless, as the process of forming fruit-bearing twigs in some varieties of pear fruit trees is more than two years long, while studying the branching pattern, Sansavani (1993) determined 5 fruit-bearing ideotypes in some pear varieties. According to the type of the organogenesis of the fruit bearing tree of pome tree species, Lespinaze (1993) and Lauri et al. (1995) examined the genotypic differences in the axillary bud development as well as fruit-bearing models of fruit-bearing apple twigs during the several years. They also examined the approach to the regulation of fruit-bearing potential. Mi i and uri (1997) determined the base for the mathematical modeling of organogenesis cycle, i.e., algorithm basis of organogenesis cycle in pome fruit species. Based on this research, they observed there had been intensively developed computer programs for searching information about the buds, both vegetative and generative ones, that is, fruit-bearing twigs (the type, age, location on the structure of the fruit-bearing tree, etc), the structure of the fruit-bearing tree (the angle towards the parent branch and the ground; the degree of the differentiation of the bud along the fruit-bearing structure, etc) and also the

information about the characteristics of the growths that bear physiologically mature fruits. Based on these information the algorithms of genotype specificity of fruit-bearing potential may be defined; by means of them the main pomotechnical operations are suggested, too. (Lauri et al., 1995; Mi i , 1997).

The ultimate objective of mathematical modeling is the maintaining of relations between growth and fruit-bearing at a certain level as the basis for obtaining the maximum and stable yields.

Material and method

The samples were collected in a orchard in the locality Jurkovica (Gradiška municipality) in the years 1998, 1999 and 2000. The following pear cultivars were selected for the study: 'Trevuška', 'Santa Maria', 'Williams', 'Abate Fetel', 'Kalu erka', 'Krasanka'. The analysis of the certain growth categories was carried out during a three-year period. In order to determine the fruit-bearing potential of the fruit-bearing trees of the examined pear cultivars, 30 two-year-old outspread branches were taken for the analysis of the following elements:

1. The length of the two-year-old part of the two-year-old outspread branch
2. The structure of the growths on the two-year-old outspread branch
3. The fruit-bearing potential of the two-year-old outspread branch

The obtained results were tested by the analysis of variance with two variables (the cultivar and the year).

The presence of the growth which has generative buds in the two-year-old part is expressed in the percentage from which the coefficient of fruit-bearing potential is calculated according to the formula:

$K = Z \, x \, P$;

Z- % branches which have generative buds on the two-year-old part (in %)
P- Average number of generative buds in 1 meter of two-year-old part of the outspread branch.

Results and discussion

1. Length of the two-year-old part of the two-year-old outspread branch

The two-year-old outspread branch (the last year outspread shoot) is the key for defining pomotechnical operations in a genotypically defined fruit tree pruning (Mi i , 2008). The results of the analysis of the two-year-old outspread branch in the examined cultivars are in Table 1. According to the data shown in Table 1, the longest length of the two-year-old outspread branch was in 'Trevuška' (91.13 cm) in the year 1998, while the shortest one was in 'Abate Fetel' (21.97) in 2000. The analysis of the variance of the average length of the two-year-old part of the two-year-old outspread branch in the examined pear cultivars shows that the cultivar (as a factor) is highly statistically significant for this feature ($F_{calcul.}$280.84), while the year is also highly statistically significant for the length of the two-year-old part of the two-year-old outspread branch ($F_{calcul.}$18.41). Interaction effect between the cultivar and the year is highly statistically significant, as well ($F_{calcul.}$21.38).

The analysis of the interactive effects performed by the graphical method is presented in Graph 1. Having observed the graph, it can be generally concluded that the cultivars exhibited little variation in the average length of the two-year-old part of the branch. Besides, there are clearly observed genotypic differences between the examined cultivars; in the year 2000 'Trevuška' showed highly significant decrease in the average length of a two-year part of the branch, which is essentially an interactive effect. Taking into account the behavior of the cultivars for the final observation, the determination of this change in 'Trevuška' may be acceptable.

Tab. 1. The length of the two-year-old part of the two-year-old outspread branch

No.	Year Cultuvar	1998	1999	2000
1	Williams	50.73 ± 3.42	47.00 ± 1.21	50.79 ± 1.03
2	Abate Fetel	24.67 ± 2.19	22.03 ± 1.01	21.97 ± 0.92
3	Krasanka	22.97 ± 1.70	20.00 ± 1.08	23.89 ± 4.55
4	Kalu erka	25.47 ± 1.93	23.87 ± 1.28	25.73 ± 0.85
5	Santa Maria	41.40 ± 3.28	38.57 ± 1.73	40.17 ± 1.24
6	Trevuška	91.13 ± 3.16	90.03 ± 4.21	48.53 ± 2.84

Based on the above observation, the examined cultivars may be divided into 3 groups as follows:

1. The cultivars with variation occurence; they are the cultivars with the average length of the two-year-old part of the branch ('Trevuška')
2. Cultivars with the medium length of the two-year-old part of the branch ('Williams' and 'Santa Maria').
3. Cultivars with a relatively short two-year-old part of the branch ('Kalu erka', 'Abate Fetel' i 'Krasanka').

2. Structure of growths on two-year-old outspread branch

The abundance of the fruit-bearing tree in the evolution on the two-year-old outspread branch can basically be related to the type of organogenesis of fruit-bearing fruit trees. As for pomotechnics, the higher abundance of the fruit-bearing tree in evolution on the two-year-old outspread branch imposes a different approach to pruning, since the formation of generative bud from the lateral vegetative cones is prolonged - postponed in this way. The results of studying the abundance of one-year-old vegetative growths - fruit-bearing tree in evolution in relation to fruit-bearing twigs on a two-year-old part of the outspread branch are shown in Table 2. Based on the data in Table 2, it can be concluded that the smallest abundance of the one-year-old growths, which are by nature a fruit-bearing tree in evolution, was in 'Williams' (45.00 %) in 1999, while the highest abundance was in 'Kalu erka' (99,43 %). Otherwise, the abundance of these growths in 'Kalu erka' in all three years of the study was close to 100 %.

Tab. 2. The abundance of one-year-old vegetative growths - fruit-bearing tree in evolution in relation to fruit-bearing twigs on the two-year-old part of the outspread branch

No.	Year Cultivar	1998	1999	2000
1	Williams	58.87 ± 4.23	45.00 ± 4.01	61.87 ± 4.08
2	Abate Fetel	86.13 ± 3.91	62.79 ± 3.77	80.27 ± 3.89
3	Krasanka	59.87 ± 4.77	50.79 ± 4.19	60.73 ± 12.16
4	Kalu erka	99.43 ± 0.56	98.30 ± 0.98	98.77 ± 0.73
5	Santa Maria	81.03 ± 3.98	64.90 ± 4.19	81.59 ± 3.85
6	Trevuška	82.93 ± 3.89	79.93 ± 5.37	91.47 ± 2.97

The analysis of variance of the percentage abundance of the one-year-old lateral vegetative growths on the two-year-old outspread branch between the examined cultivars and years shows that the cultivar was highly significant for this feature ($F_{calcul.}$54.40). The exhibited differences between the cultivars per years are highly statistically significant, as well

(F_{calcul}18.04), while the presence of the interaction effect between the cultivar and the year is statistically insignificant (F_{calcul}1.48).

The analysis of the interaction effect done by the graphical method is shown in Graph. 2. Despite the interaction effects which were not statistically significant, the graphical analysis clearly shows genotypic differences, while the cultivar grouping according to this segment of the organogenesis of the fruit-bearing tree is as follows:

1.The smallest abundance of one-year-old vegetative growths-fruit-bearing tree in evolution in relation to fruit-bearing twigs on the two-year-old part of the outspread branch as well as correlated tendency in all the observed years are in 'Williams' and 'Krasanka'. This also suggests that pruning principle in these two cultivars is the least problematic one.

2. 'Santa Maria' and 'Abate Fetel' had a higher abundance of one-year-old vegetative growths-fruit-bearing tree in evolution per 20 % in relation to fruit-bearing twigs on the two-year-old part of the outspread branch comparing to 'Williams' and 'Krasanka'. The tendency to change is almost identical between 'Santa Maria' and 'Abate in the observed period.

3. 'Trevuška' partially varies from 'Santa Maria' and 'Abate Fetel'; in the observed period it exhibits a greater tendency of the abundance of the fruit-bearing tree in evolution on the two-year-old part of the outspread branch.

4. Genotype specificity of 'Kalu erka' is manifested in the fact that all the lateral branching on the two-year-old part of the outspread branch are the growths of the vegetative character in all the observed years.

The structure of the fruit-bearing tree in evolution in relation to the fruit-bearing twigs on the two-years-old part of the outspread branch is basically the aforementioned type of the organogenesis of the fruit-bearing tree; it is essential for defining the pruning (during fruit-bearing) which aims to establish a certain relationship between the growth and fruit-bearing potential. With the increase of the abundance of the fruit-bearing tree in evolution on the two-year-old part of the outspread branch, the possibility for the establishing of pillar pruning system is decreased, while the necessity for growing in the slender spindle training system is imposed, as well.
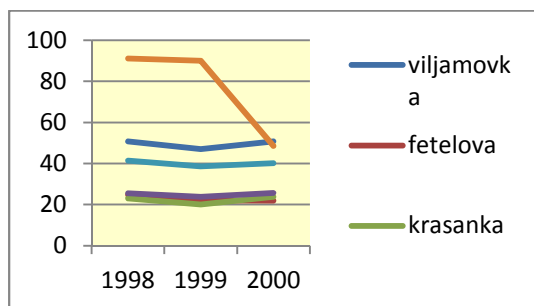
Graph 1. The length of the part of two-year-old outspread branch
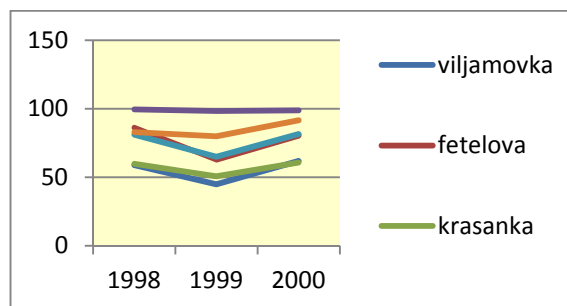
Graph 2. The abundance of one-year-old vegetative growths-fruit-bearing tree in evolution in relation to fruit-bearing twigs on two-year-old part of the outspread branch

3. Fruit-bearing potential of the two-year-old outspread branch

The basic indicator of pomotechnical establishment of the certain relation between growth and fruit-bearing is the type of the organogenesis of the fruit-bearing tree, i.e., the required

number of vegetations for the process of forming the generative bud from the lateral vegetative bud. The indicators presented in Table 3 will be a decisive factor for defining pruning system as well as training system. However, fruit-bearing coefficient as genotype specificity is a significant indicator for the final modeling of growing system and fruit loading of the fruit tree during the full yielding age. The basic calculation parameters and fruit-bearing coefficient are shown in Table 3. The analysis of the abundance of the branches which on their two-year-old part have the growths bearing generative buds in the examined pear cultivars shows as follows:

1. 'Williams', 'Krasanka' and 'Santa Maria' are the cultivars with a high abundance of generative buds on the two-year-old part of the two-year old branch. This suggests a high genetic yield capacity, too.

2. 'Trevuška' and 'Abate Fetel' are the cultivars with a lower abundance of the branches which on their two-year-old part have the growths bearing generative buds.

3. 'Kalu erka' is the cultivar with a extremely low abundance of the branches which on their two-year-old part have the growths bearing generative buds.

Tab. 3. The abundance of branches which on their two-year-old part have generative buds

No.	Cultivar	Year	A	B	C
1	Williams	1998	96.67	12.94	1,251.00
		1999	83.02	13.56	1,125.75
		2000	94.18	18.32	1,725.38
2	Abate Fetel	1998	30.00	13.01	390.30
		1999	42.13	12.24	514.08
		2000	65.27	20.15	1,315.19
3	Krasanka	1998	83.33	16.94	1,411.61
		1999	74.54	18.33	1,315.19
		2000	68.32	19.97	1,364.35
4	Kalu erka	1998	3.33	5.26	17.52
		1999	1.84	3.98	7.32
		2000	2.73	4.38	11.96
5	Santa Maria	1998	63.33	13.02	824.56
		1999	64.54	16.24	840.31
		2000	72.32	39.03	2,822.65
6	Trevuška	1998	43.33	4.74	205.38
		1999	40.13	3.29	142.56
		2000	45.08	5.44	235.71

A - The abundance of branches which on their two-year-old part have generative buds (%)
B - The average number of generative buds in 1m of the two-year-old part of the outspread branch
C - Coefficient of potential fruit-bearing

When the percentage of the abundance of the branches which on their two-year-old part have generative buds is multiplied with the average number of generative buds in 1 m of the two-year-old part of the outspread branch, coefficient of potential fruit-bearing is gained.

The analysis of this coefficient is completely in accordance with the observation given in the analysis of the abundance of branches which on their two-year-old part have generative buds. However, the coefficient of potential fruit-bearing in 'Santa Maria' is 3.5 times bigger than it is usual, which clearly indicates a strong tendency toward alternation. The same tendency is in

'Abate Fetel'. Based on the obtained coefficients, it can be concluded that apart from doing differentiation of cultivars according to fruit-bearing potential, the coefficient of potential fruit-bearing can also be a good indicator of alternative preferences.

Conclusion

Based on the average length of the two-year-old part of the two-year-old outspread branch, the observed cultivars can be divided into 3 following groups:
• The cultivars with the average length of the two-year-old part of the branch but with variations such as 'Trevuška';
• The cultivars with the medium length of the two-year-old part of the branch such as 'Williams' and 'Santa Maria';
• The cultivars with a relativelly short length of the two-year-old part of the branch such as 'Kalu erka', 'Abate Fetel' and 'Krasanka'.
The structure of the growths on the two-year-old outspread branch observed through the relation of the fruit-bearing tree in evolution and fruit-bearing twigs ranged from 99.43% of the abundance of vegetative growths in 'Kalu erka' to 45.00% in 'Williams'. These data enable the grouping of cultivars according to genotypic differences as follows:
• Williams' and 'Krasanka' have the least abundance of the one-yeat old vegetative growths – fruit-bearing tree in evolution in relation to fruit-bearing twigs on the two-year old outspread branch. They also have a correlated tendency in all three observed years.
• 'Santa Maria' and 'Abate Fetelova', comparing to 'Williams' i 'Krasanka', had a higher abundance of one-year-old vegetative growths-fruit-bearing tree in evolution per 20 % in relation to fruit-bearing twigs on the two-year-old part of the outspread branch
   • 'Trevuška' partially varies from 'Santa Maria' and 'Abate Fetel'; in the observed period it exhibits a greater tendency of the abundance of the fruit-bearing tree in evolution on the two-year-old part of the outspread branch.
   • Genotype specificity of 'Kalu erka' is manifested in the fact that all the lateral branching on the two-year-old part of the outspread branch are the growths of the vegetative character in all the observed years.
Based on the abundance of branching on the two-year-old part of the two-year-old branch which has generative buds and coefficient of potential fruit-bearing, the examined cultivars were divided into following 3 groups:
• 'Williams', 'Krasanka' and 'Santa Maria' are the cultivars with a high abundance of generative buds on the two-year-old part of the two-year old branch, which also proves a high genetic yield capacity.
   • 'Trevuška' and 'Abate Fetel' are the cultivars with a lower abundance of the branches which on their two-year-old part have the growths bearing generative buds.
• 'Kalu erka' is the cultivar with a n extremely low abundance of the branches which on their two-year-old part have the growths bearing generative buds.

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EFFECT OF DIFFERENT HAYLAGE LINES ON HAYLAGE CHEMICAL COMPOSITION

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Abstract

Haylage is obtained by combining the process of making hay and silage. Green mass is dried in the air, so that the moisture content drops to 40-50 %. After that, dried mass undergoes fermentation in sealed towers, or other silo - objects. Making of haylage presupposes the use of such silo - spaces, which completely prevent the presence of air. The main objective in this study is whether the way of making haylage can affect the quality of received silage. Since all processes in the production of haylage are mechanized, it's understandably potentiation of proper and economical choice of making haylage. Basically, the assessment is based on the results of the organoleptic and chemical analysis, including the share of legumes, protein, cellulose, etc. Our research was based on the data obtained in chemical analysis of samples of haylage from Silo-trenches and haylage in wrapped bales. The following parameters is determined: moisture content, crude protein, crude fat, crude fiber and starch. Obtained silage quality is on the satisfactory level with moisture content from 51.46 to 52.45 %, crude protein from 4.82 to 5.57 % and the results showed very little variation in the chemical composition of both lines of preparing haylage.

Keywords: *self-loading trailer, roll baler, haylage, grass silage, protein, dry matter*

Introduction

Haylage is obtained by combining the process of making hay and silage . Green mass is dried in the air, so that the moisture content drops to 40-50 % . After that, dried mass undergoes fermentation in sealed towers, or other silo - objects (Obradovic, 1976). Haylage represents the closest replacement for green animal feed and today is the basis of cost-effective and modern animal husbandry. The quality of grass silage and haylage varies depending on the applied agricultural techniques and technology, weather conditions, the composition of the meadows and the most important thing, the phenological phases of the material, ie. given meadows.The main factors affecting the quality of silage and haylage are moisture content, phenological stage in which the plants are at the moment of mowing, the mass of sugar in the material that is ensiled and anaerobic environment during the ensiling process. Delaying the time of mowing grass for haylage directly affects the chemical composition, the quality of the fermentation, and the quality of the silage and its digestibility and intake of the animals themselves. Except for biological factors mentioned above, one of the important factors is the method of applying the ensiling grass mass.

Haylaging represents a more successful method of preservation green fodder than drying of hay in a natural way. Haylage has many advantages over the hay, first and foremost, is that storing silage preserves leaves as the best parts of plants. Proces of making silage considerably lessens nutrient losses than the traditional method of storing hay. Also, when storing silage losses are negligible around 5%, while losses in hay making 25 - 40%, and sometimes higher. Conservation biomass by haylaging is in full implementation of mechanization starting from the cutting and storing, preparation and distribution of farm

animals in the stable. Haylage as animal fodder contains more than twice dry matter content, and animals consume it in larger quantities in relation to the silage. Less water in the nutrients, also reduces the cost of transportation to the stable, and is more economical than storing silage. Preparation of haylage requests significantly lower costs compared to storage of hay especially when loading and transport of feed to the stable are mechanized.Conservation of biomass by storing the haylage consists of the ensiling process, and dried in the air, so that the moisture content drops to 40-55 % of humidity.

The main objective in this study is to determine whether the way of making haylage can affect the quality of received silage. Since all processes in the production of haylage are mechanized, it's understandably potentiation of proper and economical choice of making haylage. Plants for haylaging significantly range (in sugar content and buffer capacity). According to the presence of sugar and ensiling ability, green plants are classified into three groups: plants that are easily ensilaged, second which are difficult to ensiled and third plants that can't be ensiled alone (obi et al., 1983). The principle of ensiling is based on the transformation of water soluble carbohydrates, which must transformed at least 10% of the dry matter in lactic acid. This is achieved in an anaerobic environment, by work of anaerobic lactic acid bacteria, and other microorganisms, with adequate moisture, 65-70% in forages and 33-38% in the concentrated feed (Dini and Djordjevic, 2005) and temperature ($35-38^0C$). For these reasons it is recommended drying of cutted biomass of grasses and legumes in order to achieve optimum moisture. Drying requires greater involvement of mechanization and workforces, because the first pass requires mowing the plants for haylaging, and the second collecting them into larger windrows and picking them up and choping them up using silo–combine. The procedure of making, haylage is the most appropriate replacement of green fodder, because the modern approach of storing forage achieves the highest degree of preservation of the quality and nutritive value of forages, which has the particular importance to the savings in additional animal nutrition with expensive concentrated feeds. As such it is used for feeding ruminants during the whole (or at least half) year. Making of haylage in a bales wrapped with stretch foil is the best way of storing haylage. The quality of haylage is determined keeping in mind chemical, biological and nutrient values including: dry matter content (DM), organic matter content (OM), crude proteins (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), methabolic energy value (ME), pH, content of products of fermentation (lactic acid, volatile fatty acids), content NH_3-N (Vrani et al., 2005). It is desireable for haylage to have more than 300 g kg^{-1} DM, more than 11 MJ kg-1 SM ME, more than 70% metabolic energy (FME/ME), 150-175 g SP kg^{-1}SM, pH value 4,0-4,5, 500-550 g NDF kg^{-1}SM, less than 50 g kg^{-1} SM nitrogen in form of NH_3-N, more than 100 g residue sugar kg^{-1}SM, 80-120 g lactic acid kg^{-1} SM (Chamberlain and Wilkinson, 1996). In the vegetative stage of plant developement, leaves percentage is equal or higher to the percentage of stem, while the older meadow gets percentage of leaves is lower, and the stem percentage gets higher, the amount of crude proteins decreases while the amount of crude fiber increases. (Di Marco et al., 2002). The decreasing in quality of mowed mass is connected directly to increasing of lignin and structure parts of cell walls, meaning that decreasing of amount of crude proteins and digestable parts of cells in the plant such as starches, monosaccharides and sucrose (Aman and Lindgren, 1983). In the same time consumption is lowering as well as digestibility.

Materials and methods

There are different methods for determining the quality of haylage. All the methods are based on the results of organoleptic and chemical analysis, including legumes, content of proteins, fiber and so on. Analysis of the haylage samples has been done in the certified laboratory „Sistem Qualita S" by standard methods AOAC, 2002 for animal fodder analysis. Basic chemical qualities of haylage are determined with folowing methods:

Determining the amount of moisture- drying on 105^0C until constant mass

Determining amount of crude fiber by Kjeldahl method

Determining amount of crude fats by Soxhlet method

Determining amount of crude cellulose by Gerhardt method

Determining amount of starch by polarimethric method

Determining amount of mineral matter by burning it

Determining amount of NFE by calculating it

Determining energy value by chemical composition and energy value of nutrients

Checking to see whether there is significant statistical influence of different production lines on the quality of haylage using diferent mechanical equipment (round bales wraped in strech foil, sillo mass pressed in silo and covered with foil) has been done by standard statistical methods, or testing the hypothesis that the middle values of two different groups are equal. Testing has been done using t-test, or testing the ground hypothesis about a difference between average values of the two groups.

Results and discusion

Chemical composition and nutritive value of haylage are greately influenced by grass to clover ratio, species and types of grass and clover phytophenological maturity of meadows at the time of mowing, technology of preparation (chopping, SM content, adding preservers), supplying the soil with enough nutrients, agricultural practices and climatic factors (temperature, light, precipitation).

Picture 1. Haylage sample from silo   Picture 2. Haylage sample from wrapped bale

Our research, we have based on the data of chemical analysis of samples from silo haylage and bales wrapped in stretch foil.

Table 2: Chemical analysis of haylage samples (%)

Chemical composition and energy value	Way of storing haylage	
	Silo-trenches	Wrapped bales
Moisture, %	51.46	52.45
Ash, %	3.30	4.69
Crude cellulose, %	17.82	18.48
Content of starch, %	0.0	0.0
Crude protein, %	4.82	5.57
Crude fat, %	1.21	1.32
NFE, %	21.39	17.13
Energy value, KJ/100g	429.65	457.69

The lower level of protein and high levels of cellulose is one of the indicators for late mowing and haylaging. Mowing in the later phytophenological stages reduces the protein content and increases the content of cellulose (Glavic at al., 2013) Testing, done using t-test, or testing the ground hypothesis about a difference between average values of the two groups, has shown that machine production line has no greater influence on chemical composition of haylage. These results are similar to the research of Glavic (2013), by comparing the quality of haylage on 10 farms in Bosnia and Herzegovina, level of DM (48.26% haylage), low content of CP (12.69% haylage), high content of CC (42.03% haylage), low content of MM (2.05 haylage).

Table 3: Results of testing on the quality of silage

X_1	X_2	d_i	$d_i - \bar{d}$	$(d_i - \bar{d})^2$	
51.46	52.45	-0.99	2.96	8.79	
3.3	4.69	-1.39	2.56	6.58	$t_{tab5\%} = 2.45$
17.82	18.48	-0.66	3.29	10.85	
4.82	5.57	-0.75	3.20	10.27	$t_{tab1\%} = 3.71$
1.21	1.32	-0.11	3.84	14.78	
21.39	17.13	4.26	8.21	67.47	$t_{exp} < t_{tab}$ accepted H_0
429.65	457.69	-28.04	-24.09	580.12	
	$\sum = -27.68$			698.86	
	$\bar{d} = -3.95$				
	$t_{exp} = -0.969$				

Conclusion

Haylaging is the process of preparing the green mass of animal feed, which provides high quality animal feed, with little loss of dry matter and nutrients (carbohydrates, proteins, vitamins, mineral substances).In the process of preparation the green mass for silage or haylage, all processes can be mechanized starting from mowing, raking, chopping and loading, transportation and unloading of chopped material.

Producing high-quality grass silage and haylage today is not easy. Currently one of the biggest problems in storing haylage in Bosnia and Herzegovina is the lack of adequate and modern agricultural machinery for storing hay and silage. Obtained silage quality is satisfactory, moisture content from 51.46 to 52.45% , crude protein from 4.82 to 5.57% and the results showed very little variation in the chemical composition of both lines of

preparation. After chemical analysis of silage samples and their statistical analysis using the t - test,it can be concluded that the different lines haylage making, or method of storing silage had no greater impact on the quality of the silage. Greater impact is found in phenological phases during mowing process than the production itself.

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HABITAT CONDITIONS AND USABILITY OF THE HOG TRUFFLE (*Choiromyces Meandriformis* Vitt.) FOUND IN BOSNIA AND HERZEGOVINA

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Abstract

Several specimens of the hog truffle fungus (*Choiromyces meandriformis* Vitt.), that belongs to the family *Tuberaceae* Dumort. (1822) were found in the artificially established middle-aged Norway spruce forests (*Picea abies* (L.) Karsten) in the Kneževo area of the Republic of Srpska in Bosnia and Herzegovina. Besides the spruce as a sole species in the tree layer, common hazel, single-seeded hawthorn and old man`s beard were found in the high shrub layer. Nine species were registered in the low shrub layer and 32 species in the herb layer, with mosses as the most abundant species due to acidification of the upper soil layer by the spruce needles. Unlike the "true truffles", hog truffle partly emerges on the surface, which makes it easier to spot without truffle dogs or other trained animals. Soli under spruce plantation were strongly acid (pH 3.9 - 4.6) and illimerised. Parent materials were flysch, i.e. conglomerates, marls and breccias. Soil texture was silt loam and dominant soil separate was silt (63.59 %). Chemical analysis of the flesh of fungus show that it fulfills criteria related to the edible mushrooms, except concentration of arsenic (As), that is much above (2.1 mg/kg) prescribed limit (0.3 mg/kg). At the same time, chemical analysis of the soil did not show increased concentration of arsenic (found 4,4 mg/kg) in comparison with average value for all soils (5 mg/kg), neither to the allowed interval for uncontaminated soils (0.2 – 40 mg/kg) according to the WHO. This fact leads to the conclusion that hog truffle has particularly emphasized affinity towards arsenic because of its capability to accumulate almost 50 % of arsenic content in the soil, unlike, for example, bolete mushrooms (*Boletus* spp.) which used to accept just around 0.6 % of the available soli arsenic.

Keywords: *hog truffle, usability, arsenic content, habitat conditions*

Introduction

Many fungi species spend the most of their life cycle underground, but majority of them produce large fruit bodies above the earth's surface. Smaller number of the fungi from the classes *Zygomycetes*, *Ascomycetes* and *Basidiomycetes* produce relatively large hypogenous fruit bodies and thus belong to true underground fungi (Hawker, 1954).

Underground fungus hog truffle was for the first time scientifically described by Elias Fries in 1830 under the name of *Mylitta venosa* Fr. At the same time Italian mycologist Carlo Vittadini described the genus *Choiromyces* with the species *C. meandriformis* Vittad. Later on, species *Mylitta venosa* was assigned to this genus as *Choiromyces venosus* (Fr.) Th.Fr. Species *C. meandryformis* Vittad. and *C. venosus* (Fr.) Th.Fr. are considered to be synonyms, while the former name is used more often in southern Europe (Montecchi et Sarasini, 2000). This approach is based on the great similarity of fruit bodies and spore morphology. According to DNA analysis, this fungus is phylogenetically closer to the so called "true" truffles of the genus *Tuber*, than it is with the truffle-like species such as "desert truffles" of the family *Terfeziaceae* (Percudani et al, 1999; Moreno et al., 2011).

Hog truffle lives in mycorrhizal association with many tree species, coniferous as well as deciduous, though Focht (1986) states that false truffle is not obligatory mycorrhizal, but "*it grows on the fields without trees"*. In Sweden it fruits during the summer (June-August), while in USA in October (Castellano et al, 1999). Unlike the "true truffles", it partly emerges on the surface, which makes it easier to spot. But, studies conducted with the truffle dogs have shown that adult fruiting bodies don't always come up on the surface, but rather fully develop underground (Wedén, 2007).

Hog truffle is known from Balkans (Anon., 2010/1; Hrka, 1984), Scandinavian countries (Wedén, 2007), England (Hawker, 1954; Pegler et al., 1993), France, Germany, Hungary (Wedén, 2007), Slovenia (Piltraver et Ratoša, 2006; Poler, 2010), Spain, Italy and Turkey (Anon., 2011), Russia (Wasson et Wasson, 1957), North America (Montecchi et Sarasini, 2000; Castellano et al, 1999) and some other parts of the world.

In Bosnia and Herzegovina hog truffle is considered a vulnerable species (Anon. 2010/1).

Material and methods

Study area

Hog truffle was found in the artificially established Norway spruce forest (*Picea abies* (L.) Karsten) in the Kneževo area, village Ra i i, locality Vrhovine (44°32$^'$42$^{''}$N, 17^{o}18$^'$48$^{''}$E), in the second half of the August of 2010 and 2011. Elevation is 840 m, inclination is 5%, eastern exposure, and canopy cover is 60%. Bedrock is carbonate flysch, i.e. conglomerates, marls and breccias. According to available information, the same species was found at southeastern slopes of mountain Vlaši , locality Gluha Bukovica (44^{o}19$^'$50$^{''}$N, 17^{o}43$^'$44$^{''}$E), at the straight line distance of 40 km (Anon., 2011/1).

Figure 1: Norway spruce forest where the hog truffle was found
(photo: S. Ljubojevic)

Methods

Age of the plantation was determined by tree-rings counting on the cross-section in the zone of the lower trunk of the representative tree. Floristic composition of the Norway spruce forest was determined using standard phytosociological method (Braun-Blanquet, 1964, according to Stefanovi , 1977). Contours of a typical forest association were staking out with GPS „Garmin eTrex Summit". With the same device altitude and exposure were determined, while terrain slope was measured with clinometer "Meridian". Degree of canopy closure was estimated occularly based on conditional scale by Bunuševac (1952).

Plant species were determined using basic and standard floras keys taken from: Javorka et Csapody (1975), Josipovi (1970-1977) and Sari et Josipovi (1986).

Physical and chemical analysis of the soil was done using the standard procedures for selected characters. Soil pH in water as active acidity and in 1M of KCl as exchangeable acidity was determined electrochemically using the combination pH electrode on the PHM240 pH/ion meter–radiometer. Humus content in soil was determined using colorimetric method, in the sample with 1N $K_2Cr_2O_7$ and concentrated sulfuric acid. Organic matter was determined by burning at 600 °C. Total nitrogen (% N) was determined by Semimicro-Kjeldahl method, modified after Bremner. Accessible forms of nitrogen in soil (NH_4^+, NO_3^-) were determined using the Bremner method – by extraction of mineral forms of nitrogen using 2N KCl. Amount of the accessible form of phosphorus in the soil was determined using Al-method (Egner-Riehm-Domingo) along with the readings of the optical density on the Jenway Spectrophotometer 6405 UV/Vis. Total phosphorus was determined by "wet burning" method in the solution of acids – with the ammonium vanadate (yellow method). Amount of the accessible form of potassium was determined by Al-method (Egner-Riehm-Domingo) with the direct reading of the concentration on the flame photometer Jenway PFP 7. Total potassium amount was determined by "wet burning" method in the acid solution using the technique of the flame photometry. Total amount of manganese (Mn), zinc (Zn), iron (Fe), copper (Cu), lead (Pb) was determined by destroying the sample with the "aqua regia", and readings were obtained by the AAS (Atomic Absorbtion Spectometry) using the flame technique. Total amount of mercury (Hg) and arsenic (As) was determined by destroying the sample with the "aqua regia", and readings were obtained by the AAS and hybrid technique. Mechanical structure of soil was determined by the pipette method using sodium pyrophosphate. Determination of the fungus was done by the macroscopic and anatomical-histological characteristics, according to the standard methodological procedure (Lazarev, 2003). Specimen's belonging to the genus *Choiromyces* was determined using the key based on the morphology of asci and spores (Trappe et Castellano, 2007). Specimen's belonging to the species *Choiromyces meandriformis* was determined using the prepared microscope slide of the spore, and comparing it with the referent description and drawing (Hawker, 1954).

Figure 2: Hog truffle
(photo: S. Ljubojevic)

Figure 3: Hog truffle, cross section
(photo: S. Ljubojevic)

Chemical composition of the fungus was determined as follows: protein content was analyzed applying the Kjeldahl method, and lipid content was analyzed following the standard method of Soxhlet. Content of carbohydrates was determined by calculating the difference between 100 and the sum of the contents of proteins, fat, water and ash. Percentages of lipids, carbohydrates and proteins were multiplied by corresponding factors. Thus obtained values were added together, and their sum represents energy value of 100 g of the sample. Arsenic content in the fungus flesh was analyzed following the standard procedure for food products (Anon., 2005). Contents of lead and cadmium were analyzed following the method UMH-243

(method for determination of the metal and metalloid residuals in foodstuff). Nutritive value was assessed by the comparison of the results with the relevant regulations (Anon., 2009).

Results and discussion

Habitat conditions

Several specimens of the hog truffle fungus were found in the vicinity of spruce trees, after their fruit bodies partly emerged on the soil surface.

Norway spruce artificial forest (i.e. plantation) in which we found the hog truffle was 41 years old, with 60 % canopy closure. We made two phytocoenological records in the object of the research. First record (Tab. 1) was taken near the plantation fringe, so there we found some species from the surrounding plant communities. On this record we have the layer of high shrubs (thanks to the lower canopy cover), which we don't have on the other one, taken inside the plantation. Spruce (*Picea abies* (L.) Karsten) was the sole representative of the tree layer, while common hazel (*Corylus avellana* L.), single-seeded hawthorn (*Crataegus monogyna* Jacq.) and old man's beard (*Clematis vitalba* L.) represented high shrub layer. Lower shrub layer consisted of: blackthorn (*Prunus spinosa* L.), common hazel, dog rose (*Rosa canina* L.), European wild pear (*Pyrus pyraster* Burgsd.), field maple (*Acer campestre* L.), silver birch, spindle (*Evonymus europaeus* L.), single-seeded hawthorn and wild cherry (*Cerasum avium* (L.) Moench). In the herb layer 32 species were recorded, with mosses as the most abundant species due to acidification of the upper soil layer by the spruce needles. The carpet of mosses together with the layer of raw humus are leading to the soil moisture increment, which results in the occurrence of some herbaceous species belonging to the vegetation of wet meadows.

Table 1: Phytocoenological records taken in the study area

No	Species	Record No.			
		1		2	
Tree layer					
1	*Picea abies* (L.) Karsten – Norway spruce	4	5	4	5
High shrub layer					
2	*Clematis vitalba* L. - old man's beard		+		
3	*Corylus avellana* L. - common hazel		+		
4	*Crataegus monogyna* Jacq. - single-seeded hawthorn		+		
Low shrub layer					
5	*Betula pendula* Roth - silver birch				+
6	*Acer campestre* L. - field maple		+		+
7	*Crataegus monogyna* Jacq. - single-seeded hawthorn		+		+
8	*Cerasum avium* (L.) Moench - wild cherry		r		+
9	*Rosa canina* L. - dog rose		r		+
10	*Prunus spinosa* L. - blackthorn		+		
11	*Evonymus europaeus* L. - spindle		r		
12	*Pyrus pyraster* Burgsd. - European wild pear		r		
13	*Corylus avellana* L. - common hazel				r
Herb layer					
14	*Pteridium aquilinum* (L.) Kuhn	1	1		+
15	*Veronica officinalis* L.		+		+
16	*Hieracium pilosella* L.				+
17	*Dactylis glomerata* L.	1	2	+	1

18	*Poa nemoralis* L.	+	1	1	2
19	*Brachypodium sylvaticum* (Hudson) Beauv.	+	1	+	1
20	*Cruciata glabra* (l.) Ehrend	+	1	+	1
21	*Helleborus odorus* Waldst. et Kit.	+	2		+
22	*Primula vulgaris* Hudson	+	1	+	1
23	*Cirsium erisithales* (Jacq.) Scop.		r		+
24	*Aremonia agrimonoides* (L.) D.C.	1	2		
25	*Bellis perennis* L.		+		
26	*Fragaria moschata* Duchesne		+		
27	*Symphytum tuberosum* L.	+	1		
28	*Sanicula europaea* L.		r		+
29	*Crocus neapolitanus* Merd. et Lois		r		
30	*Platanthera bifolia* (L.) Richard		r		
31	*Veronica chamaedrys* L.				
32	*Taraxacum officinalis* Weber		+	1	2
33	*Galium mollugo* L.		+		+
34	*Potentilla erecta* (L.) Räuschel		+		+
35	*Trifolium repens* L.		+		+
36	*Campanula patula* L.				+
37	*Ranunculus acris* L.		r		
38	*Peucedanum carvifolia* Vill.		+		+
39	*Plantago lanceolata* L.		+		+
40	*Scabiosa leucophylla* Borbas		+		+
41	*Pimpinella saxifraga* L.		r		+
42	*Viola hirta* L.		+		
43	*Prunella vulgaris* L.		r		
44	*Rhodobryum roseum* (Hedw.) Limpr.			+	3
45	*Polytrichum formosum* Hedw.			+	2

Analysis of the physical properties of the soil has shown that according to its texture, soil can be classified as a silt loam. Dominant soil separate is silt (0.06 – 0.002 mm) with 63.59 %. There are also clay (< 0.002 mm) with 23.61 %, and sand (2.0 – 0.06 mm) with 12.80 %. Chemical analysis of the soil is presented in Table 2. Observed ground shown strong acidity; active acidity is 4.6 (pH in H_2O), and exchangeable is 3.9 (pH in KCl). Total arsenic amounted 4.4 mg/kg, while the mercury wasn't detected. According to the World Health Organization (WHO), the content of arsenic in uncontaminated soil ranges between 0.2 and 40.0 mg/kg (Anon., 2010/2), and according to Beyer et Cromartie (1987), average concentration of arsenic in the soil is about 5 mg/kg. With that regard, we can consider arsenic concentration in the observed soil as a normal. Arsenic is characterized by high adsorption and fixation with acid soils, particularly with upper layers, so that it is possible another fungus and mushrooms to have increased content of arsenic on these and similar habitats.

Table 2. Soli chemical analysis

Parameter	Determined value	Parameter	Determined value
pH in H_2O	4.6	Total potassium (K)	0.24 %
pH in KCl	3.9	Accessible potassium (K_2O)	11.0 mg/100g
Organic matter content	16.97 %	Total iron (Fe)	4.85 mg/kg

Humus	7.2 %	Total zinc (Zn)	64.3 mg/kg
Total nitrogen (N)	0.36 %	Total copper (Cu	30.8 mg/kg
Total phosphorus (P)	0.12 %	Total lead (Pb)	45,4 mg/kg
Accessible phosphorus (P$_2$O$_5$)	2.0 mg/100g	Total arsenic (As)	4,4 mg/kg

Obtained results are partially agreed (acid soil, wet site, spruce forest) with findings of Rodrigez (2008) who states that in Spain this fungus is found on the acidic, clay soils in the areas with high precipitation, under the English oak (*Quercus robur* L.) and Norway spruce. Habitats that this fungus occurs in Sweden are far more different from observed in Kneževo area. Preliminary results of the Wedén`s research in Sweden (2007) show that false truffle prefers clay soil, broadleaved symbionts and open habitats with scarce herb layer. Fruit bodies were found in different habitats: garden lawns together with English oak and linden (*Tilia* spp.) or English oak and birch (*Betula* spp.); in the old opened English oak woods; at the fringes of the forests of conifers and birch. These results point to English oak, linden and birch as possible symbionts for the hog truffle, as well as Scots pine (*Pinus sylvestris* L.), fir (*Abies* spp.) and hazel (*Corylus* spp.). Regardless of the habitat variability, the soil was always clayish, and covered with very sparse herb layer, with large share of moss. Researches in the USA have shown that hog truffle is in mycorrhizal relationship with different pine species, with the Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) and the western hemlock (*Tsuga heterophylla* (Raf.) Sarg.), but they did not specified Norway spruce as a possible symbiont (Castellano et al, 1999).

Usability of the hog truffle
Hog truffle's flash at the intersection is of the white colour, hard and marbled (Fig. 3). It has a distinguish strong odor that is reminiscent of the smell of some inhalational anesthetic, which comes from the present arsenic. It contains 4,99 g of proteins, 0,006 g of fat and 12,36 g of carbohydrates in 100 g of fresh flash (Tab. 3). Related to our most important species of edible fungi, hog truffle is characterized by significantly higher content of carbohydrates and bigger energy value, and much lesser content of fat (Tab. 4). Contents of cadmium and lead are lesser than allowed, while the arsenic content (2.1 mg/kg) is many times higher than allowed (0.3 mg/kg max.), (Anon., 2005). That means this fungus shouldn't be used in human diet, or sold on the B&H market as a foodstuff.

Table 3. Hog truffle's flash chemical analysis

Parameter	Measurement unit	Referent value	Determined value
Protein content	g/100g	-	4.99
Fat content	g/100g	-	0.006
Carbohydrates content	g/100g	-	12.36
Arsenic (As) content	mg/kg	< 0.3	2.1
Cadmium (Cd) content	mg/kg	< 1.0	0.26
Lead (Pb) content	mg/kg	0.30	< 0.05
Energy value	kcal/100 g	-	69
	kJ/100 g	-	295

Table 4. Comparative overview of the main nutrients in hog truffle and the most important

mushrooms in Bosnia and Herzegovina (according to Lazarev, 2003)

No	Name of fungi species	Proteins	Fat	Carbohydrates	Energy value kcal/100g
		%			
1	***Choiromyces meandriformis***	**4.99**	**0.006**	**12.36**	**69**
2	*Agaricus campestris*	4.88	0.20	3.57	26
3	*Cantharellus cibarius*	2.64	0.43	3.81	21
4	*Boletus edulis*	5.39	0.40	5.12	33
5	*Lactarius deliciosus*	3.08	0.76	3.09	22
6	*Marasmius oreadus*	6.83	0.67	6.06	41
7	*Suillus luteus*	1.48	0.27	3.95	17
8	*Morchella spp.*	3.28	0.43	4.50	25
9	*Tuber spp.*	7.57	0.51	6.58	44

Content of the arsenic in the plants, including fungi, is usually much lower than in the soil (Živanovi , 2010). In the studies that were conducted at 18 localities in Serbia, arsenic content in boletes (*Boletus* spp.) was many times lower than in the soil where the mushrooms grew. In the Norway spruce natural forest at the locality Prijepolje – Jabuka arsenic concentration was 3.53 mg/kg, while in the flash of the boletes were only 0.02 mg/kg or 176 times lesser (Milinovi , 2011). In other words, boletes adopt only about 0.57 % of the available soil arsenic. Our study shows significantly higher affinity of the hog truffle towards arsenic accumulation, which is capable do adopt almost half of the available quantities (47.7 %) - 4.4 mg/kg in the soil vs. 2.1 mg/kg in the fungus' flash (Tab.3).

Affinity towards accumulation of arsenic is not exclusive feature of hog truffle. Among others, Byrne et Tusek-Znidaric (1983) registered arsenic in concentrations between 34 and 182 mg/kg of dry matter in caps and stalks of the amethyst deceiver (*Laccaria amethystina* (Bolt. ex Hooker) Murr).

Obtained results are in accordance with opinions of Focht (1986) and Hrka (1984) in Croatia, considered hog truffles as poisonous. However, some authors in Croatia consider it edible (Tomovi et Lisjak, 2004; Luki 2006) and some inedible or with no value (Božac, 1984). Hog truffles are considered poisonous (in fresh condition) in Slovenia (Poler, 2010), as well as in France and Italy (Montecchi et Sarasini, 2000). In Spain it is on the list of fungi that can not be commercially exploited. However, because of the size and colour, it is very often falsely represented as the white truffle (*Tuber magnatum* Picco 1788) (Rodrigez, 2008). At the same time, in the Upper Silesia in Germany it is considered as a mushroom of choice and called "Kaiserpilz". In Turkey it is foraged in significant quantities and exported during the season as a fresh, and during whole year as a dried or frozen (Anon., 2011). Hog truffle is being used in Sweden for the last 100 years. Major foraging areas are around the lakes in the southeastern part of the country. Fruiting bodies are quite large, with the smell that varies from the quite inconspicuous to very pleasant and aromatic, and even more to repellent. These differences reflect the state of fruiting bodies and spores, in the range from immature over mature to state of decaying. Mature fungi are considered a delicacy and used fresh, specially mixed with the butter. In such a way volatile lipophilic compounds are preserved which contribute to complexity of odors. This fungus is also used fried, and for the longer storage it is dried or deep-freeze. Preliminary study of citotoxicity of *Choiromyces venosus* in Sweden shows that the concentration of extracts of this fungus, required for the cell death, is similar to those of common mushroom (*Agaricus bisporus* (J.E.Lange) Emil J. Imbach) and summer truffle (*Tuber aestivum*), (Wedén et al., 2007).

Conclusions

Hog truffle can be found in the artificially established middle-aged Norway spruce forest in the Kneževo area of the Republic of Srpska in Bosnia and Herzegovina, on acid and illimerised solis, at the end of the summer.

Due to the acidification of the upper soil layer by the spruce needles, the most abundant species in the herb layer are mosses. The carpet of mosses together with and the layer of raw humus are leading to the soil moisture increment, which results in the occurrence of some herbaceous species belonging to the vegetation of wet meadows.

Unlike the "true truffles", hog truffle partly emerges on the surface, which makes it easier to spot without truffle dogs or other trained animals.

Hog truffle's flash at the intersection is of the white color, hard and marbled. Has a distinguish strong odor that is reminiscent of the smell of some inhalational anesthetic, which comes from the present arsenic. Arsenic content is many times higher than allowed, making this fungus inedible or even poisonous. If there is no increased content of arsenic, hog truffles would be considered as a quality edible fungus.

Content of arsenic in the plants, including fungi, usually is much lower than in the soil where they grow, which is not the case with hog truffle in this study. It shows particular affinity to arsenic, and accumulates it in the amount that is equivalent almost to the half of its concentration in the soil.

Arsenic is characterized by high adsorption and fixation with acid soils, particularly with upper layers, so that it is possible another fungus and mushrooms to have increased content of arsenic on these and similar habitats.

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UPTAKE AND UTILIZATION EFFICIENCY OF NITROGEN AND PHOSPHORUS IN DURUM WHEAT

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Abstract

The uptake and utilization efficiency of nitrogen and phosphorus in durum wheat was studied under conditions of long term fertilizing experiment. The standard variety „Progress", selected in Institute of field crops – Chirpan town, Bulgaria was grown in two field crops rotation cotton – durum wheat under rain conditions for the period of three vegetations including years 2011 – 2013. The experimental design was the method of Latin square with trial plot size 50m^2 in four replications. The treatments were as follows: N_0P_0; N_0P_{80}; N_0P_{120}; N_0P_{160}; $N_{120}P_{80}$; $N_{120}P_{120}$; $N_{120}P_{160}$. Nitrogen fertilization as NH_4NO_3 was applied early spring. The phosphorus fertilization was applied before sowing as triple superphosphate. The soil type of experimental field was Eutric vertisols. Weather conditions during the studied period 2011 – 2013 were different as a temperature and rainfall each year.

It was established that productivity of aboveground biomass and grain was two-fold higher in fertilizing systems with applied N_{120} and phosphorus rates of 80 - 120 kg P_2O_5.ha^{-1}, compared to the systems with no phosphorus fertilizing. Uptake efficiency of nitrogen and phosphorus or total uptake of these nutrients in aboveground dry mass at maturity, similar to wheat productivity, was higher in systems fertilized with nitrogen. The uptake of nitrogen was in the range 52.5 – 166 kg N.ha^{-1}, and phosphorus uptake – 22.5 - 77.4 kg P_2O_5.ha^{-1}, in average for the period. The highest expense of nitrogen for 100 kg grain formation was established in fertilizing system $N_{120}P_{120}$ – 3.84 kg N. The expense of phosphorus for 100 kg grain formation increased in parallel with applied phosphorus rate and did not depend of nitrogen fertilizing. The highest value was observed in systems with applied high phosphorus rate of $P_{160.}$ Nitrogen utilization efficiency for biomass and grain production in durum wheat was the lowest in fertilizing system $N_{120}P_{120}$, and the lowest phosphorus utilization efficiency was obtained in fertilizing treatment $N_{120}P_{160}$.

Key words: *durum wheat, nitrogen, phosphorus, efficiency*

Introduction

Durum wheat needs nitrogen during all vegetation period. For the formation of 100 kg grain durum wheat uptaked 3.0 – 3.7 kg nitrogen. Nitrogen fertilization should be well balanced with phosphorus and potassium in the soil and provide the necessary amounts to formation of the planned yields, included nitrogen losses (Lalev at. al., 1995).

For the fertilization of durum wheat in the region of Chirpan was established, that for formation of 100 kg grain at fertilization rates from 60 to 180 kg.ha^{-1} was uptaked 3.05 to 4.37 kg N, 1.2 – 1.5 kg P_2O_5 and 1.7 – 2.4 kg K_2O (Panayotova, 2005).

Bauer et al. (1987) indicated, that the various phosphate availability and fertilization affect the percentage of phosphorus in plants and phosphorus uptake with the aboveground biomass. Quantity and quality of durum wheat grain were formed during all vegetation period and depends on the genetics of the variety, agro-ecological conditions and farming technology (Dekov et. al., 1989). Laconde et. al. (1993) indicated that durum wheat averaged demand to

phosphorus, and according to Schulthess et al. (1993) the content of phosphorus was preferably genetics. According to Miller et al. (1994) ripening stage in the grain was concentrated over 78% of total phosphorus.

The aim of this study was to investigate uptake and utilization efficiency of nitrogen and phosphorus in various systems of combined nitrogen-phosphorus fertilization in durum wheat variety Progress.

Materials and methods

The investigation was studied under conditions of long term fertilizing experiment. The standard variety „Progress", selected in Institute of field crops – Chirpan town, Bulgaria was grown in two field crops rotation cotton – durum wheat under rain conditions for the period of three vegetations including years 2011 – 2013. The experimental design was the method of Latin square with trial plot size $50 m^2$ in four replications. The treatments were as follows: N_0P_0; N_0P_{80}; N_0P_{120}; N_0P_{160}; $N_{120}P_{80}$; $N_{120}P_{120}$; $N_{120}P_{160}$. Nitrogen fertilization as NH_4NO_3 was applied early spring. The phosphorus fertilization was applied before sowing as triple superphosphate. The soil type of experimental field was Eutric vertisols.

Results and discussion

In the studied period 2011 - 2013 was established, that least nitrogen was uptaken from the soil with the aboveground biological yield of durum wheat cultivar Progress in the system without fertilization (control variant) – 52.5 kg.ha^{-1}. The uptake in the combined nitrogen-phosphorus systems (146.6 – 166.0 kg.ha^{-1}) proven exceed more than 2 times those in systems without nitrogen (61.3 – 70.4 kg.ha^{-1}). The uptake of nitrogen increased to fertilization rates $N_{120}P_{120}$ – 166.0 kg.ha^{-1}, and then in the high phosphoric rate 160 kg.ha^{-1} in cultivar Progress nitrogen uptake decreased by 13%, indicated that phosphorus affect positive for rational use of nitrogen by plants. The difference in uptake between combined nitrogen fertilization systems was not proven. (Fig. 1).

The phosphorus uptake for the vegetation period depends on the concentration of the element and formed biomass. It was established, that least phosphorus was uptaken from the soil with the aboveground biological yield of durum wheat cultivar Progress in the control variant (without fertilization) – 22.5 kg.ha^{-1}. In combined nitrogen-phosphorus fertilization the uptake values was (68.7 – 77.4 kg.ha^{-1}), as proven almost twice exceeds those in the systems with alone phosphorus fertilization (34.7 – 39.5 kg.ha^{-1}), which indicated that inclusion of nitrogen in the fertilization system increased the amount of uptaken phosphorus of durum wheat. The phosphorus uptake increased with increasing phosphorus rate and was highest in fertilization system $N_{120}P_{160}$ – 77.4 kg.ha^{-1}, but the difference between the combined nitrogen-phosphorus fertilization systems was unproved (Fig. 2).

The expense of nutrients, i.e. kilograms active substance nitrogen (N) and phosphorus (P_2O_5) to formation of 100 kg main production of wheat grain was usually within the range 2,5 - 3,5 kg N; 0,8 - 1,5 kg P_2O_5 (Gorbanov, 2010; Nikolova and Yordanova, 2000), which corresponds with the results of the present study.

The average results for three-year experimental period indicated, that the expense of nitrogen to formation of 100 kg durum wheat grain in the fertilization systems was proven highest in the combined fertilization $N_{120}P_{120}$ - 3,84 kg and exceeded those of the high phosphorous rate 180 kg.ha^{-1}combined with N_{120} by 7%, and the difference with the control variant was 37% (Fig. 3).
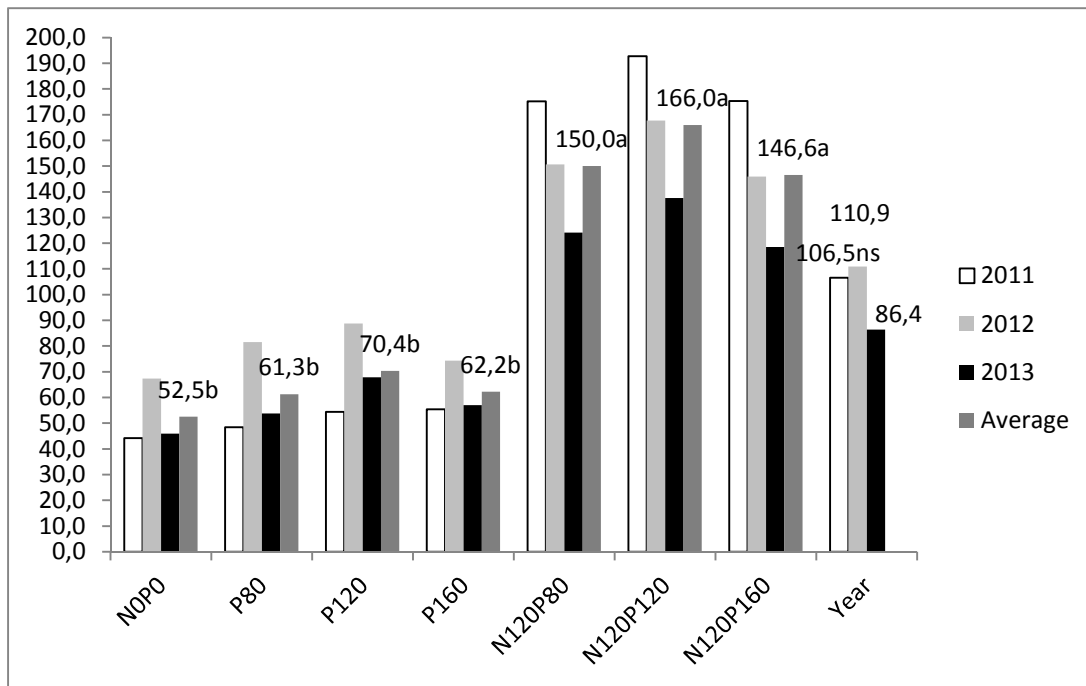
Figure 1. Nitrogen uptake in grain+straw (kg.ha^{-1}) in cultivar Progress depends on the fertilization system
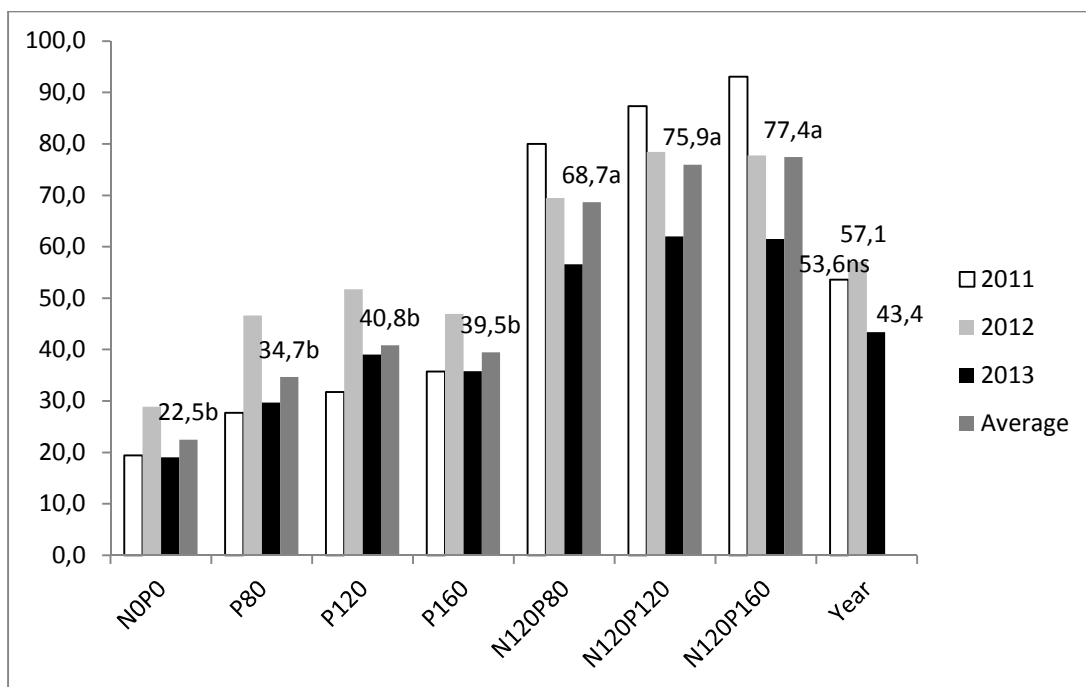
Figure 2. Phosphorus uptake in grain+straw (kg.ha^{-1}) in cultivar Progress depends on the fertilization system
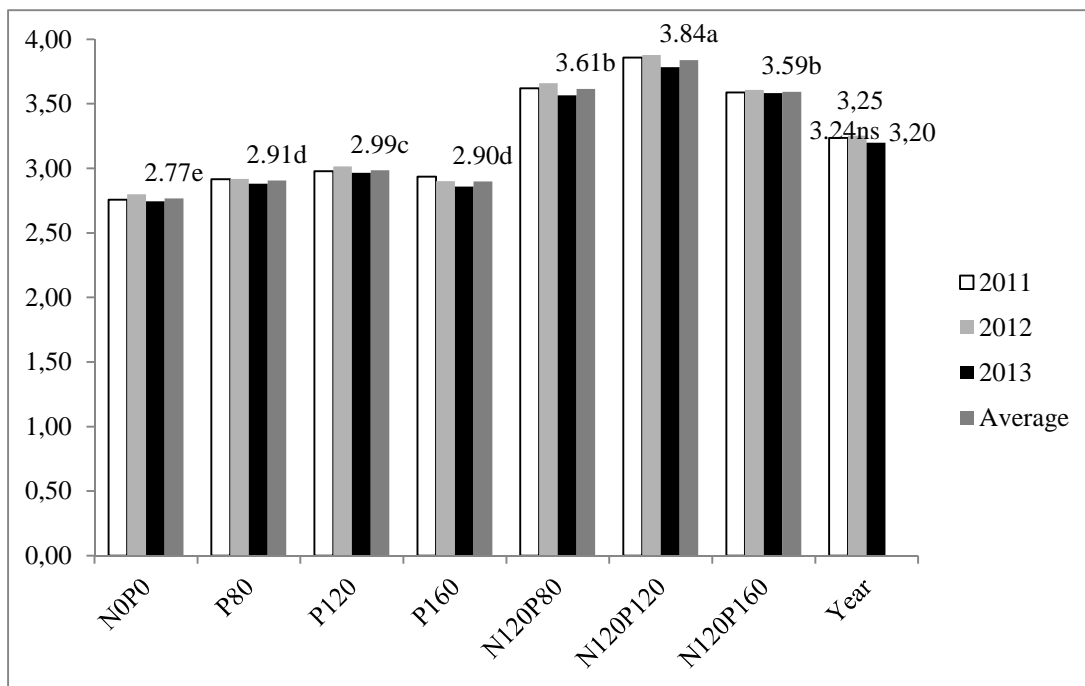
Figure 3. xpense of nitrogen (kg N for the formation of 100 kg grain) in cultivar Progress depends of the fertilization system
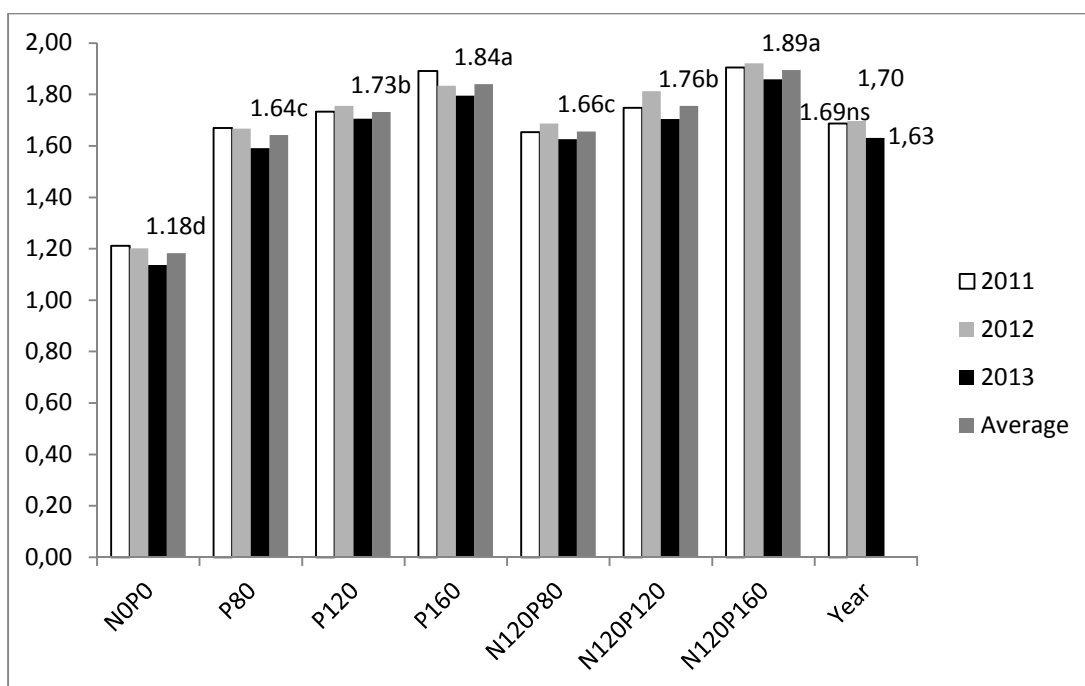
Figure 4. xpense of phosphorus (kg N for the formation of 100 kg grain) in cultivar Progress depends of the fertilization system

The expense of phosphorus in durum wheat cultivar Progress increased with increasing phosphorus fertilization rates for all fertilization systems as the highest expense was in combined nitrogen-phosphorus fertilization rate $N_{120}P_{160}$ - 1,89 kg, proven exceed the expense of control variant (without fertilization) by 60%. With the increasing phosphorus fertilization rates the expense of formation for 100 kg durum wheat grain increased, and when input the

nitrogen into the fertilization system and the differences was minimal and unproved, which indicated that the nitrogen was not affect the expense of phosphorus (Fig. 4).

Conclusion

It was established that productivity of aboveground biomass and grain was two-fold higher in fertilizing systems with applied N_{120} and phosphorus rates of 80 - 120 kg P_2O_5.ha^{-1}, compared to the systems with no phosphorus fertilizing.

Uptake efficiency of nitrogen and phosphorus or total uptake of these nutrients in aboveground dry mass at maturity, similar to wheat productivity, was higher in systems fertilized with nitrogen.

The uptake of nitrogen was in the range 52.5 – 166 kg N.ha^{-1}, and phosphorus uptake – 22.5 - 77.4 kg P_2O_5.ha^{-1}, in average for the period.

The highest expense of nitrogen for 100 kg grain formation was established in fertilizing system $N_{120}P_{120}$ – 3.84 kg N.

The expense of phosphorus for 100 kg grain formation increased in parallel with applied phosphorus rate and did not depend of nitrogen fertilizing.

The highest value was observed in systems with applied high phosphorus rate of $P_{160.}$ Nitrogen utilization efficiency for biomass and grain production in durum wheat was the lowest in fertilizing system $N_{120}P_{120}$, and the lowest phosphorus utilization efficiency was obtained in fertilizing treatment $N_{120}P_{160}$.

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IMPACT OF LIMING WITH FERTDOLOMITE ON GRAIN YIELD OF FIELD CROPS

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Abstract

The stationary field experiment was conducted in spring of 2004 on Pavlovac (Bjelovar-Bilogora County-Croatia) very acid soil (pH in 1n KCl = 3.80) by the application of NPK 10:30:20 fertilizer as follows (kg ha^{-1}): a = 0 (the conventional fertilization); b = a + 416; c =1249; d = 2028; e = 2916; f = 3748. Differences of N amounts added by fertdolomite were equalized by CAN (calcium ammonium nitrate: 27% N). The experiment was conducted in four replicates and the basic plot size was 77 m^2. Two replicates of the experiment was limed in autumn of 2007 by granulated fertdolomite (24.0 % CaO + 16.0 % MgO + 3.0 % N + 2.5 % P$_2$O$_5$ + 3.0 % K$_2$O) in amount 10 t ha^{-1}. Two subplots from each replicates were harvested in order to obtain four replicates of grain yield data for each treatment. In this study was shown survey grain yield of field crops grown in rotation for 5–year period 2008–2012 (maize – maize – soybean – maize – winter wheat). Mean yields of the field crops in the experiment were as follows (t/ha): 11.64, 10.70 and 9.02 (maize 2008, 2009 and 2011, respectively), 3.57 (soybean 2010) and 7.59 (wheat 2012). Response to liming was depended on the growing season (year effect) and field crop. As affected by liming, yields of maize were significantly increased for 5% (2008 and 2009) and for 8% (2011). Also, yields of wheat were similar for unlimed and limed plots in 2012 (7.64 and 7.54 t/ha, respectively). However, soybean responded to liming in 2010 by yield increases for 18% (3.28 and 3.85 t/ha, respectively).

Key words: *liming, grain yield, maize, wheat, soybean*

Introduction

Increase of crop production is present in numerous countries over the world which raises need for arable land. Maximum yields of field crops are possible only when producers meet plant nutritional requirements and other basic production factors. For decades, one of the most common constraint of low soil fertility is soil acidity. Soil acidity is global problem because of estimation that acid soils occupy about 30% (3.95 b ha) of the world's ice-free land area (von Uexkull and Mutert, 1995). Crop production systems undergo accelerated soil acidification as a consequence of anthropogenic inputs and outputs. Plant growth-limiting factors in acid soils include deficiencies (N, P, Ca, Mg, Mo, Zn) and toxicities (Al, Mn, Fe, H) of elements. Acid soils are widespread in Croatia and they cover 831.704 ha, representing about 32% of total agricultural land (Mesic et al., 2009).

Increase in pH, cation exchange capacity and base saturation were expected to improve vitality and growth of crops. Thus, liming, the application of calcitic materials to soil, is increasingly used in acidic soils and represents general recommendation for short-term and long-term improvement of acid soil fertility (Mesic, 2001; Rengel, 2003). Liming improves the characteristics of soil through its direct effect on the amelioration of soil acidity and through its indirect effects on the mobilisation of plant nutrients and promote humus decomposition. Various materials may be applied for acidity correction, as long as the product is constituted by neutralizing components such as calcium and/or magnesium oxides,

hydroxides, carbonates and silicates (Castro and Crusciol, 2013). Costa and Rosolem (2007) reported that lime application, as an investment in soil productivity, lasts about three growing seasons, but there are findings that benefit of liming can have subsequent effects (Caires et al., 2008; Kovacevic et al., 2012).

According to Statistical Yearbook of the Republic of Croatia (2013) in 5-year period from 2008 to 2012 average total arable land in Croatia is 882 752 ha of which wheat, maize and soybean sown area occupies 19%, 34% and 6%, respectively of total arable land with average yield of 5 t ha^{-1}, 6 t ha^{-1} and 3 t ha^{-1}, respectively.

Aim of this study was testing effects of liming by dolomite enriched with nitrogen, phosphorus and potassium (commercial name fertdolomite) on yields of maize, soybean and wheat under stationary field experiment conditions.

Material and methods

The stationary field experiment was conducted in spring of 2004 on Pavlovac (Bjelovar-Bilogora County-Croatia) very acid soil (pH in 1n KCl = 3.80) by the application of NPK 10:30:20 fertilizer as follows (kg ha^{-1}): a = 0 (the conventional fertilization); b = a + 416; c =1249; d = 2028; e = 2916; f = 3748. The experiment was conducted in four replicates and the basic plot size was 77 m^2. The applied methods, weather characteristics and results of the first four years of the experiment were shown in detail by the previous studies (Kovacevic et al., 2006; Rastija et al., 2006).

Two replicates of the experiment was limed in autumn of 2007 by granulated fertdolomite (24.0 % CaO + 16.0 % MgO + 3.0 % N + 2.5 % P_2O_5 + 3.0 % K_2O) in amount 10 t ha^{-1}. Two subplots from each replicates were harvested for receiving four replicates of grain yield data for each treatment.

Soil and weather characteristics, methods of experimentation and the results were in details elaborated by the previous studies (Kovacevic et al., 2011; Iljkic et al., 2013; Josipovic et al., 2013; Stojic et al., 2014).

Results and discussion

In general, a positive response of maize, soybean and wheat to lime is expected. In the 5-year period from 2008 to 2012 maize was grown in three growing seasons and average yields in the experiment were in range from 9.02 (2011) to 11.64 (2008) t ha^{-1}.

Table 1. Response of the field crops to liming

Fertdolomite (autumn 2007)	Grain yield (t ha^{-1})* in 5–year period 2008 – 2012				
	2008	2009	2010	2011	2012
	Maize	Maize	Soybean	Maize	Wheat
0 (control)	11.36	10.40	3.28	8.67	7.64
10 t ha^{-1}	11.92	11.00	3.85	9.38	7.54
LSD 0.05	*0.27*	*0.47*	*0.21*	*0.57*	*ns*
Average yield	11.64	10.70	3.6	9.0	7.6
Liming effect	+ 4.9%	+ 5.8%	+ 17.4%	+ 8.2%	0
* averages of five PK-fertilization and four replicates (20 individual results)					

Response to liming was depended on the growing season (year effect) and field crop. As affected by liming, yields of maize were significantly increased about 5% (2008 and 2009) and 8% (2011). Also, wheat yield were quite similar for unlimed and limed plots in 2012. However, soybean responded to liming in 2010 by increase yield for about 18% (Table 1).

In general, legumes are known to be more responsive to liming than other crops (Soon and Arshad, 2005). Soil acidity results with lower occupancy of root nodules and there is less

potential for N_2 fixation than those in limed soil (Stevovic, et al., 2010; Yanjun et al., 2010; Milakovic et al., 2012).

Liming is known to positively influence Ca and Mg nutrition in soybean and maize yield due to better development of the root system (Caires et al., 2008). Increasing the pH of acid soils by liming resulted in increased N mineralization, which have a positive effect on field crops yield. Even though, response of maize to liming was mainly moderate probably because of the other limitation of the soil fertility, for example unregulated air–water relations and low humus contents.

Weather characteristics, particularly precipitation quantity and distribution as well as temperature regime during growing season, have important impact of field crop yields, but adequate fertilization stabilizing yield differences among years. In general, the lower yields of maize are in close connection with drought and high air temperature stress (Kovacevic and Rastija, 2010; Komljenovic et al., 2010; Andric et al., 2012; Kovacevic et al., 2012; Stojic et al., 2012; Rastija et al., 2012; Videnovic et al., 2013). Antunovic et al. (2012) reported that in unfavorable weather conditions (water shortage followed by higher air–temperatures) nutrient supply can fade which result in lower soybean yield (2.4 t ha^{-1}).

Caires et al. (2008) reported that applying lime material (dolomitic lime, 176 g kg^{-1} Ca and 136 g kg^{-1} Mg) did not have significant influence on maize and soybean yield, whereas wheat yield increase for 115% as compared to the control. In 3-year experiment Costa and Rosolem (2007) use lime rates (199 g kg^{-1} of Ca, 138 g kg^{-1} of Mg), ranging from 0.0 to 9.0 t ha^{-1}, of which 4.5 t ha^{-1} lime in 1st year of the experiment resulted with higher yield of soybean (cultivar Embrapa 58) for 36% and wheat (cultivar Iapar 29) for 13%, as compared to no limed treatment. In spite of the fact that benefit of liming can have a positive long-term effects on field crops, in our study five years after fertdolomite application, wheat yield was not affected by lime application.

Conclussion

Liming with fertdolomite had different effects on grain yields depending on the growing season and field crop. In general, these effects were mainly moderate probably because of the other limitation of the soil fertility, for example, non–regulated air–water relations, low humus contents etc. Furthermore, in unfavorable weather conditions like lack of rainfall followed by higher air–temperatures real benefit of liming can fade.

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EFFECT OF INTEGRATED MINERAL AND ORGANIC NITROGEN APPLICATIONS ON CROP PERFORMANCE

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Abstract

Field experiments were conducted to evaluate the effects of integrated organic and mineral fertilization through drip irrigation (fertigation) on nitrogen and water use efficiencies by maize and bean grown on a sandy soil. Fertilization treatments: (a) 120 kg N/fed and 20 kg N/ fed for maize and bean respectively were applied to the soil through fertigation either in 100% mineral form (ammonium nitrate), 100% organic form (Chicken manure extract) or mixtures of organic and mineral fertilizers by the proportions: 75% mineral + 25 % organic; 50 % mineral + 50% organic and 25 % mineral + 75 % organic. (b) The same fertilization treatments as in (a) plus a supplement addition of 50 L/ fed of humic substances (Hu). Increasing the mineral content in fertilizer mixtures had a positive effect on the yield of both maize and bean. The highest yield was realized with the plants that received the fertilizer mixture 75% mineral + 25 % organic. Addition of Hu with the 100% mineral fertilization further increased the yield of the two crops. Nitrogen use efficiency (NUE expressed as kg yield/kg N) increased with increasing the mineral content in the fertilizer mixtures. Highest values were realized with the plants that received the fertilizer mixture 75 % mineral + 25 % organic. Increasing the mineral content in fertilizer mixtures had a positive effect on values of irrigation water use efficiency (WUE expressed as kg yield/m^3 water) recording 0.76 kg/ m^3 and 0.79 kg/ m^3 for maize grain and bean seeds respectively; both were realized with the plants that received the fertilizer mixture 75% mineral + 25% organic.

Keywords: *fertigation; maize; nitrogen; water use efficiency*

Introduction

Due to the limitation of further expansion of irrigated land in most countries, a large part of the future food requirements will need to be covered by a more efficient use of irrigation water and fertilizers. One of the most important challenges facing sustainable agriculture is to provide crops with an optimal quantity of water and nutrients throughout the growing season in the most efficient manner possible. Fertigation is considered the best answer to this challenge, whereby both water and fertilizers are delivered to crops simultaneously through the irrigation system. Scheduling fertilizer applications on the basis of needs reduces nutrient losses compared to conventional application methods that depend on the soil as a reservoir for nutrients. The method of fertilizer application also improves the use efficiency of nutrients (Zotarelli et al. 2009). Well-balanced fertigation program will satisfy the exact needs of the plant as they change along the season, increase efficient use of water and fertilizers, increase yield, protect the environment and sustain irrigated agriculture.
The fertigation technique is used mainly with N, P and K mineral fertilizers, whereas, little data have been reported concerning the fertigation using organic fertilizers.
Therefore, the present investigation was conducted to study the effect of fertigation involving mineral and organic fertilizers applied through drip irrigation on growth, yield and yield quality of maize and bean plants cultivated in a sandy soil.

Materials and Methods

The experimental part of this work aimed principally at evaluating the effects of integrated organic and mineral fertilization through irrigation (fertigation) on different crops cultivated in a virgin sandy soil.

Grains of maize and seeds of faba bean were obtained from the Field Crops Research Institute, A.R.C, Ministry of Agriculture, Giza, Egypt; seeds of faba bean were inoculated with the proper rhizobia before sowing. Drip irrigation system with fertilizer distribution equipment was used. Emitter discharge was 1.6 Lh^{-1} at 1.0 bar operating pressure and 30 cm spacing between emitters. Calculated irrigation water requirements were 2860 m^3 fed^{-1} for maize and 1425 m^3 fed^{-1} for faba bean (fed = 4200 m^2).

 Fertilization:

1) Control treatment: soil without any fertilizer added to the soil through fertigation.

2) Fertilizers added to the soil through fertigation:

a) Mineral fertilizer (120 kg N/fed) for maize (250 kg/fed 20 : 20 : 20 fertilizer + 210 kg/ fed ammonium nitrate 33.5% N) and 20kg N/fed for faba bean (100 kg fed^{-1} 20 :20 :20 fertilizer).

 b) Organic fertilizer - chicken manure extract (100% ChM) at the rate of 120 kg N/ fed^{-1} for maize and 20 kg N fed^{-1} for faba bean.

 c) Mixtures of chicken manure extract and the mineral fertilizers by the following ratios:

 75% ChM + 25 % NPK ; 50% ChM + 50 % NPK; 25 % ChM + 75 % NPK

d) The same fertilization treatments in (c) + 50 L fed^{-1} of humic substances.

Results and Discussion

Integrated fertilizer application through irrigation affected positively the vegetative characteristics of both maize and bean plants. Fertigation with different combinations of NPK+ChM mixtures plus holmic substances produced more vigorous shoots compared to the corresponding combinations without holmic substances. These results are in accordance with those of Medina et al. (2004); Singer et al. (2004). Abd-El Mageed et al. (2006) and Roy et al. (2006).

Yield and yield attributes

Integrated mineral/organic fertigation positively affected the yield of maize and bean with different magnitude. Increasing the mineral content in fertilizer mixtures had a positive effect on the yield of both maize and bean, where the higher yield was realized with the plants that received the fertilizer mixture 3/4 mineral + 1/4 organic. Addition of Hu with the fertilization treatment NPK 100% in mineral form further increased the yield of the two crops. Combinations of mineral/organic fertigation had positive effects on maize straw and grains and also on bean straw and seeds. Increasing the mineral content in fertilizer mixtures had a positive effect on the grain yield of maize, where the higher yield was realized with the plants that received the fertilizer mixture 3/4 NPK + 1/4 ChM. The effect of addition of Hu was less evident. However, with increasing the proportion of the mineral content in the fertilization dose, a positive but not significant effect was noticed due to the addition of Hu with the mixture. Ertan (2007) studied the effect of foliar and soil fertilization with humic acid on tomato and found that both foliar and soil HA treatments positively affected fruit characteristics including fruit diameter, fruit height, mean fruit weight and fruit number per plant. According to Selim *et al.* (2009), application of humic substances through drip irrigation enhanced potato tubers yield, starch content and total soluble solids. Taha *et al.* (2006) concluded that humic substances gave the highest values of available nutrients, yield and nutrient uptake by wheat plant grown on different Egyptian sandy soils.

Humic substances have been shown to increase the uptake of nitrogen by plants, and to increase soil nitrogen utilization efficiency (Yusuf et al. 2009). It can also enhance the uptake of potassium, calcium, magnesium and phosphorus (Arancon *et al.* 2006).

Water and nitrogen use efficiency

Increasing the mineral content in fertilizer mixtures had a positive effect on the value of water use efficiency (WUE). The highest values were realized with the plants that received the fertilizer mixture 3/4 NPK + 1/4 ChM. Addition of Hu with the fertilization treatment NPK 100% in mineral form had insignificant effect on values of water use efficiency of both maize and bean plants. El-Gindy and Abdel Aziz (2003) reported that the highest value of WUE was (1.3 kg/m^3) for corn crop under drip irrigation system. The drip irrigation saved about 20.3% from water requirement compared to sprinkler irrigation system. Zotarelli et al. (2009) evaluated the interaction between N-fertilizer rates and irrigation scheduling on yield and irrigation water use efficiency (IWUE). The surface drip irrigation treatment required 15-51% less water when compared to conventional treatments.

Also, increasing the mineral content in fertilizer mixtures had a positive effect on the values of nitrogen use efficiency (NUE). The highest value for maize grain yield (17.9 kg kg^{-1}N),

Table 1: Water use efficiency (Kg/m^3) by maize and bean

Treatments	Maize			Bean		
	Biomass	Straw	grains	Biomass	Straw	grains
Control	1.665	1.399	0.266	1.576	1.282	0.294
NPK	3.325	2.662	0.663	2.675	2.062	0.613
3/4NPK + 1/4ChM	3.665	2.956	0.709	3.230	2.527	0.703
1/2NPK + 1/2ChM	3.324	2.679	0.645	2.870	2.114	0.756
1/4NPK + 3/4ChM	3.240	2.641	0.599	2.804	2.204	0.600
ChM	2.815	2.259	0.556	2.420	1.807	0.613
NPK + Hu	3.394	2.728	0.666	2.702	2.090	0.612
3/4NPK + 1/4ChM + Hu	3.846	3.088	0.758	2.992	2.204	0.788
1/2NPK + 1/2ChM + Hu	3.410	2.784	0.626	2.831	2.175	0.656
1/4NPK + 3/4ChM + Hu	3.281	2.643	0.638	2.529	2.000	0.529
ChM + Hu	3.225	2.642	0.583	2.478	1.924	0.554

Table 2: Nitrogen use efficiency (Kg kg^{-1}N) by maize and bean

Treatments	Maize			Bean		
	Biomass	Straw	grains	Biomass	Straw	Grains
Control	-	-	-	-	-	-
NPK	79.233	63.433	15.800	190.700	147.00	43.700
3/4NPK + 1/4ChM	87.350	70.458	16.892	230.350	180.200	50.150
1/2NPK + 1/2ChM	79.217	63.842	15.375	204.650	150.750	53.900
1/4NPK + 3/4ChM	77.192	62.925	14.267	199.900	157.150	42.750
ChM	67.108	53.850	13.258	170.850	128.850	42.000
NPK + Hu	80.185	64.447	15.738	183.081	141.601	41.480
3/4NPK + 1/4ChM + Hu	90.876	72.965	17.911	202.707	149.347	53.360
1/2NPK + 1/2ChM +	80.565	65.785	14.780	191.828	147.398	44.430

Hu						
1/4NPK + 3/4ChM + Hu	77.527	62.456	15.071	171.344	135.424	35.920
ChM + Hu	76.195	62.415	13.780	167.927	130.387	37.540

and for bean seed yield (53.4 kg kg^{-1}N) was realized with the plants that received the fertilizer mixture 3/4 NPK + 1/4 Ch.M. Addition of Hu with the fertilization treatment NPK 100% in mineral form had insignificant effect on values of water use efficiency of both maize and bean plants. Neilsen et al., (2002) and Neilsen and Neilsen (2006) showed that scheduling of irrigation with fertigation in high density apple orchards improved the efficiency of fertilizer used by 10 to 38 percent. In this respect, Thomas et al. (2003), with cauliflower and broccoli grown on sandy loam or finer soils and fertigated through subsurface drip irrigation concluded that yield and quality, N uptake in the above ground biomass and N use efficiency were significantly affected. The nutrient-uptake efficiency with mineral-nutrient applications through the irrigation stream, according to (Mustafa et al., 2006 , Akimasa and Uehara 2007) ,was increased substantially.

Conclusion

It has been established that integrated mineral and organic fertilization through irrigation (fertigation) increased the measured vegetative growth parameters, yield, nutritional status and both water and nitrogen use efficiency by maize and faba bean plants compared to sole application. Positive effects were recorded using mixtures of different organic and mineral proportions. Therefore, it is recommended to apply the fertilizer as mixture of the two forms taking into consideration the soil type, the irrigation system under use and also the economical factor.

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THE EFFECT OF PLANT DENSITIES AND PLANT ORIENTATION ON YIELD AND YIELD COMPONENTS IN WHEAT CULTIVARS

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Abstract

In order to study the effect of plant density and plant orientation on yield and yield components in wheat cultivar, a factorial experiment was conducted based on randomized complete block design with three replications in research field of Gonbadkavus University in 2012. The treatments were included plant orientation (north-south, east-west, northeast-southwest and northwest-southeast), plant densities (250, 300 and 350 plant per square meter) and two cultivars (Koohdasht and line 17). The results of variance analysis indicated that the effect of density, orientation, cultivar and their interaction on number grain per square meter, thousand grain weight were significant at levels of %1 and %5, but these treatments on grain yield, biological yield and harvest index were not significantly affected. The effect of plant orientation and cultivar on grain number per spikelet and spike was significant at %1. An interaction of plant orientation, plant density and cultivar on thousand grain weight was significantly at %5. In the plant density of 350 plants per square meter the orientation of east-west and the cultivar of koohdasht had the highest number grain per square meter, number grain per spikelet and thousand grain weight.

Key words: *cultivar, density, plant orientation, wheat.*

Introduction

Wheat is one of the key strategic products. Economists believe that the increase in wheat production leads to independent on other countries; because it has essential role in providing food for people (Sarmadnia and Koochaki, 1987). Murinnen (2006) believe the progresses that has been made in recent decades can be indicated the factors affecting genetic improvement of cultivars and be effective in future genetic improvements. Wang (2010) attributed yield components of wheat multiplied by the number of spike, number of grain per spike and grain weight. Naseri et al (2012) conducted an experiment on three cultivar of wheat and they showed that cultivars had significant effect on yield, number of spike per square meter and grain number in spike. Plant density affected on all cultivars so that in density of 400 plant per square meter compare to densities of 300 and 350 plant per square meter; were obtained highest number of spike per square meter, grain number in spike and harvest index. Alavi and Shamsedin saiid (2008) conducted an experiment on sorghum and reported that the effect of plant orientation was significant because it absorbs more light on the north-south direction and also the effect of density on grain yield was significant at level of %1. Osman (1992) evaluated the effect of row space and plant orientation on barley and stated that plant orientation had little effect on yield, yield components and light interception. The aim of this study was to evaluate the effect of plant density on yield and yield

components in different plant orientation to determine the best cultivar and density with the most suitable plant orientation to achieve maximum yield.

Material and methods

This experiment was conducted in crop year 2012-2013 at research field of Gonbad kavus university located at latitude 37 degree and 16 minute north and longitude 55 and 12 minute east and the height of sea level was 45 meters. This experiment was conducted in factorial based on randomized compelet block design with three replications. The treatments consisted of two wheat cultivars (Kouhdasht and line 17) with four plant orientations (North-South, East-West, Northest-Southwest and Northwest- Southeast) and three plant densities of 250, 300 and 350 plants per square meter. The bed was Prepared by plowing in early fall and second disk was done before conducting the experiment. The experiment was rainfed and during the test, diseases, pests and weeds were controlled. In order to measure characteristics at physiological maturity stage 20 spikes from each plot were randomly selected and yield components (panicle length, number of fertile and infertile spikelet, grain number, number grain per spike, biological yield and harvest index) were measured. Removing borders, number length of harvest lines were noted for measuring of yield, dry weight was weighed by sensitive scale with an accuracy of 0.01g. The analyze of traits in this study were performed by using Excel and SAS software and average comparisons were conducted with LSD test at 0.05 level of probability.

Result and discussion

The results of the analysis of variance showed that the main effect of plant density, plant orientation, cultivar and their interaction on number grain per square meter and thousand grain weight were significant at 0.01 and 0.05 levels of probability respectively. But these treatments had no significant effect on grain yield, biological yield and harvest index (table1). The results were consistent with mozafari et al (2006) and were inconsistent with moradi et al (2012). Interaction of plant density and plant orientation on grain number per spikelet and grain number per spike was significant (table 3). Hozayn et al (2012) and Catrine et al (2010) likewise (also) reported similar results. The significant effect of treatments interaction shows that the differences between each treatment levels depends on other treatments levels. The interaction effects (orientation, density and cultivar) slicing shows that grain number per square meter in 250 (pd1), 300 (pd2) and 350 (pd3) densities were significant (table 3).

Table 1.varaiance analysis of yield and yield components in density, planting orientation and wheat cultivars									
Changes sources	Freedom degree	Grain number	Grain number per spikelet	Grain number per spike	Flowered spikelet per spike	Thousand grain yield	Grain yield	Biological yield	Harvest index
Replication	2	22693.06^{ns}	0.01^{ns}	1.63^{ns}	1.01^{ns}	16.43^{ns}	32347.53**	59510.59^{ns}	29.19^{ns}
Orientation	3	76434.72**	0.22^{ns}	27.09**	1.21^{ns}	14.02^{ns}	1876.84^{ns}	7609.33^{ns}	11.74ns
Density	2	60088.89**	0.04^{ns}	8.89^{ns}	1.23^{ns}	17.85^{ns}	11512.83^{ns}	29888.21^{ns}	9.39^{ns}
Cultivar	1	74112.50**	0.52**	85.59**	0.13^{ns}	211.94**	18018.35*	21889.99^{ns}	20.14^{ns}
Cultivar × orientation	3	38845.83**	0.06^{ns}	11.04^{ns}	0.01^{ns}	12.99^{ns}	7247.06^{ns}	9048.98^{ns}	15.60^{ns}
Density × orientation	6	625533.33**	0.06^{ns}	16.20*	1.18^{ns}	21.59^{ns}	4820.39^{ns}	37795.40^{ns}	7.76^{ns}
Density × cultivar	2	118516.67**	0.18**	46.72**	0.78^{ns}	10.75^{ns}	6365.66^{ns}	27417.55^{ns}	2.03^{ns}
A * b* c	6	60994.144**	0.03^{ns}	3.24^{ns}	0.89^{ns}	26.54*	4536.89^{ns}	8894.24^{ns}	7.82^{ns}
Error	46	7698.85	0.03	5.89	0.61	10.94	3731.45	23743.28	10.51
Cv	-	9.52	7.61	7.06	5.30	11.22	10.17	8.90	9.33
Cv	-	9.52	7.61	7.06	5.30	11.22	10.17	8.90	9.33
^{ns}- No significant difference, *- significant difference at 0.05 level, **- significant difference at 0.01 level									

In Pd_1, the northwest-southeast plant orientation and line 17 were the best. In Pd_2 the best orientation and cultivar were northeast-southwest and line 17 respectively, and in density of Pd_3, grain number per square meter in east-west orientation and kouhdasht cultivar was the highest; these orientation and cultivar had the maximum thousand grain weight in Pd_1 but in the other densities was not observed difference in thousand grain weight. Cutting (slicing) physical of interaction between cultivar and density showed that kouhdasht cultivar produce highest number of grain per spikelet and grain number per spike in Pd_1 and Pd_2 densities but there was not any different between these traits in Pd_2 density. Slicing (Cutting) physical of interaction for plant density and orientation showed that north-south direction had maximum grain number per spike in Pd_3 density and in other densities was not observed different between plant orientations in this trait.

Conclusion

Generally the orientation of sowing effects on yield and some characteristics of plant in result of better light absorption.

Table2- slicing of interaction: sum of squares of orientation and cultivars at density levels

Density levels	Freedom degree	Grain number (m^2)	1000grain weight (gr.)
1	7	991029^{***}	335.51^{***}
2	7	378096^{***}	153.74^{ns}
3	7	329029^{***}	113.98^{ns}

slicing of interaction: sum of squares of cultivars in density levels

Density levels	Freedom degree	Grain number in spikelet (m^2)	Grain number in spike (m^2)
1	1	0.24^{***}	86.45^{***}
2	1	0.001^{ns}	6.51^{ns}
3	1	0.64^{***}	86.07^{***}

slicing of interaction: sum of squares of orientation in density levels

Density levels	Freedom degree	Grain number in spike (m^2)
1	3	28.93^{ns}
2	3	29.25^{ns}
3	3	120.26^{***}

Table3- mean comparison of grain number per square meter and 1000 grain weight at cultivars and orientation in density

density	orientation	cultivar	Grain number (m^2)	1000grain weight (gr.)
1	1	1	786.67^{h}	27.26^{defg}
1	1	2	876.67^{efgh}	32.61^{abcd}

1	2	1	933.33^{defg}	24.08^{g}
1	2	2	946.67^{cdefg}	34.52^{ab}
1	3	1	1083.33^{bc}	25.18^{efg}
1	3	2	870^{tgh}	32.43^{bcd}
1	4	1	1473.33^{a}	28.49^{cdefg}
1	4	2	866.67^{gh}	25.10^{fg}
2	1	1	823.33^{gh}	32.47^{abcdef}
2	1	2	830^{fgh}	34.05^{abcd}
2	2	1	873.33^{defgh}	26.62^{g}
2	2	2	786.67^{h}	29.08^{defg}
2	3	1	1213.33^{a}	28.56^{efg}
2	3	2	843.33^{efgh}	32.23^{cdef}
2	4	1	873.33^{cdefgh}	27.80^{fg}
2	4	2	$900^{bcdefgh}$	32.42^{bcdef}
3	1	1	776.67^{h}	25.31^{g}
3	1	2	913.33^{cdefgh}	29.64^{bcdefg}
3	2	1	800^{fgh}	29.61^{cdefg}
3	2	2	1166.67^{a}	28.26^{efg}
3	3	1	870^{efgh}	29.35^{defg}
3	3	2	796.67^{gh}	33.65^{abcdef}
3	4	1	940^{bcdefg}	28.25^{fg}
3	4	2	880^{defgh}	$30.17^{abcdefg}$

Table3- mean comparison of grain number per square meter and 1000grain weight at cultivars and orientation in density

density	orientation	cultivar	Grain number(m2)	1000grain weight
1	1	1	786.67^{h}	27.26^{defg}
1	1	2	876.67^{efgh}	32.61^{abcd}
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1	2	2	946.67^{cdefg}	34.52^{ab}
1	3	1	1083.33^{bc}	25.18^{efg}
1	3	2	870^{tgh}	32.43^{bcd}
1	4	1	1473.33^{a}	28.49^{cdefg}
1	4	2	866.67^{gh}	25.10^{fg}
2	1	1	823.33^{gh}	32.47^{abcdef}
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2	4	2	$900^{bcdefgh}$	32.42^{bcdef}

3	1	1	776.67[h]	25.31[g]
3	1	2	913.33[cdefgh]	29.64[bcdefg]
3	2	1	800[fgh]	29.61[cdefg]
3	2	2	1166.67[a]	28.26[efg]
3	3	1	870[efgh]	29.35[defg]
3	3	2	796.67[gh]	33.65[abcdef]
3	4	1	940[bcdefg]	28.25[fg]
3	4	2	880[defgh]	30.17[abcdefg]

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OAT GRAIN YIELD VARIATIONS ASSOCIATED WITH PRODUCTIVITY PARAMETERS AMONG OAT CULTIVARS GROWN IN LATVIA

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Abstract

Common oat (*Avena sativa* L.) is an important field crop cultivated in temperate climate zone for green fodder and grains production as well. Oat sown area occupies 62.4 thousand hectares that is only 10.7 % from all cereals sown area in Latvia. The low oat productivity which is approximately two times lower comparing with winter wheat is the main reason in cereal choice. For farmers it is economically advantageous to cultivate more productive crop like wheat although oat with its biochemical structure and ways of usage is unique among other cereals. The aim of this research was to compare 19 oat cultivars by their yield and productivity parameters to demonstrate connections among them. Field trials were carried out at State Stende Cereals Breading Institute in the years 2012 and 2013. These two years in Latvia were significantly different in their temperature limits and precipitation. Results showed that significantly higher (p<0.01) yield was observed in 2013 due to favourable meteorological conditions. Although most part of productivity parameters were significantly (*p*<0.01) lower in 2013, but kernel size uniformity test and proportion of productive and unproductive stems was significantly (*p*<0.01) higher for all investigated cultivars. It can be concluded that the main yield formers after two year field trials can be grain size and proportion of productive and unproductive stems, which are closely dependent on meteorological conditions.

Key words: *oat, meteorological conditions, yield, productivity*

Introduction

Avena sativa (Linnaeus, 1753) or common oat is one of the major crops cultivated in temperate climate zones. It is used both for human and animal nutrition although nowadays about 70% of the produced oat yield is used mostly for animal feed (Sadiq Butt et. al. 2008). In Latvia oat sown areas takes approximately 10.7% from all cereal occupied territories. The total demand for oat in the world has decreased, because of the comparatively low yields – 2.1 t ha^{-1}, while winter wheat achieves 4.2 t ha^{-1} in Latvia in 2013. It makes farmers to choose for good high yielding cereal crops for making business. But comparing grain dietetic value and suitability to the production of functional foods oat is more frequently mentioned in scientific literature. With the development of the techniques of intensive management over crop production demands to oat varieties have changed considerably. Oat breeders through hybridization and selection have improved yielding ability potential of oat varieties, they have developed oat varieties dwarfed in length and more resistant to lodging (Zute et.al. 2010). On consumers' side lower standards are set forward regarding biochemical composition of grain: protein, lipids, β-glucan, starch amount in grain, though dietetic value of oats is just due to these traits (Wood, 1997).

Grain yield, test weight and thousand kernel weight are the most important economic traits mentioned by the oat consumers, because the end-product outcome is due to these traits when

processing oat grain. Grain productivity is dependent of agro-metrological conditions and individual variety potential (Zute et.al. 2010).

The aim of this research was to compare 19 oat cultivars by their yield and productivity parameters to demonstrate connections among them.

Materials and Methods

Field trial. The trial was carried out during 2012 – 2013 at State Stende Cereals Breeding Institute. 19 oat cultivars (int. al. four perspective lines from Latvian breeding program – '32659', '32986', '32584' and '33122') were used. The soil of the site was sod-podzolic, the humus content in 2012 and 2013 – 18 and 20 g kg^{-1}, the soil pH KCl – 6.2 and 6.6, the available for plants content of phosphorus P – 42 and 39 mg kg^{-1}, and that of potassium K – 59 and 53 mg kg^{-1}. The previous crop during both years of investigation was barley. All agronomic practices not specifically considered in this study were in accordance with the methods accepted for growing of this crop. Seed rate was 500 seeds per 1 m^2. Before cultivation of the soil a complex mineral fertilizer was applied: N – 51, P – 30, K – 42 kg ha^{-1}. Variants were arranged in four replications with a plot size 10 m^2 in a randomized block design. Sowing was completed on April 28 in 2012 and on May 3 in 2013.

Meteorology. The temperature and atmospheric precipitations provided perfect oat field germination in 2013 and 2012 and are represented in Figure 1. Precipitations exceeding long term average and sufficient mean daily temperatures in May and June provided good conditions for germination and tillering. Low sum of precipitation and mean daily temperature close to long term average in 2013 in July and August ripened oat grains and gave excellent yield, while in 2012 harvesting was delayed approximately by ten days because of heavy rainfalls at first decade of August. However strong wind gusts in both years through all vegetation period provided perfect conditions for stem lodging.
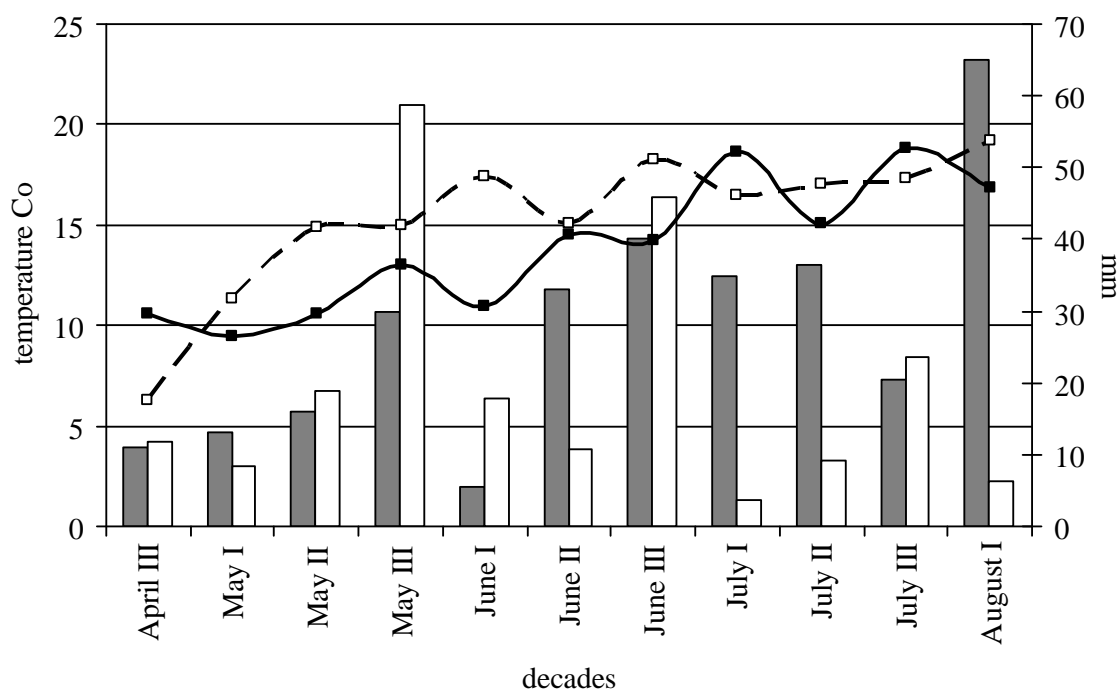
Figure 1. Meteorological data in the experimental period (Stende meteostation data, 2012, 2013)
– precipitation of 2012, mm;   – precipitation of 2013, mm; – – - mean daily temperature of 2012, °C; – – - mean daily temperature of 2013, °C.

Grain yield, grain yield components. Before harvesting there were taken bundle examples containing plants from 0.125 m^2 large areas from each cultivar and replication. All plants were counted and achieved amount of productive and unproductive tillers. 10 plants from each bundle were measured to receive plant and panicle height. Panicle was weighted and grains counted in it to receive grain count in panicle. Thousand kernel weight was detected by standard method LVS EN ISO 520:2011. Yield was measured from 10 m^2 plot in t ha^{-1}. The value of potential yield was calculated by formula:

$$R = \frac{V \times G \times M}{100000},$$

where   R – potential yield t ha^{-1};
                 V – number of panicles per 1 m^2;
                 G – number of grains per 1 panicle;
                 M – thousand kernel weight.

Mean samples from all replications (0.5 kg) were taken for testing kernel size fractions by separator machine SORTIMAT. Cleaned sample of 100 g to be weighed on a balance accurate to 0.01 g and then placed onto the top sieve. The sieving period was set from 3 minutes, recommended by producers. There were used sieves with diameter 2.5 and 2.2 mm. With a weighed batch of 100 g the percentage proportion is then obtained by weighing the individual fractions.

Statistic analysis. The obtained results were statistically processed by MS Excel program package using the methods of descriptive statistics; arithmetic mean value and standard division were calculated for each measured and calculated parameter. ANOVA procedures were used for data analysis. P-values less than 0.05 were considered to be statistically significant.

Results and Discussion

When processing the results, at first we need to speak about plants and tillers per m^2, describing the productivity of studied oats. Martynial (2008) and Deiss et. al., (2014) mentioned that productive tiller number of cereals is dependent on environmental conditions at tiller initiation and the subsequent stages until flowering. According, Spasova et al., 2013, number of plants, productive and unproductive tillers could be dependent on fertilization, growing system and agrometeorological conditions. In this study fertilization and growing system was similar in both years, in that reason attention was paid to meteorology in first growing stages tillering. Meteorological conditions in third decade of April and first and second decades of May in 2012 were favorable for oat germination. April and May were warm and wet, but comparing with year 2013 when soil was drier and temperatures lower. In that reason using similar seed rate – 500 seeds per 1 m^2 in both years; plants per m^2 in 2013 was only 82.7% of plant amount of 2012. As well as because of remarkable changes of atmospheric precipitation in 2012; the number of unproductive tillers was four times larger than in 2013 performed in Table 1.

Differences between years were observed significant for all tested cultivars at the level of p<0.01. Also differences among cultivars were significant as well (p<0.01). With largest number of plants per m^2 characterized cultivar 'Rajar' in 2012 (564 plants per m^2), but in 2013 it was 'Aveny' – 470 plants per m^2.

Number of productive tillers is only one parameter influencing grain yield. Calculated potential yield was grater comparing with actual yield in both years. It is correct, because potential yield is showing potential of cultivar, but can be affected by many conditions, including meteorology, losses during harvesting and agrotechnology. Although potential yield calculated in 2013 lower comparing with 2012, opposite actual yield represented in Table 2.

Table 1. Measured parameters of tested cultivars (n=19) in 2012 and 2013

Parameter	Year	Average by cultivars	LSD 0.05
Yield, t ha^{-1} (R)*	2012	5.81	0.14
	2013	7.74	
Potential yield, t ha^{-1}	2012	10.86	0.43
	2013	9.07	
Number of plants, per 1 m^2	2012	473	15.03
	2013	391	
Number of productive tillers, per 1 m^2 (PT)	2012	460	17.20
	2013	381	
Number of unproductive tillers, per 1 m^2 (UT)	2012	204	11.10
	2013	50	
Plant height, cm (PH)	2012	109	1.64
	2013	106	
Panicle length, cm (PL)	2012	17	0.34
	2013	16	
Number of grains per panicle (NGP)	2012	65	2.85
	2013	60	
Thousand kernel weight, g (KW)	2012	36.98	0.33
	2013	39.91	
Weight of one panicle, g (PW)	2012	5.90	0.40
	2013	5.31	
Grain size >2.5 mm, %	2012	55.21	1.03
	2013	59.50	
Grain size 2.2-2.5 mm, %	2012	33.25	0.80
	2013	35.69	
Grain size <2.2 mm, %	2012	11.55	0.36
	2013	4.81	

All tested parameters were significant between years and cultivars at the level of p<0.01.
* Abbreviators used in correlation test.

Differences between years were observed significant as well as among tested cultivars at the level of p<0.01. The highest yield was observed for cultivars 'Scorpion' and 'Rajtar' (respectively 6.81 t ha^{-1} (2012) and 8.86 t ha^{-1} (2013)).

Table 2. Yield and potential yield of tested cultivars (n=19) in 2012 and 2013, t ha^{-1}

Cultivar	Yield		Potential yield	
	2012	2013	2012	2013
Stendes D rta	6.01	7.23	12.31	7.91
32659	5.19	7.04	9.01	8.66
32986	5.99	8.03	11.19	11.17
32584	5.95	7.68	9.37	8.72
Kirovec	5.72	7.36	11.33	7.39
Stendes L va	4.95	6.18	10.63	7.66
Arta	4.51	6.23	7.22	7.43
Corona	6.20	8.40	10.36	8.92
Pergamon	6.16	8.14	8.52	9.44
Laima	5.45	7.79	10.04	10.59
Vendela	5.21	7.85	10.45	10.88
33122	5.55	7.78	9.85	8.24
Duffy	5.69	8.38	12.12	8.52
Scorpion	6.81	8.36	15.27	9.62
Aveny	6.72	8.78	12.23	11.60
M ra	5.44	7.06	11.82	7.25
Kerstin	6.05	8.02	10.85	9.04
Freja	6.11	7.84	10.72	10.35
Rajtar	6.74	8.86	12.96	8.91

Although yield in 2013 was higher, some yield forming parameters were lower, like, number of plants, productive tillers, number of grains per panicle and size of the plant. Though grains were greater and heavier, as thousand kernel weight demonstrate (in 2012 – 36.98 g, but in 2013 – 39.91g) and also kernel size distribution (number of large grains (>2.5 mm) was raised by 4.49%). The small grain number was lower in 2013, because of number of unproductive tiller decreased. In the seasons when oat cultivars are producing many unproductive tillers, the lack of nutrients appears for grain growing and filing, that is the main reason for small grains appearing also mentioned by Zute et al. 2010.

Table 3. Correlative connections among several measured parameters (n=19; $r_{0.05}$=0.456) in 2012

Parameters	PT	UT	PH	PL	PW	KW	NGP	R
PT	1							
UT	0.472	1						
PH	-0.005	-0.094	1					
PL	-0.268	-0.387	**0.681**	1				
KW	-0.021	-0.495	-0.325	-0.269	0.377	1		
NGP	-0.484	-0.626	0.230	0.601	**0.601**	-0.094	1	
R	0.200	-0.446	**-0.473**	-0.075	0.267	0.626	0.154	1

Table 4. Correlative connections among several measured parameters (n=19; $r_{0.05}$=0.456) in 2013

Parameters	PT	UT	PH	PL	PW	KW	NGP	R
PT	1							
UT	-0.263	1						
PH	0.061	0.016	1					
PL	-0.423	0.330	**0.680**	1				
KW	-0.190	0.232	-0.292	-0.097	0.377	1		
NGP	-0.195	0.199	-0.203	0.118	**0.601**	-0.163	1	
R	0.150	-0.016	**-0.757**	-0.410	0.267	0.335	0.353	1

Correlation among measured parameters (performed in Table 3 and Table 4) showed significant negative correlation to yield and plant height in both years (r=-0.473 (2012); r=-757 (2013) > $r_{0.05}$=0.456), but there is no literature describing that smaller sized cultivars characterizes with higher yield.

Such result is achieved, because of the choice of cultivars. Berry et. al. 2004 has mentioned that breeding programs use dwarf forms of wheat to increase lodging resistance and preserve high yields, Strong positive significant correlation was between plant height and panicle length (r=-0.681 (2012); r=-680 (2013) > $r_{0.05}$=0.456). As well as between panicle weight and number of grains per panicle (r=-0.601 (2012); r=-601 (2013) > $r_{0.05}$=0.456).

There were observed significant correlations among several parameters, but they didn't remain between tested years, which could be explained with each year individuality in meteorological conditions, but it is not proved in scientific literature.

Conclusions

Based on two years of research, the following conclusions can be drawn: For all tested parameters there were observed significant (p<0.01) difference between years and tested cultivars. In the year 2013 the growing conditions for oat in early growing stages were good for tillering, because the number of unproductive tillers was four times lower comparing with 2012, when differences in meteorological conditions were really radical. With higher yield characterized the year 2013, although few yield forming parameters were lower, grains were greater and heavier, as thousand kernel weight showed (in 2012 – 36.98 g, but in 2013 – 39.91g) and also kernel size distribution (number of large grains (>2.5 mm) was raised by 4.49. Correlation analysis showed significant negative correlation between yield and plant height (r=-0.473 (2012); r=-757 (2013)).

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EXAMINATION OF SEEDLINGS QUALITY OF *PELARGONIUM X HORTORUM L. H. BAIL.* TREATED WITH DIFFERENT FERTILIZERS

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Abstract

In order to determine the quality of the seedlings of *Pelargonium x hortorum L. H. Bail. hybrid "Ringo 2000 deep scarlet"* examinations were conducted with several crystal fertilizers, including different contains and concentration.

Easily soluble fertilizers were used in the following composition: NPK 9-10-34+M.E.; NPK 14-7-28+5CaO+M.E. and NPK 14-10-26+3MgO+M.E. The plants of the control variant were irrigated with plain water.

The following biometric parameters were examined: mass of stem, mass of root, number of branches, number of leaves and number of inflorescences.

The research period was three years, from 2010 to 2012. The obtained results were statistically processed with the method of analysis of variance and test with LSD test.

According to results of all examined biometrical parameters, it was determined that the nutrition with the crystal fertilizer NPK 9-10-34+M.E. and the crystal fertilizer NPK 14-10-26+3MgO+M.E., both with dose of 1.6 g/l solution and with dose increased to 3.2 g/l solution when the roots are in fool growth, have shown best results.

The highest stem mass for about 83% in comparison with control variant, has the plants fertilized with NPK 9-10-34+M.E. and NPK 14-10-26+3MgO+M.E.. The highest root mass for about 105% in comparison with control variant, has the plants fertilized with NPK 9-10-34+M.E. The highest number of branches (141%), number of leaves (61%) and number of inflorescence (25%), in comparison with control variant, has the plants fertilized with NPK 14-10-26+3MgO+M.E.

Keywords: *Pelargonium x hortorum L. H. Bail., seedling, fertilizer, biometric parameters*

Introduction

Species of the genus *Pelargonium* are perennial plants, with a height of 50 cm and higher. They are often grown as annual plants. Pelargonium is flower that is mass-produced and it is required on the market. It features a long blooming during the whole summer, until the appearance of autumn frost.

Pelargonium which are used for commercial purposes, are used to form the flower beds and as pot cultures. This flower species are important because it is combined very well with a variety of seasonal flowers such as begonias, ageratum, lobelia, verbena, petunias, etc. (Vujosevi et al., 2009).

Pelargonium are neutral cultures and the initiation of the formation of flowers depends on the total received light energy (intensity x duration) at appropriate temperature (Langton and Runger, 1985). They are produced on substrates that are well drained and rich in nutrients. Many problems of rotting of the root are associated with the excess water, low oxygen, improper humidity and excess of accumulated soluble salts (Dole and Wilkins, 1999). According to Hammer (1991) and Bethke (1993), the optimal pH for the substrate of "zonal"

geraniums should range from 5.6 to 6.0. This is of particular significance because of the availability of the elements and the needs of the plants of certain elements.

Geraniums have a great need for magnesium and calcium. Therefore, the regime of nutrition is based on a combination of KNO_3 and $Ca (NO_3)_2$ (Dole and Wilkins, 1999). The purpose of this research is to examine the impact of different types of fertilizers on the quality of seedlings of floral species Pelargonium hortorum LH Bail and to determine the most appropriate composition and concentration of fertilizer in the seedling production of Pelargonium hortorum LH Bail.

Materials and Methods

The examinations were made in the years 2010, 2011 and 2012, in the farm "Flower-Garden" in the village Vladevci, Strumica, Republic of Macedonia. As examination material was used Pelargonium x hortorum L. H. Bail., Hybrid "Ringo 2000 deep scarlet", commercial substrate that is primarily used to produce seedlings of flowering and vegetable crops and easily soluble crystalline fertilizers with composition of: NPK 9-10-34 + M.E.; NPK 14-7-28 +5 CaO + M.E. and NPK 14-10-26 +3 MgO + M.E. The seedlings of Pelargonium x hortorum L. H. Bail. were obtained from the Dutch company Syngenta. It was produced from seed and for the research was used seedling with formed cotyledons leaves. Transplanting was made immediately after the purchase of seedlings, in the traditional way. Each plant was individually removed from the cells and transplanted in pots with diameter of 9.5 cm. The flowerpots were previously filled with a substrate with trade name Tref. Immediately after the transplanting irrigation was made with 155 ml water in each pot.

The nutrition of the seedlings of Pelargonium x hortorum LH Bail. was initiated when the first two to three true leaves appeared. The nutrition was performed once a week. Each plant from the control variant was irrigated only with 80 ml pure water. Variants are shown in Table 1.

Table 1. Variants regime using easy soluble fertilizers

Variant	Fertilizer
I	Without fertilizer ∅
II	Crystal NPK 9-10-34+M.E.
III	Crystal NPK 14-7-28+5CaO+M.E.
IV	Crystal NPK 14-10-26+3MgO+M.E.

By the first two feedings, the variants were fertilized with dose of 1.6 g / l solution. The dose of fertilizer was doubled (3.2 g / l solution) in all variants after the second fertilization, i.e. in the phase of full rooted seedlings. The double dose was based on the increased vegetative mass and consequently the increased need for nutrients. With a double dose the variants were fed six times.

Seedlings ware produced at optimum conditions necessary for the production and standard measures of care were applied: watering, ventilation, protection from diseases and pests. After 70 days from the transplantation in pots, with method of random selection, 30 plants of each variety were measured. For determining the quality of seedlings, the following biometric parameters were examined: mass of stem, mass of root, number of branches, number of leaves and number of inflorescence.

The received results were processed by variant, statistically according to the method of analysis of variance and test with LSD (Least Significant Difference) test.

Results and Discussion

The highest average value for the mass of stem (12.54 g) was obtained in the plants fertilized with crystalline fertilizer NPK 14-10-26 +3 MgO + ME. These plants also had the most homogenous mass of stem (CV 14.9%). Furthermore, the plants fertilized with crystalline

fertilizer NPK 9-10-34 + ME showed good results with an average value of the mass of the steam of 12.52 g, which is only about 0.02 g (0.2%) lower value in comparison with variant 4. Lowest average value for the mass of stem (6.85 g) was obtained in the control variant and these plants had the most heterogeneous mass (CV 25.53%). The mass of stems that were obtained by applying different crystalline fertilizers showed significant statistical difference compared with the mass of the plant stems from the control variant. Among the variants which were fertilized there was no statistically significant difference (Table 2.).

Table 2. Mass of stem (g)

Variation / fertilizer	Arithmetic mean	Standard error	Standard deviation	Coefficient of variation	Interval of variation	Comparison with Var. 1	Comparison with Var. 2	Comparison with Var. 3	Comparison with Var. 4
1. Without fertilizer ∅	6.85	0.18	1.75	25.53	3.7-11.7	∅	-5.68	-3.89	-5.69
2. Crystal NPK 9-10-34+M.E.	12.52	0.27	2.61	20.82	8.2-18.1	5.68	Var. 2	1.78	-0.02
3. Crystal NPK 14-7-28+5CaO +M.E.	10.74	0.23	2.15	19.97	7.1-15.8	3.89	-1.78	Var. 3	-1.80
4. Crystal NPK 14-10-26+3MgO +M.E.	12.54	0.2	1.87	14.9	6.6-15.5	5.69	0.02	1.80	Var. 4

LSD 0.05 = 2.22
LSD 0.01 = 3.08

The average mass of root ranges from 1.06 g in the plants from the control variant to 2.17 g in the plants fertilized with crystalline fertilizer NPK 9-10-34 + M.E.. Plants fertilized with crystalline fertilizer NPK 14-10-26 +3 MgO + M.E. showed similar results with the plants of variant 2, with an average value of the root mass of 2.13 g. Plants in all variants showed homogeneity in terms of the root mass (CV <30%). According to the value of the LSD test, the mass of roots in variants 2, 3 and 4 compared to the control variant had statistically significant difference at a level of 0.01. Among the variants that were fertilized there was no statistically significant difference (Table 3.).

Table 3. Mass of roots (g)

Variation / fertilizer	Arithmetic mean	Standard error	Standard deviation	Coefficient of variation	Interval of variation	Comparison with Var. 1	Comparison with Var. 2	Comparison with Var. 3	Comparison with Var. 4
1. Without fertilizer ∅	1.06	0.02	0.23	21.5	0.5-1.5	∅	-1.11	-0.89	-1.07
2. Crystal NPK 9-10-34+M.E.	2.17	0.06	0.53	24.21	1.3-3.8	1.11	Var. 2	0.22	0.04
3. Crystal NPK 14-7-28+5CaO +M.E.	1.95	0.04	0.36	18.36	1.95	0.89	-0.22	Var. 3	-0.18
4. Crystal NPK 14-10-26+3MgO +M.E.	2.13	0.04	0.35	16.43	1.4-3	1.07	-0.04	0.18	Var. 4

LSD 0.05 = 0.35
LSD 0.01 = 0.49

The number of branches was largest in the plants fertilized with crystalline fertilizer NPK 14-10-26 +3 MgO + ME. They had the highest homogeneity (21.21 %) for the number of branches. The lowest number of branches had plants of control variant, averaged 2.2 branches. These plants are most heterogeneous (CV 30.75%).

Plants that were fertilized with different crystalline fertilizers showed significant statistical difference in the number of branches compared with plants of control variant. Among the variants that were fertilized there was no statistically significant difference (Table 4.).

Table 4. Number of branches

Variation / fertilizer	Arithmetic mean	Standard error	Standard deviation	Coefficient of variation	Interval of variation	Comparison with Var. 1	Comparison with Var. 2	Comparison with Var. 3	Comparison with Var. 4
1. Without fertilizer ∅	2.2	0.07	0.68	30.75	1-3	∅	-2.83	-2.31	-3.12
2. Crystal NPK 9-10-34+M.E.	5.1	0.12	1.17	23.23	3-7	2.83	Var. 2	0.52	-0.29
3. Crystal NPK 14-7-28+5CaO +M.E.	4.5	0.1	0.96	21.23	3-7	2.31	-0.52	Var. 3	-0.81
4. Crystal NPK 14-10-26+3MgO +M.E.	5.3	0.12	1.13	21.21	3-8	3.12	0.29	0.81	Var. 4

LSD 0.05 = 0.61
LSD 0.01 = 0.85

The number of leaves per plant ranged from 14 to 57. With using of the crystalline fertilizer NPK 14-10-26 +3 MgO + ME in average largest number of leaves (38 leaves) was acquired, while the lowest average number of leaves had the plants from the control variant. For this parameter, the values of all variants were homogeneous (CV <30). The number of leaves in variants 2, 3 and 4 compared to the control variant, according to the value of the LSD test, had statistically significant difference at a level of 0.01. There was statistically significant difference between variant 3 and variant 4 at the level of 0.05 and between other fertilized variants there was no statistically significant difference (Table 5.).

Table 5. Number of leaves

Variation / fertilizer	Arithmetic mean	Standard error	Standard deviation	Coefficient of variation	Interval of variation	Comparison with Var. 1	Comparison with Var. 2	Comparison with Var. 3	Comparison with Var. 4
1. Without fertilizer ∅	23.6	0.49	4.60	19.53	14-35	∅	-12.80	-11.51	-14.40
2. Crystal NPK 9-10-34+M.E.	36.4	0.44	4.21	11.59	27-45	12.80	Var. 2	1.29	-1.60
3. Crystal NPK 14-7-28+5CaO +M.E.	35.1	0.48	4.54	12.93	26-47	11.51	-1.29	Var. 3	-2.89
4. Crystal NPK 14-10-26+3MgO +M.E.	38	0.58	5.49	14.46	28-57	14.40	1.60	2.89	Var. 4

LSD 0.05 = 2.83
LSD 0.01 = 3.93

The number of inflorescences per plant ranged from 1 to 3. The highest average number of inflorescences (2.1) was obtained in plants that were fertilized with crystalline fertilizer NPK 9-10-34 + ME and NPK 14-10-26 +3 MgO + M.E. Plants fertilized with crystalline fertilizer NPK 14-7-28 +5 CaO + ME gave approximately the same results with previous ones, with an average value of 2 inflorescences. Plants from the control variant had the lowest values, with an average value of 1.7 inflorescences. These plants were most heterogeneous regarding the parameter (CV 26.64%). The number of inflorescences in plants fertilized with crystalline fertilizers showed significant statistical difference compared with the number of inflorescences from plants of the control variant. Among the variants that were fertilized there was no statistically significant difference in terms of the number of inflorescences.

Table 6. Number of inflorescences

Variation / fertilizer	Arithmetic mean	Standard error	Standard deviation	Coefficient of variation	Interval of variation	Comparison with Var. 1	Comparison with Var. 2	Comparison with Var. 3	Comparison with Var. 4
1. Without fertilizer ∅	1.7	0.05	0.46	26.64	1-2	∅	-0.38	-0.30	-0.43
2. Crystal NPK 9-10-34+M.E.	2.1	0.04	0.39	18.5	1-3	0.38	Var. 2	0.08	-0.06
3. Crystal NPK 14-7-28+5CaO +M.E.	2	0.03	0.28	13.93	1-3	0.30	-0.08	Var. 3	-0.13
4. Crystal NPK 14-10-26+3MgO +M.E.	2.1	0.04	0.38	17.91	1-3	0.43	0.06	0.13	Var. 4

LSD 0.05 = 0.18   LSD 0.01 = 0.25

Conclusion

The analysis of the biometric parameters, by which the quality of seedlings of Pelargonium hortorum LH Bail. was determined, showed that the best results for mass of stem, number of branches and number of leaves were acquired by fertilized plants with crystalline fertilizer NPK 14-10-26 +3 MgO + M.E.. The best results for the mass of root showed fertilized plants with crystalline fertilizer NPK 9-10-34 + M.E. Most of numbers of inflorescences were obtained in plants fertilized with crystalline fertilizer NPK 9-10-34 + ME and NPK 14-10-26 +3 MgO + M.E.

The analysis of the parameters which determines the quality of seedlings which are fertilized with different crystalline fertilizer, showed that the quality of seedlings depends on the type of fertilizer used to produce seedlings. Quality seedlings can be obtained only by the application of appropriate fertilizers and application of appropriate technology for production of certain plant species.

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PHENOLOGIC, BIOMETRIC AND PRODUCTION PARAMETERS IN SOME WHEAT VARIETIES CULTIVATED IN THE REGION OF POLLOG

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Abstract

The experiment with wheat was performed on agricultural private-owned land in the village of Pirok and Tearce, Pollog region (municipality of Tetovo). The research was performed during two consecutive years (2011-2013) on 8 wheat varieties of different origin, namely: Pobeda, Radika, Milenka, Apachi, Ingenio, Europe, IBK – 1, KG – 100, the same being placed on the model of the block system, with three repeats. During vegetation the plants were measured and the changes were phenologic followed up i.e.: the number of days necessary from sowing to sprouting, the dynamics of growth, the number of days till appearance of ears, flowering and ripening, and in the process significant differences in the individual wheat varieties were noticed. Of the biometric parameters, the length of the straw, the length of the wheat ears, the number of grains in the ears as well as the average yield were examined. The highest average yields were registered in the varieties Apache (7.2 t/ha), while the lowest were registered in the varieties KG – 100 (5.7 t/ha). The values obtained regarding the yield of individual varieties indicate significant oscillations being result not only of the type of the varieties, but also of the agro-ecological conditions present in this region.

Key words: *wheat, varieties, phenologic, biometric, yield*

Introduction

The cultivation and production of wheat in the world and among us is the main source of food for the population and the needs of the processing industry. So, the plant with the most productivity and higher consumption in the world is undoubtedly the wheat (Herllan, 1976, cit. Borojevic 1981-1992). In Macedonia, the need for this grain is bigger and bigger every day, hence the seeking ways to increase the production. It is evident that in Macedonia the arable land is continuously reduced. It is known that wheat production is related to a number of factors, like climate, soil and agronomy. Some of them cannot be controlled, while others depend on human activity (Bostinino A; Jugenheimer J; Aldrick SR etc.). The problem is to find ways to increase the production which are of agronomic and of genetic nature.

This paper presents the results of two-year research, following the impact of different factors to which the production in Pollog region is related, aiming:

First: we shall have an overview of the situation regarding the structure of wheat varieties and wheat regionalization in Pollog region.

Second: the study of soil and climatic conditions facing these with biological requirements of wheat.

Third: study of production capacity of most widespread cultivars.

On this basis, are given the possible ways of improving of the most diversified structure for the future.

Materials and methods

The study was conducted in the years 2011/12 and 2012/13 where were field tested 8 varieties (cultivars) of wheat of different origin with the perspective of spreading, namely:
Pobeda, Radika, Milenka, Apachi, Ingenio, Europe, IBK – 1, KG-100.
Varieties (cultivars) that were taken for study represent a material with high potential that we think are of interest for the future. Experimental field tests were set up in the private properties of individual farmers of Pirok and Tearce villages. The test was carried out according to randomized block scheme with three (3) repetitions; each cultivar was planted in an area of 10 m2. The sowing was done manually, sowing 550 to 600 plants per m2. According to the methodology of study, field assessments during the vegetation were made, such as main phenological stages and biometric measurements at each repetition on the basis of 10 plants randomly taken, where the average value was calculated for each feature.
The data were subject to statistical analysis in order to facilitate their interpretation. On this basis, conclusions and relevant generalizations are made.

Agro-climatic aspects of Pollog region regarding the wheat
The geographical position of Pollog region: In the western part of Macedonia is situated the Pollog lowland. This area is lies starting from the source of the Vardar River to the beginning of the Radusha Gorge. This is a fertile valley divided into two parts:
Upper Pollog and Lower Pollog, lies at 400-600 meters above sea level and covers an area of 550 km^2.
According to the latest scientific data, it is claimed that wheat can be grown successfully in those
regions, where the amount of annual active temperature ranges between 1700-2100 degrees Celsius. In the successful growth and development of this plant high effect have positive and negative temperatures.
In Table 1 are given optimum temperatures in degrees, essential for wheat in various stages of development confronted with the most important areas of wheat production in Pollog.

Table 1. Optimal temperatures of wheat, in degrees, in various stages of development.

Areas	Sowing Germination	Sowing Twinning	Rising of production formation	Formation of ear	Flowering	Formation of grain
Optimal	**12-24**	**8-13**	**14-20**	**16-20**	**20-25**	**20-25**
Tetovo	16.9-11.1	11.1-5.6	11.4-15.8	15.8-19.9	15.8-19.9	19.2-21.3
Gostivar	16.1-10.8	10.8-5.4	10.7-15.4	15.4-18.8	15.4-18.8	18.8-20.4

This table (Table 1.) shows that in general, biological requirements of grain match those provided in the studied regions, with a very small deviation of Tetovo and Gostivar region where the first stages of growth face the lowest minimum temperatures. However, from these minor deviations from the optimal requirements, it can be said that Pollog region has optimal conditions.
In the year 2011 the average annual temperature in Tetovo was 11.5° C, while in Gostivar 11.1°C. The next year (2012) 11,7° C in Tetovo and 11.3° in Gostivar. As long as the year 2013 were to 12.4° C and 12.1° C for Tetovo and Gostivar, respectively.
Problems that must be taken into consideration during the regionalization of wheat are spring

and autumn frosts. In conclusion we can say that by confronting the biological requirements of wheat, with the climate data taken in the study of the area shows that the route of temperatures from germination, development and until the end of the vegetation is suitable for a successful production of wheat.

Humidity is an important factor in the production of wheat. From the scientific experimental data, it results that this culture can be cultivated successfully in all regions in which during the year the rainfall varies from 350-1100 mm. If we face these requirements with the concrete conditions of Pollog plain, it turns out that in most regions with a moderate continental climate where wheat crops are, there are optimal conditions in terms of grain moisture requirements. In Tetovo the average rainfall is about 700 mm, Gostivar over 800 mm of rain per year. By analyzing the data of leading climatic indicators, we can say that in Pollog area are good conditions for successful cultivation of wheat. Tetovo region lands are mainly diluvial, alluvial etc. These are usually deep subsoil, rich in nutritive elements and microelements needed for wheat growth and development.

Results and discussion

As it was mentioned in the methodology of work, in the study were put 8 cultivars with structure or perspective to be widespread in the area where the study was conducted. To see the values of these cultivars and their behavior to the conditions of Pollog lowland, we focused on phenological, biometric and performance indicators.

Table 2. Passing of phenological stages of the tested cultivars.

Cultivars	Growing phenophases (days)				
	Sowing	Rising	Ear formation	Flowering	Maturity
	2012/13	2012/13	2012/13	2012/13	2012/13
Pobeda	16	168	186	193	223
Radika	15	169	187	193	222
Milenka	14	167	186	192	221
Apache	16	168	187	194	224
Ingenio	15	168	186	193	222
IBK-1	14	167	185	192	222
Europe	16	169	187	194	224
KG-100	15	167	186	192	220

This table indicates that the germination occurred 14 to 16 days after sowing, a very evident difference between cultivars for this indication. The rising phase has come earlier to the cultivar kg-100; Milenka and IBK-1, later to Radika, after 169 days and Europe after 169 days. The average ear formation phase is after 185-187 days. IBK-1 cultivar formed its ear earlier and Radika, Apache and Europe after 197 days. The flowering as well as other phenological stages has not had major differences. Specifically at Milenka cultivar, IBK-1 and KG-100 came after 192 days, while at Apache and Europe after 194 days. The same counts for the stage of full maturity. Earliest cultivar that came out is Milenka and KG-100,

i.e. it reached the maturity stage in 220 full days after germination and in Europe and Apache cultivar after 224 days. The other cultivars are included within this interval of time. From these data we come to the conclusion that the studied cultivars despite coming from different sources, they have no big differences in terms of phenological phases.

Following, we represent the average data of main wheat biometric indicators tested in Pollog-Tetovo area (Table3).

Table 3.Biometric indicators of wheat cultivars tested in Tetovo Pollog area.   .

Types	Studied parameters			
	Pollog region			
	Plant height (cm)	Ear length (cm)	No. of grains per ear	Weight of grains per ear (gr.)
Pobeda	98	9.4	55	2.3
Radika	89	10.1	52	2.4
Milenka	83	9.1	51	2.1
Apache	86	10.1	61	2.5
Ingenio	85	9.8	60	2.4
Europe	102	9.9	58	2.3
IBK-1	87	10.1	63	2.4
KG -100	82	9.2	51	2.0
Average	89	9.7	56.3	2.3

Data in this table show that between cultivars there are more pronounced differences for biometric indicators which were not observed in the case of phenological indicators. The plant height ranges from 82 cm at KG-100 cultivar to 102 cm Europe cultivar with an average of 89 cm. The length of the ear varies from 9.1 cm at Milenka cultivar to 10.1 cm Radika and Apache cultivar with an average of 9.7 cm. The number of grains in the ear ranges from 51 grains in Milenka cultivar through 63 grains at IBK- 1 cultivar with an average of 56.3. Weight of grains in the ear ranges from 2.1 grams at Milenka and Europe cultivar, to 2.5 at Apache cultivar, with an average of 2.3 grams.

Table 4 Yield per kg/ha of wheat cultivars in Pollog area in 2011 - 2013.

Type/year	2011/12	2012/13	Mean yield
Pobeda	68.3	69.1	68.7
Radika	62.1	67.4	64.7
Milenka	57.4	60.2	58.8
Apache	69.7	72.2	70.9
Ingenio	69.6	72.1	70.8
Europe	61.6	67.5	64.5
IBK-1	68.9	70.2	69.5
KG – 100	51.1	57.3	54.2
Average	**63.5**	**67.0**	**65.2**

Table 4 shows the differences between cultivars in terms of yield in kg/ha. Specifically for 2012 the yield was 51.1 kg/ha at KG-100 cultivar to 69.7 at Apache cultivar, with an average of 63.5 kg/ha. In 2013, lowest yield gave KG-100 cultivar, while highest yield gave Apache. The yield average was 67.0 kg/ha, higher than in 2012.

In order to see that changes are significant or random, analysis of variance of yield kg/ha of experimented cultivars was performed. Details of this analysis are given in Table 5. In this table, the rows represent variations of yield cultivars, while in columns yield variations from one year
to another. The data of this table show significant changes between cultivars as well as from one year to another, which should be considered during the regionalization of wheat cultivars.

Table 5 Analysis of varieties for yield kg/ha of tested cultivars.

Source of variety	Quadratic sum	Freedom rate	Quadratic mean	F-factual	F-critical
Rows	517.3	7	73.9	**33.5**	**3.7**
Columns	46.3	1	49.5	**21.1**	**5.5**
Error	15.4	7	2.2		
Total	579.3	15			

Conclusion

From the data of comparative study of some wheat cultivars in the conditions of Pollog, Tetovo, Macedonia seen in relation to ecological conditions, the following generalizations are made:

By confronting the climate and soil indicators of Pollog region with the biological requirements, we come to the conclusion that Pollog region has the best conditions for grain production.

Experimented wheat cultivars are characterized by differentiated morphological and phonological features.

From the study of morphological features, some indicators show strong positive connections that can be taken in consideration if these cultivars are used in a genetic improvement program.

Experimented wheat cultivars have different yielding capacity; the most successful are Apache, Ingenio, IBK-1 Pobeda cultivars. By analysis the variance, we see the annual effects in the yield of studied cultivars which should be kept in mind during the regionalization of this plant.

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EFFECT OF COVERING ON SWEET CORN GROWING PERIOD AND SOME MORPHOLOGICAL PROPERTIES

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Abstract

Experiment aims to investigate, in 2013, shortening of sweet corn growing period with application of some technological elements: propagation time, propagation method, floating row cover. The choosen variety was a conventional sweet corn hybrid, very early ripening 'Spirit'. The following growing technologies were compared: 1. direct sowing of plants with floating row cover, early period 2. direct sowing of plants without row cover, early period 3. plants transplantation with floating row cover, normal period and 4. direct sowing of plants without row cover, normal period (regarded as control).

The transplanted plants had shorter growing period by 6 days, compared to direct sowed covered treatment and were 15 days earlier harvested than control. Interaction of growing technology and plants covering had also favourable effect on some important morphological properties of ears such as weight of husked and unhusked ears, ear length, ear diameter, length of seeds and number of seeds.

Key words: *earliness, sweet corn, transplantation, fleece covering*.

Introduction

Based on its present growing area, the sweet corn is the vegetable which is grown on the greatest area in Hungary. After dates of Hungarian Fruit & Vegetable Interprofessional Organization in 2003 the growing area was about 38,000 hectares. After 2003 followed a sudden and sharp decline. After diminishing, the plant returned in rise, in 2006 against over 30,000 hectares. The recession mentioned above affected not only Hungary but also the holdings of the USA and Western Europe. In the case of the former, however, the increase in fresh consumption partly counterbalanced the rate of decrease. Near 50% of world sweet corn production came from US (Slezák *et al.*, 2012). In 2013 the growing area was 34, 000 hectares, less with 1000 ha, compared to 2012 (Avar, 2013).

In order to promote fresh consumption, as well as to maintain and increase the sweet corn exports, it is necessary to promote investigations so as to be able to ensure a further increase in the growing area and yields of sweet corn with the help of the experiences. The literature mainly is concerned with maize growing technology, but a lot of dates could be used by sweet corn. Of the production technology elements, a number of researchers studied or are currently studying the sowing time of sweet corn.

As early as at the ending of 19th- and the beginning of the 20th century some researchers (Cserháti, 1901) highlighted the importance of the sowing date. Ripening can occur earlier when sowing earlier and using high quality seeds as compared to normal or late sowing. I'só (1969) and Pásztor (1966), after their multi-year sowing date trial, concluded the following: in the case of an earlier sowing seed germination will be more protracted, but from the point of view of fruit maturing it was more favourable than late sowing.

Several techniques are known in the art for the purpose of early fresh market shipments: seedling growing or direct seeding with temporary plant cover (Hodossi, 2004).

About the covered early sowing as a technological variation Aylswirth (1986) mentioned, that from an early sowed crop, made in first week of April, arranged in twin rows (42 cm) and covered by plastic, we could harvested marketable cobs by the fourth of July.

The most widespread method of seedling production is the use of soil blocks (Pereczes, 1999) which can also significantly increase earliness. The combined application of seedling growing and floating row cover can advance harvest by three weeks as compared to the traditional technology and can give farmers a three to four times greater income (Kurucz, 1998). Rattin et al. (2006) compared direct sowed and transplanted sweet corn varieties, without covering and concluded no difference, in ear weight and ear length, between transplanted treatments plant's, in comparison to direct sowing treatments plant's.

Materials and methods

The experiment were set up in 2013 on an area equipped for irrigation at Carei, Satu Mare County, situated in NW part of Romania. Conventional, reliable and sufficiently known among growers sweet corn variety, Spirit, was used as a reference variety in the variety comparison trials of the Central Agricultural Office. Hybrid has short growing period of 85 days and yellow kernels. Average height of plants is 159 cm, average ear height is 37 cm, ear length 19.6 cm and average ear weight is 245 g. The variety was granted official recognitions in 1988 and has been the dominant variety of the early ripening category till now. In the year prior to the experiment the area was under wheat.

The following treatments, each with four replications, were applied during the experiment:

P1 = direct sowing of plants with floating row cover, early period (11th April)

P2 = direct sowing of plants without row cover, early period (11th April)

P3 = plants transplantation with floating row cover, normal period (21th April)

P4 = direct sowing of plants without row cover, normal period, regarded as control (21th April)

For the frame structure of the treatments with cover we used ø 4.2 mm zinc coated wire coils. The fleece, 60 cm in width, was stretched over a small tunnel of 40 cm in height and then its edges (25-25 cm, respectively) were covered with soil using a hoe and the its ends were tied to the stakes hammered down. The construction of the frame structure and the setting out of the fleece cover were carried out at the same day as direct seeding and out planting.

For the purpose of seedling growing, the seeds were sown on 5th April 2013, in trays with rigid walls having 3,7x4x5,4 cm size. For growing the seedlings, commercial mix made of white peat 10-20 mm, PG Mix 1 kg/m3 + micro nutrients, bentonite 40 kg/m3, pH 5,5-6,5 was used. The seedlings were planted out at the 3 to 4 leaf phenological stage. At the two propagation times the treatments P1 and P3 were covered with Novagryl floating row cover, having a weight of 19 g/m2, (using the small tunnel technique) in order to enhance earliness. The stand was created to contain 60,607 plants per hectare, according to the recommendations of the owner of the variety, at a spacing of 110+40x22 cm in twin rows. Each plot had an area of 6x3,5m (8 parallel rows and 16 seeds sown in each row). Sowing depth was 3 cm. The edge was the respective outer rows of the 4 twin rows of the plot.

In October 2012, 35 t/ha of farmyard manure was worked into the soil with ploughing on area. Nitrogen fertilizer (120 kg/ha) was applied at the 6-7 leaf stage, the form of top dressing. The fertilizer application was worked into the soil with a rotary hoe.

Ears were harvested together with the husks, from the two central twin rows. Twenty ears were selected from each row and the following measurements were carried out:

weight of unhusked and husked ears (g),

total ear length (cm),

ear diameter (mm),

length of seeds (mm),

number of seeds.

The statistical analysis of the results was carried out by using the programme *RopStat 1.1.* When the standard deviations were identical the mean values were compared by pairs using the *Tukey-Kramer* test, while in the case of the non identical standard deviations the means were compared using the *Games-Howell* test (Vargha, 2007).

Results and discussion

According to obtained results, harvesting time (measured in days) was the shortest in the treatment P3 and P2, merely 60, respectively 79 days, i.e. the corns became ready for harvest 15, respectively 8 days earlier than those of P4 (control). In case of P1 treatment, harvesting began 6 days earlier compared to P4 (control).

Results of the one of the major characteristics in connection with yield rating, unhusked and husked ear weight, are summarised in Figure 1.

F(3;316)=25,143
F(3;316)=11,836
Sd=99%
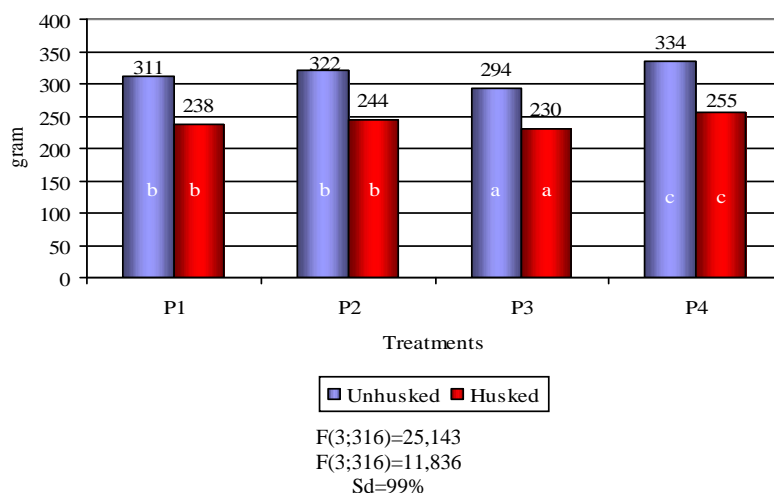
Fig. 1. Unhusked and husked ear weight (g).

Analysing the data measured for unhusked ear yield, it is noticeable that the average weight of the ears of the transplanted, covered treatment P3 was significantly (at *p<0.01* level) lower as compared to the sowed, covered and uncovered treatments P1, P2 and P4 (control). Though there was some difference between the plants of the treatments P1 and uncovered, sowed, treatment P2 in unhusked ear weight, statistically this was not significant. Significantly highest value, supported statistically (at *p<0.01* level), of unhusked ear weight was produced by ears of control treatment (P4). In case of husked ear weight the same tendencies were observed as in case of unhusked ear weight. The data concerning, an important characteristics for market appeal (total ear length) are
contained in Figure 2.

F(3;316)=20,281
Sd=99%
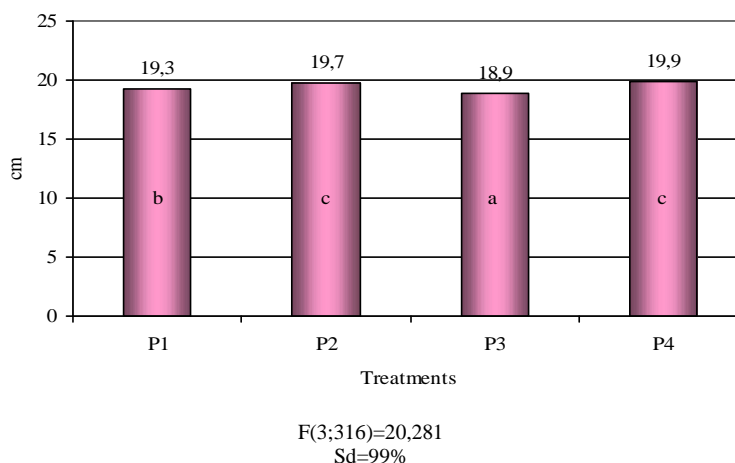
Fig. 2. Total ear length (cm).

The length of the covered transplanted treatment P3 was significantly (at *p<0.01* level) shorter compared to the ear length of all treatments. No statistically demonstrable difference was found between ear lengths of uncovered, direct sowed P3 and P4 (control) treatments.

Total ear length, average ear length 19.6 cm as measured in the variety comparison trials, achieved by the above mentioned P3 and P4 treatments.

Other important characteristics for market appeal (total ear diameter), is presented in Figure 3.

F(3;316)=66,795
Sd=99%
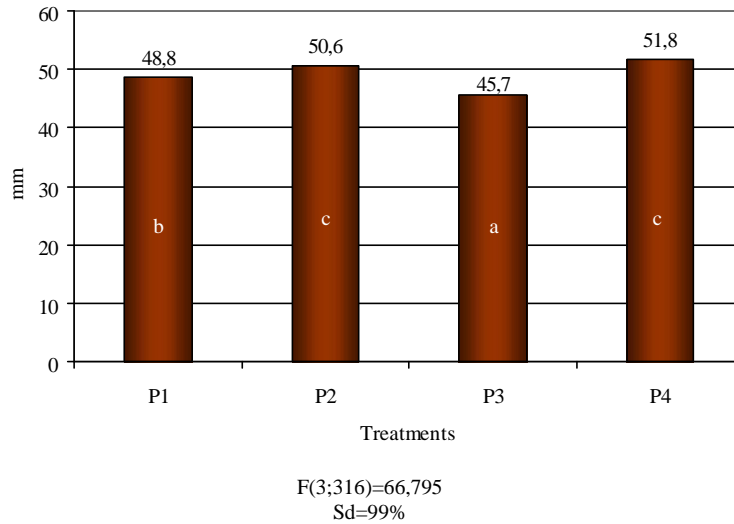
Fig. 3. Total ear diameter (mm).

The measured values were higher in case of uncovered treatments P2 and P3 compared to covered sowed treatment P1. The total ear diameter of transplanted, covered treatment P3 was significantly (at *p<0.01* level) lower as compared to the sowed, covered and uncovered treatments P1, P2 and P3.

Length of seeds is an important characteristic for yield quantity is presented on Figure 4.

F(3;316)=14,877
Sd=99%
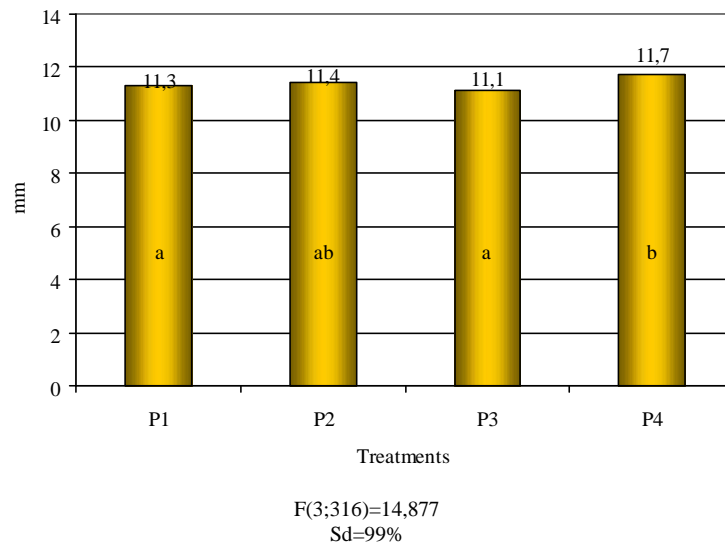
Fig. 4. Length of seeds (mm).

The measured values were higher in case of uncovered treatments P4 (control) and P2 compared to covered, control treatment P1 and P3. Length of seeds of transplanted, covered treatment P3 was significantly (at *p<0.01* level) lower as compared to the sowed, uncovered treatments P2 and P4 (control).

Number of seeds is also an important characteristic for yield quantity is presented on Figure 5.
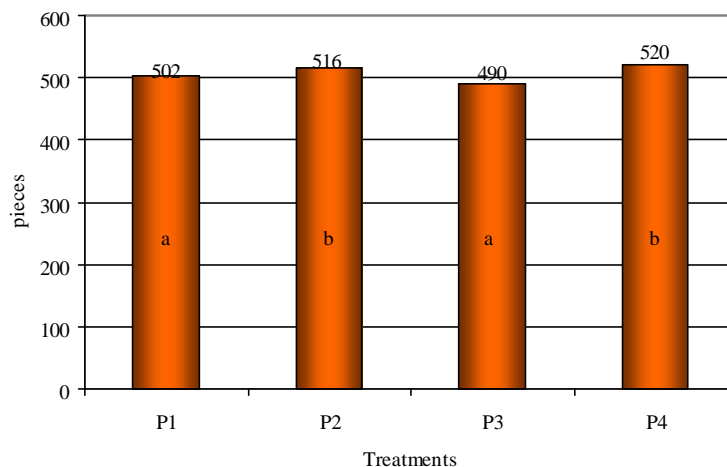
F(3;316)=11,876
Sd=99%

Fig. 5. Number of seeds (pieces).

Analysing the data number of seeds, I observed that average number of seeds the transplanted, covered and sowed covered P3 and P1 treatments was significantly (at *p<0.01* level) lower as compared to the sowed, uncovered treatments P2 and P4 (control). In case of this morphological parameter the statistical programme could not demonstrate significantly difference compared covered treatments (P1-P3) and uncovered treatments (P2-P4).

Conclusions

Based on the results of the 2013 year experiment, the following conclusions can be made:

The growing period was significantly shortened with transplantation of sweet corn plants compared to direct seeded. Harvest time occurred 15 days earlier in the case of transplantation and floating row cover (P3) application compared to direct sowed, uncovered, control (P4) treatment, and 8 days earlier compared to direct sowed, covered P1 treatment. At the same time the floating row cover produce 6 days shortening in the growing season between P1 (direct sowing of plants with floating row cover) and P4 (direct sowing of plants with no row cover) control treatments.

The fleece covering had favourable effect on studied morphological characteristics of plants that are transplanted and floated with row cover.

In case of direct sowed treatment (P2) the effect of covering had positive effect on unhusked and husked ear weight, length of ears, total diameter of ears, number of seeds and length of seeds.

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EFFECT OF DIFFERENT Mo FERTILIZERS ON YIELD, CHEMICAL COMPOSITION OF SEED AND SOME PHYSIOLOGICAL PARAMETERS IN TWO SOYBEAN (Glycine Max. Merr.) CULTIVARS

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Abstract

The Mo nutrition has crucial influence on the metabolism of nitrogen and, consequently, the total metabolism of plants. Also, cobalt facilitates the process of nitrogen fixation, and it a cofactor of vitamin B_{12}, compounds of great importance in animal nutrition (Marschner, 1995). In this regard, we examined the effects of two fertilizers on the basis of Mo and Co with a similar chemical composition, but different pH values (7.1 and 5.5) on the yield, chemical composition of seeds and some physiological parameters (growth and photosynthesis) in two soybean cultivars ("Nena", ZP015) during two years. In "Nena" cultivar Mo/Co fertilizer with pH=7.1 does not affect the yield, while the Mo/Co fertilizer with pH 5.5 in the first season slightly raised the yield. In cultivar ZP015 both Mo/Co fertilizers had very favorable impact on yield during the second season, when they were optimal environmental conditions, in contrast to the unfavorable first season, when there were no significant differences in yield. Preliminary results of analysis of influence of Mo/Co fertilizer with pH 5.5 on the chemical composition of cultivar "Nena" during the first season indicated reduction of the seed content of Ca, Mg, Fe, Mn, oil, inorganic and phytic P, while increasing the content of Cu, Zn, GSH, phenolic and -carotene, the same total phosphorus content, all against control plants. Preliminary results of analysis of influence of Mo/Co fertilizer with pH 5,5 on the seed chemical composition of soybean cultivar ZP015 during the first season indicated higher content of Ca, Mg, Fe, Cu, Zn, total phosphorus, Pi, GSH and phenolic, same content of oil, and lower content of phytic P and -carotene, all against control plants. In same soybean cultivars results of analysis of influence of treatment of Mo/Co fertilizer with pH 7,1 on the seed chemical composition indicated lesser effects. In the first season of growing varieties "Nena", we see strong growth of the plants during vegetative and the first part of the generative growth stages of soybean plants, which coincides with intense photosynthetic activity. But in second part of the generative growth stages of soybean plants of the variety "Nena", we see a practical cessation of growth and reduced photosynthetic activity, the redistribution of weight towards the generative organs ("Pouring seed"). However, this process is somewhat slower in soybean plants treated with Mo/Co fertilizer with pH 7.1. But, as you note, this retention of photosynthetic competency in soybean plants treated with Mo/Co fertilizer with pH 7.1 has no effect on the final yield.

Key words: *Mo/Co fertilizer; pH value; yield; chemical composition; growth; photosynthesis*

Introduction

Molybdenum (Mo) is a transition element with multiple valence states (4th, 5th and 6th), which indicates the different options of its apsorption and physiological function in plants (Marschner, 1995; Mendel& Hänsch, 2002, Schwarz& Mendel, 2006). So, Mo is a cofactor of nitrogenase, the key enzyme of symbiotic nitrogen fixation of atmospheric N_2 by legume bacteria and nitrate reductase, a key enzyme in the process of apsorption of nitrate in plants. Therefore, apsorption of Mo by plants influences the metabolism of nitrogen and, consequently, the total metabolism of plants. It is known that cobalt (Co) facilitates the process of nitrogen fixation, and it is the cofactor of vitamin B12, compounds of great importance in animal nutrition (Marschner, 1995).

Material and methods

Treatments were carried out with two Mo / Co fertilizers: a) „SPEEDY" (Mo: 17%, Co: 1,7%; pH=7,1) and b) „Wuxal Extra CoMo" (Mo: 16,5%, Co: 1,65%; pH=5,5) and they applied in the following doses per hektare: a) 150 ml of the „SPEEDY" fertilizer dissolved in 400 liters of water (approximately 6,2 mM Mo and 0,4 mM Co) and b) 120 ml of the „Wuxal Extra CoMo" (approximately 4,8 mM Mo and 0,3 mM Co). They were applied twice at the beginning of flowering (first half of June) on two soybean varieties, Nena and ZP015 (standard varieties). Experiments were performed in rain-fed conditions on chernozem soil type, at the vicinity of Zemun Polje in following seasons: 2008 (cv. Nena), 2012 (cv. ZP015), and 2013 (both cultivars). Seasons 2008 and 2013 were moderate for SE Europe in average temperature and precipitation amount, but 2012 was dry with high temperatures, particularly during flowering and grain filling period. In the 2008 season only for "Nena" cultivar we performed measurements of growth and photosynthesis. Parameters of growth, accumulation and redistribution of dry matter (LMR, SMR, RMR, ln TDW, RGR) were observed: 21.07.; 28.08. and 13.10. of 2008. in 10-12 reps (Poorter and Garnier, 1996). These parameters are defined by: De Groot and co-workers (2002) and Lambers and co-workers (1998). In addition, for reason of well-branched soybean habit, leaf aging and the importance of generative tissue of soybean (Vratari , 1986), we introduced additional parameters redistribution of dry matter. These are: AtMR (mass fraction retaining tissue stem, branch, leaf stems), dLMR (mass fraction senescent and dead leaves), and GtMR (mass fraction of generative tissue: buds, flowers, pods, seeds). PS_2 and ETR parameters of Chla fluorescence and photosynthesis (Maxwell and Johnson, 2000) were measured by PAM 101/103 apparatus in the central part of the younger, fully developed trifoliate leaf in 21.07. and 28.08. of 2008. in 8 reps. After harvesting, average grain yield was assessed, and contents of different metabolites in soybean grain, such as inorganic phosphorus - P_i, phytate (by method of Dragi evi et al., 2011) and -carotene (colorimetrically, AACC, 1995), as well as the following elements: Fe, Mn, Zn, Mg (by Inductively Coupled Plasma - Optical Emission Spectrometry) and total P (colorimetrically, by method of Pollman, 1991). Because of the developments that we could not control the lost samples of soybean genotype "Nena" (view 2008), treated with fertilizer "Speedy" and intended for chemical analysis. Results are given as mean values with standard deviations ($\underline{X}\pm$).

Results and disscusion

In "Nena" cultivar Mo/Co fertilizer with pH of 7.1 ("Speedy") does not affect the yield, while the Mo/Co fertilizer with pH 5.5 ("Wuxal extra CoMo") in the 2008 season slightly raised the yield (Table 1). In cultivar ZP015 both Mo/Co fertilizers had very favorable impact on yield during the 2013 season, when they were optimal environmental conditions, in contrast to the unfavorable season of 2012, when there were no significant differences in yield (Table 2).

Table 1. Yield of soybean (G. max. Merr.; cv. "Nena") grain per area unit (t/ ha)

Year of trial/ trial repeats	Yield of soybean grain (t/ ha) in a 2008 trial/ treatments			Yield of soybean grain (t/ ha) in a 2013 trial/ treatments		
	Control	Speedy (6,2 mM Mo and 0,4 mM Co; pH=7,1)	Wuxal extra CoMo (4,8 mM Mo and 0,3 mM Co; pH=5,5)	Control	Speedy (6,2 mM Mo and 0,4 mM Co; pH=7,1)	Wuxal extra CoMo (4,8 mM Mo and 0,3 mM Co; pH=5,5)
1	3,10	1,72	2,24	3,725	3,533	2,655
2	1,42	2,70	1,91	3,027	0,666	3,048
3	3,07	2,56	2,83	1,098	2,234	1,402
4	2,49	1,70	3,39	2,939	3,000	1,969
5	-	-	-	2,410	1,880	2,710
X±	2,52 ±0,79	2,17 ±0,53	2,59 ±0,65	2,640 ±0,981	2,263 ±1,102	2,357 ±0,662

Table 2. Yield of soybean (G. max. Merr.; cv. "ZP015") grain per area unit (t/ ha)

Year of trial/ trial repeats	Yield of soybean grain (t/ ha) in a 2012 trial/ treatments			Yield of soybean grain (t/ ha) in a 2013 trial/ treatments		
	Control	Speedy (6,2 mM Mo and 0,4 mM Co; pH=7,1)	Wuxal extra CoMo (4,8 mM Mo and 0,3 mM Co; pH=5,5)	Control	Speedy (6,2 mM Mo and 0,4 mM Co; pH=7,1)	Wuxal extra CoMo (4,8 mM Mo and 0,3 mM Co; pH=5,5)
1	2,731	3,446	1,645	2,342	2,943	4,266
2	2,061	2,912	2,467	2,524	3,365	4,357
3	3,535	2,200	3,420	2,897	3,373	4,594
4	1,965	2,021	2,720	2,529	4,574	2,873
5	1,625	0,835	1,869	-	-	-
X±	2,383 ±0,758	2,283 ±0,990	2,424 ±0,706	2,573 ±0,233	3,564 ±0,703	4,022 ±0,779

Preliminary results of analysis of influence of Mo/Co fertilizer with pH 5.5 ("Wuxal extra CoMo") on the chemical composition of cultivar "Nena" during the 2008 season indicated reduction of the seed content of Ca, Mg, Fe, Mn, oil, inorganic and phytic P, while increasing the content of Cu, Zn, GSH, phenolic and -carotene, the same total phosphorus content, all against control plants (Table 3). Preliminary results of analysis of influence of Mo/Co fertilizer with pH 5,5 on the seed chemical composition of soybean cultivar ZP015 during the first season (2012) indicated higher content of Ca, Mg, Fe, Cu, Zn, total phosphorus, Pi, GSH and phenolic, same content of oil, and lower content of phytic P and -carotene, all against control plants. In same soybean cultivars results of analysis of influence of treatment of Mo/Co fertilizer with pH 7,1 ("Speedy") on the seed chemical composition indicated lesser effects (Table 3).

Table 3. Content of different elements, compounds and metabolits in soybean grain

Content of different elements, compounds and metabolits in soybean grain; $\underline{X}\pm$	Soybean cultivar/ year of trial				
	"Nena"/ 2008		ZP015/ 2012		
	treatment		treatment		
	control	Wuxal extra CoMo (4,8 mM Mo and 0,3 mM Co; pH=5,5)	control	Speedy (6,2 mM Mo and 0,4 mM Co; pH=7,1)	Wuxal extra CoMo (4,8 mM Mo and 0,3 mM Co; pH=5,5)
Ca (mg/g)	2165,62±75,13	2012,50±0,00	2287,50±17,68	2243,75±35,36	2375,00±97,23
Mg (mg/g)	2268,75±61,87	2221,88±13,26	2284,38±48,61	2253,12±30,94	2456,25±97,23
Fe (mg/g)	52,25±2,83	46,78±0,04	65,66±0,49	67,28±1,55	89,31±7,25
Cu (mg/g)	10,75±2,48	14,28±1,10	11,81±1,50	10,47±0,75	16,25±2,30
Mn (mg/g)	21,06±0,44	19,03±1,10	29,66±1,37	28,47±0,04	28,91±0,66
Zn (mg/g)	30,38±2,92	35,28±3,49	34,41±2,78	34,91±1,28	40,88±3,80
P (µg/g)	12554,56± 26,94	12516,46± 80,83	13430,90± 80,83	12459,31± 161,65	15012,13± 107,77
Pi (µg/g)	0,4120± 0,0241	0,3986± 0,0048	0,2983± 0,0086	0,4853± 0,0134	0,5547± 0,0054
P_{phytic} (µg/g)	16959,59± 128,67	16335,26± 51,57	12876,90± 471,98	11157,76± 375,23	10746,77± 647,97
Crude oil (%)	18,11	17,96	20,61	20,27	20,73
GSH (nmol/g)	614,95± 0,92	632,81± 6,95	421,20± 18,83	839,37± 3,60	1061,52± 3,13
-karoten (µg/g)	16,49± 0,02	18,40± 0,04	13,53± 0,04	12,09± 0,17	11,78± 0,13
Total phenols (µg/g)	1288,89± 18,83	1344,68± 14,15	754,96± 26,24	1346,41± 14,90	1459,54± 5,70

In the first season (2008) of growing varieties "Nena", we see strong growth of the plants during vegetative and the first part of the generative growth stages of soybean plants, which coincides with intense photosynthetic activity (Table 5). But in second part of the generative growth stages of soybean plants of the variety "Nena", we see a practical cessation of growth (Table 5) and reduced photosynthetic activity (Table 6), the redistribution of weight towards the generative organs ("Pouring seed"; Table 4). However, this process is somewhat slower in soybean plants treated with Mo/Co fertilizer with pH 7.1. But, as you note, this retention of photosynthetic competency in soybean plants treated with Mo/Co fertilizer with pH 7.1 (Table 6) has no effect on the final yield (Table 1).

Table 4. Parameters of dry matter acumulation and partitioning between soybean (*G. max. Merr.*; cv. "Nena") plant parts during different Mo treatment. 2008 trial

Parameters of dry matter acumulation and partitioning	Tretmants by different Mo fertilizers / time of plant harvesting								
	Control			Speedy (6,2 mM Mo and 0,4 mM Co; pH=7,1)			Wuxal extra CoMo (4,8 mM Mo and 0,3 mM Co; pH=5,5)		
	21.07 (t_1)	28.08 (t_2)	13.10 (t_3)	21.07 (t_1)	28.08 (t_2)	13.10 (t_3)	21.07 (t_1)	28.08 (t_2)	13.10 (t_3)
LMR (g/g)	0,339± 0,030	0,260± 0,020	0,059± 0,087	0,333± 0,033	0,249± 0,041	0,018± 0,034	0,330± 0,036	0,260± 0,024	0,072± 0,108
RMR (g/g)	0,106± 0,014	0,087± 0,017	0,109± 0,029	0,094± 0,036	0,087± 0,013	0,128± 0,068	0,096± 0,022	0,101± 0,010	0,089± 0,022
SMR (g/g)	0,275± 0,033	0,238± 0,097	0,202± 0,075	0,275± 0,044	0,210± 0,063	0,168± 0,099	0,242± 0,082	0,275± 0,052	0,210± 0,054
AtMR (g/g)	0,468± 0,022	0,436± 0,049	0,332± 0,073	0,490± 0,036	0,438± 0,031	0,364± 0,101	0,493± 0,016	0,447± 0,047	0,362± 0,047
GtMR (g/g)	0,027± 0,003	0,184± 0,071	0,483± 0,128	0,026± 0,009	0,212± 0,049	0,481± 0,167	0,024± 0,003	0,178± 0,071	0,468± 0,146
dLMR (g/g)	0,059± 0,024	0,034± 0,027	0,012± 0,012	0,057± 0,032	0,016± 0,012	0,009± 0,009	0,062± 0,037	0,014± 0,009	0,013± 0,010
lnTDW (g)	2,85± 0,29	3,34± 0,85	3,40± 0,49	2,97± 0,28	3,65± 0,44	3,64± 0,77	2,83± 0,34	3,29± 0,42	3,45± 0,40

Table 5. RGR plant growth parameter of soybean (*G. max. Merr.*; cv. "Nena") treated by different Mo fertilizers during various times. 2008 trial. RGR_1 plants: control plants; RGR_2 plants: plants treated with „Speedy" fertilizer; RGR_3 plants: plants treated with „Wuxal extra CoMo" fertilizer; (RGR = 1000 X ((ln TDW(t) – ln TDW(t-1))/ (t - (t-1)))

RGR ($mg\ g^{-1}\ day^{-1}$)	RGR values in soybean plants treated by different Mo fertilizers in various time intervals		
	RGR_1	RGR_2	RGR_3
RGR ($t_2 – t_1$)	14,00	19,43	13,14
RGR ($t_3 – t_2$)	1,33	-0,22	3,56

Table 6. PAR during measurements and parameters of Chla fluorescencije and photosynthesis (PS_2, ETR) measured on the younger whole developed soybean (*G. max. Merr.*; cv. "Nena") trifoliate leaves, treated by different Mo fertilizers during various times. 2008 trial

Parameter of Chla fluorescence and photosynthesis and the light during measurements	Tretmants by different Mo fertilizers / time of plant harvesting					
	Control		Speedy (6,2 mM Mo and 0,4 mM Co; pH=7,1)		Wuxal extra CoMo (4,8 mM Mo and 0,3 mM Co; pH=5,5)	
	21.07	28.08	21.07	28.08	21.07	28.08
PS_2	0,686 ±0,072	0,568 ±0,105	0,648 ±0,067	0,644 ±0,069	0,654 ±0,044	0,519 ±0,120
ETR (µmol of elektrons $m^{-2}\ s^{-1}$)	404,63 ±115,80	332,80 ±88,08	392,96 ±103,20	393,23 ±64,51	438,52 ±49,33	335,98 ±96,72
PAR (µmol of photons $m^{-2}\ s^{-1}$)	1473,20 ±370,76	1475,25 ±347,83	1507,12 ±301,33	1529,50 ±225,68	1673,25 ±105,85	1608,50 ±177,10

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AMPELOGRAPHIC CHARACTERISTISTICS OF TWO FORMS OF GRAPEVINE CULTIVAR TRAMINER IN VINEGROWING SUBREGION OF NIŠ

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Abstract

Traminer is a very old and widespread cultivar with many biotypes characterized by diversity of genetic and phenotypic properties. Researches included two Traminer cultivar forms: Gewürztraminer and Red Traminer. The study was done in the collection vineyard of the Center of Viticulture and Enology of Niš. The collection vineyard was established in 1995, with planting space 3 x 1.2 m. The investigation lasted three years (2004-2006), and it included phenological observations, fertility, grape yield of the examined Traminer cultivar forms, resistance to Botrytis cinerea and wine quality. This paper also gives a detailed ampelographic description Traminer cultivar forms, according to OIV descriptors. The purpose of this paper is to determine growth, fertility, yield, and grape and wine quality of the examined Traminer cultivar forms in the viticultivar subregion of Niš. Average grape yield varied depending on conditions of the particular year. Red Traminer recorded higher yield. Red Traminer wine has been awarded the average organoleptic grade of 18.44 points, which classifies it in the category of top-level white wines. Wine tasting grade awarded to Gewürztraminer wine is 18.21 points, which classifies it in the category of top-level white wines. According to the results obtained, the examined forms could successfully grow in this region. In addition, the best vines have been selected within the forms, and they will be used in further studies and multiplication.

Key words: *Ampelographic Description, Fetility, Traminer, Variety.*

Introduction

Traminer is an old European grape variety which still has a burden of unanswered questions and attracts attention of scientist in viticulture and enology. The variety, as well as its clones and subvarieties, is described by many researchers, and all of them pointed out to its great variability in quantitative and qualitative traits (Zirojevi , 1974; Galet, 1998; Cindri et al., 2000; Imazio et al., 2002; Kaserer et al., 2003; Santiago et al., 2007). The first written data about this variety go back to XV century (Goethe, 1887). There is an opinion that its origin is Tyrolese town Tramin in Italy, from where it speeded to many European countries (Goethe, 1887). Traminer is a heterogeneous variety with several clones and sub varieties, and there are some disputes about them. Thus, according to botanical characteristics Gewürztraminer is identical to Red Traminer, but some researchers reported it as a separate variety (Pospišilova, 1981). In many papers Hillebrand (1984) did not mention Red Traminer but Gewürztraminer. On the contrary, Nemeth (1975) did not regard Gewürztraminer as a separate variety but as a variant of Red Traminer. Gewürztraminer showed the greatest success in Alsace. During late XIX century Alsatians used name Gewürztraminer for this variety and wine from it, although the name was officially approved in 1973. Because of its limited popularity and difficulties that follow its production, area under Gewürztraminer is in stagnation throughout the world.

Approximate areas under Gewürztraminer are the following: Alsace 2500 ha; Germany less than 1000 ha; Australia 600 ha; California 690 ha. In the vine growing regions of Serbia this variety can be met only in collection vineyards, while in production vineyards it is almost completely absent. Red Traminer with its more productive subvarieties is dominant, but those genotypes have weaker scent than that usually expected from Traminer (Zirojevi , 1974; Žuni , 1995; Cindri et al., 2000).

This paper has been aimed to establish growth, productivity, grape yield, as well as quality of grapes, must and wine of the variety Gewürztraminer, which can improve knowledge about properties of this variety and its suitability for growing in the conditions of Niš subregion.

Material and Methods

The investigation has been carried out during the period 2004-2006 in the collection vineyard of the Center for Viticulture and Enology at Niš. This grape varieties' collection is located in vine growing subregion of Niš, characterized by moderately continental climate with average annual air temperature of 11.8^{o}C and average vegetational air temperature of 18.1^{o}C. The absolute minimum of air temperature during the study was -18.2^{o}C. The average annual precipitation amount in the observed period was 750 mm, 422 mm of which fell during vegetation. Soil type was eutric cambisol. The vineyard was established in 1995, with planting distance of 3x1.2 m (2777 vines per ha), which was universal value for the all varieties at this collection vineyard. Bud load per vine was 20 buds or 6.6 buds per m^2. The trial was set in random complete block design with four replications, and the data were processed by analysis of variance. Ampelographic description has been done according to the descriptor list of OIV. Resistance to *Botrytis cinerea* was estimated by means of OIV descriptor, Code 459: 1 – 3 very low resistance, 5 – medium resistance, 7 – 9 high or very high resistance. Must quality, presented through the average content of sugar and total acid, was determined on representative samples during the vintage. Oechsle´s scale was used to measure sugar content, while titration with N/4 NaOH was applied in order to measure the total content of acid. Microvinification and chemical analysis of wine were carried out in the enological laboratory of the Viticulture and Wine Production Center of Niš. The quality of the wine produced was determined based on the results of the chemical analysis and organoleptic assessment made by the wine tasting commission of the Faculty of Agriculture, University of Belgrade. The all observed parameters were determined by standard ampelographic procedures.

Results and Discussion

Ampelographic description has been done according to the descriptor list for grape varieties and *Vitis* species by OIV and harmonized with its 2nd edition (OIV, 2009).

Table 1. Ampelographic description of the Traminer forms using OIV descriptor

Code	Gewürztraminer	Red Traminer
OIV 001	5	5
OIV 003	3	3
OIV 004	7	7
OIV 006	3	3
OIV 065	3	3
OIV 067	4	4
OIV 068	2	2
OIV 069	5	7
OIV 080	2	2
OIV 082	1	1
OIV 086	7	7
OIV 093	3	3

OIV 101	2	2
OIV 103	3	3
OIV 353	3	3
OIV 151	3	3
OIV 202	3	3
OIV 204	7	7
OIV 206	1	1
OIV 220	3	3
OIV 222	2	2
OIV 223	3	3
OIV 225	1	3
OIV 236	2	2
OIV 503	1	3
OIV 242	5	5
OIV 243	1	1

The examined Traminer forms did not show any considerable differences based on the acquired data on ampelographic and botanical description of the tip of a young shoot, a leaf, a blossom, a flower, a bunch and a mature shoot (Table 1).

The number of developed and fertile shoots considerably varied between the examined forms of Traminer cultivar (Table 2).

Table 2. The number of developed and fertile shoots

Forms	The number of developed shoots				The number of fertile shoots			
	2004	2005	2006	Average	2004	2005	2006	Average
Gewürztraminer	16.50	14.75	17.92	16.39	12.25	8.67	14.50	11.81
Red Traminer	17.58	16.08	17.17	16.94	13.17	11.17	13.50	12.61
Average	17.04	15.41	17.54	16.66	12.71	9.92	14.00	12.21
Lsd $_{0.05}$	Years 0.57		Forms 0.65		Years 1.18		Forms 1.36	

The number of developed and fertile shoots was not considerably varied between the examined forms of Traminer cultivar (Table 2). Out of the total number of Gewürztraminer shoots left at pruning, about 16.39 shoots, of which 11.81 fruit bearing ones, developed. As for Red Traminer, 16.94 shoots, of which 12.61 fruit bearing ones, developed out of the 20 shoots left.

In the examination years, meteorological conditions considerably influenced differentiation of fertile buds and the development of fertile shoots.

In both forms, there were approximately as much developed and fertile shoots per vine as in the first and the third year, i.e. considerably more than in the second year of examination.

Yield parameters (yield per bud, grape yield per developed shoot, grape yield per fertile shoot, grape yield per vine, grape yield per hectare, bunch weight) were not varied significantly ($p>0.05$) between the examined forms, while between the examination years varied significantly ($p<0.05$) Table 3. The highest yield per vine in Gewürztraminer (2.099 g) was in the third (2006) year, and the lowest (1.196 g) in the second (2005) examination year. Red Traminer had the highest yield per vine (2.581 g) in the first (2004) year, and the lowest (1.267 g) in the second (2005) year. The data obtained clearly indicated that the lowest yield in both forms was in the second year, namely much lower than in the other two years of examination. Grape yield per hectare varied in the same manner as grape yield per vine.

Table 3. Grape yield of the examined Traminer cultivar forms

Form	Gewürztraminer				Red Traminer				Lsd $_{0.05}$	
	2004	2005	2006	Average	2004	2005	2006	Average	Years	Forms
GYB (g)	91.38	59.83	104.96	85.39	129.0	63.4	97.1	96.5	17.3	20.0
GYDS (g)	106.67	81.52	117.71	101.97	146.4	79.2	112.9	112.9	18.9	21.9
GYFS (g)	145.96	136.60	145.00	142.52	192.5	114.4	142.4	149.8	15.6	18.0
GYV (g)	1.827	1.196	2.099	1.707	2.581	1.267	1.942	1.931	346	400
GYH(kg/ha)	5.074	3.322	5.829	4.742	7.169	3.521	5.395	5.361	-	-
BW (g)	98.39	107.22	97.56	101.05	124.67	98.74	100.34	107.91	11.46	13.23

GYB – grape yield per bud, GYDS – grape yield per developed shoot, CYFS – grape yield per fertile shoot, GYV – grape yield per vine, GYH – grape yield per hectare, BW – bunch weight.

According the grape yield per hectar, Red Traminer (5.361 kg/ha) and Gewürztraminer (4.742 kg/ha) falls within the scope of low yield (up to 6.000 kg/ha). Gewürztraminer, with the average number of 17 bunches per vine, produced the average bunch weight of 101.05 g. on the other hand, Red Traminer, with the average number of 18 bunches per vine recorded the bunch weight of 107.91 g. Differences in the bunch weight between the examined forms, and examination years as well, were not significant. Bearing in mind that yield is mainly dependent on the number of bunches and the average bunch weight, in our researches the yield was more dependent on the number of bunches than on the average bunch weight. Taking into account biological features of Traminer forms, we can say than the yields during the research period were regular and low.

Red Traminer showed a high level of resistance, while somewhat lower resistance level was registered in Gewürztraminer (Table 4). The highest resistance level was registered in the first (2004) year (8.0), while the strongest *Botrytis cinerea* attack was registered in the second and third (2005) examination year (6.0). Data on the resistance level obtained in our researches are similar to the earlier reported data for Traminer cultivar, but there are certain discrepancies. Zirojevic (1974) stated that Red Traminer has medium sensitivity to the *Botrytis cinerea* attack, while in our examinations it was classified as a highly resistant cultivar.

Table 4. Resistance of Traminer forms to *Botrytis cinerea* (OIV Code 459)

Form	2004	2005	2006	Average
Gewürztraminer	7	5	5	5.6
Red Traminer	9	7	7	7.6
Average	8.0	6.0	6.0	6.66

A high content of sugar (23.03%) was registered in the must of the Gewürztraminer form characterized by a high average yield (Table 5). Red Traminer recorded lower sugar content (20.94%). The lowest grape yield in the second year did not cause the increase of the sugar content in must. Traminer forms had a high content of acids in must (7.82 g/l in average). This indicator was especially prominent in Red Traminer with 8.15 g/l of total acids.

Table 5. Content of sugar and total acid in must of Traminer cultivar forms

Form	Sugar content (%)				Total acid content (g/l)			
	2004	2005	2006	Average	2004	2005	2006	Average
Gewürztraminer	24.40	21.56	23.13	23.03	7.13	7.19	8.20	7.50
Red Traminer	23.02	19.12	20.68	20.94	7.83	8.44	8.20	8.15

Traminer is a grapevine cultivar that produces wine which European winemakers call the king of wine. Table 6 data indicate that the alcohol content in wine appropriately expressed, analogously to the sugar content. A higher alcohol content was obtained in Gewürztraminer wine (14.19%). Content of the total extract varied from 18.95 g/l in Red Traminer wine to 19.95 g/l in Gewürztraminer wine. Content of the total acid varied within the limits of 5.4 g/l in Red Traminer wine to 6.8 g/l in Gewürztraminer wine. Red Traminer wine has been awarded the average organoleptic grade of 18.44 points, which classifies it in the category of top-level white wines. Wine tasting grade awarded to Gewürztraminer wine is 18.21 points, which classifies it in the category of top-level white wines.

Table 6. Chemical composition and organoleptic assessment of wine of the Traminer cultivar forms

Form	Gewürztraminer	Red Traminer
Specific gravity	0.9893	0.9907
Alcohol (%)	14.19	12.67
Total extract (g/l)	19.95	18.95
Reducing substances (g/l)	1.2	1.0
Sugar-free extracts (g/l)	19.75	18.95
Titratable acidity (g/l)	6.8	5.4
Volatile acids (g/l)	0.51	0.55
Total SO_2 (mg/l)	59.5	71.0
Free SO_2 (mg/l)	11.0	13.5
Ash (g/l)	1.82	1.74
Phenolic substances (g/l)	0.14	0.16
Organoleptic assessment	18.21	18.44

Conclusion

According to the ampelographic and botanical description, between two examined Traminer grapevine forms (Gewürztraminer and Red Traminer) were not found big differences.

Average values of yield parameters of the Red Traminer were not considerably higher than those of the Gewürztraminer, excluding the bunch weight. The yield per hectar was small (4.742 kg/ha), and average (5.361 kg/ha) in Gewürztraminer and Red Traminer respectively.

Red Traminer showed high resistance level to *Botrytis cinerea*, while in Gewürztraminer resistance level was slightly weaker.

Chemical composition of wines of the examined Traminer cultivar forms showed that they had high content of alcohol and a favorable content of the total acids. Organoleptic assessment of the wine fluctuated between 18.21 points (Gewürztraminer) and 18.44 (Red Traminer), which could be considered highly satisfactory.

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EFFECT OF ADDITIONAL FERTILIZING WITH NITROGEN ON FORAGE YIELD IN RED CLOVER-ITALIAN RYEGRASS GRASS-LEGUME MIXTURE

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Abstract

The high and stable yields of good quality forage on lawns can be achieved with proper fertilization and rational utilization. The aim of this study was to analyze the impact of the additional application of nitrogen fertilizer in red clover-Italian ryegrass grass-legume mixture on forage yield, hay yield and the proportion of red clover, Italian ryegrass and weeds in the total hay yield. The field experiment was set up 2011th in a ak (Serbia) on fluvisol soil type, acid reaction (pH_{H2O} 4.8), using a randomized block design with three replications and experimental unit 5x1m. Together with the primary tillage in the autumn, the soil was entered 300 kg ha^{-1} $N_{15}P_{15}K_{15}$. Red clover cv. K-39 and Italian ryegrass cv. Tetraflorum were seeded at 20 cm inter-row spacing, both with 12 kg ha^{-1} seed. The experiment included two treatments: without fertilization (control) and additional application of nitrogen fertilizer (KAN - 27 % N) in the rate of 40 kg ha^{-1} early in the spring 2012th and 2013th. Additional application of nitrogen did not significantly increase yields of forage and hay in all cuts in both years. In the second year, nitrogen fertilization led to a significant increase in the share of Italian ryegrass in the hay, with a proportional decrease of red clover and weeds, in both cuts. This may be due to the pronounced competitiveness and faster growth of Italian ryegrass in relation to red clover, especially in drought conditions. In the third year of cultivation, there were no plants of Italian ryegrass and additional feeding resulted in a significant increase in the proportion of red clover in the hay, at the expense of reducing the share of weeds.

Key words: *additional fertilization, Italian ryegrass, nitrogen, red clover*

Introduction

In the Republic of Serbia (RS) the lawns participate with over 27 % of agricultural land (Djuki et al., 2008). Forage production is mainly realized in natural meadows and pastures and partly in the growing fields of red clover, alfalfa, mixtures of grasses and legumes, etc. Along with efforts to reduce energy consumption, environmental pollution, to intensify sustainable agriculture systems and sustain biodiversity, the possibility of the more frequent introduction of the forage legumes into grass mixtures should be considered. In this way, the use of mineral nitrogen fertilizers is reduced and thus the possibility of loss of nitrogen from the soil by leaching or gas emission (Ledgard et al., 1999). According to Vinther and Jensen (1999), the symbiotic nitrogen fixation at legumes is a fundamental process for maintaining soil fertility of soils and continuous productivity of the organic growing systems. By the cultivation of legumes and grasses in mixture, the more profitable production and better quality forage is achieved (Neši et al., 2007). The share of weeds in the total yield of grass-legume mixture is significantly lower than the pure crop of grasses or legumes (Sleugh et al., 2000).

In the period of 2001-2005, the average hay yield in the meadows of the RS ranged from 1.5-2.0 t ha^{-1} (SGS, 2006). The most frequent cause of low and unstable sward yield, and low

quality of forage is the lack of application of agro-technical measures (Dubljevi , 2007). With the proper fertilization of meadows and pastures with mineral and organic fertilizers, with rational exploitation, under the same conditions, it is possible to achieve the several times increase of the hay yield, while improving the quality of forage (Stevanovi et al., 2004; Neši et al., 2004; Vu kovi et al., 2004). One of the most important nutrients for achieving high forage yields of natural grasslands is nitrogen. Vitousek and Howarth (1991), Frink et al. (1999), LeBauer and Treseder (2008) point out that nitrogen is usually the limiting factor for high production of natural grasslands.

Soil acidity is one of the factors that complicate the cultivation of many crop plants, both legumes and grasses (Edmeades et al. 1981; Wheeler 1998). On acid soil *Rhizobia* bacteria survival is difficult and reproduction is slow, which results in lower yields of legumes (Nutman, 1976).

The aim of this study was to study the effect of additional nitrogen fertilizing of soil on the forage yield of red clover-Italian ryegrass grass-legume mixture on acid soil.

Materials and methods

The experiment was established in the period 2011-2013 in a ak (43°54'39.06" N, 20°19'10.21" E, 246m a.s.l.), on alluvial soil, acid reaction (pH$_{H2O}$ 4.8), which contains 3.18% organic matter, 0% $CaCO_3$, 22.08 mg P_2O_5, 30.0 mg K_2O 100 g^{-1} soil (Gupta, 2008). Along with tillage, 300 kg ha^{-1} $N_{15}P_{15}K_{15}$ was incorporated into the soil. The experiment was set up in a completely randomized block design with three replications, with a plot size of 5m^2 (5x1m). The analyses were carried out at grass-legume mixtures of red clover (cultivar K-39, Institute for Forage Crops, Krusevac) and Italian ryegrass (Tetraflorum – Slovenian tetraploid variety). The experiment included two treatments: without fertilization (control) and additional application of nitrogen fertilizer (KAN - 27 % N) in the rate of 40 kg ha^{-1}. Nitrogen fertilization was done in the spring just before the start of the growing season in 2012 and 2013. Sowing was done with row spacing of 20 cm (Italian ryegrass and red clover were sown in the same rows), with the amount of seeds 12 kg ha^{-1} of red clover and 12 kg ha^{-1} of Italian ryegrass. The crop was grown without irrigation.

The mean annual air temperature in 2011, 2012, and 2013 was 12.37°C, 13.12°C and 12.99° respectively and amount of annual rainfall 374.5 mm, 463.5 mm and 582.7 mm respectively (Table 1). The average annual air temperature for the multi-year period (1992-2002) is 11.97°C, and the average amount of annual rainfall 680.3 mm.

The analyses were performed on the first and second cut in the second year of cultivation (2012) and the third cut in the third year of cultivation (2013). Mowing was done in the budding stage. Green forage yield was determined by measuring the total mass of the plot immediately after cutting at the optimum stage of growth and development of the plants. From a measured sample (1000 g) the weight share of grasses (*fam. Poaceae*), legumes (*fam. Fabaceae*) and the other species in the green fodder was determined. After drying the samples at 65°C, the hay yield (t ha^{-1}) was calculated. The results were subjected to a single-factor analysis of variance (ANOVA) using the SPSS 4.5 software. Significant differences between mean values were tested by the LSD test.

Table 1. Precipitation (P) and mean monthly temperatures (t) during 2011, 2012, 2013 and several years average (1992-2002).

Month	1	2	3	4	5	6	7	8	9	10	11	12	$\bar{x}$ i Σ
2011													
t (°C)	0.7	0.7	7.6	13.1	16.7	22	23.8	23.7	21.6	11.8	3.7	3	12.366
P (mm)	22	29	31	15.5	95.5	47	30.5	9.5	42	21	2.5	29	374.5
2012													
t (°C)	1.8	-2.5	6.8	12.2	17.3	24.1	26.6	25.4	20.9	13.8	9.5	1.4	13.12
P (mm)	60	70	10	47	68	38	22	0	7.2	30	23.7	87.6	463.5
2013													
t (°C)	3,5	3.8	6,6	13.2	18,2	20,6	23,3	24,1	17,2	14,5	8,9	2,0	12,99
P (mm)	51,0	68,0	65,7	37,0	78,5	61,5	10,0	62,5	87,0	17,0	40,5	4,0	582,7
1992-2002													
t (°C)	0.5	3.1	7.6	11.7	17.9	21.3	22.6	23	16.8	12.2	6.1	0.8	11.97
P (mm)	30.7	38.9	42.5	51.2	56.4	88.4	82.6	51.6	74.9	57.6	52.8	52.7	680.3

Results and discussion

Growing of grasses in mixture with legumes leads to the increase of the biological value of soil and fixation of significant amounts of nitrogen by bacteria of the genus *Rhizobium* which could be used by the plants (Wheeler, 1998). Increased biological value of soil affects the increase of organic matter mineralization in the soil (Wheeler, 1998), which contributes to the more intensive growth of grasses and achieving higher yields. According to Mandi et al. (2004) the highest biological value of the soil of the several examined grass-legume mixtures has been noted under a mixture of red clover and Italian ryegrass. Italian ryegrass is an ideal species for growing in mixture with red clover (Simi et al., 2011). Additional nitrogen fertilization in the first cut in 2012 did not affect the significant increase of the forage and hay yield of the grass-legume mixture (Table 2). The average forage yield was 42.35 t ha^{-1}, and the average yield of hay 19.17 t ha^{-1}. Additional nitrogen fertilization in the second cut in 2012 and in the first cut in 2013 as well did not significantly affect the increase of forage and hay yield. The total forage yield in the second cut in 2012 in the control treatment was by 70.2% lower, and in the treatment with additional nitrogen fertilization 78.8% lower in relation to the first cut in 2012. In the first cut in 2013 (the third year of production) forage yield was lower than in the first cut in 2012 by 63.8% in the control treatment and by 66.6% lower in the treatment with fertilization. According to Dubljevi (2007), natural lawn fertilization with nitrogen is very important because its application increases forage and crude protein yields, potentiates growth and tillering of grasses, increases the density of grass cover, extends vegetation and slows down the aging of plants. According to Xia and Wan (2008), fertilizing the lawn with nitrogen increases the yield of carbon in the aboveground part, directly by entering the life processes of the plants and indirectly, by affecting on the rapid mineralization of organic matter in the soil (Nowinski et al., 2008). Vu kovi et al. (2004) reported that application of 160 kg N ha^{-1} resulted in the increase of the natural lawn biomass by 153% compared to the control. Ivanovski et al. (2004) point out the positive effects of surface application of manure and mineral fertilizer in spring on the dry matter yield of the grasslands, while not identified significant changes in the chemical composition of the dry matter. Ocokolji et al. (1983) indicate that the application of nitrogen fertilizers significantly increases the yield and content of proteins, which is, according to Alibegovi -Grbi et al. (2004), above all the consequence of increase in dry matter yield. According to Stevanovi et al. (2004), Neši et al. (2004), Vu kovi et al. (2004), Alibegovi -Grbi et al. (2004), Stevens et al. (2004), fertilization may significantly affect the yield and quality of dry matter of natural grasslands, as well as the change in their floristic composition. Poor response of the grass-legume mixture of red clover and Italian ryegrass to additional nitrogen fertilizing of our

research proves that due to leguminous component in the mixture, nitrogen was not a limiting factor for achieving high yields.

Table 2. The effect of additional nitrogen fertilization on yield of forage (GFY) t ha^{-1}, hay yield (HY) t ha^{-1}, the proportion of Italian ryegrass (IR%), red clover (RC%) and weeds (W%) (%) in total forage yield of grass-legume mixtures of red clover and Italian ryegrass.

		GFY	HY	IR%	RC%	W%
First cut 2012	O	39.20	9.03	76.3	22.8	1.46
	N	45.50	10.14	84.4	9.10	2.03
	ANOVA 0.05	ns	ns	ns	**	ns
	cv %	8.7	15.3	8.4	22.6	29
Second cut 2012	O	11.67	4.49	57	42.4	0.48
	N	9.64	3.2	77.9	20.2	1.98
	ANOVA 0.05	ns	ns	**	**	*
	cv %	13.9	29.3	6.4	13.8	27.3
First cut 2013	O	14.20	4.89	-	47.0	53.0
	N	15.20	5.37	-	76.7	23.3
	ANOVA 0.05	ns	ns	-	**	**
	cv %	19	23.8	-	6.4	10.3

** - F test significant at $p<0.01$; * - F test significant at $p<0.05$; ns - F test non-significant

The proportion of red clover in the total hay yield in the first and second cut in 2012 significantly decreased with additional nitrogen fertilization at the expense of increasing the share of Italian ryegrass and weeds share. This is due to a better reaction of Italian ryegrass whose competitiveness are somewhat more pronounced compared to the clover, when fertilized with nitrogen, especially in the drought conditions that occurred during the vegetation period in 2012. According to Garwood and Wiliams (1967) white clover (*Trifolium repens* L.) is more drought-tolerant than Italian ryegrass due to better nitrogen provision (due to the process of nitrogen fixation), whose adoption from the land is reduced in the conditions of lack of water. According to Živanovi -Kati (2004), denser crops suppress the weeds and prevent their mass appearance. Natural lawn fertilization with nitrogen leads to a reduction of plant diversity, reducing the presence of legumes and C4 plants and increase the presence of C3 plants (Gough et al. 2000, Stevens et al. 2004). According to Xia and Wan (2008), this phenomenon is the consequence of increased competition of plants, especially for light. Proportion of red clover was significantly higher in the second cut when compared to the first cut in 2012, which is the consequence of its greater tolerance to drought in relation to Italian ryegrass. In the first cut in 2013, the additional nitrogen fertilizing resulted in a significant increase in the proportion of red clover in relation to the control at the expence of reducing the share of weeds. There were no plants of Italian ryegrass, considering that this is the third year of crop, and the red clover crop was sparse and exausted. The additional nitrogen fertilization in such conditions contributed to a better regeneration and more rapid growth of red clover, particularly in the early stages of growth, leading to an increase of its competitive ability in relation to the weeds.

Conclusion

The high and stable yields of good quality forage on lawns can be achieved with proper fertilization and rational utilization. Additional application of nitrogen did not significantly increase yields of forage and hay in all cuts in both years. Weak reaction of red clover-Italian ryegrass mixture on additional nitrogen fertilizing proves that due to the leguminous

component in the mixture, the nitrogen was not a limiting factor for achieving high yields. However, the red clover share in the total hay yield in the first and second cut in 2012 significantly reduced with additional fertilizing with nitrogen at the expence of increase of Italian ryegrass and weed share. This is due to better reaction of Italian ryegrass, whose competitiveness are somewhat stronger compared with red clover, as a responce to fertilizing with nitrogen, especially in the drought conditions that occurred during the vegetation period in 2012. In the first cut in 2013, the additional nitrogen fertilizing affected significantly on the increase of red clover share in relation to the control treatment at the expence of reducing the share of weeds. Given that this is the third year of the crop, there was no Italian ryegrass, and the red clover crop was sparse and exausted. Additional nitrogen fertilization in such conditions contributed to a better regeneration and more rapid growth of red clover, especially in the early stages of growth, leading to an increase in its competitive ability in relation to the weeds.

Acknowledgements

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EFFECTS OF FERTILIZATION AND MULCHING ON YIELD OF EARLY CABBAGE

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Abstract

Two field experiments were organized at the experiment field of Agricultural Extension Service in Sombor in 2012 and 2013. Their purpose was to monitor the effects of different fertilization and mulching methods on the yield of early cabbage.

A two-factorial experiment was established to assess the effects of different fertilization methods (only organic fertilizers, organic and inorganic fertilizers combined, and only mineral fertilizers - factor A) and mulching (with and without black foil - factor B) on the dynamics of NO_3-N in the soil and the impact of the factors on the yield of early cabbage.

The results of the two-years research showed that the fertilization with ripe cattle manure and composted pig manure + mineral fertilizers, with and without foil, had higher amounts of NO_3-N that the other fertilization methods. The amounts of NO_3-N in the soil measured at the stage of complete leaf rosette were positively correlated with the yield of cabbage in all fertilization treatments except the treatment with ripe cattle manure in the experiment without foil. The highest yield of early cabbage in the experiment with foil was achieved in the fertilization variant with composted pig manure + mineral fertilizers. This variant also had the highest amount of NO_3-N in the soil, indicating a dependence of crop yield on the dynamics of nitrates in the soil.

Key words : *fertilization, mulching, cabbage, yield, NO_3-N*

Introduction

Vegetable crops form high yields in the course of a short growing season. This is why they have high requirements for nutrients, especially nitrogen which ensures high yields.

To be able to achieve high and stable yields of quality produce in a short growing season, vegetable crops need both mineral and organic fertilizers. Mineral fertilizers are rapidly acting sources of nutrients for plants. The application of organic fertilizers not only supplies the plants with necessary elements but also plays an important part in the process of enhancing soil fertility by improving its structure and hydro-physical properties, increasing organic matter concentration, and reducing the application of synthetic fertilizers (Grandy et al., 2002). Unlike mineral fertilizers, organic fertilizers have a long-lasting impact on chemical properties of the soil and consequently on the yield of crops grown, which is evident for several years after application (Gutser et al., 2005). Organic fertilizers contain most of the nutrients in the organic form, which become available to plants only after they turn into the mineral form following mineralization. Therefore, it is necessary to assess the mineralization capacity of organic matter from organic fertilizers by monitoring the dynamics of nitrates. Only then shall we be able to select fertilizers of appropriate composition and to time their incorporation into the soil, all aimed at harmonizing the release of nutrients with crop requirements (Bogdanovi et al., 1995; abilovski, 2009).

The dynamics of soil nitrates is determined by many factors, among which soil temperature and moisture are most important. Soil moisture directly affects the process of mineralization

and therefore the content of mineral nitrogen in the soil. Temperature directly affects the decomposition of organic matter, with microorganisms involved in this process having different temperature ranges. Field production of vegetables unfolds during the period when the soil temperature increases continuously (10-15-25-30°C) and so, as intensive vegetable production is not possible without irrigation, conditions are created for mineralization of the applied organic fertilizers and organic matter in the soil.

The rate of mineralization of organic fertilizers depends on fertilizer type, degree of organic matter decomposition, soil temperature, moisture, and microbial activity (Pansu and Truries, 2003; Bogdanovi et al., 2012). Excessive application of organic fertilizers, due to intense mineralization, may lead to a high accumulation of NO_3-N in the soil, its harmful level in plants and environmental pollution (Pang and Letey, 2000).

The objective of this study was to investigate the effect of different fertilization treatments on the soil under foil and without foil planted to early cabbage, the dynamics of NO_3-N in the soil, and the effect of the previous factors on the yield of cabbage.

Material and Methods

Dynamics of NO_3-N in the soil under early cabbage was monitored in a field experiment set in the split plot design with and without mulching foil. The experiment was factorial, with fertilization treatments as factor A and soil mulching, with and without foil, as factor B (Tab. 1).

Table 1. Fertilization treatments for early cabbage grown in the soil with and without mulching foil

No.	Experiment A With plastic foil Fertilization treatment	Experiment B Without plastic foil Fertilization treatment
1.	Control - no fertilizer	Control - no fertilizer
2.	MCM 20t ha-[1]	MCM 20t ha-[1]
3.	CPM 20t ha-[1]	CPM 20t ha-[1]
4.	MCM 20t ha-[1]+MF 11:11:21 (300kg ha-[1])	MCM 20t ha-[1]+MF 11:11:21 (300kg ha-[1])
5.	CPM 20t ha-[1] +MF 11:11:21 (300kg ha-[1])	CPM 20t ha-[1] +MF 11:11:21 (300kg ha-[1])
6.	MCP 20t ha-[1] + MF 11:11:21 (500kg ha-[1])	MCP 20t ha-[1] + MF 11:11:21 (500kg ha-[1])
7.	CPM 20t ha-[1]+ MF 11:11:21 (500kg ha-[1])	CPM 20t ha-[1]+ MF 11:11:21 (500kg ha-[1])
8.	MF 11:11:21 (300kg ha-[1])	MF 11:11:21 (300kg ha-[1])
9.	MF 11:11:21 (500kg ha-[1])	MF 11:11:21 (500kg ha-[1])

Legend: Mature cattle manure (MCM); Composted pig manure (CPM); Mineral fertilizers (MF)

Tab. 2 shows the initial agrochemical status of the soil in the experiment plots, before cabbage planting. The soil in the experiments was hydromorphic, semigley type (black meadow soils), with alkaline reaction, extremely calcareous, medium to poor in humus for vegetable production, medium provided with total and mineral nitrogen, medium to poor in readily available phosphorus and medium provided with readily available potassium.

The analysis of soil fertility was done by conventional methods. Samples for NO_3-N determination in the soil layers 0-30 and 30-60 cm were taken before the placement of

transplants, at the stage of full formation of the rosette, and at cabbage harvest. Determinations were done by the Nmin. method of Wehrmann and Scharpf (1979).

Table 2. Agrochemical properties of soil before cabbage planting

Year	Depth cm	pH		% CaCO$_3$	% humus	% N	mg 100g^{-1}		mg NO$_3$-N kg	
		H$_2$O	KCl				P$_2$O$_5$	K$_2$O	Before planting	After planting
2012	0-30	7.96	7.45	7,16	3.19	0.16	21.3	16,8	32,5	27.0
	30-60	8.26	7.47	15.59	2.25	0.11	3.3	13.7	64.6	38.0
2013	0-30	8.55	7.62	7.40	1.94	0.10	19.6	19.7	23.1	30.0
	30-60	8.78	7.87	17.98	1.80	0.09	5.1	12.1	23.9	23.0

Chemical composition of the applied organic fertilizers is shown in Tables 3 and 4. Amounts needed for fertilization of early cabbage were calculated on the basis of the nitrogen content in organic fertilizers (Table 1).
The obtained results were analyzed by the analysis of variance for two-factorial experiment.

Table 3. Chemical composition of the organic fertilizers used in the experiment

Organic fertilizer	% N		% P$_2$O$_5$		% K$_2$O	
	2012	**2013**	**2012**	**2013**	**2013**	**2013**
Composted pig manure (CPM)	1.30	3.07	3.58	4.90	1.68	1.32
Mature cattle manure (MCM)	1.20	2.20	1.82	3.17	0.33	0.91

Table 4. Concentration of micronutrients and heavy metals in the organic fertilizers (mg kg^{-1})

Fertilizer	**Mn**	**Fe**	**Zn**	**Cu**	**Cd**	**Ni**	**Pb**
Composted pig manure (CPM)	177	1087	35.8	5.54	1.56	78.86	7.12
Mature cattle manure (MCM)	123	792	170.1	31.69	1.52	88.62	3.63

Results and Discussion

Graph 1 show the dynamics of NO$_3$-N in the soil in the experiments conducted in 2012 and 2013, respectively. The dynamics was found to vary depending on the applied fertilization treatments. In both years of the experiment, higher amounts of NO$_3$-N were found, for all sampling dates and all fertilization treatments, in the variants with mulching foil than in the variants without it.
Significantly higher amounts of NO$_3$-N were found in the soil under foil than in the soil without foil, obviously because the former variant provided better conditions for mineralization of organic fertilizers. In the two years of the experiment, the variant with mulching foil provided higher soil temperatures, by 2-3°C, and higher soil moisture, by 1.5%-2.7%, than the variant without foil. The variations of the previous figures were due to the time of sampling.

The values of NO_3-N in the soil under cabbage obtained at the different sampling dates indicate that the mineralization of N from organic fertilizers was more intensive in the first part of the growing season, when the cabbage grew vigorously, than in the second part of the season, at the end of cabbage harvest when lowest values were registered.

The values of NO_3-N in the soil under cabbage obtained at the different sampling dates show the balance between the rate of mineralization of the applied organic fertilizers and soil organic matter on one side and the rate of immobilization of mineral nitrogen by the early cabbage crop and soil microorganisms on the other (Bogdanovi and abilovski, 2007; Bogdanovi and Ubavi , 2008; abilovski et al., 2010).
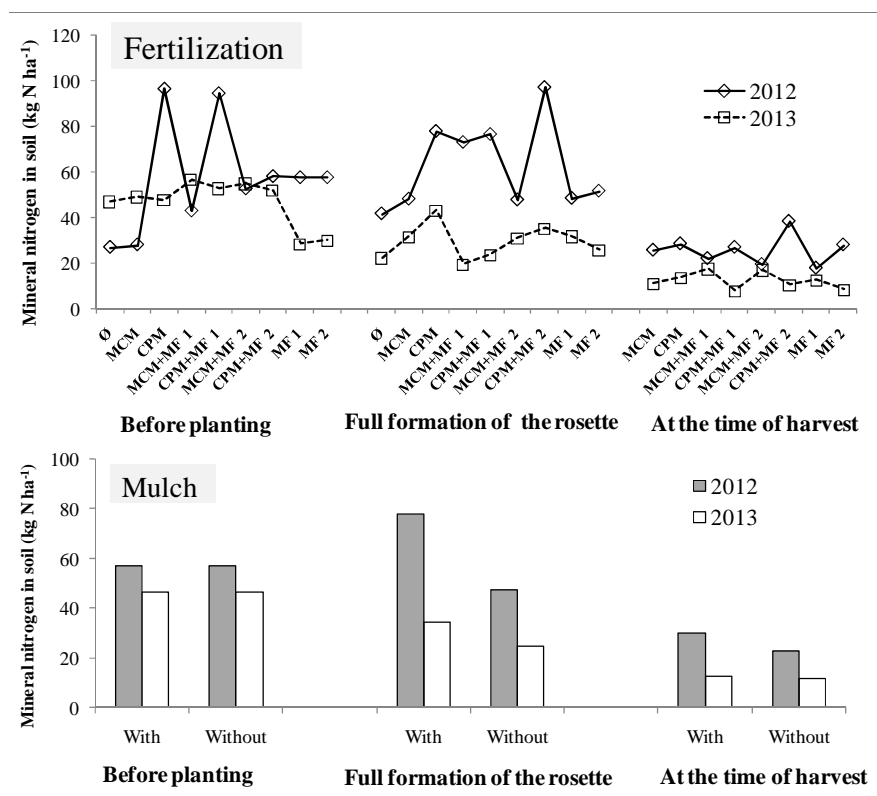
Legend: Mature cattle manure (MCM); Composted pig manure (CPM); Mineral fertilizers (MF)

Graph 1. Dynamics of NO_3-N in the soil under cabbage grown with and without foil depending on the fertilization treatments conducted in 2012 and 2013

The dynamics of NO_3-N in the soil under cabbage was in correlation with cabbage yields in both years. In all fertilization treatments, the yields of cabbage were significantly higher in the variant with mulching foil than in the variant without foil (Graphs 2). The higher yields of cabbage in the variant under foil were directly associated with the amounts of NO_3-N in the soil, as a consequence of better conditions for mineralization of organic fertilizers (soil moisture, temperature, and microbial activity) during cabbage growing season.

Highest yields of early cabbage were achieved in the treatments with composted pig manure and the higher and lower doses of mineral fertilizers, followed by mature cattle manure and the higher and lower doses of mineral fertilizer. Lowest yields were obtained with mineral fertilizers, higher with the higher dose, lower with the lower dose (Graphs 2).
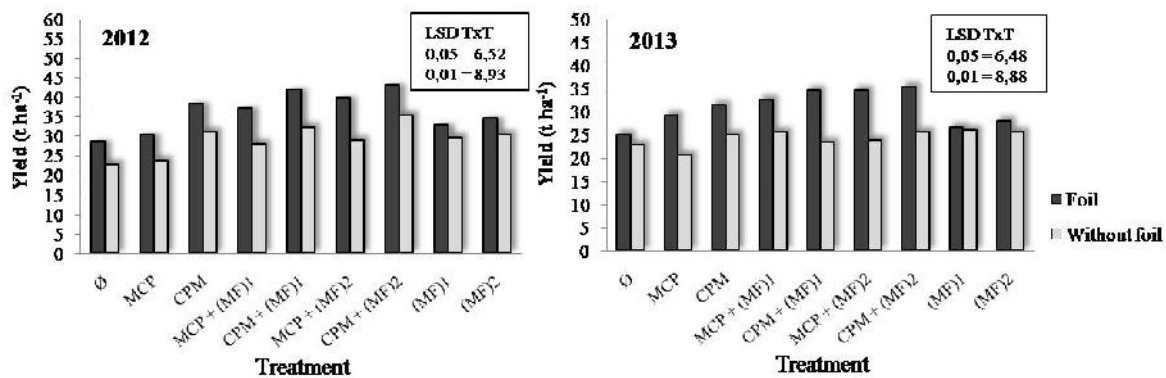
Legend: Mature cattle manure (MCM); Composted pig manure (CPM); Mineral fertilizers (MF)

Graph 2. Yield of early cabbage depending on fertilization treatment and mulching in 2012 and 2013

The higher cabbage yields in the treatment with composted pig manure than in the treatments with mature cattle manure and mineral fertilizers can be explained by the high solubility and mobility of biogenous elements, primarily nitrogen, in the first treatment compared with the other two treatments. According to Deni (2010), who studied corn, and Bogdanovi et al. (1995), who studied wheat, the effect of NO_3-N from liquid pig manure, in the year of application, was identical to the effect of the applied mineral fertilizers.

Conclusion

Following conclusions were drawn on the basis of monitoring the impact of different fertilization treatments and mulching of the soil under early cabbage on the dynamics of NO_3-N in the soil and yield of cabbage.
- Mineralization of NO_3-N from organic fertilizers was more intensive in the first part of the growing season, when cabbage growth was intense, and significantly lower in the last part of the growing season.
- In 2012, the largest amount of NO_3-N in the soil under cabbage was found in the variant with mulching foil, the treatment with composted pig manure and the higher fertilizer dose, at all sampling dates. In 2013, the largest amount of NO_3-N was found again in the variant with mulching foil and the treatment with mature cattle manure, but only at the stage of fully formed leaf rosette.
- In both years, at all sampling dates and in all fertilization treatments, larger amounts of NO_3-N were found in the variant with than in the variant without mulching foil.
- In both years, the yield of cabbage was significantly higher in the unfertilized variant with mulching foil than in the variant without foil.
- In all fertilization treatments, yields of cabbage were significantly higher in the variant with mulching foil than in the variant without foil.
Regarding the effect of the applied fertilizers on the yield of cabbage grown with and without mulching foil, highest effect was achieved with the combination of composted pig manure and mineral fertilizers, then by mature cattle manure and mineral fertilizers. The lowest effect was achieved when only mineral fertilizers were applied.

Acknowledgement

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GENETIC AND PHENOTYPIC VARIABILITY OF LENGTH OF SPIKE IN BREAD WHEAT GROWN UNDER DIFFERENT RATE OF NITROGEN NUTRITION

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Abstract

Variability of length of spike was studied in four wheat genotypes: G-3052, G-3625, G-3004 and G-3617, grown over two years under four nitrogen nutrition treatments: 0, 30, 60 and 90kg N ha^{-1}. The experiment was set up as a randomised block design in four replications. Differences in average values of length of spike among tested cultivars were determined in both years and under all variant of nitrogen fertilization. On average, for all genotypes, length of spike increased with increasing nitrogen rate in both years, it mean that phenotypic variability of length of spike was affected by nitrogen nutrition. In average for all cultivars length of spike was higher in the first year than in second year of experiment. The wheat genotypes G-3617 expressed highest length of spike (9.24cm) in average in the first experimental year while the wheat G-3625 had the least lowest (7.74cm) in average second experimental year. Spike length expression also highly depended to genetic factors (38.97%), but on this trait expression the environmental factors had higher influence (56.99%).

Keywords: *wheat, variability, spike length, nitrogen nutrition*.

Introduction

The wheat morphological traits have impact to yield values that are influenced by genetic factor, environments and interaction genotype/environment have influence to efficiency of absorption and accumulation of nutrient (Agoston and Pepo, 2005). Spike is the organ of wheat where produced grains. Also, spike is active in photosynthesis after heading and contribute to grain filling, especially under drought conditions. Increasing of genetic potential of grain yield is possible achieve through increasing of size and capacity of spike (Knezevic et al., 2012). The long and fertile spike is one of the most important and promising direction in improvement of grain yield of wheat (Ze evi et al., 2008; Knezevic et al., 2014). The difference in response of genotypes towards heterosis studied by Inamullah et al. (2006) and reported positive mid parent heterosis, while Singh et al. (2004) have recorded a negative heterosis for spike length in wheat genotypes (Khan & Ali, 2011). However, the spike traits development respond to different environmental factors, soil fertility, precipitation, temperature mineral nutrition (Petrovi et al. 2008). The optimizing nutrition by nitrogen application (dose and time) is important for improvement of efficiency of N absorption during the phase of organogenesis and grain filling in wheat to achieve high yield (Bedo et al., 2005; Bertheloot et al., 2008). However, differences in nitrogen uptake have been found between varieties (Kovacevic et al. 2006; Paunovic et al., 2007) which are adapted in variable environments. The seeding rates and N level, the stage of plants at time of N application has an important effect on yield components as well development of spike traits length of spike, number of spikelet's per spike, number of florets per spikelet and efficiency of pollination and seed developing in florets grain mass as well as other yield components (Knezevic et al.,

2007; Iqbal et al., 2012; Kondi et al., 2012). Spike length had positive relationship with number of spikelets per spike at both genotypic and phenotypic levels. It was positively correlated with number of grains per spike at genotypic level (Akram et al., 2008). Genetic potential of wheat yield represents yield of a wheat genotypes grown in environments which is adapted, with nutrients and water regime, as well as with biotic stresses (pests, diseases, weeds) effectively controlled (Miflin, 2000; Drezner et al., 2006; Shehzad et al., 2012).

The aim of this paper was to evaluate the effect of increasing rates of N, applied during the growing season on length of spike in genetically divergent wheat genotypes.

Materials and methods

The four winter wheat selected lines (G-3052, G-3625, G-3004 and G-3617) were tested in two year experiment was performed in randomized block design on $5m^2$ plots and 4 replications under different rate of mineral nutrition (control $N_0=0$, $N_1=30$, $N_2=60$ and $N_3=90$ kg ha^{-1}). The length of spike in full stage of maturity of 80 plants (20 plants per replication) were used for analysis. The average value (x) the variance (^{2}), and analysis of variance was computed. The analysis of variance was performed according to a random block system with two factors, allowing the calculation of the components of variance (^2_g-genetic, $^2_{gl}$-interaction; ^2_E-environment; ^2_f-phenotypic), Falconer (1981). The significant differences among the average values were estimated according to least significant difference (LSD) Hadživukovi (1991) .

Climatic conditions during growing seasons

During two years experiment values of temperature and precipitation were different. Those values were compared to average values of previous ten years (table 1). In the first year the average temperatures (8.3 ^{o}C) were similar to average of ten years period (8.5 ^{o}C) and in second (11.0 ^{o}C) were in avereage slightly higher than in first year and ten year period. In the first year 2005/06 the amount of precipitation (533.7mm) was higher than in second 2006/07 (369.9mm) year as wel than during ten year period (417.8mm). Amounts of precipitation in the first year are was more suitable than in second year and without big differences between minimum and maximal values per munth, as in second year (in April – 3.6mm and in May 118mm).

Table 1. Monthly and mean temperatures and monthly and cumulative precipitation

Tem& Precpt	Period	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Xm	Total
^{0}C	2005/06	11.5	5.6	3.3	-1.7	1.5	5.5	12.7	16.4	19.7	8.3	74.4
^{0}C	2006/07	13.3	7.6	3.5	6.1	6.3	9.1	12.1	18.2	22.8	11.0	99.0
^{0}C	1990/2000	11.8	6.4	1.7	-0.1	2.6	5.9	11.6	16.4	20.4	8.5	76.7
(mm)	2005/06	49.0	54.8	47.1	27.9	38.1	116	86.3	29.6	84.8	59.3	533.7
(mm)	2006/07	16.7	13.7	51.9	45.3	32.1	62.9	3.6	118	25.3	41.1	369.9
(mm)	1990/2000	61.0	44.3	44.6	30.0	29.9	33.2	52.9	52.6	69.3	46.4	417.8

Results and discussion

The varying of length of spike and of investigated wheat genotypes in dependence on genotype, nutrition variant, year of experiment was determined (table 2). In average, the line G-3617 expressed the highest length of spike (9.24cm) in the first year, and 8.46cm in the second year of experiment, while wheat G-3625 in average had the least length of spike (8.08cm) in the first year and 7.41cm in the second year of investigation. According to variant of N nutrition all wheat cultivars in both year of investigation in average had the highest length of spike (9.26cm) in the first year and (8.34cm) in second year of experiment by application the highest dose of nitrogen (90 kg ha^{-1}) and the lowest on the control variant

(without nitrogen nutrition) 8.13cm in the first year and 7.34cm in the second year. In average the highest length of spike was found for wheat G-3617 (9.86cm) in the first year and 9.15cm in second year of experiment by application the highest dose of nitrogen (90 kg ha^{-1}) while the least length of spike expressed wheat G-3625 on control variant (without N fertilizer) 7.79cm in the first year and 6.93cm in the second year of experiment.

The significant differences among the investigated wheat genotypes were established for the expressed average values of length of spike. Also, were significantly different among the investigated wheat genotypes. Also, the values of length spike of analysed genotypes were significant different between first and second experimental years, as well between nutrition variant, which indicates that the weather conditions in the first vegetation period were more favourable and enabled more efficient nitrogen exploitation from soil, as well that the 90kg ha^{-1} had the highest influence to increase length of spike. However, all wheat genotypes in both year and in average expressed higher values of length of spike in dependence of increasing rate of N application. This indicates that the effect of nitrogen on the investigated characteristic depends on applied N doses.

Table 2. Average values of analyzed length of spike of winter wheat genotypes

Year	2005/06					2006/07					Two-years average
Cultivar	Nitrogen (kg ha^{-1})					Nitrogen (kg ha^{-1})					
	0	30	60	90	x	0	30	60	90	x	
G-3052	**7.90**	**8.36**	**8.64**	**8.96**	**8.46b**	**7.06**	**7.43**	**7.76**	**8.08**	**7.58d**	**8.02**
G-3625	**7.79**	**8.05**	**8.10**	**8.36**	**8.08c**	**6.93**	**7.40**	**7.62**	**7.70**	**7.41e**	**7.74**
G-3004	**8.45**	**8.90**	**9.56**	**9.85**	**9.19a**	**7.62**	**7.85**	**8.25**	**8.45**	**8.04c**	**8,62**
G-3617	**8.38**	**9.12**	**9.60**	**9.86**	**9.24a**	**7.75**	**8.25**	**8.70**	**9.15**	**8.46f**	**8.85**
Average per N rate variant	**8.13**	**8.61**	**8.98**	**9.26**	**8.74**	**7.34**	**7.73**	**8.08**	**8.34**	**7.87**	**8.31**

The investigation of morphological traits in wheat grown under different dose of nitrogen nutrition (Ali et al., 2011) showed that all the nitrogen treatments significantly influenced to the value of spike length of wheat which found the maximum spike length was (11.30cm) in case of 130 kg N ha^{-1} followed by (10.71 cm) in case of N_1 where 80 kg N ha^{-1} was applied which is statistically different in comparison to recorded value of spike length (10.00cm) on variant N_3 (180 kg N ha^{-1}). Treatment N_0 (without nitrogen application) produced minimum spike length of 10.13 cm. Similar results for effect of nitrogen application are reported in investigation of Ali et al., 2000; Asif et al., 2009; Iqbal et al., 2010).

Different value of spike length among different wheat of genotypes are effected more by genotype than by relationships to the geographic origin of cultivars (Dotla il et al., 2003). Also, the sensitivity of length of spike under environmental variation noticed (Ze evi et al., 2008) and represent important components of wheat yield.

Among morphological characters, there is a lower positive correlation between spike length and plant height (r=0.34), grain protein content of cultivars (r=0.55), TGW (r=0.28) and grain weight per spike (r=0.21). Significant but low contribution to the spike productivity was noted for time to heading (4% of variability) and spike length (1%). The increase of spike productivity was facilitated by the increase of harvest index (23% and more) due to stem shortening (33%). It seems that spike length was influenced by breeding much less (Dotla il et al., 2003).

According to phenotypic variance analysis, the spike length expression also highly depended to genetic factors (38.97%), but on this trait expression environmental factors had higher influence (56.99%) Table 3. The investigated trait highly depended to genetic and environmental factors. These results are in agreement with previous reported by Ze evi et al.

(2004a). The spike length is yield components which highly positively correlated to number of spikelets per spike (Ze evi et al., 2004b; Akram et al., 2008). Likewise, the spike length has strong indirect influence through number of spikelets per spike on grain weight per plant (Ze evi et al., 2004b).

Table 3. Components of phenotypic variance for length of spike (cm) of wheat

Source of variance	Degree of freedom (DF)	Mean square (MS)	F-test	Components of variance		LSD	
				σ^2	%	0.01	0.05
Repetitions (R)	3	0.001	0.180	-	-		
Genotypes (G)	3	2.094	436.269**	0.251	38.97	0.2065	0.1125
Years (Y)	1	5.951	1248.199**	0.367	56.99	0.071	0.052
Interaction (GxY)	3	0.087	18.252**	0.021	3.26	0.292	0.1591
Error	21	0.005	-	0.005	0.78		
Total	31	-	-	0.644	100.00		

The analysis of variance reveals significant differences in length of spike among genotypes and N application rates in both years (Table 3).

The direct effect of spike length on grain yield was negative in dryland condition and positive in supplemen tal irrigation condition (Ahmadizadeh et, al. 2011; Mohammadi et al., 2012) . Regardless of sowing date, year and water regime, yield per spike had a positive phenotypic correlation with spike length (Zeeshan et al., 2014). Analysis of variance showed highly significant differences among genotypes (G) for length of spike. Differences between investigated years (Y), interactions (GxY) were also high significant for this investigated trait.

Conclusions

In this investigation were determined differences among wheat genotypes according to values of length of spike and high influence of mineral N nutrition to the expression of this trait. The application of mineral fertilizers in variants N_3 (90 kg ha^{-1}) showed the highest values of length of spike of winter wheat in comparison with other variants of mineral nutrition. The highest values of length of spike (9.24cm) in G-3617 expressed in the first experimental year while the least (7.74cm) in wheat G-3625 had in second experimental year. Nitrogen application had significant effect on length of spike. By analysis of variance, it was established that analyzed yield component significantly dependeds to genotypes and investigated years, and increasing quantity of N. In the expression of value of length of spike the impact of genetic factors is (38.97%) and impact of environmental factors was higher (56.99%). Interactions between genotypes, applied nitrogen doses and years were also highly significant, which means that new genotypes are positive reacted on nitrogen applying

Acknowledgements

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EVALUATION OF NEW APRICOT CULTIVARS FROM SLOVAK REPUBLIC IN THE REGION OF BELGRADE

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Abstract

The evaluation of seven introduced apricot cultivars originated from Slovak Republic was carried out in the region of Belgrade over a period of five years (2009–2013). Control cultivar for comparison was 'Hungarian Best'. Among studied cultivars small differences in flowering time were found (1–5 days). Average maturing time of introduced cultivars was from June, 18 ('Velita' and 'Veselka') to July, 15 ('Veharda'), or from 14 days before to 13 days after the 'Hungarian Best'. The average yield per tree ranged from 4.1 kg in 'Veharda' to 9.4 kg in 'Vestar'. Compared with the control cultivar, significantly higher yield was achieved in two cultivars: 'Vestar', and 'Veselka'. The average fruit weight ranged from 40.6 g in 'Veharda to 55.6 g in 'Veselka'. Significantly higher fruit weight had only cultivar 'Veselka', while smaller fruit weight had two cultivars: 'Veharda' and 'Velita'. The content of soluble solids varied from 12.0% in 'Vesna' to 17.1% in 'VS-22/32'. Cultivars 'VS-22/32' and 'Veselka' stands out for fruit appearance, and 'Veselka' also for fruit quality. Among studied cultivars, the best results were shown by 'Veselka' which can be recommended for growing in this region, predominantly for fresh consumption. In addition, cultivars 'Vestar' and 'Vesprima' can also be recommended, mostly for processing.

Key words: *Prunus armeniaca*, flowering, maturing, yield, fruit quality

Introduction

Assortment of apricots in Serbia is characterized by relatively small number of cultivars and short period of harvest. Most apricot fruits are harvested in the season of 'Hungarian Best', or at a short time (about ten days) afterwards. There is particularly a lack of early-season cultivars, maturing in June, and characterized by high quality of fruit.

There is a lot of work in the world on the creation of new apricot cultivars with improved characteristics, such as better adaptability to different environmental conditions, higher resistance to disease-causing agents, higher yield, and better fruit quality. In the last 20 years more than 500 new apricot cultivars were created (Milatovi , 2013a). The introduction of new foreign cultivars and their study in Serbian climatic and soil conditions allow better choice of cultivars, and may improve production of apricots.

In Slovak Republik a public apricot breeding programme took place in the Research Breeding Station Veselé at Pieš any. Under this programme 10 new cultivars were created during 1991–2000 (Benediková, 2006; 2013). The main breeding goals were: resistance to frost, late blooming, high quality, regular yields, early and late ripening, processing suitability, flesh firmness, resistance to diseases. Both European and Central Asian cultivars were used as parents in the hybridization.

The aim of this study was the evaluation of seven new apricot cultivars of different maturing time originating from Slovak Republic. The best performing cultivars will be recommended for growing in the region of Belgrade, as well as in other regions with similar ecological conditions.

Material and methods

The study was conducted in the apricot collection orchard at the Experimental Station "Radmilovac" of the Faculty of Agriculture in Belgrade during the period of five years (2009–2013). The orchard was planted in 2007. The rootstock is Myrobalan (*Prunus cerasifera* Ehrh.) seedling, training system is central leader, and tree spacing is 4.5 x 3 m. All cultivars are represented by five trees.

The study included seven apricot cultivars: 'Velita', 'Veselka', 'Vesna', 'VS-22/32', 'Vestar', 'Vesprima', and 'Veharda'. Cultivar 'Hungarian Best' was taken as a control.

Flowering was recorded by recommendations of the International Working Group for pollination: start of flowering – 10% open flowers, fool bloom – 80% open flowers, end of flowering – 90% of the petal fall (Wertheim, 1996). The beginning of harvest was recorded as the date of maturing. Fruit characteristics were measured on a sample of 25 fruits per cultivar. Fruit shape index was calculated using the formula: length x length / width x thickness. Soluble solids were determined by refractometer and total acids (expressed as malic acid) by titration with 0.1 N NaOH. Sensory properties of the fruit (appearance and taste) were evaluated by a five-member jury, scoring the cultivars using the scale from 1 to 5 points.

The obtained data for yield and fruit traits were statistically analyzed using analysis of variance. The significance of differences between mean values was determined using Dunnett's test at 0.05 level of probability.

Results and discussion

Phenological traits included time of flowering and time of maturing, and the results are shown in Table 1.

Table 1. Phenological traits of apricot cultivars (average, 2009–2013)

Cultivar	Flowering dates			Duration of flowering (days)	Date of harvest	N^o of days comparing to control
	Start	Full	End			
Velita	31.03.	02.04.	07.04.	6.9	18.06.	–14
Veselka	29.03.	01.04.	08.04.	9.4	18.06.	–14
Vesna	30.03.	01.04.	07.04.	8.4	20.06.	–12
VS-22/32	26.03.	29.03.	04.04.	9.2	03.07.	+1
Vestar	28.03.	31.03.	07.04.	8.4	07.07.	+5
Vesprima	31.03.	02.04.	07.04.	7.2	13.07.	+8
Veharda	29.03.	01.04.	06.04.	8.0	15.07.	+13
H. Best (control)	29.03.	31.03.	05.04.	6.8	02.07.	0

Average time of flowering of apricot cultivars was late March and early April. Among studied cultivars small differences in flowering time were recorded. The start of flowering was from three days before the 'Hungarian Best' ('VS-22/32') to two days after the control ('Velita' and 'Vesprima'). All introduced cultivars manifested longer duration of flowering than the control cultivar ('Hungarian Best' with 6.8 days). It ranged from 6.9 days in cultivar 'Velita' to 9.4 days in cultivar 'Veselka'.

Compared to the results of Milatovi (2005) obtained at the same location for the ten-year period (1995–2004) duration of flowering was shorter by two days in average. This difference can be explained by higher temperatures during flowering season in the period of study (2009–2013).

Average time of maturity was from 18th of June ('Velita' and 'Veselka') to 15th of July ('Veharda'). Compared to the control cultivar ('Hungarian Best') time of maturity was from

14 days earlier to 13 days later. Average difference in the date of maturity between the year with the earliest harvest (2009) and the year with the latest harvest (2010) was 6 days, and among cultivars it ranged from 4 to 11 days.

The average yield per tree ranged from 4.1 kg in 'Veharda' to 9.4 kg in 'Vestar' (Table 2). These data refer to the yield in the period of initial cropping, when the age of the trees was between three and seven years. Compared with the control cultivar significantly higher yields were achieved in two cultivars: 'Vestar' and 'Veselka'.

Table 2. Yield of apricot cultivars (kg per tree)

| Cultivar | Years | | | | | Average |
	2009	2010	2011	2012	2013	
Velita	1.5	2.3	10.9	0.1	11.0	5.2bc
Veselka	0.7	5.9	16.5	10.7	5.7	7.9ab
Vesna	0.3	7.8	8.4	4.2	3.6	4.9c
VS-22/32	0.1	5.8	8.0	8.1	0.9	4.6c
Vestar	0.5	6.4	24.5	7.0	8.7	9.4a
Vesprima	0.1	3.4	8.8	8.1	5.7	5.2bc
Veharda	0.2	6.9	9.1	0.5	3.9	4.1c
H. Best (control)	0.3	2.1	10.8	2.0	3.0	3.7c

[*] Mean values followed by the same letter within a column do not differ significantly according to Dunnett's test at P 0.05

In all cultivars the highest yield was obtained in 2011 when the weather conditions were favourable. In 2012 most cultivars achieved low yield due to the occurrence of winter frost (-20.7°C on 9 February), and late spring frost (-2.4°C on 10 April) (Milatovi et al., 2013). In this year the considerable yield achieved cultivars 'Veselka', 'VS-22/32', 'Vesprima' and 'Vestar', and they can be considered as less susceptible cultivars to frost. In 2013 the yield was also low because of the cold weather during flowering which resulted in low fruit set (Zec et al., 2013). The obtained results of yield are in accordance with the results of Vach n (2002), who studied the productivity of 24 apricot cultivars during six-year period and found variation of average yield from 3 to 20 kg per tree. The average fruit weight ranged from 40.6 g in 'Veharda to 55.6 g in 'Veselka' (Table 3). Compared to the control cultivar significantly higher fruit weight had only cultivar 'Veselka', while smaller fruit weight had two cultivars: 'Veharda' and 'Velita'. In most cultivars the lowest fruit weight was in 2011, when the highest yield was recorded, while the highest fruit weight was obtained in 2013, when the yield was low.

Table 3. Fruit properties of apricot cultivars (average, 2009–2013)

| Cultivar | Fruit weight (g) | Stone weight (g) | Stone share (%) | Fruit dimensions (mm) | | | Shape index |
				Lenght	Width	Thickness	
Velita	41.3d	4.4a	10.6	42.3c	40.8c	38.7c	1.14
Veselka	55.6a	4.3a	7.8	46.3b	45.8a	43.3ab	1.08
Vesna	44.7cd	3.0d	6.7	43.1bc	42.4bc	41.2abc	1.06
VS-22/32	48.2bc	3.1d	6.4	46.2b	45.6a	40.6bc	1.15
Vestar	48.2bc	4.0ab	8.4	44.3bc	43.9abc	40.3bc	1.11
Vesprima	52.3ab	3.6bc	6.8	50.6a	44.6ab	41.9ab	1.37
Veharda	40.6d	3.4cd	8.4	43.8bc	41.6bc	38.8c	1.19
H. Best (control)	50.9bc	3.8bc	7.4	46.8b	46.4a	44.0a	1.07

[*] Mean values followed by the same letter within a column do not differ significantly according to Dunnett's test at P 0.05

Stone weight ranged from 3.0 g ('Vesna') to 4.4 g ('Velita'), and its share in the fruit weight ranged from 6.7% ('Vesna') to 10.6% ('Velita'). According to the classification given by Milatovi (2013b) four cultivars had medium share of the stone in the fruit weight (6.1–8.0%), while three cultivars ('Velita', 'Vestar' and 'Veharda') had high share (above 8.1%).

Fruit length of the studied cultivars varied from 42.2 to 50.6 mm, width from 40.8 to 46.4 mm, and thickness from 38.7 to 44.0 mm. Based on the fruit dimensions, the shape index was calculated, whose values ranged from 1.06 in 'Vesna' to 1.37 in 'Vesprima'.

Results of pomological fruit characteristics are in accordance with the previous findings for some cultivars (Benediková, 2006; 2013).

The content of soluble solids in tested apricot cultivars varied from 12.0% in 'Vesna' to 17.1% in 'VS-22/32' (Table 4). Cultivar 'Vesna' had significantly lower content of soluble solids than the control cultivar.

Table 4. Fruit quality properties of apricot cultivars (average, 2009–2013)

Cultivar	Soluble solids (%)	Total acids (%)	Soluble solids /Total acids	Sensory evaluation (1–5)	
				Appearance	Taste
Velita	13.9bc	1.09cd	12.8	3.3b	3.7ab
Veselka	14.0bc	1.31bcd	10.6	3.9a	4.0a
Vesna	12.0c	1.02d	11.8	3.4b	3.5b
VS-22/32	17.1a	1.76a	9.7	4.0a	3.7ab
Vestar	15.6ab	1.49ab	10.4	3.7ab	3.5b
Vesprima	14.6b	1.44abc	10.1	3.6ab	3.5b
Veharda	15.4ab	1.15bcd	13.4	2.7c	3.3b
H. Best (control)	16.0ab	1.38bc	11.6	3.6ab	4.1a

[*] Mean values followed by the same letter within a column do not differ significantly according to Dunnett's test at P 0.05

The total acid content varied from 1.02% in 'Vesna' to 1.76% in 'VS-22/32'. Ratio between soluble solids (consisting mostly of sugars) and acids contents indicates the sweetness of the fruit. In majority of the studied cultivars this ratio was lower than in the control. Higher ratio was found in two cultivars: 'Veharda' and 'Velita'.

The data on the chemical composition of fruits are in accordance with the previous findings (Badenes et al., 1998; Gurrieri et al., 2001; Ruiz and Egea, 2008; Mendelová et al., 2013).

Cultivars 'VS-22/32' and 'Veselka' stand out for attractive fruit appearance. Taste of all introduced cultivars was evaluated with lower scores than the control. The best score for fruit quality got the cultivar 'Veselka'.

Conclusion

Based on the five-year evaluation of seven new apricot cultivars from Slovak Republic in the Belgrade area, the best results were shown by cultivar 'Veselka'. It can be recommended for growing, predominantly for fresh consumption. In addition, cultivars 'Vestar' and 'Vesprima' can also be recommended, mostly for processing.

Acknowledgements

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THE EFFECT OF FOLIAR APPPLIACATION OF ZINC ON YIELD OF ALFALFA SEED

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Abstract

The effect of foliar application of zinc on yield of alfalfa seed was investigated in the present study. Objective of the study was to investigate the influence of fertilization with zinc on yield of alfalfa seed in the model of seed production of dual utilization (production of forage and production of seed). In foliar zinc fertilization 1% zinc sulphate was used. Fertilization was foliar with divided application. The most pronounced effect on yield and yield components was recorded for meteorological factors during the year. Ecological conditions, among which the most important were the amount and distribution position of precipitation, had the most prominent influence on the yield and the components of alfalfa seed yield. Foliar Zn application had no influence on the number of plants, height of plants, number of stems per plant, number of stems per m^2, number of branches per plant as well as seeds per pod. The treatments with foliar fertilization with zinc formed a slightly higher number of pods per unit area, but the differences were not significant in either year. The use of zinc averaged slightly increased seed yield, but these differences were not significant justified.

Key words: *alfalfa, zinc, foliar application, seed, yield*

Introduction

All nutrients must be available in sufficient quantity in order to be able to achieve the maximum seed yield (Marble, 1989; Hall et al., 2002). Microelements are essential for normal physiological activity of the plant, and some are important also as macro-elements (Razmjoo and Henderlong, 1997). Symptoms of nutrient deficiency, however, often become clearly visible only after a deficiency is acute and growth and yield are already severally depressed (Bell, 1997, Roy et all., 2006). These critical values were determined based on the analysis of plant tissue on visual symptoms and not on yield response especially in crops grown for seed production (Bergmann, 1992). Terzi et al. (2012) have reported that foliar fertilization with boron affected the increase in alfalfa seed yield were plant tissue nad soil analysis showed appropriate range.

Some authors (Rincker et al., 1988) reported that application of microelements did not contribute to significant increase in alfalfa seed yield. Hall et al. (2002) have stated that none of the foliar applied micronutrients increased the number of stems, yield, or quality of alfalfa in the environment where the pH was 6.5. Compared to the maintaining of the adequate pH in soil, fertility through the standard application of lime and fertilizer, the additional cost of foliar application of products is not covered by the yield or quality.

Stjepanovi et al. (1986) have achieved an average increase in yield of 12.9 to 21.2%, with zinc treatment. Vu kovi (1994) has reported that zinc fertilization through soil had no effect on seed yield. Also, in the research conducted by Du et al. (2009) zinc had no positive effect

on seed yield. Grewal and Williams, (2000), indicate that the ability of alfalfa to cope with stress is increased if adequate zinc nutrition is provided. The authors note that also varieties exhibit different behaviour due to the lack of zinc in stressful conditions.

Objective of the study was to investigate effect of foliar application of zinc on yield of alfalfa seed.

Materials and Methods

The experiments were performed at the experimental field of the Institute for Forage Crops in Kruševac, Serbia. Trial was established in 2002, and the results obtained in 2005, 2006 and 2007 are presented in the present paper. The experimental plot was 10.5 m^2. Pre-forage harvest was done in different phases. In foliar zinc fertilization 1% zinc sulphate was used. Fertilization was foliar with divided application with 1000 litres per ha of water/application. First application was carried out in the stage of intensive plant growth, and the second application at the beginning of blossoming of crops. The land on which the research was conducted was low acidity soils and Zn content in the soil was 1.6 ppm.

Statistical processing of obtained data was done by variance analysis. Statistical analysis was performed for each year separately. Testing of the significance of differences was done by LSD test.

Results and Discussion

The data effect of foliar application of zinc on alfalfa yield components are shown in the table 1. The number of plants is the basic component of seed yield, because through the impact on the total number of stems the crop density is determined, on which all alfalfa seed yield components are dependent. Number of plants decreases with age. In our research, the number of plants decreased from 91.1 and 92.4 plants per m^{-2} (2005 - fourth year of exploitation) to 48 and 51.2 plants per m^{-2} (2007).

Thinning of the alfalfa crop during the period of exploitation is a regular occurrence due to aging of plants and effects of external factors, particularly low temperatures, heavy machinery trampling, diseases and pests (Sheffer at al., 1988; Undersender et al., 2004).

Decrease in the number of plants leads to increase in the number of stems per plant and the ability of alfalfa to compensate small number of plants with the larger number of stems. The minimum number of stems per plant was formed in 2005 and the most stems in 2007. The formation of a large number of stems per plant with a reduction in the number of plants has been proven by numerous authors (Vu kovi , 1994; Karagi , 2004; Bekovi , 2005; Stanisvljevi , 2006), and confirmed in this study. Observed per unit area, on average the highest number was recorded in year 2005, then 2006 and the lowest in 2007. The decrease of the number of stems per unit area can be explained by the decrease in the number of plants per unit area and considerably worse climate conditions in 2006 (arid May and July), and especially in 2007 (arid June, July and August).

Plant height is an important indicator of alfalfa forage yield and seed yield. Greater height provides opportunities for forming of increased number of flowers, but also the ability to facilitate lodging which may be one of the causes of low seed yield. Plant height on average ranged from 69.6 i 70.5 cm in 2006, when in May the rainfall amount was only 34 mm, to 91.1 and 92.5 cm when in the same period in year 2005, precipitation recorded was 104 mm. The results indicate that the plant height is heavily influenced by climatic factors, and the drought conditions greatly reduce plant height, which is consistent with the results of numerous authors (Fick et al., 1988; Marble, 1989; Vu kovi , 1994; Bekovi , 2006).

Table 1. Yield components and seed yield of alfalfa

Yield components	Year						Average	
	2005		2006		2007			
	$\varnothing$	Zn	$\varnothing$	Zn	$\varnothing$	Zn	$\varnothing$	Zn
Number plant per m^{-2}	92.4	91.1	77.9	78.1	48	51.2	72.77	73.47
Number stems per plant	2.96	3.00	4.93	5.1	5.57	5.66	4.49	4.59
Number stems per m^{-2}	411	461	372	389	246	265	343.00	371.67
Plant height	92.5	91.1	69.6	70.5	78.3	78.5	80.13	80.03
Number branches per plant	20.7	21	41.1	42	35.7	35.8	32.50	32.93
Number branches per m^{-2}	1860	1836	3194	3212	1565	1716	2206.33	2254.67
Number pods per plant	13.19	13.57	67.2	68.8	157.5	154.6	79.30	78.99
Number pods per m^{-2}	1192	1179	4994	5164	6797	7159	4327.67	4500.67
Number seeds per pods	3.58	3.54	4.71	4.7	4.43	4.51	4.24	4.25
Seed yield per plant (g)	0.086	0.088	0.61	0.63	1.41	1.39	0.70	0.70
Seed yield per ha (kg)	70.2	72.9	433.3	452.2	579.3	603.1	360.93	376.07

* significantly different P<0.05; ** significantly different P<0.01

The application of zinc had no effect on the number of plants, plant height, number of stems per plant, number of branches per plant.

The number of pods per inflorescence is important component of alfalfa seed yield, which directly affects yield. Terzi et al. (2012) state that the number of pods and number of seeds per pod have significant effect on seed yield of alfalfa in foliar treatment with boron.

The number of pods per plant ranged from 13.19 (2005) to 157.5 (2007) due to reduction in the number of plants and also increase in the number of pods. Observed according surface unit, the number of pods increased from 1179 m^{-2} and 1192 m^{-2} (2005) to 4994 m^{-2} and 5164 m^{-2} (2006) to 6797 and 7159 m^{-2} in 2007. The numbers of pods per unit area differs significantly. A higher number of pods was formed also per unit area in 2007, slightly lower in 2006, and the lowest in 2005. This indicates that in the studied periods conditions for pollination and fertilization were significantly different, which caused that in years 2006 and 2007 significantly more pods were formed compared to 2005.

The total amount of precipitation during the month of July were the highest in 2005 (86 mm), slightly lower in 2006 (20 mm), while significantly lower precipitation was recorded (8 mm) in 2007. During June, July and August in the 2005, precipitation amount was 274 mm, and in 2006 was 167 mm. The lowest precipitation (136 mm) was in 2007. Smaller amounts of rainfall in 2006 and especially in 2007 summer (June, July, August) created better conditions for pollination, which led to forming of significantly higher number pod per plant, seed per pod and significantly higher yields of seed kg ha^{-1} in 2006 and especially in 2007, in comparison with 2005.

It can be observed that the number of pods per unit area in the later years showed lower relative increase compared to the increase in the number of pods per plant as a result of reducing the number of plants per year, which further contributed to increase of the number of

pods per plant. Also, in research by Vu kovi (1994), Bekovi (2005), Stanisavljevi (2006) plants growing in the greater vegetation area regularly formed higher number of pods per stem compared to plants on a smaller vegetation area.

The treatments with foliar fertilization with zinc did not result in larger number of pods per plant, but slightly higher number (4%) of pods per unit area was recorded. The results cited by Vu kovi (1994) have showed that fertilization with zinc through soil did not affect the number of pods per plant. Also, in research by Du et al. (2009), foliar application of zinc had no effect on the formation of reproduction organs in alfalfa, which is consistent with our results. The results are in agreement with those obtained by Korjakina (1974) that zinc significantly affects the formation of reproduction organs.

Foliar application of zinc did not contribute to the formation of more seeds per pod and which was at the average level. The effect of zinc on the number of seeds per pod is not established in the study Vu kovi (1994) and Du et al. (1999).

The average seed yield realized with the foliar zinc fertilization (376.1 kg ha^{-1}) was slightly higher (4.2%) compared with the control (361 kg ha^{-1}). Broken down by years, in all the years variants with the zinc achieved slightly higher yields, but these differences were not statistically significant. These results are consistent with those obtained by Vu kovi (1994), Hall et al. (2002), Du et al. (2009), and different from those stated by Stjepanovi et al. (1986).

The availability of Zn is largely dependent on the pH, it is higher in acid soils, and lower in alkali soils. Therefore, the absence of Zn was observed in the soils with pH>6.0 (Katayal and Randhawa, 1983; Roy et al., 2006). Our studies were conducted on soil with a pH value of 6.5 in H_2O and 5.7 in N KCl, which probably contributed to Zn not exerting significant influence on seed yield. The soil analysis determined the content of 1.6 ppm of Zn, which can be regarded as an adequate amount of (Zn>1.0 ppm), according to Koenig et al. (1999), Brown and Barbour (2004). Also, the analysis of the plant material, in the beginning of flowering, of the top 15 cm, 31 ppm Zn was determined, which presents a satisfactory level (20-60 ppm), according to the Undersander et al. (2004), i.e. adequate level, according to Koenig et al. (1999). This is likely to have affected that foliar fertilization with zinc has not exerted a stronger influence on seed yield.

The agro-ecological conditions during the year have the highest influence on seed yield. Seed yield showed very large variation in year and ranged from 70.2 kg ha^{-1} in 2005 to 603 kg ha^{-1} in 2007, which is in accordance with the findings of numerous authors.

The world yields range from 0 kg ha^{-1} (crop failure) (Rincer et al., 1988) to more than 2200 kg ha^{-1} when *Megachile rotundata* is used in pollination (Strickler, 2000).

Karagi et al. (2003) have reported the average alfalfa seed yield in agro-ecological conditions of Serbia of about 250 kg ha^{-1}, with large variations depending on the year from 50 to 700 kg ha^{-1}. According Vu kovi (2003), yield seeds range from 100-1500 kg ha^{-1}, and usually 300-500 kg ha^{-1}. In the research by Stanisavljevi (2006), the average (2002-2004) of 352.2 kg ha^{-1} has been achieved. Bekovi (2005), in the first full year of exploitation, has realized 245.7, and in the second year - 426.7 kg ha^{-1} or an average of 336.1 kg ha^{-1}. In the research of Jevti (2007), in the first year, yield of 600 kg ha^{-1} is recorded, in the second year 648.2 kg ha^{-1}, in the third 694.9 kg ha^{-1}, while in the fourth year significantly lower yield of 232.5 kg ha^{-1} is achieved.

Conclusions

Seed yield showed great variation in different years under the influence of environmental conditions during the year, primarily the amount and distribution of rainfall in June, July and August. The lowest yield was formed in years with the highest rainfall in this period, and the highest yield in the year with the least rainfall in this period.

The foliar Zn application had no influence on the number of plants, height of plants, number of stems per plant, number of stems per m^{-2}, as well as the number of branches per plant.

Slightly higher number of pods per unit area was realized in the treatments with foliar zinc fertilization, but the differences were not significant in either year. Foliar application of zinc did not affect the number of seeds per pod. The application of zinc increased seed yield by 4.2% relative to the average, but the differences were not statistically significant.

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INFLUENCE OF PLANTING DENSITY ON YIELD OF PEACH AND NECTARINE

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Abstract

The influence of three different planting densities on yield of three peach cultivars: Early O' Henry', Sunprince', and Autumn Glo', and two nectarine cultivars: 'Vin anka' (clone of Stark Redgold') and Max 7' was studied during three-year period (2009-2011). In high density planting, seedlings of vineyard peach were planted at the space of 3.5 x 1 m (2,800 trees ha^{-1}) and grafted at the height of 50 cm. The trees were trained as a new original training system named 'Sloping Leader' that is characterized with a central leader that is bent and follows row direction at an angle of 25° to the trunk. In standard experimental plot, one-year old peach trees were planted and trained as 'Fusetto' form (4 x 2 m; 1,250 trees ha^{-1}) and Open Vase (4 x 4 m, 625 trees ha^{-1}). The following characteristics were studied: yield per tree and unit area (ha), as well as yield efficiency based on trunk cross-sectional area and on crown projection area. In the first three years of cropping significantly higher yields were achieved in the high-density planting system. Yield efficiency expressed based on the crown projection area, was also significantly higher in the high-density planting system.

Key words: *high density planting, Sloping Leader, peach, nectarine, yield*

Introduction

One of the major prerequisites for the achievement of high and regular yields in peach and nectarine production is the introduction of new training systems along with the application of appropriate cultural practices.

In the high density orchards it is possible to achieve precocity, higher yield, more efficient application of cultural practices and faster return of investments. Fast change of cultivar assortment of peach and nectarine is also factor that has influence on intensification of production. Production of peach and nectarine in high density plantings was researched by many authors (Ninkovski, 1986; Loreti and Pisani, 1992; Costa and Testolin, 1996).

Peach growing in Serbia was mostly based on Open Vase training system, with the large planting distance, such as 4 x 4 m. However, today the planting distance tends to decrease to 4 x 2 m (1,250 trees ha^{-1}).

Peach production is directed towards increasing the planting density in order to obtain earlier coming into bearing and achieving the full yield, increase of yield and fruit quality, while keeping the largest amount of fruits within easy reach (Corelli-Grappadelli et al., 1997). The diversity of a large number of peach and nectarine cultivars provides the possibility of selection of those cultivars which would achieve good production results in a high-density system (Zec, 2010).

The main objective of the present study was the establishment of the original training system for growing peaches and nectarines in a high-density orchards in order to increase fruit yield per unit area.

Materials and methods

The experimental orchard (0.5 ha) was established in Padinska Skela (near Belgrade). Three training systems with different planting distances were studied. The first system is Sloping Leader, a new original training system with high-density planting. This system has one central leader that is bent and follows row direction at angle of 25° to the trunk. The bending was done in a row direction (North-South), by binding of the future leader to trunk of the neighboring tree. The rootstocks (vineyard peach seedlings) were planted in the orchard in 2007, at the beginning of June, at the spacing of 3.5 x 1 m (2,800 trees ha^{-1}). The seedlings were budded at the height of 50 cm, at the beginning of September. Two other applied training systems were 'Fusetto' – form of Slender Spindle (4 x 2 m; 1,250 trees ha^{-1}) and Open Vase (4 x 4 m, 625 trees ha^{-1}). In these two systems, one-year old nursery trees were used, and they were planted in November 2007.

Three peach cultivars: 'Autumn Glo', 'Early O' Henry' and 'Sunprince', and two nectarine cultivars: 'Vin anka' (clone of Stark Redgold') and 'Max 7' were used in this experiment. The trees were grown under standard cultural practices, without irrigation. Dormant pruning (in February) was combined with summer pruning (in June). Medium vigourous and well – lignified fruiting shoots that were uniformly distributed in the canopy were left for yield.

During a three-year period (2009-2011) the following traits were studied: yield per tree and per unit area (ha), as well as yield efficiency based on trunk cross-sectional area (TCSA; kg cm^{-2}) and on crown projection area (kg m^{-2}).

Statistical analysis was performed with 'Statistica' (StatSoft, Inc., Tulsa, Oklahoma, USA) program using a three-factor factorial experiment design. The significance of the differences between means was tested using LSD test at the probability levels of 1% and 5%.

Results and discusion

Yield

Yield per tree in studied cultivars planted at the distance of 4 x 4 m was higher from 84% ('Max 7') to 171% ('Sunprince') in comparison with trees in the high-density planting (Table 1). However, regardless of the lower yields per tree, in the high-density system higher yields per hectare were achieved.

Lower yield per tree that is obtained in high-density planting is the result of reduced area for the development of the fruit tree. This is in accordance with previous findings (Caruso et al., 1999, DeJong et al., 1999).

Table 1. Yield per tree and hectare of peach and nectarine cultivars in different training systems.

Cultivar	Planting distance (m)	Yield per tree (kg)				Yield per area unit (t ha^{-1})			
		2009	2010	2011	Mx	2009	2010	2011	Mx
Sunprince	4 x 4	3.90	7.48	22.90	11.42	2,437	4,680	14,312	7,143
	4 x 2	3.59	6.70	16.4	8.89	4,487	8,375	20,500	11,120
	3.5 x 1	2.02	2.70	7.90	4.21	5,660	7,560	22,120	11,780
	Mx	3.17	5.62	15.73	8.17	4,195	6,872	18,977	10,014
Early O' Henry	4 x 4	3.33	8.53	15.10	8.98	2,080	5,330	9,437	5,616
	4 x 2	2.69	7.80	11.60	7.36	3,362	9,750	14,500	9,204
	3.5 x 1	1.90	3.60	6.20	3.90	5,320	10,080	17,360	10,920
	Mx	2.64	6.64	10.96	6.74	3,587	8,387	13,766	8,580
Autumn Glo	4 x 4	4.68	8.94	24.90	12.84	2,925	5,590	15,562	8,026
	4 x 2	3.91	8.40	17.90	10.07	4,887	10,500	22,375	12,587
	3.5 x 1	2.27	5.20	11.20	6.22	6,360	14,560	31,360	17,426

	Mx	3.62	7.51	18.00	9.71	4,724	10,217	23,099	12,680
Vin anka	4 x 4	3.22	8.32	16.50	9.35	2,015	5,200	10,312	5,842
	4 x 2	3.00	7.30	12.90	7.73	3,750	9,125	16,125	9,667
	3.5 x 1	1.80	5.10	9.80	5.56	5,040	14,280	27,440	15,586
	Mx	2.67	6.90	13.06	7.55	3,602	9,535	17,959	10,365
Max 7	4 x 4	3.43	5.62	14.10	7.72	2,145	3,510	8,812	4,822
	4 x 2	2.70	5.10	11.05	6.28	3,375	6,375	13,812	7,853
	3.5 x 1	1.80	2.40	6.90	3.70	5,040	6,720	19,320	10,360
	Mx	2.64	4.37	10.68	5.90	3,520	5,535	13,981	7,678
Means of years		2.95	6.21	13.69			3,926	8,109	18,624
Means of training systems	4 x 4 m	3.71	7.78	18.70	10.06	2,320	4,862	11,687	6,290
	4 x 2 m	3.18	7.06	13.97	8.07	3,972	8,825	17,642	10,146
	3.5 x 1 m	1.96	3.80	8.40	4.72	5,484	10,640	23,520	13,215
Training systems (TS)	LSD 0.05				1.90				1,860
	LSD 0.01				2.57				2,511
Years (Y)	LSD 0.05				1.90				1,862
	LSD 0.01				2.57				2,578
Cultivars (C)	LSD 0.05				2.46				2,390
	LSD 0.01				3.31				3,242
Interaction (TS x C)	LSD 0.05				N.S.				N.S.
	LSD 0.01				N.S.				N.S.

N.S. – Not significant.

During the initial three years of cropping the highest average yield was obtained in peach cultivar 'Autumn Glo' in the high-density planting (2,800 trees ha^{-1}) and it amounted to 17,426 kg ha^{-1} (Table 1). In the same cultivar under dense planting in 2011, the highest yield in the experiment was recorded (31,360 kg ha^{-1}). The lowest average yield was obtained in nectarine cultivar 'Max 7' on trees trained as Open Vase (625 trees ha^{-1}; 4,822 kg ha^{-1}).

In studied cultivars average yield in the dense planting was from 65% ('Sunprince') to 167% ('Vin anka') higher comparing to Open Vase trained trees (4 x 4 m). The trees grown in the dense planting in the form of 'Sloping Leader' had higher average yield than trees trained in the form of 'Fusetto' (4 x 2 m) from 6% ('Sunprince') to 66% ('Vin anka'). In the dense planting, on trees trained in the form of 'Sloping Leader' significantly higher yields were achieved compared to semi-dense planting and standard-density planting.

High yields achieved in a dense planting in the first years of cropping can be explained by the large number of trees per unit area and shorter period of crown formation. These are the benefits of dense planting and 'Sloping Leader' as the training system.

Several authors found that the planting distance has greater influence on the yield than the training system (Bargioni et al., 1983; Grossman and DeJong, 1998; Marini and Sowers, 2000). They stated that fruit trees at low densities have higher yields per tree, but lower yields per hectare, which emphasizes the planting density as a factor that significantly affects the yield.

Yield efficiency

The lowest average value of the yield efficiency per trunk cross-sectional area (0.165 kg cm^{-2}) had trees of nectarine cultivar 'Max 7' planted at the space of 4 x 2 m, while the trees of peach cultivar 'Autumn Glo' in the high-density training system (3.5 x 1 m) had the highest value (0.319 kg cm^{-2}) (Table 2).

Loreti and Massai (1998) reported that the yield efficiency in peach cultivar 'Springcrest' grafted on different rootstocks ranged from 0.35 to 0.76 kg cm^{-2} in the sixth year after planting. The obtained results of the yield efficiency per TCSA in this study were close to the

lower values reported in the literature. This is due to lower yields, which are characteristic for initial bearing years.

All cultivars in the experimental orchard (except 'Sunprince') had a slightly higher value of this parameter in a dense planting. However, the differences between training systems were not statistically significant. The obtained results are in accordance with the findings of Caruso et al. (1999).

The lowest average value of the yield efficiency per crown projection area (1.77 kg m^{-2}) had trees of the peach cultivar 'Early O' Henry' grown at the planting distance 4 x 4 m with a form of Open Vase (Table 2). Trees of the peach cultivar 'Autumn Glo' in the dense planting (3.5 x 1 m) and trained in the form of 'Sloping Leader' had the highest value of this parameter (4.30 kg m^{-2}). Trees of nectarine cultivar 'Vin anka' trained in the form of 'Sloping Leader' had 78% greater yield efficiency per crown projection area comparing with trees trained in the form of Open Vase.

In the dense planting significantly higher yield efficiency per crown projection area was achieved compared to semi-dense planting and standard-density planting. The obtained result can be explained by the rapid covering of productive area and a quick coming into full bearing using smaller planting spaces and the 'Sloping Leader' training system.

Table 2. Yield efficiency per trunk cross-sectional area (TCSA) and per crown projection area in different training systems.

Cultivar	Planting distance (m)	Yield efficiency per TCSA (kg cm^{-2})				Yield efficiency per crown projection area (kg m^{-2})			
		2009	2010	2011	Mx	2009	2010	2011	Mx
Sunprince	4 x 4	0,170	0,189	0,434	0,264	1,17	1,65	4,67	2,49
	4 x 2	0,176	0,215	0,371	0,254	1,62	2,19	4,95	2,92
	3,5 x 1	0,178	0,149	0,345	0,224	1,77	1,81	4,96	2,84
	Mx	0,175	0,184	0,383	0,247	1,52	1,88	4,86	2,75
Early O' Henry	4 x 4	0,140	0,188	0,243	0,190	1,13	1,49	2,68	1,77
	4 x 2	0,122	0,215	0,237	0,191	1,11	2,40	3,41	2,30
	3,5 x 1	0,158	0,176	0,252	0,196	1,53	2,35	3,69	2,52
	Mx	0,140	0,193	0,244	0,192	1,25	2,08	3,26	2,20
Autumn Glo	4 x 4	0,212	0,246	0,483	0,314	1,69	2,06	5,19	2,98
	4 x 2	0,191	0,288	0,416	0,298	1,77	2,81	5,34	3,31
	3,5 x 1	0,200	0,287	0,472	0,319	2,02	3,66	7,21	4,30
	Mx	0,201	0,274	0,457	0,311	1,82	2,84	5,91	3,52
Vin anka	4 x 4	0,146	0,285	0,374	0,268	1,21	1,97	3,53	2,24
	4 x 2	0,153	0,319	0,378	0,283	1,47	2,63	3,90	2,66
	3,5 x 1	0,151	0,271	0,384	0,269	1,74	3,64	6,66	4,01
	Mx	0,150	0,292	0,379	0,274	1,47	2,74	4,69	2,96
Max 7	4 x 4	0,162	0,150	0,267	0,193	1,28	1,31	2,87	1,82
	4 x 2	0,138	0,113	0,244	0,165	1,17	1,62	3,07	1,95
	3,5 x 1	0,151	0,138	0,325	0,205	1,63	1,64	4,04	2,43
	Mx	0,150	0,134	0,279	0,188	1,36	1,52	3,32	2,06
Proseci godina		0,163	0,215	0,348		1,48	2,21	4,41	
Mx	4 x 4	0,166	0,212	0,360	0,246	1,30	1,70	3,79	2,26
	4 x 2	0,156	0,230	0,329	0,238	1,43	2,33	4,13	2,63
	3,5 x 1	0,168	0,204	0,356	0,243	1,74	2,62	5,31	3,22
Training systems (TS)	LSD 0,05				N.S.				0,46
	LSD 0,01				N.S.				0,63
Years (Y)	LSD 0,05				0,035				0,46
	LSD 0,01				0,047				0,63

Cultivars (C)	LSD 0,05	0,041	0,60
	LSD 0,01	0,055	0,81
Interaction (TS x C)	LSD 0,05	N.S.	N.S.
	LSD 0,01	N.S.	N.S.

N.S. – Not significant.

Conclusion

All cultivars of peach and nectarine had significantly lower yield per tree in a dense planting. The obtained result is a consequence of the reduced space for the development of the tree and significantly lower habit of trees in a dense planting.

In a dense planting all cultivars achieved significantly higher yield per unit area (ha) and reach full bearing earlier compared with semi-dense planting and standard-density planting. These benefits of 'Sloping Leader' training system are expressed in particular in the first three years of cropping.

The yield efficiency expressed per unit of the trunk cross-sectional area was not significantly different depending on the planting density.

The obtained values of the yield efficiency expressed per crown projection area pointed to the benefits of the training system 'Sloping Leader' which is significantly more efficient in the use of land, resulting in a higher yield. The architecture of the new training form occupies less space, which allows increase of the planting density and earlier coming into full bearing.

Acknowledgements

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IMPORTANCE OF TWO-CROP ROTATION IN MAIZE WEED CONTROL

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Abstract

Importance of two-crop rotation on decreasing a number of weed plants and fresh weed biomass and increasing maize grain yield, were studied on two cropping system: maize monoculture (MM) and maize-wheat rotation (MW) in period 2009-2013. Experiment was conducted at the experimental field of Maize Research Institute Zemun Polje, Belgrade. During five years of study, on MM plot maize was sown every year and on MW plot maize and wheat were rotated (maize was sown in 2009, 2011, 2013 and wheat was sown 2010 and 2012). Studies were conducted on maize hybrids ZP 677 (H1) and ZP 606 (H2).

After every rotation of maize and wheat, number of weed plants and their fresh biomass in maize decreased in MW. In 2013, after closing of two rotation, weed infestation decreased for 20 plants/m^2 and 412,0 g/m^2 in H1 and 12 plants/m^2 and 449,9 g/m^2 in H2. After two rotation of maize and wheat, in maize monoculture weediness increased for 4 plants/m^2 and 133,0 g/m^2 in H2. Number of weed plants and their fresh biomass was the same as in the first year of study in H1. Compared to monoculture, maize grain yield was higher in MW for 1,14 t/ha (H1) and 2,03 t/ha (H2) in 2011 and for 1,06 t/ha (H1) and 2,35 t/ha (H2) in 2013. All differences in maize grain yield were significant, based on statistical analysis. Wheat can directly influence decrease of weediness in maize and indirectly increase its grain yield.

Key words: *maize, wheat, monoculture, crop rotation, weeds.*

Introduction

Weed infestation of cereals is a problem for growers despite numerous options and methods of weed suppression, both chemical and non-chemical ones (Stasinskis, 2009). Continuous cropping, as a system of plant production, can be a significant infection source by many diseases and pests, and also a factor of intensive weed development on soils (Kova evi , 2003). Polycrop rotations adversely affect both, the disease development cycle and the growth and development of weeds and, in such a way, they contribute to the yield increase of crops (Karlen et al., 1994). Crop sequencing and due to it the application of different herbicides, significantly contributes to control of annual, and especially of perennial weeds (Simic et al., 2014). Crop rotation sometimes is not the most important measure, but only one that can properly help in suppression of weeds, diseases and pests (Kova evi et al., 2008).

The composition of weed associations depends more on preceding crops and herbicide application timing than on tillage methods (Streit et al., 2003). Wheat as a preceding crop, alongside with herbicides applied during the growing season as well as glyphosate-based herbicides applied to stubble fields after wheat harvest, greatly contribute to the reduction of weed infestation of maize as the following crop.

The objective of the study was to demonstrate the significance and the advantages of wheat as a preceding crop of maize for the reduction of weed infestation and therefore for the increase of maize gain yield compared to maize continuous cropping.

Materials and Methods

The split-plot trial was carried out in the experimental field of the Maize Research Institute, Zemun Polje (44º52' N 20º20' E) in the 2009-2013 period. Two types of crop rotation were applied: maize continuous cropping and maize-wheat rotation. Comply with the alteration of crops, maize was continuously cropped in all five years of investigation, while in the two crop rotation maize was grown in 2009, 2011 and 2013, while wheat was grown in 2010 and 2012. The trials were performed with the following two maize hybrids of FAO maturity group 600 developed at the Maize Research Institute: ZP 677 (hybrid of the older generation) and ZP 606 (hybrid of a more recent generation).

Herbicides Trophy (acetochlor 1536 g a.i./ha) and Merlin (isoxaflutole 105 g a.i./ha) were applied in the recommended rates after sowing but prior to emergence of maize. Weeds were estimated by a one square meter survey 45-50 days after the application of herbicides. The number of weed plants and then weed fresh biomass per square meter, were determined. The grain yield was established at the full maturity of maize and calculated at 14% moisture. As results obtained on maize weed infestation and grain yields were compared between maize continuous cropping and maize-wheat rotation, this paper presents results gained in 2009, 2011 and 2013. The differences in weed infestation and grain yields were not compared between hybrids, because maize hybrids do not affect weediness and also hybrids used in the study were of the older and the more recent generation, and as it is known newly developed hybrids are more yielding.

In tables we presented only six species of weeds: CHEAL (*Chenopodium album* L.), CHEHY (*Chenopodium hybridum* L.), DATST (*Datura stramonium* L.), SORHA (*Sorghum halepense* Pers.), CONAR (*Convolvulus arvensis* L.) and CIRAR (*Cirsium arvense* L. Scop.) and in last row of table we gave total weediness.

Meteorological conditions were similar for maize production in 2009, 2011 and 2013 (Table 1). Maybe, last year of experiment was the most unfavourable for maize production. One of reasons can be less precipitation in summer (Jun and July) of 2013 year than in same period in 2009 and 2011 year.

Table 1. Precipitation sums (mm) and average monthly temperatures (°C) on experimental field in 2009, 2011 and 2013.

Month	Precipitations			Temperatures		
	2009	2011	2013	2009	2011	2013
April	5,6	11,1	14,9	16,2	14,6	14,9
May	35,0	62,6	93,9	19,8	17,3	19,7
Jun	153,0	40,4	37,8	21,2	22,4	21,9
July	79,6	107,4	16,0	24,0	24,2	23,8
August	44,8	8,9	12,7	24,1	24,8	23,7
September	4,6	48,5	70,1	21,1	23,2	16,9

Results and Discussion

The number of weed plants differed in both hybrids in dependence on the type of crop rotation (Tables 2 and 3). This number in the hybrid ZP 677 generally remained unchanged in maize continuous cropping (12-14 plants/m^2), while it ranged in maize-wheat rotation from 20 plants/m^2 in the first year of investigation (2009) over 3 plants/m^2 at the end of the first rotation (2011) to 0 plants/m^2 after the second rotation (Table 2). It is important to emphasise that the two-crop rotation significantly lowered number of perennial weeds in comparison to maize continuous cropping, taking in account that applied herbicides are not created for perennial weeds control.

According to the LSD test, the difference in the number of weed plants between observed crop rotations was statistically very significant (Table 2).

Table 2. Number of weed plants in maize continuous cropping and maize-wheat rotation in hybrid ZP 677 (plants/m^2)

	MM			MW		
	2009	2011	2013	2009	2011	2013
	Annual weeds (A)					
CHEAL		2				
CHEHY	3	2	3	6		
DATST				4		
Total	**4**	**6**	**4**	**10**	**0**	**0**
	Perennial weeds (B)					
SORHA		1	4	1	1	
CONAR	8	4	6	8	2	
CIRAR	2	1				
Total	**10**	**6**	**10**	**10**	**3**	**0**
Sum A+B	**14**	**12**	**14**	**20**	**3**	**0**
LSD $_{0,05}$	6,47		LSD $_{0,01}$		8,50	

Table 3. Number of weed plants in maize continuous cropping and maize-wheat rotation in hybrid ZP 606 (plants/m^2)

	MM			MW		
	2009	2011	2013	2009	2011	2013
	Annual weeds (A)					
CHEAL		2				
CHEHY	6	2	2	1		
DATST	1					
Total	**10**	**5**	**5**	**1**	**1**	**0**
	Perennial weeds (B)					
SORHA		3	7	3		
CONAR	5	4	6	8	5	1
CIRAR	1			1		
Total	**6**	**7**	**15**	**12**	**5**	**1**
Sum A+B	**16**	**12**	**20**	**13**	**6**	**1**
LSD $_{0.05}$	9.70		LSD $_{0.01}$		13.41	

In regard to the hybrid ZP 606, the number of weed plants in maize continuous cropping increased from 16 plants/m^2 in 2009 to 20 plants/m^2 in 2013 (Table 3.). On the other hand, weed infestation decreased in the maize-wheat crop rotation from 13 plants/m^2 in 2009 to 1 plant/m^2 in 2013 (Table 3). It should be noted that the number of perennial weed plants in

maize continuous cropping increased from 6 plants/m^2 (2009) to 15 plants/m^2 (2013), while this number in the two crop rotation decreased from 12 plants/m^2 (2009) to 1 plant/m^2 (2013). According to the LSD test, the differences in the number of weed plants between maize continuous cropping and the maize-wheat rotation were statistically significant (Table 3).

One of the reasons that could decrease the number of weed plants in the two-crop rotation is wheat, a crop alternating with maize. Wheat seedlings and straw have allelopathic effects on the increase of weed plants (Wu *et al*.,1998). A preceding crop has a great effect on a weed population (Streitetal, 2003). Small grains due to a higher growing density can suppress many weeds, particularly some perennial species, resistant to other control measures (Stefanovi et al., 2011).

Weed fresh biomass in the hybrid ZP 677 in maize continuous cropping in the first year of investigation and after two crop rotations was completely equal, while it was reduced in the two crop rotation from 412.0 g/m^2 (2009) to 57.2 g/m^2 after the first rotation, while there were no weeds after the second crop rotation (Table 4). In addition to unchanged weed fresh biomass in maize continuous cropping, fresh biomass of perennial weeds increased by 54.5 g/m^2 in maize continuous cropping and it decreased by 291.9 g/m^2 in the crop rotation (Table 4).

Table 4. Weed fresh biomass in maize continuous cropping and two-crop rotation in hybrid ZP 677 (g/m^2)

	MM				MW	
	2009	2011	2013	2009	2011	2013
	Annual weeds (A)					
CHEAL		25.6				
CHEHY	130.1	37.8	85.1	50.9		
DATST				69.2		
Total	**144.3**	**89.5**	**89.3**	**120.1**	**0.0**	**0.0**
	Perennial weeds (B)					
SORHA		30.3	266.3	3.0	30.8	
CONAR	174.9	80.1	164.2	264.4	26.4	
CIRAR	201.1	33.6				
Total	**376.0**	**144.0**	**430.5**	**291.9**	**57.2**	**0.0**
Sum A+B	**520.3**	**233.5**	**519.8**	**412.0**	**57.2**	**0.0**
LSD $_{0.05}$	230.7			LSD $_{0.01}$	318.9	

A similar trend was noticed in the hybrid ZP 606 (Table 5). Total weed fresh biomass and fresh biomass of perennial weeds in maize continuous cropping increased from 440.1 g/m^2, i.e. 219.5 g/m^2 (2009) to 573.1 g/m^2, i.e. 499.0 g/m^2 (2013), respectively (Table 5). However, total weed fresh biomass and fresh biomass of perennial weeds in the maize-wheat rotation reduced from 535.3 g/m^2 and 498.8 g/m^2 (2009), respectively, to 85.4 g/m^2, which was total weed fresh biomass and fresh biomass of perennial weeds, because only perennial weeds were distributed after herbicide application.

According to the LSD test, the differences in weed fresh biomass between maize continuous cropping and maize-wheat rotation were very statistically significant in hybrid ZP 677 and on the level of statistical significance in hybrid ZP 606.

Table 5. Weed fresh biomass in maize continuous cropping and two-crop rotation in hybrid ZP 606 (g/m^2)

	MM			MW		
	2009	2011	2013	2009	2011	2013
	Annual weeds (A)					
CHEAL		50.9				
CHEHY	137.6	43.6	22.4	36.5		
DATST	47.9		15.8			
Total	**220.6**	**103.9**	**74.1**	**36.5**	**17.3**	**0.0**
	Perennial weeds (B)					
SORHA		262.7	310.2	69.0		
CONAR	188.7	51.3	136.7	419.0	103.4	85.4
CIRAR	30.8			10.8		
Total	**219.5**	**314.0**	**499.0**	**498.8**	**103.4**	**85.4**
Sum A+B	**440.1**	**417.9**	**573.1**	**535.3**	**120.7**	**85.4**
LSD $_{0.05}$		489.1		LSD $_{0.01}$		676.2

Gained results are in accordance with results obtained by Kova evi et al. (2008). These authors showed that weed fresh biomass in two crop rotations was significantly lower than in maize continuous cropping and other polycrop (3, 4 and 6) rotations. Crop sequencing unlike continuous cropping reduces the number of weed species as well as total coverage of weed communities (Milošev et al., 2008). Positive effects of crop rotations on weed suppression, therefore, consist of prevention of over-distribution and spreading of certain weed species and accumulation of their seeds and vegetative organs in the soil, which is normally achieved by growing crops in continuous cropping.

Due to observed weed infestation, grain yields were higher in two-crop rotations than in maize continuous cropping (Table 6). Grain yields of the hybrid ZP 677 were higher by 1.04 t/ha, 1.18 t/ha and 1.16 t/ha in 2009, 2011 and 2013, respectively. The corresponding values of the hybrid ZP 606 were 0.2 t/ha, 2.05 t/ha and 2.35 t/ha.

According to the LSD test, the differences in grain yields between maize continuous cropping and the two-crop rotation in hybrids ZP 677 and ZP 606 were statistically significant and very statistically significant, respectively (Table 6).

Table 6. Grain yields of hybrids ZP 677 and ZP 606 obtained in maize continuous cropping and maize-wheat rotation (t/ha)

Year	H1		H2	
	MM	MW	MM	MW
2009	11.60	12.64	15,06	15,26
2011	7.92	9.10	8,55	10,60
2013	7.45	8.51	9,11	11,46
	H1		**H2**	
LSD $_{0.05}$	1.04		1.27	
LSD $_{0.01}$	1.44		1.75	

Effects of continuous cropping on grain yields mainly depend on the duration of continuous cropping, climate, varieties (hybrids) and the level of applied cropping practices, first of all applied rates of fertilisers and herbicides (Dolijanovi et al., 2005). Crop rotations improve grain quality and reduce maize yield variability (Kaye et al., 2007). Grain yield is on the average higher by 10-17% when maize is grown in crop rotations in comparison with continuous cropping (Higgs et al., 1990).

Conclusion

Weed infestation of maize, in respect to the number of weed plants and weed fresh biomass is much weaker in two-crop rotations than in continuous cropping. The effects of crop rotations are particularly more expressed on reducing weed infestation in perennial weeds that are very troublesome for suppression. Wheat, grown in maize-wheat rotation, had allelopathic and mechanical effects on the reduction of weed infestation. The lower weed infestation level gives more favourable growing conditions for maize production, causing weaker competition for water, nutrients and light between maize and weeds.

Acknowledgement

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AGROECONOMIC ANALYSIS OF APRICOT PRODUCTION IN EARLY YEARS AFTER PLANTING

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Abstract

This paper presents the results of an analysis of economic effects (costs and income) of apricot production during the first 7 years after planting. The analysis involved an orchard of apricot cv. 'Roxana' grafted onto 'Myrobalan' (*Prunus cerasifera* Ehrh.) seedling rootstock and grown at a plant spacing of 6 x 3.5 m (476 trees/ha). Since 'Roxana' is primarily a fresh market cultivar, income was calculated based on the fresh apricot market price (the average price for the last 3 years 0.5 €/kg). Production costs included material input costs, labour costs and machinery operating costs. Results showed that orchard establishment costs were 2,980.00 €/ha. Orchard management costs increased continuously from year 1 to 6 of orchard life (565 €, 865 €, 1,145 €, 1,470 €, 1,840 € and 2,600 €/ha in the 1st through 6th growing seasons, respectively). Cumulative costs until the start of the 7th growing season were 11,465 €/ha. The first yield (1.15 t/ha) and, hence, the first income (575 €/ha) were achieved in the 3rd growing season. During the 4th, 5th and 6th years after planting, there was an increase in yield (4.50 t/ha, 9.33 t/ha and 16.75 t/h) and, accordingly, in the income gained (2,250 €, 4,665 € and 8,370 €/h, respectively). Cumulative income until the start of the 7th growing season was 15,860 €/ha. Return on investment and the first positive balance in apricot production for fresh use were attained in the 6th growing season after planting.

Key words: *apricot, agroeconomic analysis.*

Introduction

Apricots are generally cultivated in the Northern Hemisphere. In the Mediterranean and Central Asia, they account for more than 80% of the world's production (Milatovi , 2013). The world's leading apricot producers are Turkey, Iran, Uzbekistan, Italy and Pakistan (FAOSTAT, 2012). These 5 countries produce half of the world's apricot production. In Europe, Italy is the largest apricot producer, followed by France, Spain and Greece. Serbia ranks among 10 apricot producers in Europe in terms of average annual production. The production is characterised by high yield fluctuations across years. In the last 10 years, apricot yield ranged from 13,409 - 40,754 t. The main causes of variations in apricot production include late spring frosts and sudden wilting (Miloševi et al., 2008). Moreover, additional reasons for yield variations are winter kill of flower buds before blooming (Mileti et al., 2006; Milatovi et al., 2013), absence of proper management practices and low-intensity cultivation methods (Miloševi et al., 2011). Nevertheless, under Mediterranean conditions and in temperate continental climates, variations in apricot production are mostly due to unstable winter and early spring temperatures (Rodrigo and Herrero, 2002). Marked variation in apricot yield across years leads to highly variable cost-effectiveness of apricot production (Veljkovi et al., 2009). Investment costs are also generated during the years when yields and, hence, income are reduced. High-intensity growing methods can ensure early bearing, a fast return on investment and somewhat reduced instability of the cost-effectiveness of apricot

production. The objective of this study was to analyse the cost-effectiveness of apricot production in a high-intensity orchard during early years after planting by comparing orchard establishment and management costs with the income gained.

Material and methods

The study was conducted in an apricot orchard located at the village of Prislonica near   a ak (Serbia), a well-known apricot production centre. The municipality of   a ak covers only 0.7% of the total area of the Republic of Serbia, but it accounts for as high as 10-15% of the total apricot production in Serbia.

The analysis involved a high-intensity orchard of apricot cv. 'Roxana' grafted onto Myrobalan seedling rootstock (*Prunus cerasifera* Ehrh.) and grown at a plant spacing of 6×3.5 m (476 trees/ha). The research was conducted over a period of 6 years (from year 2008 to year 2013) i.e. from the orchard establishment date until the beginning of the 7th growing season.

Production costs were divided into orchard establishment costs and orchard management costs during the 1st through 6th growing season. Management costs included material input costs, labour costs and machinery operating costs. Income was calculated by multiplying the yield of apricot by its market price. Since 'Roxana' is primarily a fresh market cultivar, income was calculated based on the fresh apricot market price (the average price for the last 3 years 0.5 €/kg). Relating income to production costs gives the cost-effectiveness of apricot production in early years after planting i.e. the answer to the question as to when the return on investment and the first positive balance in apricot growing are attained.

Results and discussion

Notwithstanding its marked variation in Serbia across years, apricot production showed a slight tendency to increase annually during the first decade of the 21st century. The increase in apricot production is the result of new growing methods used (Miloševi et al., 2012) and new apricot orchards established. 'Roxana' is among cultivars commonly found in new apricot orchards (Miloševi et al., 2013). This cultivar also plays an important role in new apricot orchards in Hungary (Szabó et al., 2011). Newly established apricot orchards have narrow plant spacings, a high number of trees per unit area, and a low crown volume. Establishment costs for such an orchard were calculated, involving 480 trees per ha i.e. a plant spacing of 6 x 3.5 m. Orchard establishment costs are presented in Tables 1, 2 and 3.

Tab. 1. Material input costs for the establishment of a 1 ha apricot orchard

	Material input	Amount	Unit price	Total price
1.	Manure	45 t	5 €	225 €
2.	Stakes used for planting	50 pcs.	0.3 €	15 €
3.	Markers used for planting	1,440 pcs.	0.01 €	15 €
4.	Rope used for planting	8 pcs.	4 €	32 €
5.	Apricot plants	480 pcs.	2.5 €	1.200,00 €
6.	Mineral fertiliser	50 kg	0.5 €	25 €
7.	Plastic mesh to protect against rodents	100 m	1 €	100 €
Total material input				1,612.00 €

Material input costs for establishing a 1 ha apricot orchard are 1,612.00 € Material inputs do not include irrigation system and anti-hail net, but rather the items that are found in most apricot orchards in Serbia.

Labour costs for the establishment of a 1ha apricot orchard are given in Tab. 2. .

Tab. 2. Labour costs for establishing a 1 ha apricot orchard

	Operation	Volume of work	Unit price	Total price
1.	Soil analysis	6 samples	20 €	120 €
2.	Spacing	18 h	5 €	90 €
3.	Loading and unloading of plants and fertiliser	4 h	2 €	8 €
4.	Planting (physical)	100 h	2 €	200 €
5.	Planting (professional)	30 h	5 €	150 €
6.	Irrigation	12 h	2 €	24 €
7.	Protection against rodents	18 h	2 €	36 €
Total labour				628.00 €

Total labour costs for establishing a 1 ha apricot orchard are 628 € The calculation was made by taking the average labour price in Serbia of about 2 €for physical activity and 5 €for professional engagement.

Machinery operating costs for establishing a 1ha apricot orchard are presented in Tab. 3.

Tab. 3. Machinery operating costs for establishing a 1 ha apricot orchards

	Operation	Volume of work	Unit price	Total price
1.	Loading and broadcasting of manure (the price given for a 3 t trailer)	15 trailers	10 €	150 €
2.	Deep ploughing	1 ha	350 €	350 €
3.	Disking or harrowing	1 ha	120 €	120 €
4.	Transport of plants and mineral fertilisers	1 conveyance	50 €	50 €
5.	Supply of irrigation water	7 cisterns	10 €	70 €
Total machinery operating costs				740.00 €

Machinery operating costs in establishing a 1 ha apricot orchard are 740.00 € The primary role of the machinery used to establish the orchard is to prepare the soil for planting (deep ploughing, final soil preparation for planting through disking or harrowing), and to be engaged for different transportation purposes.

Total costs of establishing a 1 ha apricot orchard are the sum of material input costs, labour costs and machinery operating costs, a presented in Tab. 4.

Tab. 4. Total costs of establishing a 1 ha apricot orchard

	Type of cost	Total price
1.	Material input costs	1,612.00 €
2.	Labour costs	628.00 €
3.	Machinery operating cost	740.00 €
Total		2.980,00 €

Total establishment costs for a 1 ha apricot orchard (without an irrigation system and anti-hail net) are 2,980.00 € Total establishment costs for a 1 ha apricot orchard are significantly lower than in apple (Subi et al., 2011) or raspberry (Veljkovi et al., 2006), and similar to those for plum (Miloševi et al., 2008).

Management costs during the 1st growing season were 565 € and largely included costs of pruning, additional fertilisation, soil tillage and disease and pest control. Management practices during the 2nd growing season were the same as in the 1st growing season, with the volume of work and, hence, costs increased to 865 € In the 3rd growing season, the apricot orchard produced its first yield. From the 3rd through 6th growing seasons, the yield steadily increased, thus resulting in increased costs, primarily due to harvest costs and pest and disease control costs. The costs were: 1,145 €, 1,470 €, 1,840 € and 2,600 € in respective growing seasons.

Yield and, hence, income, increased from the 3rd to 6th growing season. The first yield was attained in the 3rd growing season – 1.15 t/ha, and substantial yield was obtained in the following i.e. 4th growing season – 4.5 t/ha. The results are in agreement with those of (uri and Keserovi , 2007) who found that first major yields in apricot can be produced in the 4th growing season, or during the 3rd at the earliest. This yield enabled the first income (575 € and 2,250 € in the 3rd and 4th growing seasons, respectively). The yield was significantly higher in the 5th growing season (9.33 t/ha), and particularly in the 6th growing season (16.75 t/ha), when it approached optimal values per hectare in apricot for fresh use. These yields also brought about significant income (4,665 € in the 5th growing seasons and 8,370 € in the 6th growing season).

A comparison between costs and income in a 1ha apricot orchard during the first 6 growing seasons is presented in Tab. 5.

Tab. 5. A comparison between costs and income in a 1 ha apricot orchard during the first 6 growing seasons

	Costs (€/ha)		Income (€/ha)		Balance (€/ha) B-A
	In the year specified	Total (A)	In the year specified	Total (B)	
planting	2,980	2,980	0	0	-2,980
1st year	565	3,545	0	0	-3,545
2nd year	865	4,410	0	0	-4,410
3rd year	1,145	5,555	575	575	-4,980
4th year	1,470	7,025	2,250	2,825	-4,200
5th year	1,840	8,865	4,665	7,490	-1,375
6th year	2,600	11,465	8,370	15,860	+4,395

Until the beginning of the 3rd growing seasons, the apricot orchard generated only costs – 4,410 € (cumulative, planting costs + management costs in the 1st and 2nd growing seasons). In the 3rd growing season, the first yield (income) was obtained, but it was lower than

production costs in this year, indicating further increase in the negative balance during the 3rd growing season (- 4,980 €).

During the 4th growing season, the income (2,250 €) was for the first time higher than the costs during the year (1,470 €), but the total balance remained negative (- 4,200 €). The tendency to decrease the negative balance continued into the 5th year and at the end of the 5th growing season it was - 1,375 € During the 6th year, substantial income (8,370.00 €) was gained. This resulted in the first positive balance in the 6th year, i.e. it was the first time in the 6th year that total income was higher than total costs. Return on investment and the first profit are made in the 6th growing season.

The cost-effectiveness of apricot production is largely dependent on the frequency of late spring frost events. It is noteworthy that there were no late spring frosts during the experimental years.

Conclusion

The results of the agroeconomic analysis of apricot cultivation in early years after planting suggest the following:

Establishment costs for a 1 ha apricot orchard are significantly lower than those in some other fruit species such as apple or raspberry.

During the first 2 years of orchard life, total costs increased to include orchard management costs in the 1st and 2nd year. In the 3rd, 4th and 5th growing seasons, first yields and, hence, income, are attained, but in cumulative terms the costs are still higher than the income attained.

During the 6th growing season, return on investment is gained, the value of the production becomes higher than the total costs, and the first profit is reported.

Acknowledgement

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EFFICIENCY OF INOCULATION WITH *AZOTOBACTER CHROOCOCCUM* ON AGRONOMIC CHARACTERISTICS AND YIELD OF MAIZE AND SUGARBEET

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Abstract

The aim of this study was to determine the effect of inoculation with *Azotobacter chroococcum* strains on the root yield and white sugar yield of sugarbeet, as well as on the yield of maize, total microbial number and number of azotobacters in maize and sugarbeet rhizosphere. The effect of inoculation on microbial abundance in sugarbeet rhizosphere was evaluated in 2007 and 2008 at the locations of Pan evo and Rimski Šan evi. The experimental design was a randomized, complete block with four replications. The experimental object was the sugarbeet, cultivar Drena developed at Institute of Field and Vegetable Crops in Novi Sad. Five strains of *Azotobacter chroococcum* (1, 5, 8, 10 and 14) were used as microbiological fertilizer for sugarbeet. The strains are from NS Collection of Nitrogen fixing bacteria registered in WFCC World Data Center on Microoorganisms (registration number is 754 with the acronym ("NSCNFB"). The effect of inoculation on microbial abundance in maize rhizosphere was evaluated at the location of Rimski Šan evi. Three maize hybrids were used in the experiment: NS 444 ultra (FAO 400), NS 5010 (FAO 500) and Tisa (FAO 700) developed at Institute of Field and Vegetable Crops, Novi Sad. The microbial abundance in rhizosphere was determined during the growing season of investigated plants. Positive effect of inoculation with *Azotobacter chroococcum* was on total microbial number and number of azotobacters in the rhizosphere. Inoculation significantly increased maize yield, root yield and crystal sugar yield.

Key words: *Microbial abundance, rhizosphere, sugarbeet, maize, yield.*

Introduction

Microorganisms are important for agriculture in order to promote the circulation of plant nutrients and reduce the need for chemical fertilizers. Beneficial plant–microbe interactions in the rhizosphere are the determinants of plant health and soil fertility. In the era of sustainable agricultural production, the interactions in the rhizosphere play a pivotal role in transformation, mobilization, solubilization, etc. from a limited nutrient pool in the soil and subsequent uptake of essential plant nutrients by the crop plants to realize full genetic potential of the crop (Mrkova ki and Mili , 2001; Jeffries et al., 2003; Dey et al., 2004).

Plant growth promoting rhizobacteria (PGPR) are a group of bacteria that actively colonize plant roots and increase plant growth and yield. Plant growth promoting bacteria (PGPR) may be important for plant nutrition by increasing N and P uptake by the plants, and playing a significant role as PGPR in the biofertilization of crops (Cakmakci et al., 2005). Bacterial inoculants are able to increases in germination rate, root growth, plant growth, yield, leaf area, chlorophyll content, nitrogen content, protein content, tolerance to drought, shoot and root weight, and delayed leaf senescence (Lugtenber et al., 2002; Dobbelaere et al., 2003). Successful examples of inoculation of maize, canola, wheat and other crops with PGPR species *Azotobacter*, *Azospirillum*, *Bacillus*, *Pseudomonas* and *Enterobacter* have been

achieved both in laboratory and field trials (Glick et al., 1997; Sharma and Johri, 2003; Egamberdiyeva, 2007). Plant growth responses were variable and dependent upon the inoculant strain, soil organic matter content, growing stage, harvest date and growth parameters evaluated (Cakmakci et al., 2007). Inoculation of plants with *Azospirillum* could result in significant changes in various growth parameters, such as increase in plant biomass, nutrient uptake, tissue N content, plant height, leaf size and root length of cereals (Bashan et al., 2004). Intensive research on associations between nitrogen–fixing bacteria and cereal roots began as early as the 1970s. In the production of field and vegetables crops, *Azotobacter* is the one which is most frequently applied. Inoculation of wheat and maize with *Azotobacter* strains increased the mass of the above–ground plant parts by 26–50% and yields by 19–30% (Jagnow, 1987). Numerous studies have established a significant impact of *Azotobacter chroococcum* on production and technological properties of sugar beet (a i et al., 2003; Mrkova ki et al., 2009). Also, in several studies have reported that maize is able to support free–living N_2 fixers in its rhizosphere (Naureen et al., 2005; Perin et al., 2006; Mehnaz et al., 2007) and maximal nitrogenase activity has been reported to be dependent to the maize genotype (Picard et al., 2008). For example, Pandey et al. (1998) have reported that improvements in yield and plant growth resulted in part from the stimulation of N_2–fixing bacteria in the rhizosphere of maize after the bio–inoculation by two PGPR strains.

The aim of this study was to determine the effect of inoculation with *Azotobacter chroococcum* strains on the root yield and white sugar yield of sugarbeet, as well as on the yield of maize, total microbial count and number of azotobacters in maize and sugarbeet rhizosphere.

Materials and Methods

The effect of inoculation with *Azotobacter chroococcum* on sugarbeet and microbial abundance in sugarbeet rhizosphere was evaluated in 2007 and 2008 at the locations of Pan evo and Rimski Šan evi (Serbia). The experimental design was a randomized, complete block with four replications. The length of the experimental unit was 10 meters, the width was 2 meters. The experimental object was the sugarbeet, cultivar *Drena* developed at Institute of Field and Vegetable Crops in Novi Sad. Five strains of *Azotobacter chroococcum* (1, 5, 8, 10 and 14) were used as microbiological fertilizer for sugarbeet. The strains are from NS Collection of Nitrogen fixing bacteria registered in WFCC World Data Center on Microoorganisms (registration number is 754 with the acronym ("NSCNFB"). The strains were grown on Fiodorov medium in liquid culture. The soil was treated with 2 l ha^{-1} of inoculum (cell density of 10^9 in 1 ml) added to 300 l ha^{-1} of water. No treated soil were designed as control. Three maize hybrids were used in the experiment: NS 444 ultra (FAO 400), NS 5010 (FAO 500) and Tisa (FAO 700) developed at Institute of Field and Vegetable Crops, Novi Sad. Before seeding the maize, a mixture of *Azotobacter* strains (5, 8, 14) was introduced into one half of the experimental plot. One liter of inoculum with the cell density of 10^9 in 1 ml was dilluted in 300 l of water and sprayed into the soil. The microbial abundance in rhizosphere was determined during the growing season of investigated plants. The total microbial count was done in soil agar (dilution 10^6), the number of azotobacters in Fiodorov medium (dilution 10^2) (Jarak and uri , 2006). After harvesting, the grain yield (with 14% grain humidity) was measured in t ha^{-1}. The data were processed by analysis of variance and the significance was expressed by LSD test.

Results and Discussion

Effect of *Azotobacter* on sugarbeet: root and white sugar yield

The average yield of sugarbeet in both locations, achieved in this study in consequence to *Azotobacter* application, was 68.92 t ha^{-1} or 3.10 t ha^{-1} over the control. All *Azotobacter* strains exhibited positive effects on sugarbeet yield. The maximum increase in root yield – 2.8

t ha^{-1} was achieved by strain 8. For Pan evo location average yield increase was 4.11 t ha^{-1}. The highest root yield on location Rimski Šan evi were obtained with strains 10 and 8 (2.64 and 2.25 t ha^{-1} over control). In Pan evo the highest effect on root yield were with strains 1 and 5 (4.63 t ha and 3.40 t ha^{-1} over control) (tab.1).

Table 1. Effect of *Azotobacter chroococcum* strains on root and white sugar yield of sugarbeet (t ha^{-1})

Root yield of sugarbeet (t ha^{-1})							
Location	Control	Strain 1	Strain 5	Strain 8	Strain 10	Strain 14	Average	Increase (t ha^{-1})
R. Šan evi	68.55	69.32	69.28	70.80	71.19	70.71	69.98	2.09
Pan evo	65.18	69.81	68.58	68.53	67.56	67.52	67.86	4.11
Average	**66.86**	**69.56**	**68.93**	**69.66**	**69.37**	**69.11**	**68.92**	**3.10**
White sugar yield							
R. Šan evi	9.71	9.89	9.78	10.11	10.21	10.04	9.96	0.25
Pan evo	8.58	8.79	8.74	8.77	8.46	8.69	8.67	0.09
Average	**9.14**	**9.34**	**9.26**	**9.44**	**9.33**	**9.36**	**9.31**	**0.17**

LSD		
0.05	3.61	0.51
0.01	4.78	0.68
CV (%)	9.22	10.33

The average yield of sugar obtained in both locations by *Azotobacter* application was 9.31 t ha^{-1}. A positive effect on calculated sugar yield was achieved by applying all five *Azotobacter* strains while the biggest increase was recorded in the case of strain 8 (9.44 t ha^{-1} or 0.3 t ha^{-1} over the control. On location Rimski Šan evi the highest yield of white sugar were with strains 10 and 8 (with increase of 0.5 and 0.4 t ha^{-1} over control). In Pan evo the highest increase in white sugar were with strains 1 and 8, 0.21 and 0.19 t ha^{-1} over control (tab. 1).

Effect of *Azotobacter* on sugarbeet: total microbial and *Azotobacter* count
Microbial populations in both locations were more numerous in the treated variants than in the control. The average total bacterial count was 223.16 which was 34.3% higher than the control. The biggest effect on the total number of microorganisms was achieved in the case of strain 14, and the largest increase in Pancevo location – 56.02%. The highest effect on total microbial number was achieved with strain 1 on location Rimski Šan evi (27.9% over control) and with strain 14 on location Pan evo (99.1% over control). The number of *Azotobacters* was increased by all tested strains. The actual increases ranged from 34.3 to 53.1% compared with the control. The highest increase in the *Azotobacter* count was obtained in case of strain 8 (tab. 2).

Table 2. Effect of *Azotobacter chroococcum* strains on microbial abundance in sugarbeet rhizosphere

Total microbial count							
Location	Control	Strain 1	Strain 5	Strain 8	Strain 10	Strain 14	Average	Increase (%)
R. Šan evi	185.57	237.43	219.07	202.63	225.97	234.35	217.50	17.2
Pan evo	146.66	228.06	255.23	225.29	225.68	292.02	228.82	56.0
Average	**166.11**	**232.74**	**237.15**	**213.96**	**225.82**	**263.18**	**223.16**	**34.3**
Azotobacter count							
R. Šan evi	23.03	36.40	39.27	39.26	32.85	40.73	35.26	53.1
Pan evo	58.84	83.53	83.38	84.98	82.40	80.81	78.99	34.2
Average	**40.93**	**59.96**	**61.32**	**62.12**	**57.62**	**60.77**	**57.12**	**39.6**

The highest number of *Azotobacter* was obtained with strain 14 on location Rimski Šan evi (76.8% over control) and with strain 8 on location Pan evo (44.2% over control) (tab. 2).

Effect of *Azotobacter* on maize: yield of maize
In all three hybrids, the grain yield was significantly increased in the variants with *Azotobacter* compared to the control. The increase in yield in NS 5010 was highly significant. Grain yield was higher by about half a ton per hectare, in relation to the control (tab. 3).

Table 3. Effect of *Azotobacter chroococcum* strains on maize yield (t ha^{-1})

Hybrid (A)	**NS 444 ultra**	**NS 5010**	**Tisa**	**Average**
Ø (B)	9.898	9.008	9.496	9.467
A. chroococcum (B)	10.294	9.649	9.889	9.944
A.c.- Ø	0.396	0.641	0.393	0.477

L$_{SD}$		
0.05	0.484	0.395
0.01	0.669	0.546

Effect of *Azotobacter* on maize: total microbial and Azotobacter count
Microbial population with three examined hybrids, were numerous in the treated variant than in the control. The average total bacterial count was 120.5 which was much higher than the control. The biggest effect on total microbial count was achieved with hybrid NS 5010. The number of *Azotobacters* was increased with inoculation. The highest increase in the *Azotobacter* count was obtained in case of NS 444 ultra. The number of the examined microorganisms was also dependant upon the maize hybrid (table 4).

Table 4. Effect of *Azotobacter chroococcum* strains on microbial abundance in maize rhizosphere

Total microbial count				
Hybrid (A)	**Tisa**	**NS 5010**	**NS 444 ultra**	**Average**
Ø (B)	9.3	5.3	11.9	8.8
A.chroococcum (B)	23.4	252.5	85.5	120.5
A.c.- Ø	14.1	247.2	73.6	111.6
Azotobacter count				
Ø (B)	42.2	29.5	40.5	37.4
A.chroococcum (B)	60.1	44.7	79.7	61.5
A.c.- Ø	17.9	15.2	39.2	24.1

The potential use of *Azotobacter* as biofertilizer has been rewieved by Mrkova ki & Mili (2001) who concluded that inoculation with these microorganisms occasionally promote plant growth probably by mechanisms other than biological N fixation. *Azotobacter* has been used as a potential fertilizer to increase sugarbeet yields (Stainberga et al., 1996; Antipcuk et al., 1997). The results obtained in production fields in the Vojvodina Province inoculated with a mixture of *Azotobacter chroococcum* strains (NS *Betafixin*), showed that the sugarbeet yield was increased by 3.08 t ha^{-1} in 2007 and by 6.18 t ha^{-1} in 2008 (Mrkova ki et al., 2009). In previous studies, the increases in the root yield of three sugarbeet cultivars treated with *Azotobacter* strains were from 0.65 to 3.7 t ha^{-1} respectively, as compared with the control (a i et al., 2003). Antipcuk et. al. (1997) obtained increase of 2.6–12.7% relative to the control plot, in two year study of *Azotobacter* influence on sugarbeet yield with no nitrogen mineral fertilizer additions. The introduction of *Azotobacter* into the soil increased the sugarbeet yield 17–24% in relation to the control (Steinberga et al., 1996). Sahin et al. (2009) conclude that inoculation significantly increased root and sugar yield of sugarbeet over the control. Single inoculation with N_2–fixing bacteria increased sugarbeet root yield by 5.6–11%. Increases of white sugar yield by 680 kg ha^{-1} and by 1050 kg ha^{-1} were achieved in production plots in the Vojvodina Province in 2007 and 2008, respectively (Mrkova ki et al., 2009). Rodelas et al. (1999) concluded that the yield of sugarbeet, carrot and cabbage was increased by 10% in the case of *Azotobacter* application. Some researcers have showen negative or no effects of EMC (effective microorganism culture) application on crop growth and yield (Kinjo et al., 2000; Formowitz et al., 2007; Daiss et al., 2008). Our previous studies (Mrkova ki et al., 2002, 2008; Mrkova ki and Mezei, 2006) showed that the total microbial count in the rhizosphere of inoculated sugarbeet was increased by 45.7 % or from 35 to 118 % in relation to control. According to results of Govedarica et al. (2004), with introduction of *Azotobacter*, biological activity in soil increases and yield of maize depends on hybrids and applied strains. The increase in yield can be due to the influence of *Azotobacter chroococcum* which fixes up to 90 kg N ha^{-1} a year which increases the nitrogen pool and biological activity of soil (Irissarri and Reinhold–Hurek, 2001; Hajnal et al., 2005; Raimam et al., 2007). Using *Azospirillum* as PGPR bacteria, Okon and Labandera-Gonzales (1994) obtained an increase in maize yield by 15–25%, and by 40% when inoculation was combined with fertilization. They were also reported a constant increase of the yield in medium–fertility soil and observed possibility of replacing 35–40% nitrogen fertilizer by using biofertilizers. Inoculation of maize increased shoot dry weight from 63–115% (Biari et al., 2008). Plants secrete through the root different organic and mineral substances which are used by rhizospheric microorganisms for nutrition. Even though the plant is the same, the number of microorganisms in rhizospheric soil also depends on hybrids and varieties within the same sort (Walker et al., 2003). A large number of rhizospheric microorganisms, including *azotobacter*, produce growth substances such as auxins, gibberellins etc. Biofertilizer PGPR inoculation significantly increased maize growth, seed maize yield as compared to treatment without inoculation (Yazdani et al., 2009). Important characteristic of *Azotobacter* assosiated with plant improvement is excretion of ammonia in the rhizosphere in the presence of root exudates which could explain why the inoculation resulted in a slightly higher total N content in soil (Wu et al., 2005). Egamberdiyeva (2007) examined the effect of PGPR on the growth and adsorption of nutrients of maize in two different soils and concluded that inoculation had a better stimulating effect on plant growth in soil with lower nutrient content than in rich.

Conclusions

The inoculation increased yield of the studied sugarbeet variety and maize hybrids. The total microbial count and azotobacter count in the rhizosphere of sugarbeet and maize were increased by inoculation. Long-term positive effect of PGPR may result in improvements in

plant growth and sustainable food production with a positive relation toward the environment and economy of production. Overall, the results suggest that inoculants could be used to allow reductions in the current high rates of fertilizer and the resulting environmental problems without compromising plant productivity. However, it should be noted that no microbial inoculant can be universal for all systems as the effectiveness may be affected by plant type, soil type, and some other factors. Further greenhouse and field studies should provide more definitive information about the movement and uptake of macroelements (N and P) to plants with the impacts of PGPR–based inoculants.

Acknowledgements

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SOYA BEAN BIOMASS PRODUCTION UNDER DIFFERENT WATER REGIME CONDITIONS

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Abstract

The paper investigates soya bean biomass production on brown forest soil (cambisol) under conditions of dry farming and irrigation. The experimental studies were carried out on brown forest soil in Mladenovac during 2011 and 2012. The subject-matter of this research was *Proteinka*, a domestic soya bean cultivar, grown under conditions of natural water regime and two irrigation variants. The results showed that irrigation had caused significantly larger plant height and pod mass per plant. In the biennial average, the best results were achieved with the second irrigation variant (three waterings). Therefore, what can be recommended for soya bean production under these agro ecological and soil conditions is three waterings with the amount of water higher than optimal. This irrigation system will lead to more favourable relative humidity of air, considering soya bean is equally sensitive to soil and air drought during gametogenesis.

Key words: *soya bean, natural water regime, irrigation, plant height, pod mass per plant*

Introduction

The relationship between the soya bean and climatic factors is determined by the origin of the soya bean. The soya bean originates from Mandzuria, where there is a monsoon-type climate during the period of blooming and pod formation, i.e. the climate is hot with high relative humidity. In such climatic conditions, the soya bean gives high and stable yields (Popovi , 2010; Kolaric et al., 2014a, 2014b; Popovic et al., 2014). Modern production technologies, the imperative of which is economic efficiency, have set high standards not only in the way of biomass production, but also for the preservation of natural resources and protection of ecosystems. To fulfil these requirements, the results of numerous studies point to problems and limiting factors in soya bean production. Considering that the soya bean seed is a necessary component of quality forage feeds due to its high energy and easy digestibility, the aim of soya bean production is therefore the production of seeds with a high nutritional value. The most important components of the seed are proteins and oils. Environmental conditions significantly affect the ontogenesis and yields of the soya bean seed. The soya bean in Serbia is irrigated in a small number of areas, although most researchers point out there are more possibilities for crop irrigation in the most important agricultural areas (close to big rivers). Rational water management enables achieving maximum yields per unit water use, while preserving the environment and its sustainability, as Tolimir (2002) pointed out. This is the reason why all the studies on growing field crops under different soil moisture conditions are important, since their results not only contribute to the economic efficiency of the production, but they are also in line with the priority objectives of the EU agricultural policy, aimed at natural resources protection (European Union, 2000). The

soya bean is a plant specific for its water requirements. As pointed out by Al-Kaisi et al (2003), a lack of water causes lower yields, due to discarding of flowers and a relatively large decrease of fertilisation. Besides soil drought, air drought is also very unfavourable. In extreme conditions, more strata of the soya bean canopy lag behind, plant height decreases, as well as the photosynthetically active leaf area, therefore decreasing the size of the seed (Popovi , 2010; Popovic et al., 2012). There are several methods of drought management, ranging from genetics, breeding, selection, and zoning of certain cultivars to the application of numerous agricultural measures in soya bean production. Irrigation is the only measure that can solve drought problems (Miladinovi et al., 2008, a citation of: Bošnjak, 2001; An elkovi et al., 2001). Analysing the dynamics of water use per phenophase, Glamo lija (2012) emphasised that the soya bean absorbs the minimum amount of water during seed germination and emergence. In initial growth stages, water use is relatively small - only $0.5 \, l \, m^2$ a day, although in the swelling stage the soya bean absorbs approximately 150% of its mass. Water use increases with later growth stages, achieving its maximum in the periods of pod formation and seed filling. In these periods plants absorb $8 \, l \, m^2$ of water, which is about 70% of the total amount required. After that, water use gradually decreases. In the agro ecological conditions of Serbia, water regime in the period of the largest water use is not favourable in most production areas. The goal of this paper was to identify the effect of irrigation rates on key morphologic characteristics that determine soya bean biomass, such as plant height and the number of fertile pods per plant.

Materials and methods

The experimental studies were carried out in the agro ecological conditions of Mladenovac on brown forest soil, as two–year block field trials (Hadživukovi , 1991) with three replications. Main plot area was 4,000 m². The size of the experimental plot was 2,000 m², and the size of the basic plot was 6 m². Key morphological characteristics that directly determine soya bean biomass, such as plant height and the number of fertile pods per plant, were studied in relation to applied irrigation rates. The rates had been determined based on the average precipitation in critical periods and then compared with the actual plant requirements. According to the calculated model, two variants of irrigation were determined, comprising two and three waterings with 70 l of water each. The trials comprised three variants: control (variant 1 - no irrigation); two waterings (variant 2); and three waterings (variant 3) carried out in critical periods for soya beans, such as flowering - R1-R3, pod formation and growth - R3-R4, and seed formation and growth - R4-R6. The statistical analysis of the results was done with the analysis of variance. The variant without irrigation was used as a control variant, and the differences between each treatment were analysed with the LSD test, at the significance level of 0.05% and 0.01%

Meteorological conditions

The water requirements of the soya bean are not the same during the whole growing season. They are lower in the first part of the growing season when vegetative parts are formed, increasing during the formation of generative organs and reaching its maximum during seed filling (Popovi , 2010).
Having analysed the weather conditions in 2011 and 2012, the authors made a conclusion the conditions were unfavourable for soya bean production. In both years, there was less precipitation during the growing season compared with the multi-year average for this production area, and significantly less precipitation than it was optimal for these growing conditions. This water regime was accompanied with very high air temperatures, unfavourable for soya bean production.
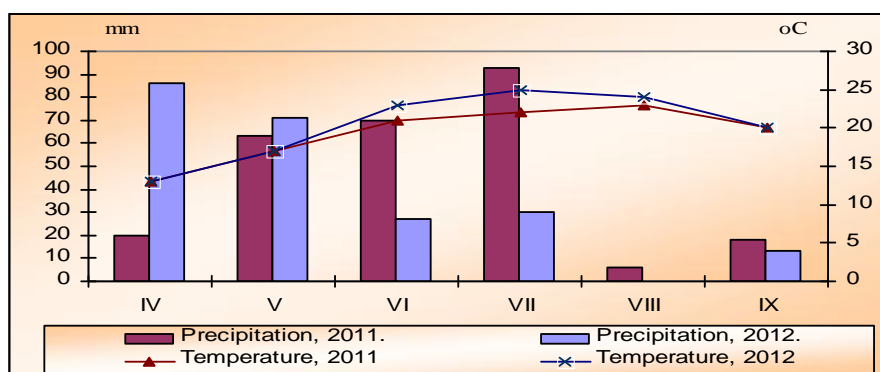
Graph. 1. Temperature (^{0}C) and precipitation (mm) in the soya bean growing season, 2011-2012 (Meteorological station of Mladenovac)

In both years, there was less precipitation when compared with the multi-year average for the area of Mladenovac. The monthly distribution of precipitation in the growing season was different each year, and generally unfavourable for soya bean production. The amount of precipitation in 2011 was 270 mm, which was 84 mm less when compared with the multi-year average, while the precipitation deficit was 168mm. In the 2012 growing season, the amount of rainfall was 227 mm, being 127 mm less than the average, with the deficit of 186 mm (Table 1, Figure 1).

Table 1. Precipitation and plant water requirements, mm
(Meteorological station of Mladenovac)

Year/Month	IV	V	VI	VII	VIII	IX	Sum
Requirements	50	75	90	90	95	30	430
2011	20	63	70	93	6	18	270
Deficit	-30	-12	-20	+3	-89	-12	-168
2012	86	71	27	30	0	13	227
Deficit	+36	-4	-63	-60	-95	-17	-186
Average	48	56	85	62	53	50	354
Deficit	-2	-19	-5	-28	-42	+20	-76

It should be noted also that pre-season precipitation (winter and early spring precipitation) in 2010/11 was 25mm less than the multi-year average. In the second year of research, a lack of precipitation in the same period was even higher, being 82 mm.

Table 2. Monthly and optimal air temperatures, ^{0}C
(Meteorological station of Mladenovac)

Year/Month	IV	V	VI	VII	VIII	IX	Average
2011	13	17	21	22	23	20	19.3
2012	13	17	23	25	24	20	20.3
Average	12	17	20	22	21	17	18.1
Optimal	12	15	20	20	21	16	17.3

In both years, the average monthly temperature in the growing season was higher than the multi-year average, by 1.17 ^{o}C in 2011 and 2.07 ^{o}C in 2012. During the summer months, there were particularly large deviations from the average temperature, and the soya bean was then in the generative stages of growth when it was very sensitive to high temperatures and low relative humidity (Table 2).

Results and discussion

The results comprised key morphological characteristics, such as plant height and the number of fertile pods per plant, which directly determined soya bean biomass.

Plant height

Soya bean height, as a cultivar trait, depends on agro ecological and soil conditions and it is subject to variation (Popovic et al., 2012). The two-year average height of the soya bean in all variants was 113.23 cm. The results showed that irrigation rates and soil water regime during the growing season affected soya bean growth significantly (Table 3).

Table 3. Plant height per variant, cm

Year	Variant 1 - Control	Variant 2 – two waterings	Variant 3 – three waterings	Average
2011	90.2	130.5	135.8	118.83
2012	77.1	120.4	125.4	107.63
Average	83.65	125.45	130.60	113.23
LSD of variants	0.05% = 1.788; 0.01% = 2.330			
LSD of years	0.05% = 1.622; 0.01% = 2.330			
LSD of years x variants	0.05% = 3.097; 0.01% = 4.182			

In the research period (2011-2012) irrigation helped the crops reach the average height of 125.45 cm and 130.60 cm, respectively, which was an increase of 49.70% and 56.13% compared to the control variant. The lowest stem height (77.1 cm) was recorded in arid 2012, in the variant of natural water regime. The crops were significantly lower in the control variant than in the variants with two and three waterings, and also lower compared to the first year. In 2012, the irrigated crops achieved the height of 120.40 cm, and 125.40 cm, respectively, which was a significant increase of 56.16% and 62.65% compared to the control variant.
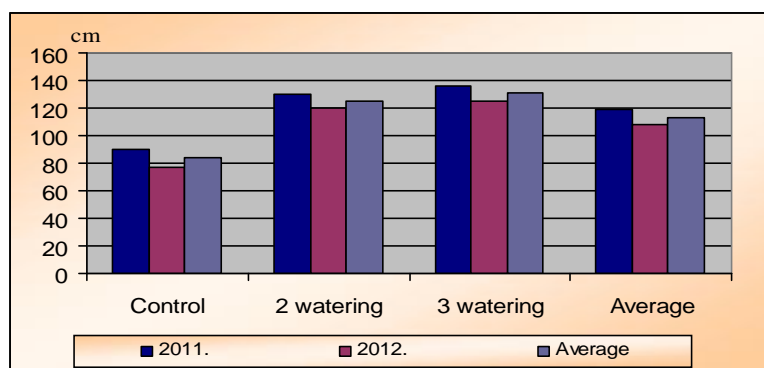
Graph 2. Average plant height per variant, cm

In 2011, the irrigated crops reached the height of 130.50 cm, and 135.80 cm, respectively, which was a significant increase of 44.68% or 50.50% compared to the control variant. Under favourable conditions, soya beans form longer internodes and higher stems (Glamo lija et al., 2009). Some authors reported that soya bean growth depends on thermal conditions and soil moisture in the period from germination to the formation of the first 5-6 internodes. The impact of cropping practices on plant height is also significant.

Mass of fertile pods per plant

The two-year average mass of fertile pods per plant was 8.70g in all variations. The results showed that the water regime of soil during the growing season and irrigation rates had a very significant impact on this parameter (Table 4).

Table 4. The mass of pods with seed per plant, g

Year	Control	Two waterings	Three waterings	Average
2011	8.31	11.28	10.77	10.10
2012	3.34	8.82	9.83	7.30
Average	5.80	10.05	10.30	8.70
LSD of variants	0.05% = 0.0701; 0.01% = 0.0946			
LSD of years	0.05% = 0.1159; 0.01% = 0.1665			
LSD of years x variants	0.05% = 0.1214; 0.01% = 0.2539			

In 2011-2012, the average mass of fertile pods in the variants with two waterings (10.05 g), and three waterings (10.30g) was significantly higher than in the control variant (5.80 g), by 73.28% and 77.59%, respectively. The mass of fertile pods ranged from 8.82 g in 2012 to 11.28 g in 2011 in the variant with two waterings and from 9.83g in 2012 to 10.77g in 2011 in the variant with three waterings. The irrigated plants had a significantly greater mass of fertile pods. The smallest mass of fertile pods per plant was recorded in the control variant (3.34g) in the second year of research that was rather arid, so it can be concluded that water regime plays a significant role in pod formation and the number of pods. As the number of waterings increased, the value of the studied parameter also increased, by 164.07% and 194.31%, respectively.
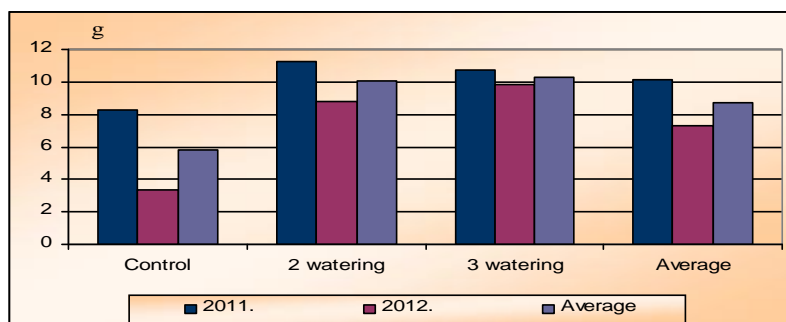
Graph.3 Mean mass of fertile pods per plant, g

In 2011, the irrigated crops had the pod mass of 11.28 g, and 10.77 g, which was a significant increase of 35.74% and 29.60%, respectively, compared to the control variant. Crops exposed to drought produce fewer seeds per pod, had smaller seed mass, resulting in lower yields (Popovi , 2010, Popovic et al., 2012).

Conclusions

This research on soya bean biomass production under conditions of different soil moisture shows the following:

Production of soya bean biomass on brown forest soil type (cambisol) under the condition of irrigation is more justifiable than dry farming, since the soya bean is sensitive on both soil and air drought, especially in the period of gametogenesis.
In the period 2011-2012, the irrigated crops reached 125.45 cm and 130.60 cm of height, which is an increase of 49.70% and 56.13%, respectively, when compared to the control variant.

In 2011-2012, the average mass of fertile pods per plant in the variant with two waterings (10.5 g), and three waterings (10.30 g) was significantly higher than in the control variant (5.80 g), by 73.28 and 77.59%.

Observed by years, variations in plant height and mass of pod were lower in the irrigated than in non-irrigated crops, showing the importance of this cropping practice for soya bean growth and pod formation. It is important for putting into practice in order to maximise the genetic potential of plants and have rational and economical production.

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THE EFFECT OF CYTOPLASMIC MALE STERILITY ON MORPHOLOGICAL TRAITS OF MAIZE INBRED LINE

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Abstract

In order to reduce costs from detasseling the production of hybrid maize seed is increasingly based on using cytoplasmic male sterility (CMS). It is very important to investigate the influence of the specific type of sterility on morphological traits of inbred lines since they are unstable due to its nature. In this study we used seven maize inbred lines developed at Maize Research Institute „Zemun Polje" and each of these seven lines were investigated in five variants: with normal cytoplasm (N), with C type sterile cytoplasm (CMS-C), the fertile counterpart C (RfC), with S type sterile cytoplasm (CMS-S), the fertile counterpart S (RfS). We found that genotype, location and type of line have significant influence on morphological traits. The position of main ear in lines with sterile cytoplasm and there fertile counterpart were higher comparing to lines with normal cytoplasm. The greatest plant height was observed in RfC lines, while all other lines had similar plant height. The highest percentage of lodged and broken plant was observed in inbred lines with normal cytoplasm, while the smallest value of this parameter was found in lines with C type sterile cytoplasm. This can lead us to conclusion that introduction of new genes have influence on morphological traits of maize inbred lines.

Key words: *maize, citoplasmic male sterility (CMS), inbred lines, morphological traits, position of main ear, plant height*

Introduction

The cytoplasmic male sterility (CMS) is widely used procedure for producing hybrid seeds in many important field crops, due to this technique is very cost effective, so using CMS hybrids we can decrease time and costs in seed production. For the breeding programs and production of modern maize hybrids special attention is given to the morphological traits of maize. There is a tendency to make hybrids that will have low plant height in order to increase plant density per unit (Russell, 1984). Maize breeders and producers have tendency to produce hybrids in which main ear is lower-positioned, because this will reduce lodging and brokening of plants (Meghji et al., 1984; Duvick et al., 2004). The icreasment of lodged and broken plants is not desirable, because it leads to reduction in grain yield. Due to all named reasons, it is very important to determine whether the use of CMS and the introduction of new genes affect the morphological traits of maize hybrids.

In the last forty years, there are not so many investigations related to the effect of cytoplasmic male sterility on morphological traits of maize hybrids. Scientific interest for this research field was reduced in seventies years of the last century due to infection of maize hybrids with the fungus *Helminthosporium maydis* (Van etovi et al., 2007). From this reason, the use of CMS in the maize hybrids production is considered to be risky. Considering everything above, the investigation of the influence of the CMS on the morphological traits of maize should be continued in order to investigate how new, modern inbred lines are behave if in seed production we use their sterile analogues.

The main aim of this study was comparison of morphological traits of original inbred lines and their CMS and Rf variants in order to understand whether use of CMS and the introduction of new genes affect the morphological traits of maize.

Materials and Methods

In this study we used seven maize inbred lines developed at Maize Research Institute „Zemun Polje" that belongs to different maturity groups (FAO 300-500). The lines were named as ZPL-1, ZPL-2, ZPL-3, ZPL-4, ZPL-5, ZPL-6 i ZPL-7. CMS and Rf versions of lines were obtained by conversion of inbreds with normal cytoplasm at Maize Research Institute „Zemun Polje".

Trials were set up according to the randomised split-plot design in the period of two years (2010 and 2011). All trials were set up under conditions of dry land farming. Sowing was always done on the optimum dates with the application of common cropping practices. Trials were set up on three locations:Zemun Polje, Školsko dobro (a location within trial fields of the Maize Research Institute Zemun Polje) and Srbobran. The trial performed on location Školsko dobro in 2011. was discarded. The trial was setup in three replications in five sets (blocks), where each of those sets presented one of the type of observed inbreds:

I block – N (normal) cytoplasm, i.e. original inbred lines

II block – CMS-C inbreds

III block – RfC inbreds

IV block – CMS-S inbreds

V block – RfS inbreds .

Every plot in one replication was assembled in 4 rows, where each row possessed 12 hills at the distance of 40 cm. Hand sowing was performed and four plants were sowed per hill. The inter-row distance was 70 cm. The elementary plot size and sowing density were 7.28 m^2 and 71,429 plants ha^{-1}, respectively. At the 5-leaf stage, thinning to two plants per hill was performed.

The following traits were measured:

Plant height (cm)

Main ear height (cm)

Percentage of lodged and broken plant

Immediately after fertilization a random sample of 20 plants was used to determine plant height and position of main ear. The percentage of lodged and broken plant was determined before harvesting, and in this step all plants that were broken above node where the main ear is positioned were treated as broken, while lodged plants were ones that are inclined at more than 30 degrees from the vertical.

Statistical analysis of data included analysis of variance - ANOVA randomized block design (RCB) for the factors G (genotype) and L (location) by the factor T (the type of inbreds) as a split-plot of G and L. The software used for analysis of variance was the MSTAT (MSTAT Development Team, 1989). It also has been used the least significant difference test (LSD) for the comparison of the original inbreds and their counterparts. Both tests are applied to the significance level of 5 and 1%.

Results and Discussion

The analysis of variance for the traits plant height, main ear position and percentage of broken and lodged plants for all locations are presented in the Table 1. It was shown that genotype (G) and location (L), as well as their interaction (GxL), had very significant influence on all three traits. Type of inbreds (T) had very significant influence on main ear height and plant height, while there was no statistically significant correlation observed for the trait percentage of broken and lodged plants. The interaction of genotype and type of inbreds (GxT) very significantly affected all three investigated traits. Interaction of location and type of inbreds (L x T) showed very significant effect on main ear position and plant height, while there was no influence on percentage of broken and lodged plants. The interaction of genotype, location and type of inbreds (G x L x T) had significant influence on main ear position and percentage of broke and lodged plants, while there was no effect on plant height.

Table 1. The significance of mean squares from the ANOVAfor traits plant height. main ear position and percentage of broken and lodged plants

Trait		Main ear position (cm)	Plant height (cm)	% of broken and lodged plants
Source of variation	Degrees of freedom	Mean square	Mean square	Mean square
Repetition (R)	2	30.023 ns	216.603 ns	9.518 ns
Genotype (G)	6	177778.625 **	39864.032 **	569.614 **
Location (L)	4	346.055 **	8944.838 **	1742.770 **
G x L	24	236.218 **	555.937 **	89.781 **
Error (E-1)	68	36.522	72.137	19.397
Type of inbreds (T)	4	451.863 **	635.572 **	37.351ns
G x T	24	141.657**	352.685 **	44.854 **
L x T	16	702.205 **	302.583 **	30.059 ns
G x L x T	96	29.696 *	64.872 ns	27.256 *
Error (E-2)	280	21.366	51.631	19.683
Total	524			

*; ** - Statisticaly significant on level 0.05 i 0.01. respectively

LSD-test between inbred lines showed the highest main ear position in inbreds with RfC and C type of cytoplasm (81.23 cm and 81.1 cm, respectively) for both investigated levels of significance (5% i 1%).The lowest position of main ear was observed in inbreds with normal cytoplasm, 76.33 cm (Tab. 2). The last finding lead us to conclusion that introduction of new cytoplasmic genes into inbred lines results in increasing of main ear position. The highest plant height was observed in RfC inbreds (195.2 cm), while the lowest plant height was determined in RfS inbreds (188.4 cm) for both significance levels. The differences between inbreds with normal and sterile cytoplasm for this trait were marginal, which is consisted with research Rojc et al. (1984). For the significance level of 5%, the highest percentage of broken and lodged plants was observed in inbreds with normal and sterile S type cytoplasm (7.209 and 7.071%, respectively), while for the significance level of 1% no significant differences between investigated inbreds for this trait was observed. The lowest percentage of broken and lodged plants was found in inbred lines with C type of CMS, so we can conclude that in this case introduction of new genes leads to increased resistance on lodging. Previous researches

of Rojc et al. (1984) showed opposite results. They have shown that sterile hybrids have for 1% higher number of broken and lodged plants comparing to their fertile analogues. Our results are giving support that use of CMS in modern inbred lines may give benefit for breeders and seed producers, so the future investigation in this field is of great importance.

Tabela 2. The least significant difference test for mean values for main ear position. plant height and percentage of broken and lodged plants

		Main ear position (cm)				Plant height (cm)				% of broken and lodged plants		
Rank	Type	Value	0.05	0.01	Type	Value	0.05	0.01	Type	Value	0.05	0.01
1	RfC	81.23	A[1]	A[1]	RfC	195.2	A[1]	A[1]	N	7.209	A[1]	A[1]
2	C	81.10	A	A	N	192.2	B	B	S	7.071	A	A
3	RfS	79.43	B	B	C	192.2	B	B	C	6.870	AB	A
4	S	78.10	C	B	S	190.7	B	BC	RfC	6.750	AB	A
5	N	76.33	D	C	RfS	188.4	C	C	RfS	5.702	B	A
		Lsd	1.256	1.655		Lsd	1.952	2.572		Lsd	1.205	1.588

1 – Statistically significant values are ones that have no common letter

Conclusions

The effect of CMS on morphological traits in seven maize inbred lines developed at Maize Research Institute "Zemun Polje" was observed in the present study. Each of - them was investigated in five variants: with normal cytoplasm (N), with C type sterile cytoplasm (CMS-C), the fertile counterpart C (RfC), with S type sterile cytoplasm (CMS-S) and the fertile counterpart S (RfS). It was shown that genotype, locality and type of inbreds had very significant influence on plant height, main ear position and percentage of broken and lodged plants. The least significant difference test for mean values showed that for both significance levels (5 and 1 %) lowest position of main ear was observed in inbreds with normal cytoplasm. We could conclude that introduction of new cytoplasmic genes leads to increased position of main ear, which is not preferred trait. LSD test was also showed the greatest plant height was determined in inbreds with RfC germplasm for both significance levels. The differences between inbreds with normal and sterile cytoplasm for this trait were marginal. The highest percentage of lodged and broken plant was observed in inbred lines with normal cytoplasm, while the smallest value of this parameter was found in lines with C type sterile cytoplasm. In this case, we could conclude that introduction of new genes results in increasing resistance on lodging. Our results are giving support that use of CMS in modern inbred lines may give benefit for breeders and seed producers, so the future investigation in this field is of great importance.

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GRAIN YIELD, YIELD COMPONENTS AND MALTING QUALITY TRAITS OF SPRING BARLEY ON ACIDIC SOILS

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Abstract

A varietal trial involving six genotypes of spring barley ('Jastrebac', 'Dinarac', 'Dunavac', 'NS-404', 'Jaran' and 'Lider') was conducted over a three-year period at the farm estate of the Secondary School of Agriculture and Chemistry, Kraljevo (Serbia) (the experimental field of the Faculty of Agronomy, a ak) on an acidic soil (pH_{H2O} 4.5). The following traits were analysed: stem height, spike length, grain number per spike, thousand-kernel weight, grain yield, total germination capacity, grain protein content and extract content. Regardless of year, stem height was significantly higher in 'Dunavac' and 'Jaran' than in the other cultivars. The highest stem height in all cultivars was obtained in the second year. Spike length, grain number per spike and 1000-kernel weight were significantly higher in 'NS-404' compared to the other cultivars. Variations in grain yield across years were the lowest in 'Jaran' and 'Dinarac'. Total germination capacity was significantly higher in 'Jastrebac' than in the other cultivars in the first and second years. The significant increase in protein content in both years on average for all cultivars was accompanied by a significant decrease in malt extract, and vice versa. The high protein content in some cultivars along with the high malt extract content suggests that the strength of correlation between the traits is dependent on environmental conditions. Although the soil had poor physical and chemical properties, all cultivars had their 1000-kernel weight, total germination capacity, protein content and malt extract content within the standardised limits.

Key words: *barley, grain yield, yield components, malting quality traits*

Introduction

The proper choice of cultivar is of special importance in obtaining high grain yields in good-quality malt barley. In addition, different soil and climate conditions, notably temperature and moisture content during grain fill (Passarella et al., 2005) can largely contribute to variations in major yield components and, hence, total yield and grain quality of malting barley (Atlin et al., 2000; Paunovi et al., 2007; Madi et al., 2009). Pržulj et al. (2014) stressed that temperature and rainfall do not play the leading role in determining grain yield and quality of malting barley since grain quality is often poor when these factors approach optimal values. Moreover, grain yield and quality attributes in barley are affected by certain cultural practices such as nitrogen fertilisation (Pržulj and Mom ilovi , 2008; Marconi et al., 2010). As stressed by Pržulj and Mom ilovi (2002), realising the full yield and quality potential in barley necessitates strict adherence to production technology, given the precise quality requirements of the brewing industry for barley grain and malt. To ensure high quality of raw materials, new cultivars should be analysed for their traits and introduced into the production system, and cultivar choice made for a specific region. Grain quality i.e. malt extract content is largely dependent on growing conditions (temperature, available moisture, available N, fertilisation)

mostly indirectly through grain traits, primarily starch and protein content and composition (Collins et al., 2003). Grain quality attributes are quantitative in nature and greatly affected by environmental factors such as temperature, available moisture, N fertilisation and soil type (Zhang et al., 2006; Petterson and Eckersten, 2007). Some 30-40 % of the world's arable land is acidic, with a pH below 5.5 (von Uexkull and Mutert, 1995). On acidic soils, a range of chemical limitations and interactions between chemical compounds have a depressive effect on plant growth. Apart from the activity of hydrogen ions, plant growth is largely limited by toxic elements, particularly aluminium and manganese, as well as by the deficiency of P, N, K, Ca, Mg, S, Zn and Mo (Rao et al., 1993, Samac and Tesfaye, 2003). There is high variability in plant resistance to Al toxicity across species and across cultivars within species. Among small grains, barley exhibits the highest susceptibility to Al toxicity (Zhao et al., 2003). From among 600 barley strains, Ma et al. (1997) singled out 19 medium susceptible strains, 39 very susceptible strains, and many strains susceptible to Al toxicity.

The objective of this study was to examine the effect of genotype and growing conditions (year) on yield components, yield and major grain quality traits of spring malting barley grown on an acidic soil in Central Serbia.

Material and method

Parallel varietal trials were conducted over a period of three years at the experimental field of the Secondary School of Agriculture and Chemistry, Kraljevo (the experimental field of the Faculty of Agronomy, Čačak) on an acidic soil (pH$_{H2O}$ 4.5, humus 2.18%, P2O5 7.50 mg 100^{-1} g i K2O 15.5 mg 100^{-1} g soil), during 2010, 2011 and 2012. The experiment included six genotypes of two-rowed spring barley: 'Jastrebac', 'Dinarac', 'Dunavac', 'NS-404', 'Jaran' and 'Lider'. The experiment was laid out as a randomised block design in five replications, with plot size 5 m^2 (5x1m). The total amount of the complex mineral fertiliser N:P:K (15:15:15), 400 kg ha^{-1}, was applied manually over the soil surface prior to seedbed preparation. Sowing was performed by a grain drill suitable for microtrials, with 500 germinating grains m^{-2}, at a spacing of 10 cm between the rows and 3 cm within the row. Sowing dates were 3rd of March 2010, 12th of March 2011 and 7th of March 2012.

At grain maturity, a sample of 30 plants was collected from each plot for the analysis of stem height, spike length and grain number per spike. After harvest, grain yield obtained from each plot was measured and calculated as kg ha^{-1}. Total germination capacity (%) was determined after a seven-day germination period in a thermostat at a temperature of 20^{0}C. Grain protein content (% on a dry-matter basis) was determined by the Kjeldahl method, and extract content was calculated by Bishop's formula. The results were subjected to an analysis of variance using the SPSS software (1995). The significance of differences in means was evaluated by LSD testing.

Results and discussion

There is a tendency in breeding malting barley to create low-stem cultivars to eliminate plant lodging as a negative phenomenon, which occurs due to the weak mechanical tissue of the stem (Pržulj et al., 2010). Regardless of year, stem height was significantly higher in 'Dunavac' and 'Jaran' than in the other varieties, and the lowest in 'Dinarac' (Tabela 1). In all cultivars, stem height was the highest in the second year, significantly lower in the first year and the lowest in the third year. Cv. 'NS-404' produced significantly higher spike length compared to the other cultivars (Table 1). In all cultivars, the spike was the longest in the first year, significantly shorter in the second year and the shortest in the third year, although spike length showed different variations in the second and third years (cultivar/year interaction). Grain number per spike was the highest and significantly higher in 'NS-404' than in 'Jastrebac', 'Dinarac' and 'Dunavac' (Table 1). Regardless of cultivar, grain number per spike was significantly lower in the third year compared to the first and second years. Contrary to

the other varieties, 'Jastrebac' and 'Jaran' had a significantly higher number of grains per spike in the first year compared to the second year (cultivar/year interaction) (Table 1). Grain yield in all cultivars was the highest in the second year, significantly lower in the second, and the lowest in the third year. 'Jaran' and 'Dinarac' proved to be the most stable since their yield showed significantly lower variations across years compared to the other cultivars (Table 1).

Table 1. Means for stem height (SH), spike length (SL), grain number per spike (GNS), grain yield (GY), 1000-kernel weight (KW), total germination capacity (TGC), protein content (PC) and malt extract content (MEC) in the grain of spring barley cultivars in 2010, 2011 and 2012

		SH	SL	GNS	GY	KW	TGC	PC	MEC
Cultivars	Jastrebac	75.9bc	6.8b	19.8c	5027	42.1cd	98.5a	11.5ab	78.9ab
(C)	Dinarac	72.6c	6.6b	20.3bc	5140	41.6d	95.9b	11.6ab	78.8ab
	Dunavac	84.3a	6.7b	20.2bc	5084	42.9bc	96.3b	11.8ab	79.0a
	NS-404	76.1bc	7.4a	21.7a	5310	48.3a	95.3b	11.2b	79.5a
	Jaran	83.7a	6.9b	21.2ab	5213	43.7b	96.5b	11.9a	78.9b
	Lider	76.2b	6.8b	21.8a	5072	42.5bcd	95.6b	12.0a	78.3b
Years	2010	73.8b	7.3a	21.3a	5030b	43.5	96.2	11.9a	78.0b
(Y)	2011	98.6a	6.8b	21.3a	6067a	43.4	96.4	11.3b	79.8a
	2012	61.9c	6.4c	19.9b	4332c	43.6	96.3		
Jastrebac	2010	70.6fg	7.3abc	19.4e-i	4512de	40.0h	99.2a	11.7bcd	78.2cd
	2011	93.9cd	6.8def	18.2i	6080a	43.7ef	98.4ab	11.2de	79.7ab
	2012	60.6hi	6.3fg	18.8ghi	4488de	42.6efg	98.0abc		
Dinarac	2010	68.7fg	6.9b-e	18.8ghi	5160bcd	40.0h	95.8de	11,8bcd	77.9cd
	2011	89.2d	6.7def	20.8b-e	5640abc	42.7efg	96.2cde	11.3cde	79.7ab
	2012	57.2i	6.0g	18.4hi	4620de	42.0g	95.6de		
Dunavac	2010	78.5i	7.0bcd	19.4e-i	5072bcd	44.0de	96.4cd	11.6cd	78.5cd
	2011	105.5a	6.9cde	20.3c-g	6400a	42.5efg	96.4cd	12.0abc	79.5b
	2012	65.6gh	6.0g	18.0i	3780e	42.3fg	96.2cde		
NS-404	2010	71.2f	7.8a	21.1a-d	5660abc	51.0a	94.4e	11.5cd	78.6cd
	2011	97.1c	7.4ab	21.9ab	6420a	47.6b	95.2de	10.8e	80.4a
	2012	56.6i	7.1bcd	19.1f-i	3824e	46.3bc	96.2cde		
Jaran	2010	78.3l	7.6a	22.5a	4980bcd	44.0de	96.0de	12.2ab	77.9d
	2011	102.5ab	6.5efg	18.7ghi	5760ab	41.6gh	96.4cd	11.5cd	79.9ab
	2012	67.2fg	6.5efg	19.4e-i	4900bcd	45.5cd	97.0bcd		
Lider	2010	69.9fg	7.0bcd	20.5b-f	4796cd	42.0g	95.4de	12.4a	77.0e
	2011	97.5bc	6.7def	21.8abc	6100a	42.5efg	95.8de	11.5cd	79.9ab
	2012	58.1i	6.6def	20.0d-h	4320de	43.2efg	95.6de		
ANOVA C		**	**	**	ns	**	**	*	*
Y		**	**	**	**	ns	ns	**	**
C x Y		*	**	**	**	**	**	**	*

Means within the columns for cultivars, years and the cultivar/year interaction followed by the same lowercase letter do not show significant differences at 95% on the basis of the LSD test
** F –test significant at 0.01; * F –test significant at 0.05; ns non-significant

The increase in the yield potential of new spring barley cultivars is generally associated with higher total dry matter production, reduced plant height and increased resistance to lodging, along with slight increases in harvest index, 1000-kernel weight and number of grains per spike (Grausgruber et al., 2002; Abeledo et al., 2003). In their comparative studies of two-rowed barley cultivars released over a period of 150 years in Argentina, Abeledo et al. (2003) found that the main component associated with genetic gains in yield in the last several decades has been the number of grains per m^2, reached largely through the increase in the number of spikes m^{-2}, regardless of the number of florets per spike. New cultivars have a higher number of spikes m^{-2} compared to old cultivars, with no decrease in the average

number of grains per spike observed. The authors also reported that kernel weight changed slightly during breeding. Kernel weight is an important quality indicator in malting barley due to the positive correlation between grain weight and the content of starch as the main source of malt extract. Also, grain size is important in terms of ensuring uniform germination (Passarella et al. 2003). For malting barley, thousand-kernel weight should preferably be 41-44g, since this kernel germinates uniformly and rapidly (Fox at al., 2003). Significantly higher 1000-kernel weight regardless of year, compared to the other cultivars, was obtained by 'NS-404', which also showed the highest variation in this trait (Table 1). The lowest variation across years was observed in 'Lider' (cultivar/year interaction). In their analysis of grain and malt quality indicators in eight spring malting barley cultivars over a period of seven years, Pržulj et al. (2014) reported that the highest percent of variance for 1000-kernel weight is due to growing season, whereas genotype and the genotype/year interaction account for a similar percentage of variance. Grausgruber et al. (2002) found that the priority in breeding programmes given to the increase in grain fill led to an increase in 1000-kernel weight and to a very slight increase in the number of kernels per spike.

Large grain is among the most precise quality indicators due to a high starch content and a low protein content, which ensure sufficient energy for germination (Fox et al. 2006). In the first and second years, total germination capacity was significantly higher in 'Jastrebac' than in the other cultivars, whereas no significant difference among the cultivars was observed in the third year (cultivar/year interaction) (Table 1). Malt extract yield largely determines grain quality of barley during malting (Molina-Cano et al. 2000, Fox et al. 2003). The cultivars producing a higher protein content ('Jaran' and 'Lider') had a lower grain extract content (Table 1). In both years, the low protein content on avarega in all cultivars was associated with the high extract content, and vice versa. Extract content in cvs. 'Dunavac' and 'NS-404', which also had a lower protein content, was significantly higher compared to 'Jaran' and 'Lider'. As opposed to the other cultivars, 'Dunavac' gave a significantly higher protein content in the second year (cultivar/year interaction), but its extract content was comparable to that of the other cultivars. Fox et al. (2003) reported that protein content is negatively correlated with starch and extract contents. New barley cultivars have a low protein content mostly due to a decrease in grain N content which is the result of increased yield i.e. the "dilution effect" under which the nitrogen available to a given plant is distributed among greater grain yields in new cultivars (Calderini et al., 1999; Grausgruber et al., 2002; Abeledo et al., 2003; Gianinetti et al., 2005). Pržulj et al. (2014) observed that variation in % protein is mostly due to the genotype/year interaction, whereas the percent variance for year is higher than the genotype variance. The same authors found that all cultivars had a low protein content during the years that favoured grain fill, whereas under unfavourable conditions the differences between the test cultivars were much higher. Pržulj et al. (2014) also reported that variation in extract content is equally due to genotype and year, with a much lower percentage of the genotype/year variance. Molina-Cano et al. (2000) and Pržulj et al. (2013) found that the strength of the negative correlation between protein content and extract content is dependent on growing conditions and that a high protein content does not always suggest a low malt extract content. Garcia del Moral et al. (2003) specified that the correlation between quality attributes can be absent, present to a higher or lesser extent, sometimes even functional, often having compensatory effects. The same authors observed that the strength of a particular correlation is also largely dependent on the environment.

Conclusion

Genotype, growing conditions and their interaction had a significant effect on the traits analysed. Regardless of year, cvs. 'Dunavac' and 'Jaran' had a significantly higher stem compared to the other cultivars. Spike length and number of kernels per spike were significantly higher in cv. 'NS-404' than in the other cultivars, regardless of year. In the second and third years, the cultivars showed different variations in these traits. Grain yield exhibited the lowest variation across years in 'Jaran' and 'Dinarac'. Thousand-kernel weight was the highest in 'NS-404' and it also exhibited the highest variation across years. Total germination capacity in the first and second years was significantly higher in 'Jastrebac' compared to the other cultivars. 'Jaran' and 'Lider', which gave a higher grain protein content, had a lower malt extract content. The significant increase in protein content in both years on average for all cultivars was accompanied by a significant decrease in malt extract, and vice versa. The high protein content in some cultivars along with the high malt extract content suggests that the strength of correlation between the traits is dependent on environmental conditions. Although the soil had poor physical and chemical properties, 1000-kernel weight, total germination capacity, protein content and malt extract content were within the standardised range in all cultivars, suggesting that the barley grain provided satisfactory malting quality.

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INDIVIDUAL AND JOINT EFFECT OF SOME QUANTITATIVE TRAITS ON GRAIN YIELD OF TRITICALE AND BARLEY

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Abstract

This paper presents the two year results of a study dealing with individual and joint effect of major yield components on grain yield of representative Serbian cultivars of triticale and winter barley. The trials have been set at two locations (Kraljevo and Zaje ar, Serbia), where two triticale cultivars (KG-20, Tango) and four barley cultivars (Jagodinac, Rekord, Premium, Kristal) were grown in five fertilization and liming variants. The observed traits were the following: plant height, spike length, number of spikelets per spike, and number of grains per spike. Individual effect of yield components on grain yield was measured by simple regression, and their joint effect by multiple regression. When triticale is concerned, the all four investigated traits showed the significant effect on grain yield, but when joint effect was considered by multiple regression, only plant height and number of grains per spike showed the same effect. In barley, such significant individual effect was restricted on spike length, number of spikelets per spike and number of grains per spike, but the joint effect was significant only for intercept value and number of grains per spike. Values of adjusted R^2 coefficient showed that those four parameters were clearly responsible for a great part of variation in grain yield in both species among the investigated cultivars and fertilization variants.

Key words: *Triticale, Barley, Grain yield, Yield components, Regression.*

Introduction

Barley shows a great economical importance because of its versatile utilization. It mainly serves as animal feed and raw material in brewing industry, but it has increasingly been used as a food, characterized by high nutritive value and certain health promoting properties (Biberdži et al., 2010).Triticale is the plant species which becomes more and more important in animal feeding. Grain yield changed during the last century and yield increase had resulted mostly from the development of plant selection and breeding techniques, so that yield genetic potential achieved by new winter barley varieties reached over 11 t/ha (Pržulj and Mom ilovi , 1999), and the one of triticale even greater values.

Grain yield is a complex trait of outstanding economic significance, dependent upon a number of hereditarily determined traits and environmental conditions in which plant is developing (Madi et al., 2005). Therefore, contribution of various plant traits to grain yield is a permanent subject of studies in plant breeding.

Plant height is an important agronomic trait for morphogenesis and grain yield formation in wheat. An appropriate plant height is a prerequisite for attaining the desired yield in wheat breeding programs. The introduction of dwarfing traits into plants has achieved tremendous increase in wheat grain yield during the „Green Revolution" (Peter, 2003). Therefore, it is essential to elucidate the genetic basis of plant height in order to gain further increase of grain yield (Cui et al., 2011).

Spike length is one of the important yield components, not only because longer spike offers more room for spikelets, but also because it is the source of assimilates closest to grains.

Spike structure is more effective in utilizing illumination than the other parts of the plant, and it also will stay green and functional for a longer time. Because of these features, it contributes up to 20-30% of the dry matter accumulated in grains (Sharma et al., 2003).

Number of spikelets and grains per spike, together with grain mass, are also among crucial yield components. In fact grain yield is the product of productive tiller number per square unit, number of grains per spike and 1000 grain mass. Saleem et al. (2006*)* found strong, significant genotypic and phenotypic correlation between grain yield and spike length and between grain yield and number of spikelets per spike.

This study has been aimed to investigate individual and joint effect of major yield components on grain yield of representative Serbian cultivars of triticale and winter barley.

Material and methods

The trials have been set at two locations (Kraljevo and Zaječar, Serbia) during 2009/10 and 2010/11, where two triticale cultivars (KG-20, Tango) and four barley cultivars (Jagodinac, Rekord, Premium, Kristal) were grown in five fertilization and liming variants have been set in random complete block design with four replications. Otherwise, growing practice was standard. The observed traits were the following: plant height, spike length, number of spikelets per spike, and number of grains per spike. Individual effect of yield components on grain yield was measured by simple regression and their joint effect by multiple regression. The input data for both species were for the all cultivars and fertilization and liming variants, in order to get a better estimate of the part of grain yield variation explained by the investigated grain yield components.

Results and discussion

Simple regression analysis for triticale (graph 1) shows that the all independent variables had a positive effect on grain yield, and that effect was significant at the level of $P<0.001$ for plant height, spike length and number of grains per spike, while for number of spikelets per spike level of significance was $P<0.01$. Dependence of triticale grain yield upon each investigated yield component is quantitatively expressed by corresponding regression equation given in graph 1.

Simple regression analysis for winter barley (graph 2) shows quite different tendency. Plant height had no significant effect on grain yield. Spike length and number of spikelets per spike showed significant negative effect on grain yield at significance level of $P<0.01$, while number of grains per spike had significant positive effect on grain yield at level of significance of $P<0.001$. Dependence of winter barley grain yield upon each investigated yield component is quantitatively expressed by corresponding regression equation given in graph 2.

Multiple regression analysis of individual and joint effect of the studied parameters on triticale grain yield showed that plant height ($=0.438***$) and number of grains per spike ($=0.432***$) had significant effect on grain yield, while the effect of other two traits and intercept value were not significant. Adjusted R^2 value (0.577) showed that 57.7% of the observed variation in triticale grain yield was explained by the studied four traits. F test for goodness of fit was significant at level of $P<0.001$ (tab. 1).
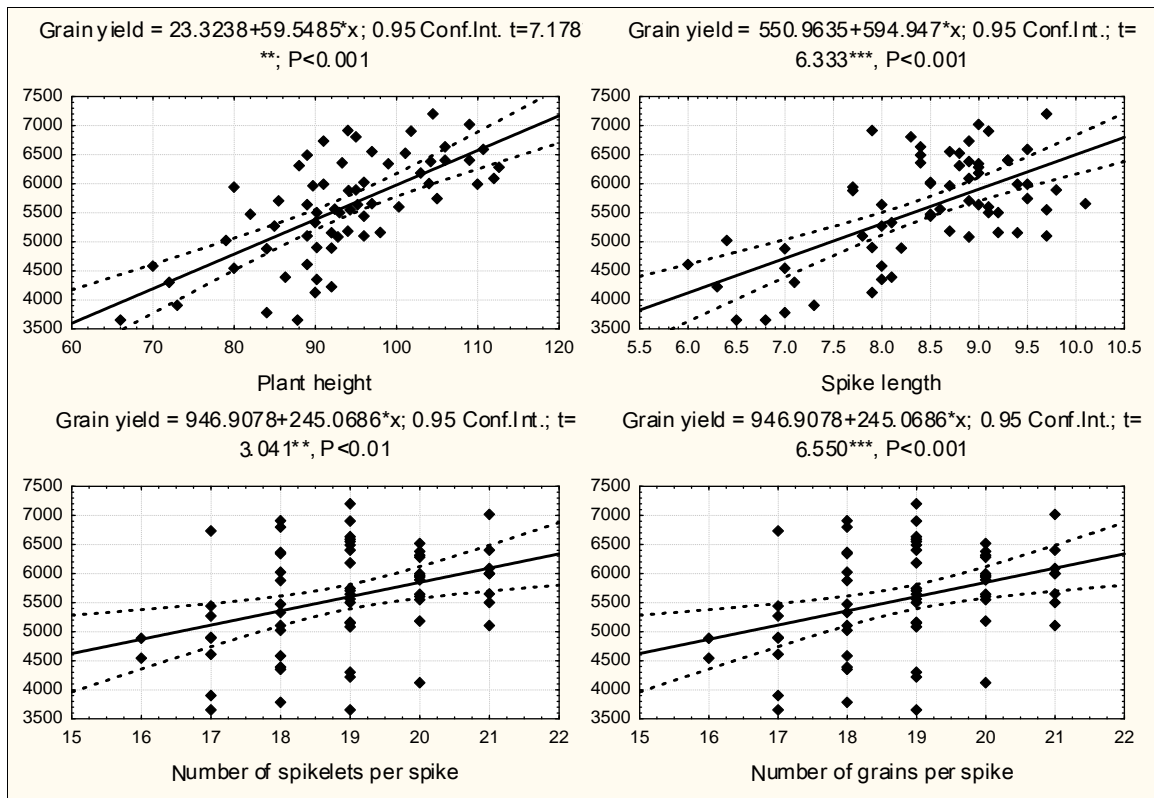
Graph 1. Effects of the observed traits on triticale genotypes' grain yield (simple regression)
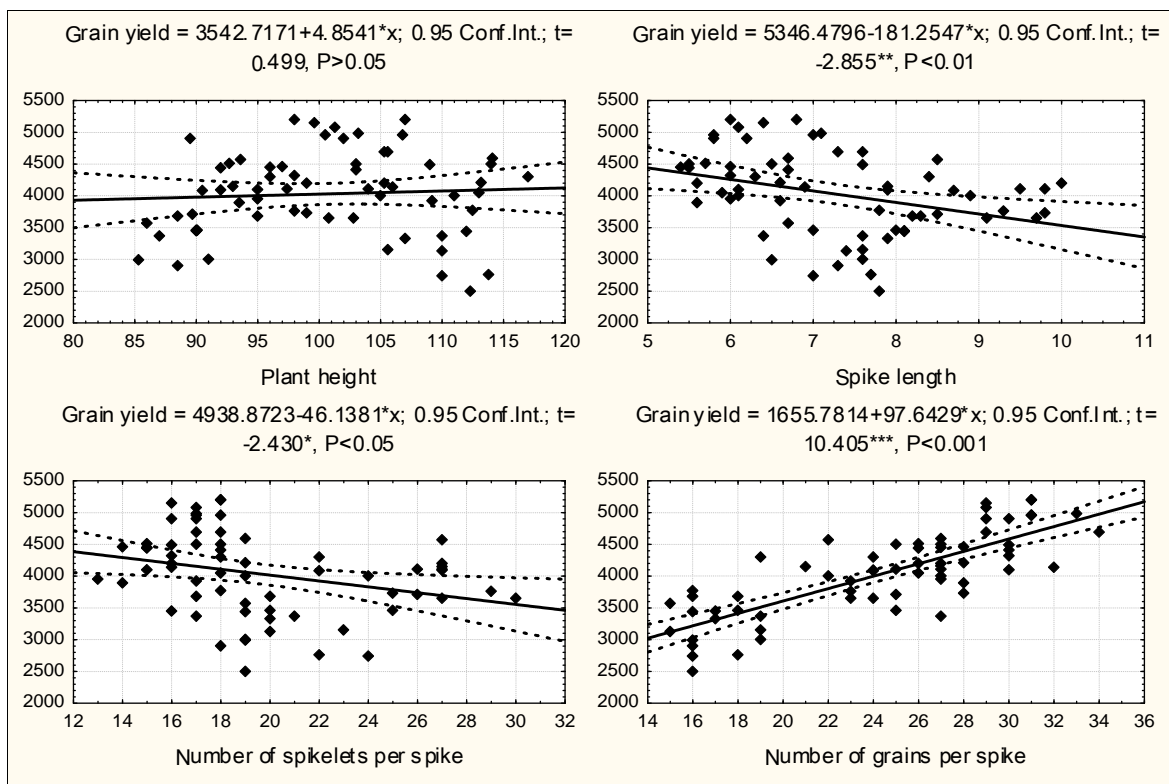
Graph 2.Effects of the observed traits on barley genotypes' grain yield (simple regression)

Table 1. Effects of the observed traits on triticale genotypes' grain yield calculated by multiple regression analysis.

	SE ( )	B	SE (B)	t (d.f.59)	P value
Intercept	--	--	-1955.76	1164.632	-1.679	0.098383
Plant height	0.438	0.108	38.74	9.563	4.051***	0.000151
Spike length	0.168	0.130	159.11	123.523	1.288	0.202732
Spikelets per spike	-0.203	0.110	-137.99	74.540	-1.851	0.069151
Grains per spike	0.432	0.122	98.15	27.644	3.551***	0.000762

R=0.777; R^2=0.604; adjusted R^2=0.577; goodness of fit: F(4, 59)=22.479P<0.0000

The results of multiple regression analysis of individual and joint effect of the studied parameters on winter barley grain yield showed that only number of grains per spike (=0.778***) had significant effect on grain yield, and intercept value was also significant but at the level of P<0.01. The effect of other three traits was not significant. Adjusted R^2 value (0.621) showed that 62.1% of the observed variation in winter barley grain yield was explained by the studied four traits. F test for goodness of fit was significant at level of P<0.001 (tab. 2).

Table 2. Effects of the observed traits on barley genotypes' grain yield calculated by multiple regression analysis.

	SE ( )	B	SE (B)	t (d.f.59)	P value
Intercept	--	--	2447.00	734.317	3.332**	0.001491
Plant height	-0.056	0.078	-4.272	6.026	-0.709	0.481135
Spike length	-0.053	0.133	-28.31	70.883	-0.399	0.691035
Spikelets per spike	-0.032	0.131	-5.04	20.475	-0.246	0.806455
Grains per spike	0.778	0.083	95.31	10.206	9.339***	0.000000

R=0.803; R^2=0.645; adjusted R^2=0.621; goodness of fit: F(4, 59)=26.778P<0.0000

Establishing individual and joint effect of principal yield components on grain yield in various conditions of nitrogen nutrition has a potential use in breeding cultivars with stable grain yield in various nitrogen nutrition levels. Values of adjusted R^2 coefficient showed that those four parameters were clearly responsible for a great part of variation in grain yield in both species (57.7 and 62.1%, respectively) among the investigated cultivars and fertilization variants.

Conclusion

On the basis of the study, dealing with individual and joint effect of major yield components on grain yield of representative Serbian cultivars of triticale and winter barley, we can conclude the following:

In triticale the all studied traits had a positive effect on grain yield measured by simple regression, and that effect was significant at the level of P<0.001 for plant height, spike length and number of grains per spike, while for number of spikelets per spike level of significance was P<0.01.

Simple regression for winter barley showed that plant height had no significant effect on grain yield. Spike length and number of spikelets per spike showed significant negative effect on

grain yield at significance level of P<0.01, while number of grains per spike had significant positive effect on grain yield at level of significance of P<0.001.

In triticale, multiple regression analysis showed that plant height and number of grains per spike had significant effect on grain yield, while the effect of other two traits and intercept value were not significant.

Multiple regression for winter barley showed that only number of grains per spike had significant effect on grain yield, and intercept value was also significant. The effect of other three traits was not significant.

Values of adjusted R^2 coefficient showed that those four parameters were clearly responsible for a great part of variation in grain yield in both species among the investigated cultivars and fertilization variants.

Acknowledgement

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OLIVE SUITABILITY IN CORRELATION WITH THE LONGITUDE OF CULTIVATION

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Abstract

This research shows the results of olive reaction to longitude (N) and aims to analyze the territory for suitability and orientation of the new oliviculture. Five geographical regions were chosen for this, during the period 2010-2012, bioclimatic, morphological and geographical indices of two olive cultivars were analysed: Kaninjot and B.Tirana (olea europaea L. ssp. sativa): specifically: thermal Constant (C^T), thermal Sum (S^t), Vegetative Constant (C^v), hydrothermal Constant (C^{ht}), Edaphic Humidity, fat index, quality index, biometric index, maturity index etc, (catminate code). The data were modelled as per JMP software and were analyzed through discriminant method, DGis modelling bioclim/domain and bivariate density. The results showed that suitability index (I^S), has produced declining results following longitude (N), and by order: plot (1>2>3>4>5). Index I^S, had a strong positive relation ($r^2=0.98$), with the longitude. Also through I^p, C^t, C^v and C^{ht}, produced positive results and the correlation coefficient ($r^2=0.88>0.82>0.79$). Analysis SG and discriminant method, displayed olive space in 4 plots (Nonparametric bivariate density) which have heterogeneous performance. The data integrated regressively had a macro- areal evaluation of the territory. The olive reacts positively up to longitude $39^0.38''$, until $42^017'$, whereas further extension in terms of longitude presents a general declining performance, especially for the indices of maturity, quality and productivity.

Keywords: *Olive; Humidity; Bioclimatic; Olive culture; Territory*

Introduction

Olive distribution is a function of the interaction of several climate elements, which stipulate the biological phases within the annual cycle (Di Tomaso 1998; Ismaili et al. 2013*).* The olive tree responds to climate elements especially temperature, light, wind, precipitation etc. Altogether they undergo physiological and morphological suitability and define yield (Forbes et al.1978; Franzluebbers 2013; Younge 2013). Each element becomes important as of the area where it is studied, thus different authors have set different criteria in selecting the indices, in relation to the area under study (Baldini et al. 1955; Mulas et al. 2003). The most important climate influences belong to vegetative growth, from blossom to fruit, dynamics of fruiting and fruit growth, and the process of fruit ripeness, oil contents etc, which in a lot of cases limit biological processes (Bottari et al.1952 ; Damigella 1960; Gregoriou 1996). Considering the olive bio climate relations temperature is of great importance, as it is the first parameter that adjusts the geographical distribution of this species. This research uses several indices of the environment, defining the varietal performance at the longitude of cultivation, in order to serve the formulation of new olive groves.

Material and Method

Bio climate correlations of Kaninjot and B. Tirana cultivars were analysed at the longitude $39^0 38$' in the South and $42^0 17$' in the North, in five different areas during the period 2010-2012, for the index of suitability. Numerical indices of temperature and precipitation were gathered for a 30-year- period (*1970-2010*). Criteria were set for the selection of areal indices per each element. Thermal Constant (C^T) was analysed per each place, constituting the average temperature and number of days per period from blossom to ripeness ($C^T = T^m n$). Thermal Sum (S^T), was calculated via the formula; $S^T = S(t_m^o - z^b)$, above average and biological zero temperatures to identify the temperatures available at growth. Vegetative Constant (C^v), ($N^d/Z^{b)}$, for the active period of growth. Hydrothermal Constant (C^{ht}), was calculated:

$C^{ht} = \dfrac{\Sigma R}{\sum T_e} \times 10$ to analyse hydric ratios with the temperatures. Average monthly temperature

and precipitation during May-October were calculated through the formula: ($P = T_m^o . H_m$). Energetic Index (I^E), to display the heliothermal sum for the synthesis of 1 gram oil as of formula;

$I^e = \dfrac{Te.h}{P_M.O}$, was calculated by the ratio of effective temperature with the oil grams per tree.

Maturity Index (**I^M**) was analyzed on 20 December as of formula:

$$IM = \frac{a.0 + b.1 + c.2 + d.3 ... + h.7}{100}$$

Other simultaneous analysis included: oil percentage in fruit through soxhlet method, average fruit weight, D, d, D/d of the fruit, peroxides, acidity and soaps. Several indices were also calculated, such as: Edaphic Humidity, fat index, quality index, Morphological Index (M^I), (catminate code). The data were modelled as per JMP software and were analysed through discriminant method, D-Gis modelling bioclim/domain and Bivariate Density. Linear regression was used to analyse the common distribution of variables on the relation and the impact of environmental factors. The results of the statistical analysis enabled the use and processing of generalizing formulas for the scientific plausibility of such a method (Cadima et al.1955; Jolliffe et al. 2006; SAS 2012; Baseflor 2014)

Table 1. The main bioclimatic indices that resulted in five geographical study sites for two varieties of olive, Kaninjot and B.Tirana

Indice / *Area*	P	S^T	C^{ht}	C^v	C^T	O	I^e	I^M	M^I	C^B	H^{EN}	I^S
Koplik	1910	2046	9.3	197	3683	23.4	0.08	2.9	5	3	4	4
Sarande	1196	2832	4.2	305	4943	27.2	0.1	4	8	6	6	8
Shkoder	1844	2159	8.5	221	3814	24.2	0.08	3.1	5	4	4	5
Tirana	1219	2121	5.7	246	3958	25.4	0.08	3.2	6	4	5	5
Vlora	892	2427	3.6	294	4536	26.8	0.1	4	8	6	6	7

P-annual precipitation**, S^T**-Thermal Sum, **C^{ht}**-Hydrothermal Constant, **C^v**-Vegetative Constant, **C^T**-Thermal Constant, O-oil, **I^e**-Energetic Index, I^M-Maturity Index**, M^I**-Morphological Index, H^{EN}-Geographical Index, **I^S**-Suitability index

Results and Discussions

Both olive varieties: Kaninjot and B.Tirana, have a thermal Constant 2400^0, but they were under different climate conditions. Vegetative Constant K^V, has minimal values in Koplik

(197) and optimal values in Saranda (305). Maturity index as a function of thermal constant displayed the effects of bioclimatic relations per each space, for the oil and the elements responsible for quality (S>V>T>Sh>K). Energetic and hydric availability was different and has influenced differently on the physiological processes for the phase of the annual cycle of the olive tree: Formation of the floral cluster, corolla forms and predominates, corolla changes of color, We appreciate the stamens, beginning of the flowering, total flowering, dumbfounded fruit, hardening of the bone, envero, maturation of the fruit, *Figure 1*. Oil was reduced at 1% per each degree of longitude as follows: (S>V>T>Sh>K% oil). Southern oil is tastier, of better smell and colour, as it contains a higher percentage of fatty saturated acids, as opposed to the oil of the Northern areas as a result of ripeness differentiation. Low temperatures, strong winds during ripeness period have reduced the quality of oil in the Northern area. The number of peroxides goes beyond the optimal level as well as the percentage of acidity. (*K>Sh>T>V>S. Acide%*).

Bioclimatic correlations: In fig-1, *Thermal constant* (C^T) displayed variation of increasing values of the cultivars at each biological phenophase, following longitude, (S>V>T>Sh>KC^T) which was statistically proved at the value of T^F. Average temperature is different and the impact of longitude in reducing temperature is 38%. Thermal Sum (S^t), in each analyzed area has different values available for growth, of the olive. Vegetative Constant (C^v), is a function of the thermal sum and was reduced following cultivation longitude. (C^v. from Saranda to Koplik) Hydrothermal Constant (C^{ht}), changed from 3.6-9.3, and the optimal focus of growth was 3-4,5. From Tirana to Koplik $C^{ht,}$ has higher value as the large effect of humidity. This climate is favorable for cycloconium infections that damage the leaves tree and indirectly reduce suitability index. During the phenophase Formation of the floral cluster-maturation the olive needs 550-600 mm water, for the biochemical processes of fruiting, fruit growth and oil formation. It was observed that with the increase of temperatures, precipitation was reduced, thus creating the hydric crisis at the phenophase of endocarp sclerification. Fruit fallen from the trees have to preserve turgor and to survive. Pulp growth and oil formation started with the first autumn precipitation.

Maturity Index, average fruit weight has proved changes (*lsd.1.11, alpha=0.05*), simultaneously ripeness index, thus as a result oil percentage and endocarp colour. Energetic index resulted 0.08-1. Edaphic Humidity, fat index, quality index, biometric index according (catminate code) resulted differently. Pursuant to the analysis of distribution and variable relations in *figure 2*, climatic availabilities and limiting factors were provided. Information processed by statistical data, showed that the space - object of the study, in its complexity is characterized by thermal heterogeneous availability, in several cases appropriate for a wide range of varieties with retarded ripeness.
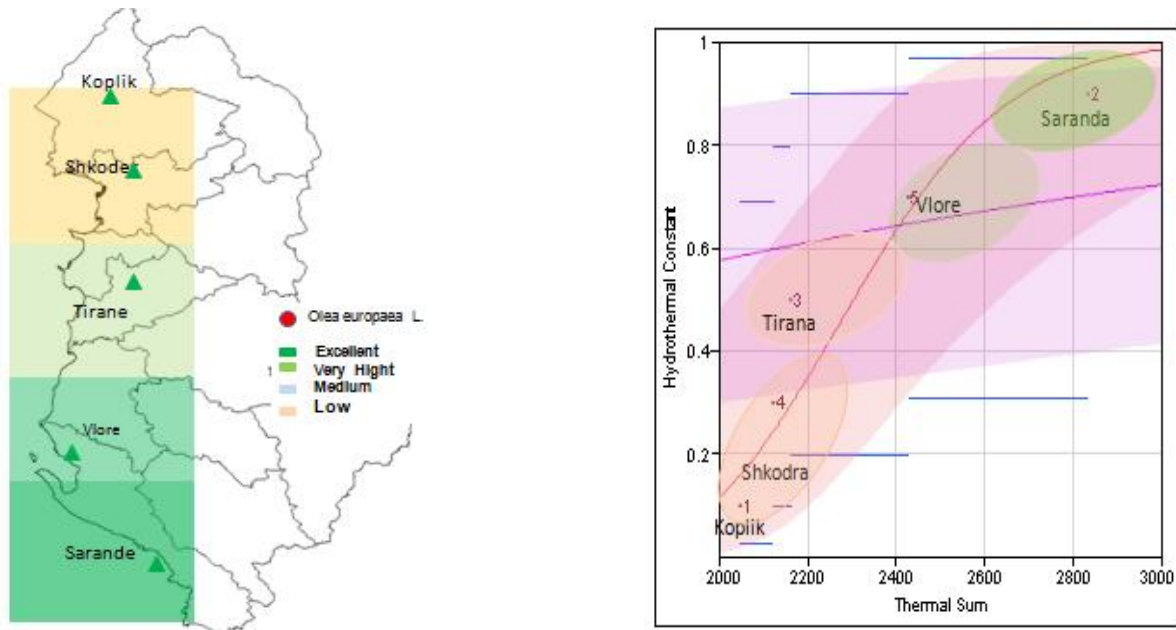
Figure 1. (left) The longitude of the olive cultivation in Albania.The presentation of five study places:*Sarande, Vlore, Tirane, Shkoder and Koplik*, DG modelling bioclim/domain, expresses the suitability index olive "Kaninjot" and "BTirana" cv.

Figure 2. (right), Dendogram for the orthogonal regression and Lognormal Results Statistics Estimates of Thermal Sum and Hydrothermal Constant probability for the Kaninjot and B. Tirana Cv.
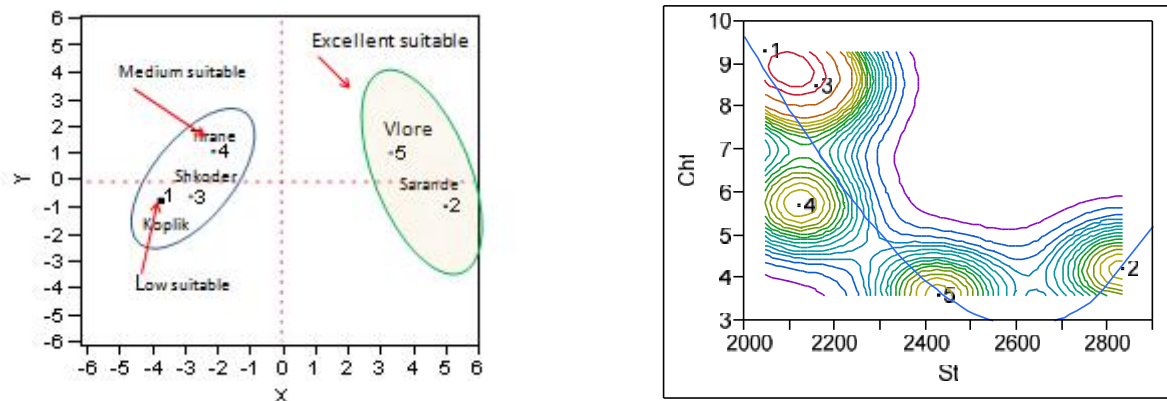
Figure 3. (left) Analysis of the main coordinates for the five study area based on the bioclimatic indices and the catminate code. PC_1 and PC_2 contitue 97.4% of the total variation. The area were distributed in four representative spaces positive and negative of PC_1 and PC_2

Figure 4. (right) Discriminant method for the Statistics Comparisons Thermal Sum By Hydrothermal Constant and biological indicators of cultivar B. Tirana and Kaninjot in five study area

Different spatial relations were identified for the relation between bioclimatic indices, which had different suitability index. PCA highlighted the degree of influence per each cultivation space, where 7 indices were important among 18 analyzed factors. PCA identified the variances of the principal components (PC) and the proportion of the total variance each factor accounts for, and three PC that account for 99.6% of the total variance are retained for further analysis. The percentages of total variation accounted for by each of the first three PCs are 91.8%, 5.6%, and 2.2%, respectively. PC_1 and PC_2 contitue 97.4% of the total variation. The area were distributed in four representative spaces positive and negative of PC_1 and PC_2,

(*Figure 3*). D-Gis, bioclim/domain processed the relation between biological and environmental indices and classified suitability spaces.

Figure 3, displays heterogeneous suitability pursuant to longitude to test maturity index quantity and quality of the oil considered as a marker of testing performance. Variance analysis has displayed the degree of interrelation genotype-environment. Phenotype features were the results of genotype interaction with the environment, which means the result of their function. Suitability index resulted differently and from this viewpoint the spaces were ranked as follows: (S>V>T>Sh>K.I^S) and with a value of (8>7>5>4 I^S). *Prob > F 0.53, Prob>t 0.49*

The results showed that suitability index (I^S), has produced declining results following longitude (N), and by order: plot (1>2>3>4>5). Index I^S, had a strong positive relation ($r^2=0.98$), with the longitude. Also through I^p, C^t, C^v and C^{ht}, produced positive results and the correlation coefficient (*$r^2=0.88>0.82>0.79$). Analysis SG Discriminant method, displayed olive space in 4* plots which have heterogeneous performance. P*olynomial Fit Degree* = Cht = 32.213241 - 0.0118304*St + 1.4533e-5*(St-2317)^2 + 1.192e-8*(St-2317)^3. The plot 2 to 5 have the excellent suitability index, number 4 has suitability average, while in the north have the shown smaller performance, *figura-4*. In conclusion: the data integrated regressively had a macro- areal evaluation of the territory. The olive reacts positively up to longitude *$39^0.38$'', until 42^039', whereas further extension in terms of longitude presents a general declining performance, especially for the indices of maturity*, quality and productivity.

In *figure 3,* the five spaces were positioned on two plots at the coordination axis. One of them had ideal performance, and the second average suitability. Characterization of spaces *figure-1* helps and orientates for the creation of new olive groves, based on the specific environmental needs.

Areas in their complexity were characterized by thermal availabilities suitable for the use of a wide range of indices. Their analysis shows the variability of latitude, which characterizes the whole plant cycle specifically during the ripeness months, thus showing a critical factor to get qualitative yield. This scarcity might be filled in by the immersion of new varieties of a short ripeness cycle. Fragmentation in bioclimatic heterogeneous spaces in the future might lead to a more rational programming to predict short cycle varieties.

Conclusions

Oil is a product of metabolism strongly influenced by the relation genotype-environment. This relation has an important role on the fruit characteristics, dimensions, pulp/endocarp ratio, ripeness index, lipid content, oleic/linoleic ratio, in strong correlation with the environmental conditions.

In Albania optimal area of olive cultivation is at longitude 39^038' to 40^045'. In the space 40^045'-41^038', suitability Index has the average value. In pursuit of the geographical longitude this index is reduced and the olive cultivation is done without economic value. In these conditions should be cultivated olive varieties with Thermal Sum (S^T), 1800-2200.

Study results demonstrate the important relationships between collected genetic characteristics and geographical length of cultivation

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PRELIMINARY POMOLOGICAL AND BIOCHEMICAL CHARACTERIZATION OF FIG (*Ficus Carica* L) GERMPLASM COLLECTED IN HERZEGOVINA

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Abstract

Inventory and sampling of 24 fig accessions were conducted in the region of Trebinje and Mostar during 2013. The trees were found in the gardens, boundaries as well as in derelict areas. The following characters of riped fruits were determined: the mass and fruit size, soluble solids content, total phenols content and antioxidant activity. The average fruit mass ranged from smallest fruit accession Zimica (29.08 g) to the biggest Mostarska (72.85 g). The biggest average fruit length was recorded in the variety Butunka (70.55 mm) and the smallest in Termenja a (37.02 mm). The highest average fruit width measured at variety Mostarka (55.83 mm) and the lowest at Zimica (37,01 mm). Soluble solids content ranged from 11.27% Brix in the acc. Vodenja a to 26.4% Brix in the acc. Zimica. The highest total phenol compounds were found in acc. Crnica (536.44 mg GAE / 100 g fresh fruit), which in addition to the acc. Zlatulja (39.01 mg of fresh fruits/mL) showed the best antioxidant activity (EC50: 40.45 mg of fresh fruits/mL).
Initial characterization of the tested fig accessions showed significant genotypic diversity. It is necessary to perform further detailed research on characterization and evaluation to assist in the preservation of the existing diversity to prevent the disappearance of the existing gene pool of fig.

Key words: *fruit mass, soluble solids, total phenols, antioxidant activities.*

Introduction

Fig (*Ficus carica* L.) is a deciduous tree belonging to the Moraceae family, and as one of the oldest cultivated fruit trees is an important crop, for both dry and fresh consumption, as well as for processing. Fig fruit is commonly consumed as fresh or dried. Fresh fig fruits are rich in amino acids, proteins, carbohydrates, fibers, minerals (Mawa et al., 2013). Fig fruit has importance in food industry for processing into preserved fruits, jam, juice, etc. Figs are an important constituent of the Mediterranean diet, one of the healthiest which is associated with longevity (Çali kan and Polat, 2011). Fig also contains flavone, rutin and quercetin as medical products used for cardiovacsular disease (Gozlekci, 2011). Antioxidant compounds, such as phenolics, organic acids, vitamin E, and carotenoids scavenge free radicals, thus inhibiting the oxidative mechanisms that may lead to degenerative illnesses (Gaaliche et al., 2012a; Puoci et al., 2011; Gozlekci, 2011). Phenolic compounds are common plant secondary metabolites which not only have physiological functions in plants but also positive effects for human health, because they can act as antioxidants (Joseph and Raj, 2011; Pande, 2009). Research of biochemical properties of fig fruits from the Mediterranean region show that figs of all colors have antioxidant capacity, but it was the highest in dark skinned fig fruits. It was also found that the antioxidant capacity is highly significantly correlated with the content of polyphenols and anthocyanins (Çali kan and Polat, 2011). Crisosto et al. (2010) investigated the antioxidant capacity of figs in conditions of California and found that most components that

have antioxidant activity, such as polyphenols, anthocyanins and flavonoids, are found in fruit skin. Fig is very interesting species because of its positive biochemical properties and significant diversity of germplasm (Çali kan and Polat, 2011; Gozlekci, 2011; Gaaliche et al. 2012a, 2012b). Growing figs in Herzegovina region is a tradition, but today generally has extensive character, as individual trees are grown in the gardens around the houses. Smaller orchards were planted recently, but still it does not have the character of significant production. More research on growing importance and pomological properties of figs were done in the area of Herzegovina, Montenegro and Dalmatia (Tabain, 1978; Kulina et al., 2002; izmovi , et al., 2005; Buci -Koji et al. 2011; Vego et al. 2008). These studies point to significant richness of germpazme that needs to be characterized and saved adequately for breeding programs and future generations. The fig tree also has special characteristics of the buds and fruit setting (Djuric and Micic, 1992; Vego et al. 2008) that should be kept in mind when selecting genotypes with positive characteristics for reproduction and further growing.

The aim of this study is to analyze the most important biochemical properties of fruits and pomological characteristics of 24 fig accessions collected from the wider Herzegovina region of Mostar and Trebinje.

Material and methods

Through coolaboration of two universities (Genetic resources Institute of the University of Banja Luka - GRIUBL and Faculty of Agriculture and Food technology, University of Mostar - FAFTMO) inventory and sampling of 24 fig accessions were conducted in the region of municipalities of Trebinje and Mostar during 2013. The trees for sampling were found in the gardens, boundaries as well as in derelict areas. The accession names were taken from the owner of these trees or guide who pointed to them.

The following characters of riped fruits were determined: the mass and fruit size, soluble solids content, total phenolics content and antioxidant activity.

Determination of fruit mass and size as well as the soluble solids content in the cell juice of fruit flesh was carried out on 15 fig accessions, while the determination of total phenolics and antioxidant activity was done on all 24 accessions. Length and width of the fruits were determined by a digital caliper, fruit mass on a digital scale type KERN EMB 600-2 and soluble solids content with digital refractometer type Atago. Total phenols content was determined by Folin-Ciocalteau (FC) spectrophotometric method based on the oxidation of the phenolic group by the FC reagent. Results are expressed as mg of gallic acid equivalents (GAE) per 100 grams of fresh weight (FW) (mg GAE/100 g FW). The antioxidant activity of the sample was determined by the method of quenching the free stable 2,2-diphenyl-1-picryl-hidrazil (DPPH) radicals. The EC50 value is defined as the concentration of sample required for 50% scavening of DPPH radicals and is a parameter widely used to measure the free radical scavenging activity. The inhibition of free radicals by anti-oxidants was monitored spectrophotometrically.

Chemicals and Reagents

The used DPPH (2,2-Diphenyl-1-picrylhydrazil) is produced by Sigma-Aldrich (Germany). Methanol optigrade for HPLC was from Promochem (Wesel, Germany). Folin–Ciocalteu phenol reagent was product of Switzerland (Sigma-Aldrich). Gallic acid 98% was from Acros Organic (CN, Belgium). Sodium carbonate was from Lach-ner (Czech Republic).

Results and discussion

The determined pomological characteristics of fig accessions collected by GRIUBL are shown in Table 1. The average fruit mass ranged from smallest fruit accession Zimica (29.08 g) to the biggest Mostarska (72.85 g). The biggest average fruit length was recorded in the variety Butunka (70.55 mm) and the smallest in Termenja a (37.02 mm). The biggest average fruit width was measured in varieties Mostarska (55.83 mm) and Dužica (50.25 mm) and the

smallest at Zimica (37.08 mm; 35.39 mm)). The soluble solids content ranged from 11.27 % Brix in the accession Dužica to 26.04 % Brix in the accession Zimica.

Table 1. - Pomological characteristics of fig accessions collected by GRIUBL

Accession name (Location)		Mass (g)	Lenght (*mm*)	Width 1 (*mm*)	Width 2 (*mm*)	Solids (% Brix)
Bijela tenica (Mostar)	Xsr	40.71	45.78	46.40	45.96	16.34
	±Sx	1.85	0.84	0.72	0.74	0.63
Butunka (Mostar)	Xsr	60.71	70.55	44.34	42.90	21.48
	±Sx	2.61	1.54	0.96	0.74	1.16
Dužica (Trebinje)	Xsr	71.15	60.18	50.43	50.25	11.27
	±Sx	2.47	1.54	1.21	0.89	0.89
Zimica (Trebinje)	Xsr	29.08	40.24	37.08	35.39	26.04
	±Sx	1.34	0.85	0.86	0.68	1.90
Klapavica (Trebinje)	Xsr	69.81	52.49	52.19	49.95	11.6
	±Sx	3.02	1.29	1.59	1.45	0.95
Mostarska (Mostar)	Xsr	72.85	56.54	55.83	49.80	16.52
	±Sx	3.75	2.36	1.07	0.94	1.17
Petrova a bijela (Mostar)	Xsr	46.0	38.10	47.73	44.26	17.43
	±Sx	1.38	0.55	0.65	0.59	0.95
Petrova a bijela (Trebinje)	Xsr	43.79	44.49	46.11	44.54	19.58
	±Sx	3.1	1.21	1.09	1.01	0.76
Sušilica (Trebinje)	Xsr	33.79	43.39	39.07	37.75	22.28
	±Sx	1.17	1.15	0.67	0.58	1.84
Tenica (Mostar)	Xsr	34.33	47.58	39.27	37.85	18.49
	±Sx	1.33	0.78	0.55	0.46	0.90
Termenja a (Mostar)	Xsr	34,64	37.02	39.13	37.61	23.42
	±Sx	1.43	0.76	0.65	0.78	1.39
Crnica (Mostar)	Xsr	41.0	39.71	44.49	43.01	18.56
	±Sx	1.24	0.54	0.49	0.58	0.83
Crnica 1 (Trebinje)	Xsr	45.88	42.59	45.48	44.36	17.33
	±Sx	1.46	2.08	0.86	0.62	1.63
Džokovica (Trebinje)	Xsr	36.83	47.86	41.87	38.66	18.08
	±Sx	1.93	1.19	1.39	1.09	1.05
Šaragulja Trebinje	Xsr	36.13	47.27	40.84	37.74	20.97
	±Sx	1.36	1.16	1.49	1.26	1.16
Šipanka (Trebinje)	Xsr	44.54	50.11	45.64	45.27	13.21
	±Sx	2.19	0.97	0.99	0.91	1.03

GRIUBL - Genetic Resources Institute of the University of Banja Luka

The determined biochemical characteristics of fig accessions collected by GRIUBL are shown in Table 2. The highest total phenolic compounds were present in accession Zimica (533.14 mg GAE/100 g fresh fruit), which in addition to the accessions Tenica and Termenja a has the best antioxidant activity (EC50: 46.04; 41.91; 43.66 mg of fresh fruits/mL, respectively).

Table 2. - Total phenolic compounds and antioxidant activity of fig accessions collected by GRIUBL

Accession	Total phenolic compounds (mg GAE/100 g fresh fruits)		EC50 (Antioxidative activities (mg fresh fruits/mL)
	Xsr	±Sx	
Bijela tenica Mostar	277.70	±30.39	73.69
Butunka Mostar	285.27	±27.97	62.65
Dužica Trebinje	271.85	±14.08	119.38
Zimica Trebinje	533.14	±40.55	46.04
Klapavica Trebinje	93.13	±6.23	152.57
Mostarska Mostar	268.21	±22.74	70.71
Petrova a bijela Mostar	242.23	±30.74	80.86
Petrova a bijela Trebinje	301.43	±33.13	90.00
Tenica Mostar	352.14	±36.58	41.91
Termenja a Mostar	413.39	±41.96	43.66
Crnica Mostar	230.72	±12.04	63.26
Crnica 1 Trebinje	207.89	±21.51	95.82
Džokovica Trebinje	195.51	±9.01	201.60
Šipanka Trebinje	443.01	±35.81	65.64
Šaragulja Trebinje	225.71	±13.05	87.56

The determined biochemical characteristics of fig accessions collected by FAFTMO are shown in Table 3. The highest total phenolic compounds were present in accession Crnica (536.4 mg GAE/100 g fresh fruit), which in addition to the accessions Zlatulja and Talijanka has the best antioxidant activity (EC50: 40.45; 39.01; 46.30 mg of fresh fruits/mL respectively).

Table 3. - Total phenolic compounds and antioxidant activity of fig accessions collected by FAFTMO

Accession	Total phenolic compounds (mg GAE/100 g fresh fruits)		EC50 (Antioxidative activities (mg fresh fruits/mL)
	Xsr	±Sx	
Crnica (tunel, Ulog Varda)	536.4	±46.42	40.45
Zlatulja-(Zubac)	410.84	± 28.41	39.01
Talijanka (Ili i Vrelo)	439.76	± 37.26	46.30
Bjelica (Ili i Vrelo)	194.37	± 23.64	68.99
Morka (Sovi i)	282.95	± 27.67	112.49
Termenja a (Sovi i)	235.32	± 14.92	55.17
Vodenja a (Balinovac)	312.32	± 24.68	72.40
Crnica (Sovi i)	405.65	± 38.34	58.26

FAFTMO - Faculty of Agriculture and Food technology, University of Mostar

Fig genotypes collected in the Herzegovina region, when compared to other research, show exceptionally good pomological and biochemical characteristics. Antioxidative activity of most genotypes is better than dark fig varieties from east mediterranean part of Turkey for which Çali kan and Polat (2011) state to have average antioxidant activity of 118.9 GAE/100 g FW. Dry matter content in picked genotypes is very good and within limits indicated in literature. Gozleck (2011) states that average dry matter content in fig fruits collected from western part of Turkey ranges from 13 to 29 % Brix.

Conclusions

Initial characterization of the tested fig accessions from Herzegovina region showed significant genotypic diversity. It is necessary to perform further detailed research on characterization and evaluation to help with the preservation of the existing diversity and to prevent disappearance of the existing fig gene pool. Bearing in mind the richness of fig germplasm in Herzegovina, and favorable agro-ecological conditions, the fig tree may have a significant role in the revitalization of rural areas of Herzegovina. Prior to the introduction of new varieties, it is necessary to do the inventory of existing fig germplasm, as well as its characterization and evaluation. It is also necessary to determine the limiting factors in the cultivation and try to find technical measures which shall reduce or eliminate these obstacles. Only then, it will be possible to make recommendations for growing of existing genotypes or propose the introduction of new ones. Regardless of all else, it is important to evaluate existing gene pool and keep it from losing for the future.

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INVESTIGATIONS OF THE VARIABILITY OF QUANTITATIVE CHARACTERS OF ORIENTAL BASMAK TOBACCO

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Abstract

Three-year comparative investigations (2009, 2010 and 2011) were carried out on the Experimental field of Scientific Tobacco Institute - Prilep with the following oriental tobacco varieties: YK -7-4/2 (control variety), MK-1, MB-2 and MB-3. The experimental design was randomized block system with five replications with transplantation spacing of 45×12 cm. Standard agrotechnics was applied in seedling and tobacco growing on the investigated varieties' field. The aim of investigations was to estimate the variability of morphological characters of tobacco varieties using the basic statistical parameters:standard deviations, degree of variability and LSD test. Basmak varieties, compared to the control variety, showed a very low variability of the investigated morphological characters, which indicates that basmak varieties are characterized by high level of uniformity and they are typical oriental varieties. The results of investigations led to the following conclusions: MK-1 and MB-2 are Basmak varieties with relatively short growing season of 59 and 61 days, respectively, after tobacco planting in the field, while the variety MB-3 blooms after 77 days. The investigated varieties are characterized by medium plant height and by leaf number ranging from 26 in the control to 35 in MB-3. The short growing season of the basmak tobacco variety lets the grower harvest and dry tobacco in time which will lead to a higher quality raw tobacco material with a higher price.We hope that these high quality characters of the basmak varieties will encourage growers, as well as tobacco factories, manufacturers and tobacco dealers.

Key words: *Tobacco, variability, standard deviation (†), degree of variability*

Introduction

Tobacco is a culture with a multi-century tradition which represents a main occupation of a large number of families. It is produced not only in the poorer countries, but it is also produced in the richer countries, such as China, which participates with 40% of the total world tobacco production, the USA with 9%, Brazil, Italy, etc.

90% of the total production of oriental tobacco in R. Macedonia (which represents 25-30 thousand tons) is exported to foreign markets. Due to the quality oriental tobacco which is produced in the Republic of Macedonia, it has gained a reputation of being a country with a small area and small population, but with the largest tobacco production per capita in the world.The change of smokers' tastes cause manufacturers to change their demands of certain raw oriental tobacco material which is used in the mass production cigarettes. Thus, every year foreign buyers are offered raw material from different types i.e. varieties in order to satisfy their demands regarding aroma, flavor and other tobacco characters. Basmak tobaccos are known in the world as being high quality and highly appreciated oriental tobaccos which are primarily grown in Greece and Turkey.However, with the drastic decrease of their production in these countries (especially in Greece), tobacco factories form R. Macedonia consider this as an opportunity to redirect part of that production to places with suitable soil and climate conditions.In order to make this production more attractive to manufacturers, we

created not only varieties with short growing season, but their price is somewhat higher in comparison with other oriental tobaccos.

Material and methods

The following 4 varieties were used in the process of the three-year investigations (2009, 2010 and 2011): YK 7 - 4/2 (control) (ø), and basmak varieties MK – 1 , MB – 2 and MB – 3. Tobacco type Yaka YK 7-4/2 was created at the   Scientific Tobacco Institute-Prilep in 1932 by Rudolph Gornik.It was obtained by massive selection of Xanthi Yaka. Basmak varieties MK-1, MB-2 and MB-3 were created at the Scientific Tobacco Institute-Prilep with individual selection from local population by a group of authors from The Scientific Tobacco Institute-Prilep and The Faculty of Agricultural Sciences and Food –Skopje with the support of the tobacco industry.They were acknowledged by the Commission for National variety list of agricultural crops in 2010.

The seedling was produced with the usual method in cold beds covered with polyethylene fabric at the seed-bed of the Scientific Tobacco Institute-Prilep.During the investigation, we used elite seed material with quantity of 5 g per 10 m^2. All necessary agrotechnics was applied in the production of the seedling (Photography 1). The soil was prepared with one autumn and three spring ploughings before tobacco planting in the field. The manuring of the soil during the three years of investigation was done with 300 kg/ha mineral manure NPK (8:22:20). The seedling of the experiment was planted on 02. 06. 2009, 07. 06. 2010 and 11. 06. 2011. Investigated varieties were set up with randomized block system with 5 replications applying planting density of 45×12 cm on a previously prepared soil (Photography 2).

Photo. 1. Production of seedling Photo. 2. Field experiment (Method-randomized block system)

The useful area of the experiment was 214 m ^{2}. During the growing season we monitored the length of the growing period of tobacco in the field.

We also conducted morphological measurements of the following parameters on 50 plants per variety: plant height and number of leaves per plant, and we checked the variability of morphological characters of tobacco varieties using the basic statistical parameters: standard deviations, degree of variability and LSD test.

Results and discussion

Length of the growing season per phases

The length of field growing period is considered to be a varietal character, thus we differentiate varieties with short, medium and long growing periods. Table 1 shows the following plant growing phases beginning of flowering in days , 50 % flowering, and 100 % flowering, in days.

Table 1. Length of the growing season per phases (days)

Variety	Year	Planting	Beginning of flowering, in days	Average (days) 09/11	Difference s from the average Absolute	Difference s from the average Relative	50% flowering, in days	Average (days) 09/11	Difference s from the average Absolute	Difference s from the average Relative	100% flowering, in days	Average (days) 09/11	Differences from the average Absolute	Differences from the average Relative
YK 7-4/2 ∅	2009	2.06	30				53				56			
	2010	7.06	39	37	/	100	50	52	/	100	54	56	/	100
	2011	11.06	42				52				59			
-1	2009	2.06	38				53				58			
	2010	7.06	44	43	+6	116	54	54	+2	104	57	59	+3	105
	2011	11.06	47				58				61			
B-2	2009	2.06	40				55				59			109
	2010	7.06	50	47	+10	127	57	57	+5	110	63	61	+5	
	2011	11.06	52				60				62			
B-3	2009	2.06	45				60				70			
	2010	7.06	57	53	+16	143	72	65	+13	125	84	77	+21	137
	2011	11.06	56				64				78			

According to average values, variety YK 7-4/2 started to bloom first (in 37 days), and variety MB - 3 started to bloom last (in 53 days).The phase from planting to 50 % blossom is earliest noticed in standard variety YK 7-4/2 (in 52 days), and latest in MB-3 (in 65 days) where the absolute difference is 13 days more than the control.

Full (100 %) blossom is earliest noticed in the control variety YK 7-4/2 (56 days), and latest in MB-3 (77 days), where the absolute difference is 21 days more than the standard. Variety MK-1 reaches full blossom in 59 days and MB-2 in 61 days. These two newly acknowledged varieties have a shorter growing season as compared to the newly acknowledged variety MB-3, which has a longer growing season.

Plant height with inflorescence
Under the influence of agro-ecological conditions and applied agricultural engineering, plant height varies within certain range which is typical of tobacco type and variety.Karajankov, et al. (2007) reported that tobacco plant height is a type and varietal character, ranging from 50 cm to 300 cm, and more.The same authors divide tobacco plants, according to their height measured from the base to the top of inflorescence, into four groups:
Types and varieties with short height (up to 70 cm),
Types and varieties with medium height (71 to 131 cm),

High types and varieties (131 cm to 210 cm),

Very high types and varieties (over 211 cm).

Uzunoski (1985) reported that tobacco height is quantitative trait which highly depends on variety and environmental conditions.

According to data presented in Table 2, the lowest stalk height with inflorescence in 2009 was measured in control variety YK 7-4/2 (85±0.92 cm), with standard deviation of 5.12 cm and variational coefficient of 6.04%. Variety MB-3 is characterized by the highest stalk height (93±0.81 cm), with standard deviation of 4.33 cm and variational coefficient of 4.66%, and these are the lowest in comparison with the values of the investigated varieties.

Table 2. Stalk height with inflorescence

Variety	2009 year			2010 year			2011 year			Average cm	Difference	
	$\bar{x} \pm c\bar{x}$	σ	cV %	$\bar{x} \pm c\bar{x}$	σ	cV %	$\bar{x} \pm c\bar{x}$	σ	cV %		Absolute	Relative
YK 7-4/2 ∅	85±0,92	5.12	6,04	80±1.11	7.03	6.93	80±1.12	7.03	8.84	82	/	100.00
-1	91±0.98[++]	6.90	6,29	89±1.15[++]	8.42	9.50	82±1.27	9.41	11.41	87	+5	106.10
B-2	92±0.99[++]	6.55	7,07	90±1.05[++]	7.12	7.93	84±1.15	7.84	9.31	89	+7	108.54
B-3	93±0.81[++]	4.33	4,66	106±0.85[++]	5.41	5.12	101±0.95[++]	6.42	6.34	100	+18	121.95

2009 year LSD 5% 3.96 [+]   2010 year LSD 5% 3.47 [+]   2011 year LSD 5% 4.80 [+]

1% 5.57 [++]   1% 4.88 [++]   1% 6.74 [++]

In 2010, the lowest stalk height was measured in control variety (80±1.11 cm), with standard deviation of 7.03 cm and variational coefficient of 6.93%. Variety MB-3 is characterized by the highest stalk height (106±0.85) and the lowest values of standard deviation (5.41 cm) and variational coefficient (5.12%).

In 2011, the lowest plant height was measured in control variety YK 7-4/2 (80±1.12 cm), with standard deviation of 7.03 cm and variational coefficient of 8.84%. The highest stalk height was measured in basmak variety MB-3 (101±0.95 cm), with standard deviation of 6.42 cm and variational coefficient of 6.34 cm.

The average height of plants with inflorescence ranges from 82 cm in control variety YK 7-4/2 to 100 cm in MB-3, or it represents 21.95 % more in comparison with the control.

Analyzing by years, a high significant difference of 1 % was noticed in the three basmak varieties MK-1, MB-2 and MB-3 in 2009 and 2010 and in variety MB-3 in 2011. If we compare MK-1 and MB-2 with the control variety, we can notice that these didn't show any significant difference in the drier year 2011. The results show that all investigate varieties belong to the group of tobaccos with medium plant growth. Dimitrieski et al. (2011), in his investigations on variety P-66-9/7 suggested that under normal conditions for growth, plant height ranges from 65 to 75 cm. Korubin – Aleksoska (2004) report the following average stalk heights: P-23-65 cm, P12-2/1-55cm and P-79-94 – 70 cm. Mitreski (2012) report the

average values for the height of the stalk with inflorescence ranged from 59.3 cm in Prilep P 12-2/1 to 148.1 cm Prilep Basma 82.

Total number of leaves in investigated varieties
The number of leaves represents a varietal character which, depending on soil, climate and agricultural engineering conditions, changes only within certain range.
Table 3 shows that the lowest number of leaves in 2009 was counted in control variety YK 7-4/2 (26±0.95), with standard deviation of 1.64 and variational coefficient of 6.33%. The highest number of leaves was counted in variety MB-3 (34±0.70), with the lowest standard deviation of 1.18 and the lowest variational coefficient of 3.46%.

Table 3. Number of leaves per variety

Variety	2009 year			2010 year			2011 year			Average number of leaves	Difference	
	$\overline{x} \pm s\overline{x}$	σ	cV %	$\overline{x} \pm s\overline{x}$	σ	cV %	$\overline{x} \pm s\overline{x}$	σ	cV %		Absolute	Relative
YK 7-4/2 $\varnothing$	26±0.95	1.64	6.33	27±0.94	1.68	6.27	25±0.99	1.80	7.07	26.0	/	100.00
-1	29±0.99[++]	2.00	6.93	30±0.88[++]	1.67	5.53	28±0.94[++]	1.75	6.30	29.0	+3.0	111.54
B-2	31±0.87[++]	1.63	5.35	31±0.79[++]	1.38	4.45	30±0.85[++]	1.55	5.10	30.7	+4.7	118.08
B-3	34±0.70[++]	1.18	3.46	38±0.69[++]	1.28	3.32	34±0.75[++]	1.37	4.02	35.3	+9.3	135.77

2009 year. LSD 5% = 1.10 [+]   2010 year LSD 5%= 1.88 [+]   2011 year LSD 5%= 1.03 [+]

1 % = 1.15 [++]   1%= 2.64 [++]   1%= 1.45 [++]

In 2010, the lowest number of leaves was counted in control variety (27±0.94), with the highest standard deviation of 1.68 and the highest variational coefficient of 6.27%. Basmak variety MB-3 has the highest number of leaves in 2010 (38±0.69) and the lowest variational coefficient (3.32%). In 2011, the number of leaves in control variety ranges from 25±0.99 with variational coefficient of 7.07%, to 34±0.75 in the newly acknowledged variety MB-3 and variational coefficient of 4.02%. The average number of leaves ranges from 26 in YK 7-4/2 to 35.3 in variety MB-3, or it represents 35.77 % more in comparison with the control variety. During investigations, newly acknowledged varieties (MK-1, MB-2 and MB-3) were characterized by highly significant difference with level of probability of 1 % in comparison with the control variety YK 7-4/2. Ko oska (2006), reports that the number of leaves in half-oriental varieties and lines is higher by 1-3 leaves in watered variant in comparison with the non-watered variant. Gornik (1983) reports that variety YK 7-4/2 has 26 - 32 sessile leaves which was also confirmed with our investigations.

Conclusion

- Newly created basmak tobacco varieties which were used in the investigations, like the control variety, are characterized by short growing seaso , from 56 to 77 days to 100% blossom. This enables the formation of leaves and the processes of ripening, harvesting and drying to be done in favourable conditions which will result in qualuty raw tobacco material.

- The average plant height with inflorescence ranges from 82 cm in control variety YK 7-4/2 to 101 cm in MB-3, which is by 21.95 % more in comparison with the control variety.

- The number of leaves ranges from 26.0 in control variety YK 7-4/2 to 35.3 in variety MB-3, which is by 35.77 % more in comparison with the control variety. Regarding this character, varieties MK-1, MB-2 and MB-3 are characterized by highly significant difference of 1 % in comparison with the control variety.

These investigations and their results have shown than basmak tobaccos can be successfully grown in the Republic of Macedonia which will result in a more diverse assortment and it will increase production of oriental tobaccos.

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APPLICATION OF PHOSPHATE GLASS IN THE PRODUCTION OF FLOWERS AND VEGETABLES

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Abstract

This paper presents the results of the application of phosphate glass with the addition of Fe, Mn, Zn and Cu in the production of cockscomb (*Celosia plumosus L* .), impatiens (*Impatiens waleriana Hook.*), aubergine (*Solanum melongena L.*) and tomato (*Solanum esculentum* L). The experiment was conducted in the greenhouse of the Faculty of Agriculture in Belgrade during the years of 2012 and 2013. The chosen plants of flowers and vegetables were produced using modern cultivation systems, in polystyrene containers and polypropylene pots. For the production of flower seedlings the influence of the following glass doses were studied: 0, 1, 2, 3 g/l; and for the production of vegetable plant seedlings the doses of 0,1,2,3 and 4g/l of substrate were studied. The research examined the effect of the phosphate glass use on the following properties of flower and vegetable seedlings' development: height, plant weight, number of lateral branches, number of leaves, root weight. Research results showed a positive effect of phosphate glass application in the production of flower and vegetable seedlings. High quality seedlings were produced in the process, thus justifying its application.

Key words: *phosphate glass, doses, seedlings, flowers, vegetables.*

Introduction

The scientific challenge of the modern greenhouse production of flower and vegetable seedlings has a few directions: introducing renewable sources of energy and new techniques in concordance with climatic conditions, integrating crops, introducing and designing sustainable irrigation systems as well as strategies of sustainable soil fertility and substrate quality. The modern production of flower and vegetable seedlings increasingly uses the new so-called alternative substrates or the existing ones improved by new components (Boyer et. al., 2007; Vujoševi , 2012). Since there is no *universal* substrate for all cultivated seedlings (Samadi, 2011), it is necessary to pay attention to the substrate's physical, chemical and biological characteristics while preparing it. Thus, the selection of the substrate with the appropriate composition is crucial for the production of quality seedlings (Latimer, 1991; Kallo et.al., 1985; Argo, 2004). As reported by other authors (Landis et.al., 1990; Heiskanene, 1993; Reinikainen, 1993), the components for substrate preparation should be easily available, of small specific weight, easy to manage and that their use ensures the uniformity of plants. Today, various materials are used for this purpose, but the advantage is given to those materials which not only bring to the the increase of crop yield but also protect the environment, as stated by *Nikoli et al., 2011.* As pointed out by all the above mentioned authors, the aim is to reduce production costs, which directly leads to the reduction of the final products' price. The past research on the application of glass as a possible component have shown that, due to its amorphous structure, glass has the characteristics which make it a suitable material, capable of participating in the biological processes of living organisms.

As reported by Toši et al. (2002), their chemical activity in the processes happening in contact with various solutions helps to design and produce new materials which are effective not only for the growth and development of living organisms but also for the environment protection.

The main advantage of glass lies in the flexibility of its chemical structure, which enables the structure changes without altering the kinetics and the mechanism of dissolution process. In addition, special significance (*Nikoli et al., 2011*) applies to the rate of isolating the components from these materials which can be equalled to the rates of consumption by plants, which eliminates the possibility of accumulation or shortage. The pioneer research to date and the obtained results about the application of glass in the production of seedlings of some flower and vegetable cultures, given by *Nikoli et al., 2012 and 2013; Vujosevi et al., 2012 and 2013* have confirmed its positive influence on the growth and development of plants and thus the necessity of further research.

In order to follow the new tendencies of the modern greenhouse production of flower and vegetable seedlings, we have chosen for the subject of this research the consideration of the justifiability of the application of phosphate glass with the addition of Fe, Mn, Zn and Cu, as the new alternative component in the substrates for the production of flower and vegetable seedlings.

Research material and methods

The research is based on the one-year experiments conducted during the years of 2012 and 2013 in the greenhouse of the Faculty of Agriculture in Belgrade. Two species of annual flowers were studied: *Impatiens walleriana Hook.-* impatiens *fam. Balsaminaceae*, *«Xtreme red »* series*, Goldsmith seed* and *Celosia plumosa L. fam. Amaranthaceae -* cockscomb*,* PanAmerican Seed. Two vegetable species were also examined: tomato - *Solanum esculentum L.* hybrid Nada F1- *fam. Solanaceae* and aubergine - *Solanum melongena L. fam. Solanaceae,* experimental series 'line15' of The Institute for Vegetable Crops in Smederevska Palanka. The seed sowing was performed in polypropylene TEKU containers type 144/4,5. The commercial sowing substrate *Floragard B-fine* was used for seed sowing. After the first two pairs of permanent leaves had appeared (4-5 weeks after the sowing), the plants were transplanted into round polypropylene TEKU 9-cm pots, while the tomato plants were transplanted into 15-centimetre pots. For the transplantation and further cultivation of the seedlings we used the commercial substrate *Floragard Medium Course* while adding the phosphate glass of the following chemical structure (the percentage represents the rate of oxide in the mass): P_2O_5-68,14%, K_2O-21,92%, CaO-1,609%, MgO-1,409%, SiO_2-2,87%, ZnO-0,838%, CuO-0,899%, Fe_2O_3-1,707%, MnO-0,682% with the granulation < 0,5mm. The plants were transplanted and separated into groups treated by the following glass doses: for vegetable plants - 1. control - 0 g/l of substrate; 2. 1g/l of substrate; 3. 2g/l of substrate; 4. 3g/l of substrate and 5. 4g/l of substrate; and for flower plants - 1.control- 0 g/l of substrate; 2. 1g/l of substrate; 3. 2g/l of substrate; 4. 3g/l of substrate. The production of seedlings was performed with daily monitoring the environmental conditions necessary for the undisturbed growth and development of the plants (day and night temperatures, relative humidity and substrate moisture). The selection of the initial seedlings for the transplantation into pots was done randomly. Transplantation was performed manually. At the end of the production cycle, the influence of the applied phosphate glass on the level of development of the seedlings was studied through the following parametres: height (cm), plant weight(g), number of lateral branches, number of leaves and root weight(g).

Statistical analysis: The results of the experiments and the results of their statistical analysis are represented in tables and graphs. The results of the Shapiro-Wilk's W test showed that the experimental data for the observed characteristics in all samples were not distributed

according to the model of the normal distribution. The observed characteristics in all samples were not homogenous and that the variances of the analyzed groups were not homogenous. That is why the study of the effects of the applied glass doses was conducted using non-parametric tests. The comparison of the simultaneous effect of different glass doses on the examined characteristics of the seedlings' quality was performed according to the results of discriminant analysis, and the degree of separation of the two plant groups treated by different glass doses was determined according to the levels of significance of the squared Mahalonobis distance. The research on the different effects of different glass doses' application on separate characteristics of the seedlings' quality was conducted using the Kruskal-Wallis test for all treatments and the Mann-Whitney U test for two treatments. Statistical analysis of the results obtained in the experiment was carried out using software STATISTICA v. 6 (StatSoft, Inc., Tulsa, OK, USA).

Results and discussion

The discriminant analysis determined that the use of different doses of phosphate glass caused statistically very significant differences if the characteristics of the studied *Celosia plumosa* seedlings (F= 4.856; p<0.001) were simultaneously observed. The characteristics of the studied seedlings of *Celosia plumosa* obtained by using the glass doses of 2 g/l and 3 g/l were very significantly different from the seedlings' characteristics obtained without the use of glass (0g/l). In addition, the glass quantities of 2g/l and 3g/l had a significantly different influence on the studied characteristics of the seedlings. Also, the use of these doses had a very significantly different effect from the use of 1g of glass/l of substrate (Table 1). The difference of the total quality of the obtained *Celosia plumosa* seedlings by using different glass doses was the consequence of the the glass effect on the above-plant weight and number of lateral branches (Graph 1).

Table 1: The significance levels of the differences between the examined glass doses' effects on the characteristics of the *Celosia plumosa* and *Impatiens walleriana* seedlings' development on the basis of the squared *Mahalanobis* distance

Dosage (g/l)	Celosia plumosa			Impatiens walleriana		
	Dosage (g/l)			Dosage (g/l)		
	1	2	3	1	2	3
0	0.100	**<0.001**	**<0.001**	0.739	0.089	0.313
1		**0.042**	**0.002**		**0.029**	0.075
2			**0.021**			0.256

The results of the Kruskal-Wallis test (H and p, Graph 1) showed that the average plant weight and number of lateral branches statistically very significantly depended on the used dose of glass. On the other hand, the glass dose did not affect the average height and root weight of the *Celosia plumosa* seedlings. The obtained results corresponded to the results acquired in the research (*Vujoševi et al., 2011*) on the influence of phosphate glass in the production of marigold, where glass doses did not have a statistically significant influence on the height of seedlings and root weight Comparing the differences of the effects of two by two glass doses on the average above-ground biomass using the *U*-test (Table 2 and Graph 1), it was determined that the use of the glass with 1g/l of substrate significantly changed the plant weight, and the use of bigger doses (2g/l and 3g/l) had a very significant influence when compared to the non-use of glass. The effects of 1g/l and 2g/l doses on the plant weght were statistically significantly different.
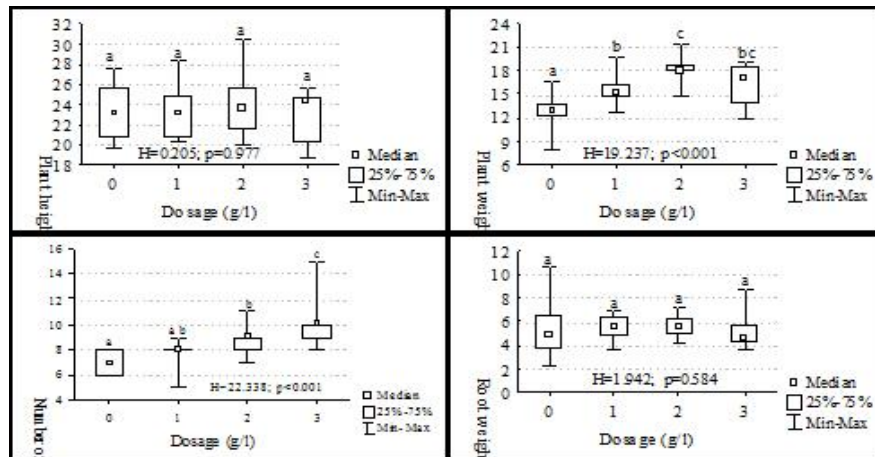
Graph 1: The effects of the application of different glass doses on the seedlings' characteristics
Celosia plumosa
Note: The same letters were used to mark the treatments with the same effect

The number of lateral branches obtained by applying the maximum studied glass dose (3g/l) was statistically very significantly different from the number of lateral branches obtained by not applying glass or by applying the 1g/l dose, and significantly different from the number obtained by applying 2g/l. The number of branches obtained by applying 2g/l was very significantly different from the number of branches obtained by not applying glass (Table 2).

The obtained results concerning the plant weight and number of formed lateral branches of *Celosia plumosa* seedlings also corresponded to the before-mentioned research (Vujosevi et al., 2012), according to which the glass application dose of 1 or 2g/l had the most favourable influence on the plant weight and number of lateral branches of *Tagetes patula* seedlings. When it comes to the *Celosia plumosa* seedlings, the 2g/l dose should have the advantage because it is a type of flowers from the medium long vegetation period of seedlings (8-10 weeks) so the need for food is greater than for the flowers from the group of short vegetation period of seedlings, such as marigold - *Tagetes patula* (6-8 weeks).

Table 2. The levels of significance between average plant caracteristics of flowers seedlings *Celosia plumosa and Impatiens walleriana* on the basis of *U*-test

Spacies	Caracteristics	Dosage	Dosage		
			1 g/l	2 g/l	3 g/l
Celosia plumosa	Plant height (cm)	0 g/l	1.000	0.791	0.734
		1 g/l		0.705	0.970
		2 g/l			0.734
	Plant weight (g)	0 g/l	**0.013**	**<0.001**	**0.007**
		1 g/l		**0.005**	0.326
		2 g/l			0.131
	Number of lateral branches	0 g/l	0.065	**0.003**	**<0.001**
		1 g/l		0.129	**0.001**
		2 g/l			**0.016**
	Root weight (g)	0 g/l	0.821	0.545	0.705
		1 g/l		0.940	0.290
		2 g/l			0.131
Impatiens walleriana	Plant height (cm)	0 g/l	0.273	0.623	0.623
		1 g/l		0.705	0.623
		2 g/l			
	Plant weight (g)	0 g/l	0.345	0.199	0.545
		1 g/l		0.940	0.650
		2 g/l			0.450
	Number of Lateral	0 g/l	0.618	0.299	0.153
		1 g/l		0.760	**0.038**

	branches	2 g/l			**0.044**
		0 g/l	0.762	0.059	0.082
	Root weight (g)	1 g/l		**0.028**	**0.041**
		2 g/l			0.257

The method of discriminant analysis was used to study the simultaneous effect of the application of different doses of phosphate glass on all the examined characteristics of *Impatiens walleriana* seedlings. The obtained results showed that the applied glass caused differences, but that they did not have any statistical significance; the results of the group test (F=1.654; p<0.075). The characteristics of *Impatiens walleriana* seedlings differed only when the 1 or 2g/l glass dose was used (Table 1). The results of the Kruskal-Wallis test (H and p, Graph 2) pointed out that the average root weight of *Impatiens walleriana* seedlings significantly depended on the used glass dose, while this dose did not affect the other examined characteristics of the seedlings. The comparison of differences of the glass doses' influence on the average plant weight roots of *Impatiens walleriana* seedlings using the U-test (Table 2 and Graph 2) showed that the use of 2g/l and 3g/l glass changed the average root weight significantly. When these glass doses were applied, the average weight of the seedlings' roots showed statistically significant difference in comparison with the root weight obtained by the application of 1g/l glass dose.

Graph 2: The effects of the application of different glass doses on the seedlings' characteristics *Impatiens walleriana*
Note: The same letters were used to mark the treatments with the same effect

Also, the application of the U-test proved that the apllication of 3g/l glass significantly changed the average number of lateral branches in relation to the number of lateral branches formed by using the smaller doses (1g/l and 2g/l). The favourable effect of bigger glass doses on the average root weight and number of the formed lateral branches of the *Impatiens walleriana* seedlings could also be attributed to its medium long vegetation of the seedlings (8-10 weeks) and the habitus itself (the appearance of the stem). Namely, this flower type is characterized by basal branching, while the primary stem is short. The quality of the obtained plants is measured by their network of branches not the height. When it comes to the studied quality characteristcs of vegetable seedlings, the use of different doses of phosphate glass showed statistically very significant effects; tomato (F=6.978; p=0.001) and aubergine (F=2.603; p=0.002). The results of the discriminant analysis pointed out that the use of different doses of phosphate glass had a statistically very significant influence on the studied quality characteristics of vegetable seedlings. With regard to tomato seedlings (*S. esculentum*), the use of 2g/l glass dose brought to the seedlings' quality which was

significantly different, and the use of 3g/l brought to very significantly different quality from the quality of the seedlings obtained without the application of glass, 0g/l (Table 3).

The application of 3g/l and 4g/l of phosphate glass had a statistically very significantly different effect from the application of 1g/l and 2g/l glass. The quality changes in seedlings made by using 1g/l or 2g/l glass were not significant, while the use of 3g/l and 4g/l glass brought to the statistically significantly different effects on the quality of tomato seedlings (Table 3 and Graph 3).
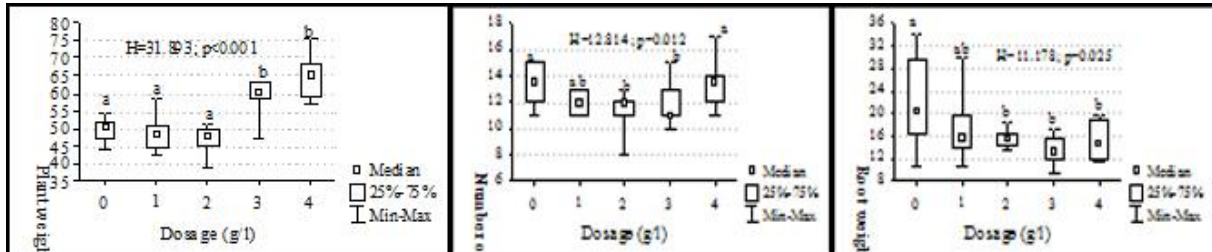
Graph 3: The effects of the application of different glass doses on the seedlings' characteristics
Solanum esculentum
Note: The same letters were used to mark the treatments with the same effect

More favourable effect of bigger glass doses could be explained by the fact that tomato was grown in the pots of bigger volume and that the plants were grown until the phase of fruit bearing. The obtained results corresponded to the results obtained in the research (*Vujosevi et al., 2013*) on the effect of phosphate glass in the cultivation of peppers (*Capsicum annum*) where the applied glass dose of 3g/l had the most favourable effect on the quality of plants.

Table 3. The significance levels of the differences between the examined glass doses' effects on the characteristics of the *Solanum esculentum* and *Solanum melongena* seedlings' development on the basis of the squared *Mahalanobis* distance

| Dosage (g/l) | Solanum esculentum | | | | Solanum melongena | | | |
| | Dosage (g/l) | | | | Dosage(g/l) | | | |
	2	3	4	5	2	3	4	5
0	0.191	**0.020**	**<0.001**	**<0.001**	0,058	0,394	**0,033**	**0,004**
1		0.723	**<0.001**	**<0.001**		0,196	**0,048**	**<0,001**
2			**<0.001**	**<0.001**			0,390	**0,019**
3				**0.033**				0,221

The results of analyzing the influence of glass doses on the plant weight of tomato seedlings, using the Kruskal-Wallis test (H and p, Graph 3), showed that the average plant weght of tomato seedlings statistically very significantly depended on the glass dose applied during the cultivation, while the average root weight and average number of leaves were statistically significantly influenced by the glass dose (Graph 3). The comparison of two by two doses of the applied glass, using the U-test, showed that the plant wieght obtained using 3g/l and 4g/l glass was statistically very significantly different from the plant weight obtained without using the glass or using a lower dose, 1g/l and 2g/l (Table 4 and Graph 3). The number of formed leaves obtained using 2g/l and 3g/l doses was statistically significantly different from the number of leaves formed when glass was not used. The number of leaves obtained when using the glass of 4g/l of substrate was statistically very significantly different from the number of leaves formed when using the 2g/l dose of glass, and significantly different from the number formed when applying the 1g/l and 3g/l doses (Table 4 and Graph 3).

In addition, the *U*-test pointed out that the root weight of tomato seedlings changed significantly when using 2g/l and 4g/l glass, and very significantly when using 3g/l in comparison with the root weight when the glass was not used (Table 4 and Graph 3).

The use of the 3g/l glass dose made a significant difference to the characteristics of aubergine seedlings, and the use of 4g/l a very significant difference in comparison with the situation when the glass was not used or when the minimum quantity was used (1g/l). The glass dose of 4g/l also had a very significantly different effect from the application dose of 2g/l (Table 3). According to the results of the Kruskal-Wallis test (H and p, Graph 4), the average height and average plant weight were statistically significantly dependent on the applied glass dose, while the average number of leaves was statistically very significantly dependent. The results also stated that the applied dose of glass did not influence the average root weight

Table 4. The levels of significance between average plant parameters of vegetables seedlings *S. esculentum* and *S. melongena* on the basis of *U-* test

Spacies	Caracteristics	Dosage	Dosage			
			1 g/l	2 g/l	3 g/ l	4 g/ l
Solanum esculentum	Plant weight (g)	0 g/l	0.406	0.096	**0.001**	**<0.001**
		1 g/l		0.545	**0.001**	**<0.001**
		2 g/l			**0.001**	**<0.001**
		3 g/ l				0.082
	Number of leaves	0 g/l	0.067	**0.018**	**0.037**	0.969
		1 g/l		0.231	0.298	**0.040**
		2 g/l			0.719	**0.007**
		3 g/ l				**0.027**
	Root weight (g)	0 g/l	0.131	**0.028**	**0.007**	**0.028**
		1 g/l		0.705	0.070	0.307
		2 g/l			0.070	0.496
		3 g/ l				0.496
Solanum melongena	Plant height (cm)	0 g/l	**0.016**	0.199	**0.034**	0.140
		1 g/l		0.273	0.496	**0.028**
		2 g/l			0.596	0.256
		3 g/ l				0.089
	Plant weight (g)	0 g/l	0.427	0.450	0.326	0.070
		1 g/l		0.131	**0.028**	**0.008**
		2 g/l			0.705	0.054
		3 g/ l				0.070
	Number of leaves	0 g/l	0.740	0.562	0.169	**0.036**
		1 g/l		0.131	**0.015**	**0.003**
		2 g/l			0.088	**0.010**
		3 g/ l				0.148
	Root weight (g)	0 g/l	0.199	0.970	0.326	0.650
		1 g/l		0.070	0.545	0.212
		2 g/l			0.226	0.307
		3 g/ l				0.345

The U-test determined that the average height of plants significantly differed when applying the glass doses of 1g/l, 3g/l and 4g/l from the height obtained without using the glass. Also, the different height of the aubergine seedlings showed statistically significant difference if grown with the use of glass doses of 1g/l and 4g/l (Table 4 and Graph 4). When the glass doses of 3g/l and 4g/l were used, the plant weight of aubergine seedlings significantly differed (3g/l) and statistically very significantly differed (4g/l) from the plant weight obtained when the glass dose of 1g/l was used (Table 4 and Graph 4).
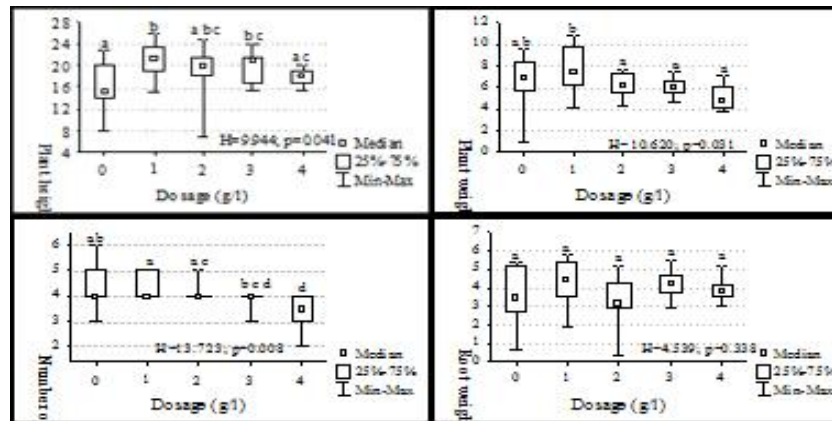
Graph 4: The effects of the application of different glass doses on the seedlings' characteristics
Solanum melongena
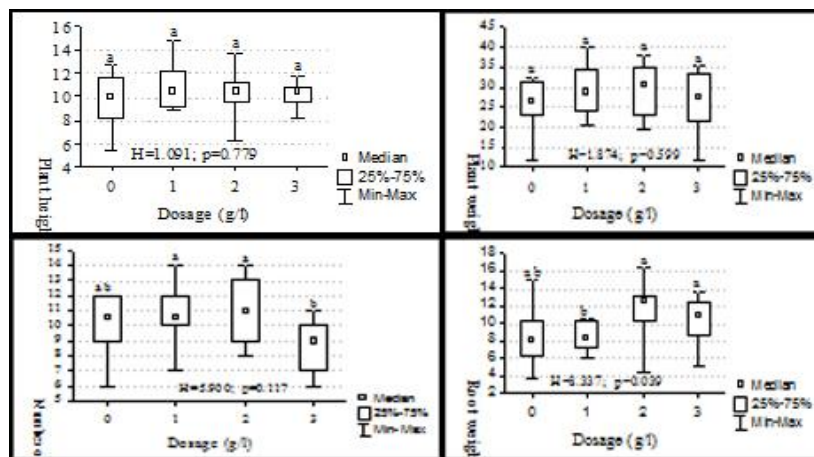Note: The same letters were used to mark the treatments with the same effect

With the application of the 4g/l glass dose, the obtained number of leaves was statistically significantly different from the number of leaves when the glass was not used, and statistically very significantly different from the number of leaves obtained with the application of the glass doses of 1g/l and 2g/l (Table 4 and Graph 4).

Conclusion

The research results showed the positive and justified effect of the phosphate glass application in the production of flower and vegetable seedlings. The favourable glass doses could be singled out for the further cultivation of each species of flowers and vegetables. The glass dose of 1-2g/l of substrate proved as the optimal dose for the production of flower seedlings *Celosia plumosa* and *Impatiens walleriana.* Although the average height of flower seedlings is determined by the characteristics of the hybrid itself, and as such does not change statistically significantly by applying the studied glass doses, it was still greater when using the glass than when the plants were grown without the use of glass. The 2g/l glass dose had the optimal effect on the realized average plant weight of flower seedlings. The use of this dose brought to the plant weight of *Celosia plumosa* seedlings which was statistically very significantly bigger than the average plant weight obtained without the application of the glass or with the application of the 1g/l glass dose. Although the average plant weight of *Impatiens walleriana* did not show statistically significant increase with the application of the studied glass doses, the average plant weight was greater when the glass dose of 2g/l was applied. The application of 2g/l and 3g/l doses with *Impatiens walleriana* seedlings had a statistically significant influence on the increase of the average root weight when compared to the dose of 1g/l. In case of *Celosia plumosa* seedlings, the application of glass doses of 1 and 2g/l had the effect on the increase of their weight, yet not a statistically significant one. The application of the glass dose of 2g/l of substrate also had the most favourable effect on the average number of branches of *Impatiens walleriana* seedlings, and the bigger dose of glass application statistically significantly decreased the number of branches per plant. In case of *Celosia plumosa* the application of 3g/l glass dose ensured a better level of branching than the level of branching obtained without the application of glass or with the application of 1g/l and 2g/l dose. On the basis of the acquired results, the glass dose of 2g/l of substrate could be recommended as the optimum dose in the production of *Celosia plumosa* and *Impatiens walleriana* seedlings as the seedlings characterized by the medium long vegetation of the seedlings (8-10 weeks). With regard to vegetable seedlings, and *Solanum melongena*–aubergine, the application of the glass dose of 1g/l of substrate had the most favourable effect on the average height and average plant weight. The obtained average height of aubergine

seedlings was statistically significantly bigger than the average height obtained without the application of the glass or with the use of the maximum researched dose of 4g/l. With regard to vegetable seedlings of *Solanum esculentum*–tomato, the application of the glass dose of 4g/l had the most favourable effect on the plant weight. With the application of this dose, the obtained average weight was statistically significantly bigger than the average weight obtained with the application of the glass dose of 2g/l of substrate. This more favourable influence of the bigger glass dose could be attributed to the period when the research ended (fruit-bearing phase). The application of phosphate glass had a positive effect on the development of the root system of vegetable seedlings. In case of both vegetable species, the applied glass dose of 1g/l brought to the statistically significant increase of its average weight in comparison with the researched doses (0g, 2g, 3g and 4g/l). The results of this research proved the justifiability of the further research on glass in the production of seedlings and other flower and vegetable species, with the aim of determining the optimum application doses, achieving maximum crop yield, obtaining healthy and safe food and protecting the environment.

Acknowledgments

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BIOCLIMATIC MOISTURE CONDITIONS IN THE LOWLANDS OF THE ŠUMADIJA-POMORAVLJE DISTRICT

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Abstract

The objective of this paper is to assess to what extent weather conditions that favor crop production have changed over the past five decades in the lowlands of the Šumadija-Pomoravlje District, an important agricultural area in Serbia. Meteorological data collected from the climatological stations at uprija and Kragujevac were analyzed for the period 1961/62–2011/12. Bioclimatic conditions were determined using the Aridity Index (UNEP), the Moisture Availability Index (Hargreaves), the Reconnaissance Drought Index and the difference between precipitation and potential evapotranspiration. The results show that in the last two decades, compared to the previous three, the air temperature, number of annual tropical days, potential evapotranspiration and water deficit suffered by crops all increased. Severe drought events occurred more frequently during the past twenty years (every third or fourth year). Detected changes in bioclimatic conditions do not favor crop production, suggesting that a strategic approach to drought management is needed.

Key words: *drought, Aridity Index, Reconnaissance Drought Index, Moisture Availability Index, Serbia*

Introduction

The Šumadija-Pomoravlje District features a combination of mountainous and hilly areas and alluvial plains along rivers, the latter of which are very important from the point of view of agricultural production. These plains represent around 70% of the total agricultural area in this district. Cereal, fodder plant and vegetables are the most cultivated crops in this area. The remaining 30% of agricultural land is made up of meadows, pastures, orchards and vineyards. Agricultural production in this district, as in the rest of Serbia, occurs mainly in rainfed conditions. The use of irrigation is restricted to smaller, local areas, which means that agricultural production is directly dependent on climate conditions.

Climatic trends show regionally varying changes in temperature and rainfall in Europe and worldwide (IPCC, 2014). The heterogeneity of climatic trends is also present in Serbia, especially when precipitation is considered (Dedijer et al., 2007). A negative trend of annual precipitation is characteristic of eastern part of the Serbia and climaxing in the region of Negotin (An elkovi and Živkovi 2007), while a positive precipitation trend characterizes mountainous areas of southwestern Serbia (Duci et al., 2009; Lukovic et al., 2013). The objective of this paper is to analyze long-term meteorological data and show to what extent weather conditions in Šumadija-Pomoravlje District have favored plant production in the past five decades and whether they are indicative of any trend change.

Material and method

Fifty-one-year monthly data (from 1961/62 to 2011/12) were obtained from the National Hydrometeorological Service of Serbia, from two weather stations, located at Kragujevac (Šumadija region) and uprija (Pomoravlje region). The following parameters

were assessed: mean annual air temperatures and mean air temperatures in the growing season (April-September); annual precipitation totals and precipitation totals in the growing season; and number of tropical days (Tmax>30°C) during the growing season. The annual data discussed in this paper reflect the hydrologic year, which in Serbia and the extended region begins in October and lasts until September of the following year. Plants' water demand is expressed via potential evapotranspiration, calculated applying the Thornthwaite method (Thornthwaite, 1948; Kafle and Bruins, 2009). Bioclimatic moisture conditions were determined by hydrologic year and by growing season. The following methods were used with regard to the hydrologic year: Aridity Index (UNEP, 1992), Moisture Availability Index – MAI (Hargreaves, 1992), and difference between potential evapotranspiration (ETo) and total rainfall (P). Bioclimatic conditions by growing season (April-September) were determined using the difference between potential evapotranspiration (ETo) and total rainfall (P), and the Reconnaissance Drought Index – RDI calculated, according to Tsakiris and Vangelis (2005). RDI was calculated as the ratio between total rainfall and potential evapotranspiration for the 6 month period (April-September).

Results and discussion

The main climate parameters for uprija (123 m a.s.l) and Kragujevac (185 m a.s.l.) are shown in Table 1 and Fig. 1.

Tab. 1. Average air temperatures, precipitation (P), total potential evapotranspiration (ETo), number of tropical days and average soil moisture deficit/surplus (P-ETo) at uprija and Kragujevac and average values for the Šumadija-Pomoravlje District

Period	Temperature (°C)		Precipitation (P) (mm)		Potential evapotranspiration (ETo) (mm)		Tropi-cal days	P-ETo (mm)	
	Hydr. year	Grow. season (Apr-Sept)	Hydr. year	Grow. season (Apr-Sept)	Hydr. year	Grow. season (Apr-Sept)		Hydr. year	Grow. season (Apr-Sept)
uprija									
1961/62-1990/91	10.7	17.2	650	368	697	601	30	-46	-233
1991/92-2011/12	11.4	18.3	672	369	732	637	50	-60	-268
1961/62-2011/12	11.0	17.6	659	369	712	616	38	-53	-247
Kragujevac									
1961/62-1990/91	11.0	17.3	633	373	704	601	26	-71	-228
1991/92-2011/12	11.9	18.6	627	363	747	644	44	-120	-281
1961/62-2011/12	11.3	17.7	630	369	721	619	33	-91	-250
Average									
1961/62-1990/91	10.8	17.2	642	370	700	601	28	-58	-231
1991/92-2011/12	11.6	18.4	650	366	740	640	47	-90	-274
1961/62-2011/12	11.2	17.6	644	369	716	618	36	-72	-249

The average annual air temperature was 11.2^{o}C, while growing season temperature averaged 17.6^{o}C over the period 1961/62-2011/12. The warmest month was July, with an average temperature of 21.3^{o}C, and the coldest was January – 0.1^{o}C (Fig. 1). The average annual rainfall was 644 mm, of which 369 mm came during the growing season. The rainiest month was June (80 mm), and the driest were February (Kragujevac 39 mm) and March (uprija 44 mm) (Fig. 1).
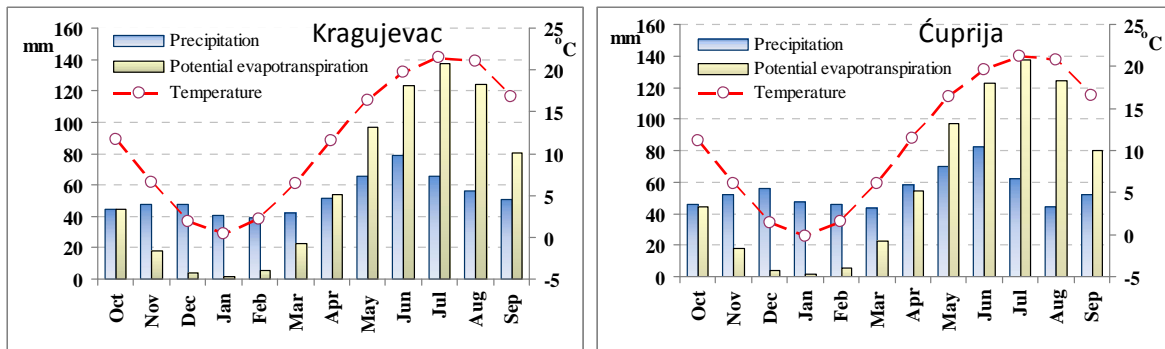
Fig. 1. Mean monthly (1961/62-2011/12) air temperatures, precipitation totals and potential evapotranspiration in the Šumadija-Pomoravlje District.

In the study area, the precipitation distribution during an average hydrologic year and the monthly plants' water demand for the period 1961/62-2011/12 (Fig. 1) shows that abundant moisture was available in the winter months (November-February), when the plants were quiescent and their needs minimal. The lack of water was greatest in July and August (Fig. 1), when most crops undergo phenological stages sensitive to moisture deficit. A lack of precipitation during this period can cause a dramatic decrease in yields (Challinor et al., 2005; Jovanovi and Stiki , 2012). A similar situation was noted in the Ma va-Kolubara District of Serbia (Matovi et al., 2013b), where plants were found to be under considerable stress in July and August during 31 out of 51 growing seasons. According to the Moisture Availability Index (Hargreaves, 1992), these were classified as semi-arid and arid conditions. The potential evaporation (ETo) in the study area during the growing season was 618 mm on average (Tab. 1).

Like the Ma va-Kolubara District (Matovi et al., 2013b), the study area registered an upward air temperature trend (Fig. 2). Upward air temperature trends have been registered across Europe (Jones and Moberg 2003), with regionally and seasonally different rates of warming (IPCC 2014). On average, long-term (1901-2005) data indicate that air temperatures in Europe are increasing more in winter than summer (Jones and Moberg, 2003). This also applies to the study area and Serbia's main breadbasket — the Province of Vojvodina (Lali et al., 2011). In the past two decades, compared to the previous three, temperatures during the growing season (April-September) increased by $1.2^{o}C$, while the annual average was $0.8^{o}C$ (Tab. 1). The number of tropical days also increased significantly. In the study period there were 28 tropical days per annum on average, while from 1992 to 2012 there were roughly 47 tropical days (Tab. 1), which is an increase by as much as 65% or more. This is consistent with the findings of Klein and Können (2003) that from 1977 to 2000 there was a greater increase in warm extremes in Europe than decrease in cold extremes. In addition, the latest IPCC report (IPCC, 2014) stated that since 1950, high-temperature extremes have become more frequent.
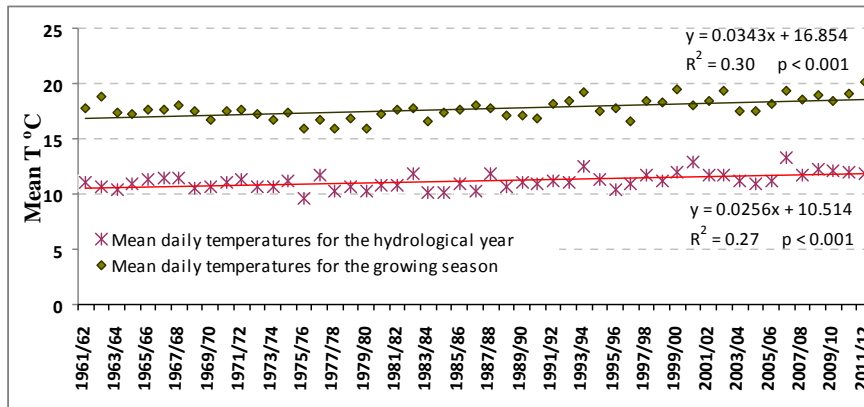
Fig. 2. Time series and linear trends of mean air temperature for hydrologic year and growing season in the Šumadija-Pomoravlje District, 1961/62-2011/12.

While in Vojvodina (Lali et al., 2011) and the Negotin region of Serbia (An elkovi and Živkovi 2007; Duci et al., 2009) annual precipitation totals exhibited a downward trend, an upward trend was noted in south-western Serbia (Duci et al., 2009; Lukovic et al., 2013). However, no significant precipitation trend was detected in the Šumadija-Pomoravlje region during the study period.

Potential evapotranspiration (April-September) during the past two decades was found to be some 30 mm higher (634 mm) than in the previous three decades (603 mm) (Tab. 1). The increase in air temperatures and potential evapotranspiration, and the relatively unaltered precipitation regime, have resulted in a greater water deficit was detected in the past two decades (268 mm), compared to the previous three (232 mm) (Tab. 1). The Aridity Index shows that the lowlands in the studied district belong to the humid climate category (uprija 0.93, Kragujevac 0.88). The Moisture Availability Index—MAI, adjusted to southern Europe (Hargreaves, 1992), indicates that the climate in the region is semi-humid (MAI 0.8). The average difference between precipitation and potential evapotranspiration over an entire hydrologic year revealed a precipitation deficit of 72 mm (Tab. 1). Judging by these values, the average moisture availability should have been satisfactory. However, there is a general disparity between moisture demand and moisture availability in Serbia in the summer months, and that is why droughts impact spring crops the most (Matovi et al., 2013a; Lali et al., 2011). The average difference between precipitation totals and potential evapotranspiration during the growing season (April-September) was found to be 249 mm (Tab. 1). The average RDI calculated for the 6 month time period (from April to September) was 0.60 (Fig.3). The RDI distribution (Fig. 3) exhibits a greater scatter of data points in the last 20 years. If according to Tsakiris and Vangelis (2005) a 0.7· averageRDI is taken as an extreme drought threshold (Fig. 3), then extreme drought events have been more frequent in the past two decades (5 extremely dry periods in uprija and 7 in Kragujevac), compared to the previous three decades (1 in uprija and 2 extremely dry growing seasons in Kragujevac). Consequently, in the past 20 years farmland in the Pomoravlje region experienced extreme drought events every fourth year, and in the Šumadija region as often as every third year.
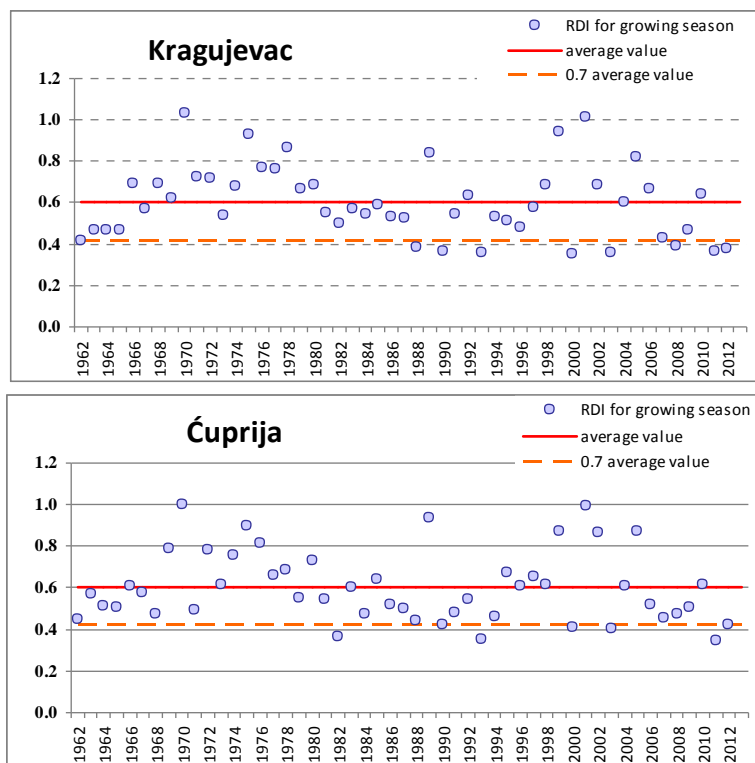
Fig. 3. Reconnaissance Drought Index (RDI) calculated for the 6 month time period (April-September) in Šumadija (upper panel) and Pomoravlje (lower panel), 1962-2012.

Conclusion

Over the past five decades (1961/62-2011/12) in the Šumadija-Pomoravlje District an increase in air temperatures, the number of tropical days per year, and an increase in potential evapotranspiration have been noted. Bioclimatic conditions for the entire hydrologic year were satisfactory (Aridity Index — humid condition, MAI — semi humid condition), but during the growing season (April-September) there was a water deficit (250 mm on average for reference crop). The RDI calculated for the growing season (April-September) shows more frequent extreme drought events in the past 20 years (every third or fourth year), compared to the previous 30 years. The study results, together with the IPCC report (IPCC, 2014), indicate that agriculture in Southern Europe is highly vulnerable to predicted climate change, and constitutes a serious warning and call for strategic measures to be implemented against increasing drought conditions.

Acknowledgement

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NITROGEN UTILIZATION OF WINTER WHEAT ON AN ACID SOIL

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Abstract

This paper presents the two year results of a study dealing with nitrogen utilization of twenty recently developed Serbian winter wheat cultivars, on the acid soil typed as eutric vertisol. Soil pH value of the cultivated layer in water was between 5.41 and 5.85, and in KCl it was between 4.15 and 4.37. There were significant differences between genotypes regarding nitrogen reutilization. As the average for both years, this parameter ranged from 12.79 mg/plant in the cultivar Jarebica to 18.75 mg/plant in the cultivar Gruža. Percent of nitrogen supply for grain obtained by reutilization was significantly higher in the first year. As the average for both years the lowest percent of nitrogen supply for grain obtained by reutilization amounted 38% in cultivars Renesansa, Jarebica and Tiha, and the highest one 66% in the cultivar Milica. Mean values of physiological efficiency of nitrogen, considering both years, were within limits from 39 (Renesansa) to 46 kg/kg (Prima, Tera and Pobeda). The lowest crude protein content was observed in the cultivar Nevesinjka (8.29%), and the highest one in the cultivar Milica (10.14%)

Key words: *Wheat, Nitrogen, Soil, Acidity.*

Introduction

Nitrogen fertilizers are widely used for increasing grain yield and protein content of bread wheat. However, farmers must optimize their use in order to decrease environmental risks and production costs (Le Gouis et al., 2008). For that reason, efficiency of plant nitrogen use becomes a trait of the greatest importance in studying and breeding of all plants, so of wheat too (Hirel et al., 2007). The core of the problem is to increase nitrogen accumulation in plants not by increased amounts of nitrogen fertilizers added, but by creating genotypes with a better ability of their root system to uptake higher quantities of nitrogen from soil. On the other hand, in order to get higher values of grain yield, that process necessarily have to be followed by an increased photosynthetic intensity. If not, only higher concentration of nitrogen in grain and straw could be reached, and nitrogen utilization efficiency of plants would be significantly lowered (Stojkovi et al., 2006; Deleti et al., 2010). One can often hear a statement that over 60% of soils in Serbia are acid. According to the Report on Soils' Status published by the Ministry of Environment and Spatial Planning of the Republic of Serbia (2009), during last ten years that percent is characteristic for central Serbia, while in Vojvodina province soil acidity status is incomparably better. It is stated in this report that the percent of acid soils (on the basis of 25,118 samples from 2008) in central Serbia was 52.1%, with additional 29.2% of mildly acid soils. Percent of acid soils is also high throughout the world, so there is plenty of references dealing with parameters of nitrogen metabolism on acid soils (Bednarek and Reszka, 2009), and a great effort is directed to establishment of genetic specificity of nitrogen metabolism parameters, as well as to those parameters' inheritance mode (Le Gouis et al., 2008; Habash et al., 2007). This study has been aimed to investigate genetic specificity of nitrogen accumulation in twenty recently developed Serbian winter wheat cultivars on an acid soil.

Material and methods

The trials were set in Kraljevo, Serbia, during 2009/10 and 2010/11, on the soil typed as eutric vertisol, which was acid. Soil acidity of cultivated layer, measured as pH value in water, ranged between 5.41 and 5.85, while this value in KCl was between 4.15 and 4.37. Titration acidity of the soil amounted 17.89 ccm, and humus percent was from 2.13 to 2.54%. The investigation lasted two years, and twenty recently developed Serbian winter wheat cultivars were included. The following traits were studied: nitrogen reutilization, percent of nitrogen supply for grain obtained by reutilization, physiological efficiency of nitrogen (PEN), as well as crude protein content. The trials were set in random complete block design (RCBD), with four replications in each year. The obtained data were processed by analysis of variances, and statistical significance of differences among genotypes was estimated in general by F test. Statistical significance of differences between particular genotypes each other was established by comparing with the least significant differences (lsd test).

Results and discussion

Results of F test revealed statistically significant differences among the investigated genotypes regarding nitrogen reutilization (tab. 1). It is obvious that this parameter had much higher values in the first year of investigation. In the first year it was within range from 19.00 mg/plant in the cultivar Evropa 90 to 28.10 mg/plant in the cultivar Kremna, with the average value of 22.86 mg/plant. In the second year, the lowest nitrogen reutilization was observed in the cultivar Renesansa (3.76 mg/plant), and the highest one in the cultivar Milica (15.76 mg/plant), while the mean value was 9.37 mg/plant. As the average for both years variation interval was from 12.79 mg/plant in the cultivar Jarebica to 18.75 mg/plant in the cultivar Gruža.

Percent of nitrogen supply for grain obtained by reutilization (tab. 1) also was significantly higher in the first year than in the second one. Differences among genotypes were significant according to F test, and among particular genotypes each other in many cases they were greater than lsd values for both probabilities of error (P<0.05 or P<0.01). Variation interval in the first year of investigation was between 40% (Nevesinjka) and 70% (Takov anka), and in the second one between 15% (Renesansa) and 85% (Milica). As the average for both years the lowest percent of nitrogen supply for grain obtained by reutilization amounted 38% in cultivars Renesansa, Jarebica and Tiha, and the highest one 66% in the cultivar Milica.

Physiological efficiency of nitrogen (PEN) means activity of nitrogen of a plant in producing assimilates needed to form its grain yield. It is also called efficiency of nitrogen utilization in plant, and represents a parameter of nitrogen utilization in forming grain yield. Physiological efficiency of nitrogen is measured as production of assimilates for grain filling per unit of plant nitrogen, so it is expressed as kg of produced grains per kg of nitrogen accumulated by crop. Differences among genotypes regarding physiological efficiency of nitrogen were significant according to F test, and comparisons between each other followed the same tendency (tab. 2). Values of the first year were between 40 (Milica) and 48 kg/kg (Takov anka, Gruža and Mina), and of the second one between 35 (Renesansa) and 50 kg/kg (Pesma). As the average for both years, values of physiological efficiency of nitrogen were within limits from 39 (Renesansa) to 46 kg/kg (Prima, Tera and Pobeda). PEN can show significant variation depending on genotype and environmental conditions (oki and Kosti , 1992). The same researchers also stated that this parameter is greater when nitrogen nutrition is poor and weather conditions are favorable for grain yield, as well as in genotypes with lower protein content, lower nitrogen accumulation in plant and higher grain yield. Available data show that physiological efficiency of nitrogen is better indicator of cultivars productivity than nitrogen harvest index. Physiological efficiency of nitrogen is the parameter of nitrogen

utilization only for forming grain yield, while nitrogen harvest index regards nitrogen utilization for increasing both grain yield and protein content.

Table 1.Nitrogen reutilization (mg/plant) andpercent of nitrogen supply for grain obtained by reutilization

Cultivar	Nitrogen reutilization			% of nitrogen supplies for grain obtained by reutilization		
	1st year	2nd year	average	1st year	2nd year	average
1. Prima	19.10	7.60	13.35	56	40	48
2. Renesansa	25.30	3.76	14.53	62	15	38
3. Tera	23.60	10.90	17.25	63	68	65
4. Pobeda	24.40	11.80	18.10	60	66	63
5. NS Rana 5	26.70	6.08	16.39	69	30	49
6. Evropa 90	19.00	9.18	14.09	44	51	47
7. Milica	20.80	15.76	18.28	47	85	66
8. Jarebica	19.80	5.79	12.79	53	24	38
9. Kremna	28.10	10.22	14.16	64	49	56
10. KG 100	20.50	10.09	15.29	51	46	48
11. Pesma	23.20	10.26	16.73	49	50	49
12. Zlatka	24.90	9.32	17.11	64	40	52
13. Nevesinjka	20.40	13.88	17.14	40	72	56
14. Takov anka	22.80	10.04	16.42	70	43	56
15. Gruža	27.20	10.31	18.75	57	45	51
16. Mina	22.70	10.67	16.68	63	52	57
17. Tiha	23.20	7.40	15.30	48	28	38
18. Toplica	21.90	5.91	13.90	66	24	45
19. Bistrica	21.60	10.52	16.06	58	50	54
20. Prva	22.10	7.94	15.02	54	47	50
Average	22.86	9.37	16.11	57	46	51
LSD 0,05	6.57			4.27		
0,01	8.99			5.84		

Crude protein content (tab. 2) of the all cultivars was significantly higher in the first year than in the second one. Differences between genotypes were not significant. Values of this parameter in the first year were between 9.52% (Prva) and 11.29% (Pesma), and in the second one between 6.50% (Pesma) and 9.23% (Zlatka). As the average for both years, values of crude protein content were within limits from 8.29% (Nevesinjka) to 10.14% (Milica).

Table 2. Physiological efficiency of nitrogen (kg/kg) and crude protein content (%).

Cultivar	PEN			Crude protein content		
	1st year	2nd year	average	1st year	2nd year	average
1. Prima	46	46	46	10.03	7.18	8.60
2. Renesansa	43	35	39	11.11	8.21	9.66
3. Tera	47	46	46	10.26	7.58	8.92
4. Pobeda	43	49	46	10.43	6.78	8.60
5. NS Rana 5	46	42	44	10.32	7.92	9.12
6. Evropa 90	43	46	44	10.77	7.64	9.20
7. Milica	40	40	40	11.11	9.18	10.14
8. Jarebica	47	39	43	9.92	7.41	8.66

9. Kremna	46	44	45	10.71	8.09	9.40
10. KG 100	47	39	43	9.75	8.61	9.18
11. Pesma	41	50	45	11.29	6.50	8.89
12. Zlatka	45	39	42	10.03	9.23	9.63
13. Nevesinjka	43	48	45	9.75	6.84	8.29
14. Takov anka	48	43	45	9.69	8.72	9.20
15. Gruža	48	40	44	10.60	8.61	9.60
16. Mina	48	40	44	9.69	8.95	9.32
17. Tiha	42	44	43	10.89	7.98	9.43
18. Toplica	46	38	42	9.75	7.75	8.75
19. Bistrica	41	42	41	10.94	8.15	9.54
20. Prva	45	46	45	9.52	7.35	8.43
Average	45	43	44	10.33	7.93	9.13
LSD 0,05		2.59			6.08	
0,01		3.54			8.32	

Conclusions and future work

On the basis of the study, dealing with genetic specificity of nitrogen utilization in twenty recently developed Serbian winter wheat cultivars on an acid soil, we can conclude the following:

There were significant differences between genotypes regarding nitrogen reutilization. As the average for both years, this parameter ranged from 12.79 mg/plant in the cultivar Jarebica to 18.75 mg/plant in the cultivar Gruža.

Percent of nitrogen supply for grain obtained by reutilization was significantly higher in the first year. As the average for both years the lowest percent of nitrogen supply for grain obtained by reutilization amounted 38% in cultivars Renesansa, Jarebica and Tiha, and the highest one 66% in the cultivar Milica.

Mean values of physiological efficiency of nitrogen, considering both years, were within limits from 39 (Renesansa) to 46 kg/kg (Prima, Tera and Pobeda).

The lowest crude protein content was observed in the cultivar Nevesinjka (8.29%), and the highest one in the cultivar (10.14%).

Regarding nitrogen nutrition, grain yield mainly depends on amount of accumulated nitrogen and degree of its utilization in plant. That means these parameters could be a base for selection of wheat genotypes efficient in nitrogen nutrition. This selection strategy would try to improve simultaneously traits for high accumulation and efficient utilization of nitrogen in plant.

Acknowledgement

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THE EFFECT OF DATE AND METHOD OF PLANTING MARSHMALLOW CROPS ON ROOT YIELD AND QUALITY

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Abstract

In 2009. and 2010. factorial trials with marshmallow crops were carried out on three localities in Serbia (Municipalities of Nova Pazova, Petrovac na Mlavi and Pan evo). The effect od planting date (spring and autumn) and method (seedling and direct drilling in the field) on root yield and qualitative traits were examined. Trials were set in accordance with planned design, and experimental results were statistically analyzed. Via adequate analytical methods we determined corresponding values for important root quality parameters (plant fibres and fats, ash, phosphorous, starch, total and natural invert sugar and sucrose). Analysis of variance showed significant impact of date and method of planting marshmallow crops on crop yield. Both planting dates showed reliably higher yield of dried root planted in the field using direct drilling method, compared to seedlings. The average yield was 4.015 kg/ha, while usage of seedlings generated 1.575 kg/ha. Date and method of planting marshmallow crops didn't have significant impact on values of important root quality parameters. Average value was highest for starch (34%), phosphorous content was 11,4%, plant fibres 12,3%, total invert sugar 8,4%, sucrose 6,9%, ash 4,16%, plant fats 2,06%, while natural invert content was the lowest (1,05%). These experimental results should be used in future technology designs for planting marshmallow crops in accordance with principles of sustainable agriculture.

Key words: *marshmallow, methods of planting, planting date, quality, yield.*

Introduction

Nine species within the family *Malvaceae* has been registered in our habitats. Three of those nine are used in traditional and official medicine: high mallow (*Malva silvestris* L.), common hollyhock (*Althaea rosea* L.) and common marshmallow (*Althaea officinalis* L.), (Sari , 1989). From the economic point of view, the most important species is common marshmallow. It is one of the most wanted and used plants for medicinal purposes, (Draži , 2010a). Uncontrolled exploitation of the wild common marshmallow led to the disappearance of its habitats, making it one of the endangered species. The advantages of cultivating common marshmallow over its collecting are the following: obtaining large quantities of raw material with uniform, standard quality, possible choice of environmentally acceptable conditions for cultivation and protection of resources from over-exploitation.

The current level of cultivation has an extensive character. Production and environmental conditions and standards also require that new solutions in the technology of cultivating common marshmallow are found. These solutions include flexible agricultural technology which shall combine conventional methods with modern technologies. Defining the cultivation technology on the principles of sustainable agriculture should ensure a stable production, product quality, preservation of natural resources, environmental protection and economic effects. Determining planting periods (spring - autumn) and the method of planting

crops (seedling application - direct sowing) and agroecological conditions of cultivation are the subject of this research.

Material and methods

During 2009. and 2010. we performed experiments with the domestic population of common marshmallow - of Vojvodina. Experiments have been performed on three locations: Nova Pazova, Petrovac na Mlavi and Pan evo. These experiments were conducted in four replications on the primary plot size 5 m^2.

The experiments examined the following factors: periods for planting crops (spring and autumn) and the method of planting crops (seeding application and direct sowing). During the spring and summer 2009. we carried out the production of seedlings in containers. Thus produced seedling had a significantly higher percentage of rooting plants when compared to other methods (cold frames and medium-warm hotbeds), (Andruszczak and Wisniewski, 2006, 2007, Draži et al., 2010). Replanting was carried out in spring (May) and autumn (October) in 2009. Spacing was 50 x 25 cm (crop density of 80.000 plants/ha).

Direct sowing was also carried out in spring (April) and autumn (October) in 2009. It was carried out with a manual planter in continuous rows with spacing of 50 cm (crop density was around 300.000 plants/ha). The seed is small so the sowing was carried out at the depth of 1 - 2 cm. We used a seed of 95% purity and 53% germination. Recent studies have shown that seed germination can be improved with pelleting (Draži et al., 2011) and by applying the indigenous strains of *Bacillus* sp.Q3 (Starovi et al., 2013).

Removing roots from the spring period in 2009, was carried out in October of the same year, while the removing the roots from the autumn period was carried out in October 2010. Root drying, after primary processing, was carried out in the place for drying with hot air. Regarding the properties, we analyzed the yield of dry root and quality parameters. The results were processed by using the analysis of variance in factorial experiments, while the least significant difference was analyzed with a LSD test. Chemical characterization and analytical methods for testing the composition of roots were defined in the laboratory of the Institute "Tamiš" in Pan evo (Majstorovi et al., 2013).

The conditions in which the experiments were carried out. - Nova Pazova is located in the northern part of Serbia (Vojvodina) in the eastern area of Srem district. Experimental plot in municipality of Petrovac na Mlavi was located at the foot of the Homolje mountains, Brani evo district (around 130 m above sea level). Pan evo municipality is located in the Serbian semi-arid climate conditions (southern Banat district in Vojvodina). According to the morphological and genetic characteristic, the soil at the experiment plot in Nova Pazova municipality belongs to chernozem, Petrovac na Mlavi to cambisols, while the one in Pan evo belongs to marsh soil. Average annual temperatures of these locations were approximately 11°C. Due precipitation in Nova Pazova (620-800 mm) was higher when compared to locations in Petrovac (600-650 mm) and Pan evo (500-550 mm). Based on the analysis of the agroecological conditions, we can state that the conditions in Nova Pazova were the most favourable.

Results and Discussion

Analysis of variance has shown locations and applied variances, which agrees with the previous research (Draži et al., 2009). Interactions between locations and variances have also been of great significance, Table 1.

Table 1. Factorial analysis of variance (2 x 3) for root yield of marshmallow

Source of Variation	d.f.	MS	
		Spring	Autumn
Treatments	5	2,536**	14,56**
A - locality	2	1,9**	0,186**
B - variants	1	8,07**	72,24**
AB - interaction	2	0,405**	0,095*
Error	18	0,02	0,02

*, **: Significant at 0,05 and 0,01 probability level, respectively

Depending on the length of cultivating the common marshmallow (one-year or two-year crop) yields can vary significantly (4.550 to 9.520 kg/ha), (Andruszczak, 2007). In our conditions, common marshmallow is cultivated as a one-year crop, but the spring crop production lasted shorter (around seven months).

In the spring planting period, there was a total yield of 1.830 kg/ha. It was higher for 510 kg/ha or 28% percent than the autumn planting period (l.320 kg/ha). The highest yield was achieved in Nova Pazova (2.270 kg/ha and 1.370 kg/ha). The differences in the yield height between locations were significant only in the spring period, Table 2.

Direct sowing gave significantly higher yields in both periods when compared to the application of seedlings. In addition, it was observed that the root does not branch (or it branches but a little and rarely) and therefore its processing is easier, which is the most significant advantage of the direct sowing. Differences in the yield height were found when comparing sowing periods. Average yield in the autumn period of 4.790 kg/ha was higher for 1,550 kg/ha i.e. 32%. When compared to the application of seedlings at the same period, the difference is very high and it amounts to 3.470 kg/ha i.e. 72%. Also, the average yields in the spring period of 3.240 kg/ha was increased by 1.410 kg i.e. 44% from the yield accomplished by applying seedlings. There are significant differences for both periods between the locations. The highest yield was accomplished in Nova Pazova. Variations in yield occurred more when applying seedlings, then in direct sowing, Table 2.

Table 2. Average yield of marshmallow

Location	Period			
	Spring		Autumn	
	Usage of seedlings	Direct drilling	Usage of seedlings	Direct drilling
Nova Pazova	2270**	3490**	1370	5080**
Petrovac na Mlavi	1650	3220**	1330	4700
Pan evo	1570	3010	1260	4590
X̄	1830**	3240	1320	4790**
CV	14,8	5,3	13,2	4,0

*, **: Significant at 0,05 and 0,01 probability level, respectively

In previous research, the analytics of root ingredients was mainly limited to determining of impurities, number of swelling, loss on drying and total ash. Therefore, the chemical characterization of the common marshmallow root was performed with prior definition of analytical methods that are suitable for testing the root composition. This is important for the purpose of better standardization of plant ingredients in order to define the liquid (necessary) dose for achieving the improvement of optimum physiological effect (Majstorovi et al., 2013). Experimentally determined content of tested ingredients showed that periods and method of planting crops did not affect the change in their values, Table 3.

Table 3. Content of the studied components in the root

| N° | Component | Period | | | | Mean | CV |
| | | Spring | | Autumn | | | |
		Usage of seedlings	Direct drilling	Usage of seedlings	Direct drilling		
1.	Plant fibres	12,03	12,91	12,06	12,2	12,3	3,0
2.	Plant fast	2,03	2,04	2,13	2,04	2,06	2,0
3.	Ash	4,03	3,64	4,33	4,64	4,16	9,0
4.	Phosphorous	11,09	11,20	12,3	11,01	11,4	4,6
5.	Starch	34,49	36,45	33,9	30,77	34,0	6,0
6.	Total invert sugar	8,32	8,96	7,63	8,69	8,4	6,0
7.	Natural invert	1,17	0,98	1,22	0,83	1,05	14,7
8.	Sucrose	6,79	7,68	6,13	7,0	6,9	8,0

Conclusion

Analysis of variance showed a significant effect that locations, periods and method of planting common marshmallow crops imposed upon the height of achieved root yield. Yield, achieved by planting crops with direct sowing when compared to application of seedlings, was reliably higher on all locations during both planting periods. On average, it was 4.015 kg/ha, while by applying seedlings 1.575 kg/ha was achieved. In the spring planting period, a higher yield (1.830 kg/ha) was achieved when compared to autumn period (1,320 kg/ha). However, when planting with direct sowing, the autumn period was more favourable and therefore the higher yield was achieved (4.790 kg/ha) when compared to spring period (3,240 kg/ha). Agroecological conditions of the location significantly affected the achieved yield. Locations, planting periods and methods of crop planting did not affect the value of analyzed root quality parameters.

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EFFECTS OF INTERCROPPING PATTERN AND FERTILIZERS ON WEEDINESS OF RED MAIZE-BLACK SOYABEAN INTERCROPPING SYSTEM

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Abstract

Intercropping, as the ecological method, is one of the actions that can reduce problems with weeds. This paper deals with results of the effects of different intercropping pattern and fertilizers on weediness of red maize-black soyabean intercropping system in two-year period (2011-2012). Trial was set up on chernozem soil type in the experimental field of Maize Research Institute in Zemun Polje, Serbia. Red maize ZP Rumenka cultivar (FAO 700 group of maturity) and black soyabean, cultivar Dukat (maturity group 0) were included in the experiment. The intercrops were created according to the method of replacement series. Two different spatial designs were applied: the sowing of maize and soybean in strips or alternate rows and sole crops. The treatments of fertilization consisted of following variants: control, mineral fertilizer AN, organic fertilizer under the trade name "Royal Bio-Humus Offert" and microbiological fertilizer Uniker. According to results from the two study years, the fresh and dry biomass of weeds was lower in intercrops than in maize and soyabean monocrops in average and for each fertilizer treatment. Alternate rows, as well as strips influenced the weed biomass production in dependence of type of fertilization. In both, alternate rows and strips, application of microbial fertilizer increased the fresh biomass of weeds almost twice in comparison to other treatments. Extremely important fact is that in the intercrops variant, compared to pure crops of maize and soybeans, weeds biomass is significantly reduced, primarily due to the increased number of plants per unit area.

Key words: *weediness, red maize, black soyabean, intercropping system,*

Introduction

Intercropping is a type of mixed cropping and defined as the agricultural practice of cultivating two or more crops in the same space at the same time (Willey, 1979; Olja a et al., 2000). Intercropping is the practical application of basic ecological principles such as diversity, competition and facilitation. The important reason to grow two or more crops together is the increase in productivity per unit of land. Intercropping especially maize and legume, has been reported to enhance yield and yield stability (Willey, 1979), increase resource use efficiency, especially of nitrogen (Jensen, 1996), reduce weed infestation (Hauggaard-Nielsen et al., 2001) and the occurrence of plant diseases and pests (Altieri, 1999). Biological and cultural weed control is important components of Integrated Weed Management (Simi et al., 2004). Competition is the result of uptake of limited resources. By increasing crop seeding rate, and consequently crop plant density, the crop population as a whole will access an increasing amount of the available resources (Simi et al., 2012). Researchers are confronted with the complex problem of weed management by ecological means, giving due consideration to minimal use of chemicals with least disturbance to the environment (Kova evi and Momirovi , 2000). Weed management in intercropping, however, has hardly been studied to date (Altieri and Liebman, 1986; Banik et al., 2006,

Dimitrios et al., 2010; Jamshidi et al., 2013). The major objective of this study was therefore, to investigate the maize–soyabean intercropping system as a biological weed control measure on the slightly calcareous chernozemin in the vicinity of Belgrade, Serbia.

Materials and methods

The experiment was established according to a randomized complete block design plan with four replications on the experimental field of Maize Research Institute in Zemun Polje, Serbia. The experiment was done during the 2011 and 2012 growing seasons on the chernozem soil type. The size of the experimental plots was 16,80 m^2. The sowing time was May 11th 2011 and 2012. Red maize ZP Rumenka cultivar (FAO 700 group of maturity) and black soyabean, cultivar Dukat from maturity group 0 were included in the experiment. The intercrops were created according to the method of replacement series. Two different spatial designs were applied: the sowing of maize and soybean in strips or alternate rows. The intercrop treatments consisted of each maize alone (six rows) or soybean alone (six rows), and two mixtures: 3 rows of maize and 3 rows of soyabean in strips, 3 rows of maize and 3 rows of soyabean in alternated rows. Maize was planted in rows 70 cm apart and within-row spacing of 22 cm in pure stands and for soyabean spacing was 70 cm inter-row and 3 cm within-row spacing. Within-row spacing in mixtures was the same as in the sole crops. The basic tillage was done in autumn at the depth of 25 cm, and spring soil preparation 10 to 15 days prior to planting. Two hand inter-row cultivations were done on all plots.

The treatments of fertilization consisted of following variants: mineral fertilizer AN (ammonium-nitrate 34,4% N) in amount of 75 kg/ha N, organic fertilizer under the trade name "Royal Bio-Humus Offert" in amount of 3t/ha was applied just before basic tillage (pH 8, 2,1% N, 3,6% P_2O_5, 2,2% K_2O), microbiological fertilizer Uniker in amount of 10 l/ha. Uniker is microbiological fertilizer witch consisted of following strains of bacteria: *Bacillus megaterium, Bacillus lichenioirmis i Bacillus suptilis.* It is applied by incorporation into soil prior to sowing, in order to improve soil microbiological activity and increase mineralization of organic matter. The forth treatment was control with no fertilizer.

The weed samples were collected on June in both seasons. Weed samples were taken with two 0.25 m^2 quadrants placed in the middle of the each plot. Whole biomass of weed plants was recorded after uprooting weeds manually from randomly selected two places with a 0.25 m^2 quadrant measuring per elementary plot. The samples were dried at 70 °C to constant weight and dry matter production was determined. Data was analyzed statistically using analysis of variance and LSD$_{0.05}$ were used for comparison, when main effects or interactions were statistically significant.

Results and discussion

Meteorological data on the experimental field during two years of trial are shown in figure 1. The data shows better meteorological conditions in first year of this experiment. This year is characterized by small amounts of rainfall (annual sum was 488 mm) specially in April and August. Annual temperature mean 13,5^{o}C was significantly higher than long term temperature mean for Zemun Polje. Relatively high average monthly air temperature was in July and August 24.1^{o}C and 24,7^{o}C, respectively. The second year of experiment 2012 had significantly small amount and bad rainfall distribution compared with first year. Long term severe drought is appeared from June to September and caused very significant decrease of maize yield. Regarding temperature conditions in this period, extremely high temperature means is recorded in June (24,6^{o}C), July (27,1^{o}C) and August, (26,2^{o}C).
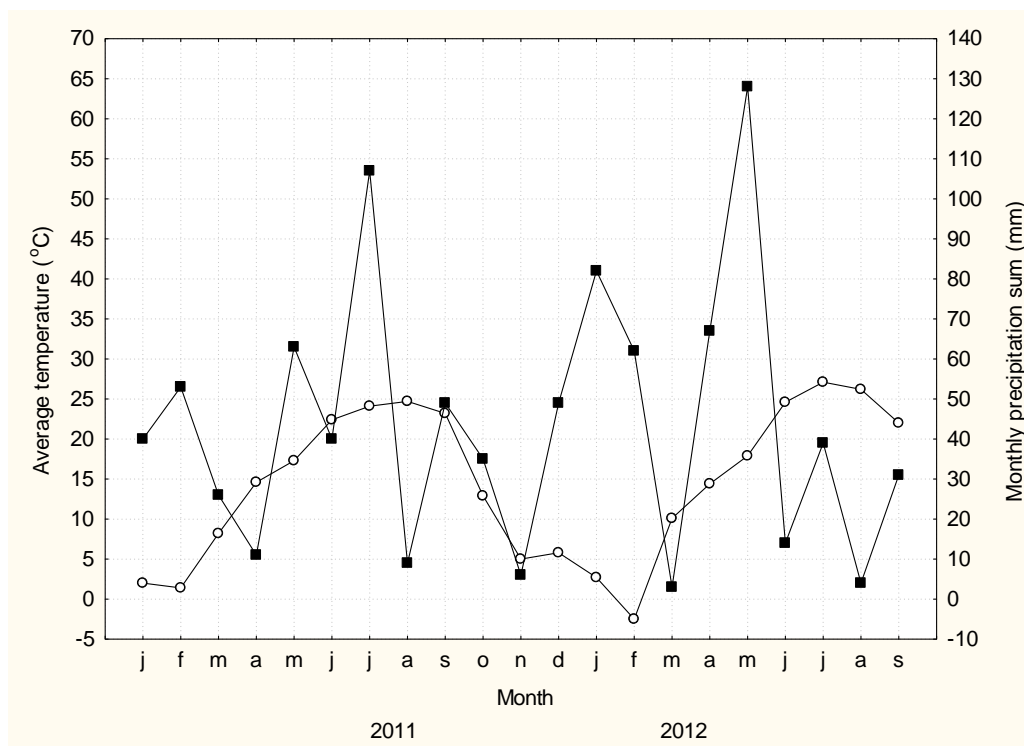
Figure 1. Climate diagram for meteorological conditions in Belgrade for 2011 and 2012

Table 1. Effects of intercropping pattern and fertilizers on weedines of red maize-black soyabean intercropping system (2011-2012)

Weed parameters	Intercrop									
	A_1					A_2				
	B_1	B_2	B_3	B_4	Aver.	B_1	B_2	B_3	B_4	Aver.
Number of weed species	8 [a]	9 [a]	12 [b]	11 [b]	**10**	9 [a]	10 [a]	10 [a]	12 [b]	**10**
Number of weeds (plants/m^2)	42 [a]	40 [a]	75 [b]	47 [a]	**51**	45 [a]	43 [a]	76 [b]	49 [a]	**53**
Weed fresh biomass (g)	356 [a]	532 [b]	481 [a]	815 [b]	**546**	445 [a]	492 [b]	487 [a]	842 [b]	**566**
Dry biomass (g)	69 [a]	104 [b]	74 [a]	157 [b]	**101**	85 [a]	99 [b]	86 [a]	167 [b]	**109**
	Maize			**Monocrop**			**Soyabean**			
Number of weed species	7 [a]	9 [a]	12 [b]	9 [a]	**9**	9 [a]	12 [b]	10 [a]	10 [a]	**10**
Number of weeds (plants/m^2)	46 [a]	44 [a]	75 [b]	51 [a]	**54**	44 [a]	42 [a]	75 [b]	54 [a]	**53**
Weed fresh biomass (g)	404 [a]	753 [b]	567 [a]	688 [b]	**603**	430 [a]	613 [b]	495 [a]	848 [b]	**596**
Dry biomass (g)	82 [a]	139 [b]	94 [a]	126 [b]	**110**	80 [a]	118 [b]	91 [a]	191 [b]	**120**

A_1-alternate rows, A_2- strips; B_1-control, B_2-mineral fertilizer, B_3-organic fertilizer, B_4-microbiological fertilizer

Means in columns followed by the same letter are not significantly different according to *LSD* values ($P = 0.05$)

The weed community was composed of a relatively small number of weed species – 9 (maize) and 10 (soyabean) in monocrops and 10 in both variants of intercrops. The dominant species in the maize weed community in the investigated field were *Cynodon dactylon* L., *Datura stramonium* L. and *Abutilon theophrasti* Medik. in 2011 and *Sorghum chalepense* L., *Solanum nigrum* L., *Chenopodium hybridum* L. and Abutilon *theophrasti* Medik. in 2012. Number of weed species has not much fluctuated depends of the cropping system but in the treatment with organic and microbiological fertilizer we recorded the most number of weeds (12). Significantly the highest weed density (76 plants/m^2) was in the treatment with organic fertilizer both in intercrop and monocrop variants (Table 1). The weed biomass changed in dependence of the arrangement pattern of maize and soyabean plants. Average fresh weed biomass was significantly lower in intercropping system, especially in alternate rows variants (546 g), than in sole maize variant (603 g). The highest fresh weed biomass was in soyabean monocrop in the treatment with microbiological fertilizer (848 g). Significantly higher fresh weed biomass was recorded in variants with microbiological (in intercrop and soyabean monocrop) and organic fertilizer in maize monocrop variants then in control or mineral fertilizer plots. In both, alternate rows and strips, application of microbial fertilizer increased the fresh biomass of weeds almost twice in comparison to other treatments. Results of dry biomass of weeds followed the trend of the results of fresh weed biomass (Table 1).

According to the results of Dolijanovi et al. (2011) number of weed species, weed plants and especially higher values in the fresh weight of weeds recorded in the strip in relation to the alternate rows of maize-soyabean intercropping system. Thus, the intercropping system in alternate rows is more favourable in terms of reducing the number of species, number of individuals, especially in terms of fresh weight of weeds. These results are in accordance with results in our paper. In maize–legume intercrops the decrease in available light for weeds led to a reduction of weed density and dry matter, compared to sole crops. Intercropping maize and legumes considerably reduced the weed density in the intercrop compared with the maize pure stand. (Dimitrios et al,2010). Results presented by Jamshidi et al. (2013) [showed] that increasing the maize density from 7.5 to 9 plants/m^2 reduced the weed biomass by 21.5%. Furthermore, cowpea acted as living mulch, reducing weed biomass by up to 45.5% and 39.6% when intercropped with maize at a density of 7.5 and 9 plants/m^2, respectively. Field experiments carried out at two sites in Denmark over three consecutive cropping seasons showed that intercropping system of cereals and grain legumes gave higher yields, less weeds, lower infection with plant diseases and higher grain quality compared to corresponding sole crops (Hauggaard-Nielsen et al., 2001).

Conclusion

Based on results obtained on the effects of the intercropping pattern and fertilizers on weed infestation of intercrops and monocrops of maize and soyabean the following can be concluded. The intercropping system in alternate rows expressed greater efficiency in weed control (number of species, number of plants per m^2 and weed biomass) in comparison to both, the intercropping system in strips and maize monocrops. Significantly the highest weed density was in the treatment with organic fertilizer both in intercrop and monocrop variants. Higher weed biomass was recorded in variants with microbiological and organic fertilizer in intercrop and monocrop variants in both crops then in control or mineral fertilizer plots.

Results of this study have several implications on weed management in maize –soyabean intercropping production. The potential decreases in weed biomass and increases in crop grain yield have led many producers to consider using enhanced arrangement patterns, aspiring, first of all, to decrease the between-row distance. Weed infestation level could be lowered if crop is grown with increased spatial uniformity and combined application of other practices.

Our results indicate that intercropping could be useful for weed suppression in organic row-crops such as maize and soyabean.

Acknowledgement

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THE EFFECTS OF DIFFERENT COVER CROPS ON YIELD AND YIELD COMPONENTS OF SWEET MAIZE

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Abstract

The objective of the study was to determine the effect of different winter grown cover crops and legume-cereal based mixtures on yield of sweet maize. Growing fall sown cover crops is an approach for environmental protection trough decreasing weed populations and increasing grain yield of sweet maize. The experiment includes two control treatments: dead organic mulch - soil covered with straw in autumn and winter time, and conventional (traditional) variant – bare soil uncovered during fall and winter time. Sweet corn was grown on slightly calcareous chernozem (locality Zemun Polje) after winter wheat as a previous crop. The experiment was in factorial setting with two factors (growing season - 2010/11 and 2012/13 and cropping system) the factor in RCBD with four replicates (the basic plot 16.8 m^2).
Along legume species, favorable effect on grain yield of sweet maize had been recorded on winter hairy vetch, as well on a kind of non-legume species based organic mulch. Depending on the treatment, yields of sweet corn in 2011 were from 8.09 t ha^{-1} (conventional system) to 10.00 t ha^{-1} (organic mulch), and 7.80 to 10.20 t ha^{-1} in the year 2013.

Key words: *cover crops; sweet maize; yield components; grain yield.*

Introduction

Unlike the standard hybrids of maize in which they conducted extensive research on the impact of different agricultural practices on yield (Khaldun et al., 2010; Tonk et al., 2011), growing conditions on yield and yield components (Beyene et al., 2011) and the effect of intercropping with other species (O'Leari and Smith, 1999) the results of investigation for grain yield of sweet maize are quite scarce (Bachireddy et al., 1992, Haas and Haas, 2009). The situation is such, not only in relation to standard hybrids of maize, but also in relation to other types of vegetables, most likely due to the very low economic importance of this crop. Sweet maize is a crop with much shorter vegetation period, in which it is very sensitive to the weather conditions, especially during germination and emergence as compared to the other subspecies of maize. The optimum time of sowing or planting could last longer, because of the possibility of growing this subspecies also from seedlings. Growing sweet maize from seedlings with cover crops significantly shortens the growing period (Orosz, 2013), but in years with pronounced drought without irrigation it is very difficult to practice this growing technology. Particularly are unfavorable very high air temperatures and lack of precipitation during and immediately after transplanting. Early sowing is also recommended by Aldrich (1970) for the reason that the roots will penetrate deeper in the soil this way, from where they can get water even in periods of drought. The more intensive vegetative growth also takes place during the period of shorter daytime and this way the plants will be smaller and will be less prone to lodge. Several techniques are known in the art for the purpose of early fresh market shipments: seedling growing or direct seeding with temporary plant cover (Hodossi, 2004 cit. Orosz, 2013). Some of the ways to mitigate the negative effects of later sowing are

sowing in optimum densities and growing of cover crops which soothe the effects of drought by the decreases of weed infestation and keeping moisture reserves. Sowing in optimum densities of some dwarf cultivars can give 3-4 ears per plant, but generally the number of ears in our conditions should be 1-2. Sweet maize likes warm weather, but for proper growth it needs a lot of moisture and it is an important way of irrigation. The worst results are obtained by artificial irrigation rain, because in the beginning they increased the number of fungal infections and pests, and at the time of pollination and fertilization could lead to a lack of pollen or its fertility. Productivity of sweet maize is quite dependent on the amount of nitrogen, whereas it is recommended every three to six weeks to add a certain amount of nutrients.

Previous studies of sweet maize were mainly focused on the sensitivity of yield to drought, especially in specific phases of the crop (Claassen and Shaw, 1970; Swan et al., 1990, Orosz, 2013). Sweet maize is different from the common maize in many important aspects, in particular by traits taste. The traits that affect the appearance of kernels and the normal appearance (condition) of kernels after cutting, as well as, the kernel colour, width and depth, are the most important properties of sweet maize hybrids that are used for industrial processing, i.e. for kernel cutting (Pajic and Radosavljevic, 1987). The sweet maize plant habitus is shorter and poorly developed. As maize hybrids of standard grain quality, these hybrids have a smaller or greater leaf area, depending on a hybrid, hence they differently response to a sowing density (Morris et al., 2000; Rangarajan et al., 2000; Simic and Stefanovic, 2007). Factors driving yield loss varied among sweet maize hybrids - more competitive hybrids established canopy dominance, restrained weed growth and experienced less yield loss (Williams et al., 2008).

Having in mind the above facts, the aim of this study was to determine the effect of different cover crops to the reduction of weed infestation and keeping moisture reserves for the period when there is not enough in soil, and the effects on yield of grain and yield components of sweet maize hybrid grown from transplants (2011 year) and direct sowing of seeds (2013) on chernozem soil type in Zemun Polje.

Materials and methods

The experiment have included two kinds of winter cover crops in the *Fabaceae* family, a variant in which soil was covered with dead organic mulch and traditional, classical variant: plowing in the fall and bare soil which was left uncovered during the winter time. Investigated types of winter legumes were common vetch and hairy vetch and its mixture with oats, all varieties originated from Novi Sad Institute for Field Crops and Vegetables (Neoplanta, NS Vilosa and NS Jadar). Crops were grown in rain-fed conditions.

Field experiments were conducted in 2010/11 and 2012/13 at Maize Research Institute, Zemun Polje, in the vicinity of Belgrade in Serbia (44°52'N 20°20'E). The soil was slightly calcareous chernozem with 47% clay and silt and 53% sand. The soil properties in a surface layer (0-30 cm) were: 3.22% organic matter, 0.19% total N, 1.9% organic C, 16.2 and 22.4 mg per 100 g soil of available P and extractable K, respectively, 1.38% total $CaCO_3$ and pH 7.3. Eventhough experiments were located in different fields in each year, the winter wheat was the previous crop. Considering both plant nutrition and nitrogen fixation in legumes, we came up to the required amount of macronutrients for sweet maize (120 kg ha^{-1} N, 90 kg ha^{-1} P_2O_5 and 60 kg ha^{-1} K_2O). In the fall, before planting of cover crops we have entered the entire amount of P and K in the form of monopotassium phosphate and 50 kg ha^{-1} N in the form of ammonium nitrate, and on the two control variants, also all of P_2O_5 i K_2O and 40 kg ha^{-1} N in the form of AN. In the spring time (April 07 2011 and April 19 2013) on a leguminous cover crops we have added another 30 kg ha^{-1} N in the form of AN (the remaining 40 kg ha^{-1} considered to have provided by nitrogen fixation), and control plots another 80 kg ha^{-1} N, also

in the form of AN. The experimental plots were ploughed in autumn, followed by one pass of a disk harrow and a field cultivator prior to sowing.

Sowing of cover crops was carried out manually, on October 10-th, 2010 and November 02-nd, 2012. Cutting and measuring the above-ground biomass of cover crops was performed 7-10 days before planting of sweet maize. Planting of the main crop, after the production of seedlings, was done on May 26-th, 2011, and direct sowing on April 25-th, 2013. Crops were harvested aproximatelly 22-24 days after pollination. In 2011. harvesting was performed on August 18. while in the year 2013. it was done on August 06.-th at the milky stage of kernel maturity which is considered optimal technological maturity.

Experimental design

The plant stand was created to contain 65.000 plants per hectare, according to the recommendations of the breeder of the variety, at a spacing of 70x22 cm in twin rows. Each plot consisted an area of 2,8x6m (4 parallel rows and 27 seeds sown in each row). Sowing depth was 3 cm. The new Zemun Polje (ZP) sweet maize hybrid in FAO 400 maturity group ZP 424su was grown. This hybrid belongs to a short season maize hybrids and it was evident that its yield increased continuosly up to the highest sowing density. In other hybrids, the higher sowing density was reflected with lower yield (Paji and Radosavljevi , 1987).

Measurements and statistical analysis

Ears were harvested together with the husks, from the two central twin rows, 25 days after silking. Ten ears were selected from each row and the following measurements were carried out: weight of husked ears (g), total ear length (cm) and ear diameter (mm). The grain yield and yield components data were underwent to ANOVA for the factorial trials design according to the plan for two years, six variants, and differences between means were tested by the least significant difference (LSD) test (Gomez and Gomez, 1984).

Meteorological conditions in the period of investigations

Table 1. The average monthly air temperatures and monthly precipitation sums from April to September at Zemun Polje

Months	Temperature (°C)		Precipitation (mm)	
	2011	2013	2011	2013
April	14,6	14,9	11	22
May	17,3	19,8	63	104
June	22,4	21,7	40	49
July	24,1	24,1	107	3
August	24,7	25,4	9	44
September	23,2	17,3	49	59
Average/Sum	**21,1**	**20,5**	**279**	**281**

The meteorological conditions during the maize growing season were presented in the Table 1. The weather conditions, especially in the first investigated year were extremely unfavorable. Regarding precipitation in 2013 their distribution was, as well in 2011 quite unfavorable, but the average air temperature for the growing period of sweet maize was significantly lower than in the first year. This fact did not have a positive impact on the growth and development of the main crop, we cannot say for sure, because in this year, maize was grown by direct sowing seeds in the field.

Results and discussion

Grain yield results and yield components data of sweet maize for the analyzed samples have presented in Table 2. By growing sweet maize from transplants, the length of the growing season in the first year of the experiment was 83 days, while in the second year of this study, when the main crop was grown by direct sowing, the length of the season was 90 days. With the first method of growing by transplanting small plug plants, cover crops had longer vegetation period, which was quiet preferable in terms of increasing organic matter in the soil, less weed infestation of main crop, and acquiring certain reserves of soil moisture, etc. Furthermore, much faster maturity of sweet maize in the first year of our study, certainly was contributed by severe drought during August (Table 1). From the aspect of the length of growing period, the priority should be given to this type of cultivation, but increased risk under rain-fed conditions, due to the lack of potential precipitation immediately after planting bring in certain limits. Orosz (2013) have emphisized that the growing period was significantly shortened with the transplantation of sweet corn youngplants compared to thd direct seeded crop. Harvesting time occurred 17 days earlier in the case of transplantation and floating row cover application compared to direct sowed, uncovered treatment, and 13 days earlier compared to direct sowed, covered treatment. At the same time the floating row cover produce 4 days shortening in the growing season between P2 (direct sowing of plants with floating row cover) and P3 (direct sowing of plants with no row cover) treatments. The fleece covering had favourable effect on studied morphological characteristics of plants that are transplanted and floated with row cover. In case of direct sowed treatment (P2) the effect of covering had positive effect on total diameter of ears, number of seeds and length of seeds. In our research, studied yield components of sweet maize had a higher value if the crop is grown from seedlings. On the other hand, Dolijanovi et al., 2012 stated that because of the extreme conditions of drought and high temperatures in the growing season 2012.-th there was a crop failure. Therefore, in 2013 we have changed method of growing, switching to a direct sowing of seeds.

Tab. 2. The cropping system effects on yield components and grain yield of sweet maize

Cropping system	Weight of husked ears (g)		Total ear length (cm)		Ear diameter (mm)		Yield of grain (t ha^{-1})	
	2011	2013	2011	2013	2011	2013	2011[**]	2013
Common vetch	178^c	176^c	16,3^b	16,2^{ab}	34,3^{cd}	34,1^{bc}	8,84^b	8,71^b
Hairy vetch	184^b	183^b	16,4^b	16,2^{ab}	34,7^c	34,4^b	9,98^a	9,17^b
Common vetch+oats	181^b	183^b	16,0^{bc}	15,8^c	34,5^c	34,5^b	8,72^b	8,12^b
Hairy vetch+oats	187^a	185^b	16,6^b	16,4^{ab}	35,1^b	34,9^a	8,61^b	7,97^c
Organic mulch	188^a	190^a	17,1^a	16,7^a	35,5^a	35,0^a	10,00^a	10,20^a
Conventional system	174^d	171^d	15,9^c	15,6^c	34,0^{cd}	33,9^c	8,09^c	7,80^c
Average	**182,0**	**181,3**	**16,4**	**16,2**	**34,7**	**34,5**	**9,05**	**8,66**

Values of means followed by the same letter are not significant;

As well as yield components, grain yield in the second year of examined period was lower than in the first one, the year 2011. Grain yield in the second year (10.20 t ha^{-1}) compared to the yield in the first year of investigation (10.00 t ha^{-1}) was higher only in the variant "dead mulch"- straw and the reason was hidden in the fact that such cover laid down shorter in the soil surface, it was not completely decomposed and thus prevented a complete waste of the reserves of moisture and intense occurrence of weeds in the spring.

The lowest yield was obtained following the traditional cultivation (8.09 t ha^{-1} and 7.80 t ha^{-1}). In addition, at least achieved yields probably the balance of nitrogen in the soil after harvest, at least, will be a subject of a subsequent paper. The yield of sweet maize achieved in this study was below average yields in similar experiments (Dolijanovi et al., 2012, 2013;

Simi et al., 2012), and the main reason was the way of growing. Between two of investigated vetch species which was grown as cover crops, both as a sole crop or in mixture with oats, the favorable effect on grain yield of the main crop have had with hairy vetch in both years and in both methods of growing.

Conclusion

According to the presented results of two-year studies on the response of ZP sweet maize hybrids to different growing methods under agroecological conditions of Zemun Polje, the following can be concluded:

The observed traits of sweet maize (weight of husked ears, total ear length, ear diameter and grain of yield) significantly varied over the years. This means that the stated traits depends to a great extent on meteorological conditions and growing system.

The highest yield components and grain of yield of hybrid ZPSC 424su, for the average of both years, was recorded on the variant with organic mulch.

Generally speaking, growing of cover crops consisting legumes or mixtures of legumes and grasses have an advantage over the conventional system of growing, both in terms of yield components and grain yield, but also in terms of the protection and conservation of agro-ecosystem, which is now a very important part of research in agriculture.

Acknowlegdement

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EVALUATION OF COMBINING ABILITIES OF ZP INBRED LINES

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Abstract

In this study fifteen mothers, two fathers and their thirty hybrids were tested in order to evaluate their general and specific combining abilities (GCA and SCA). Mothers were pooled from three different sources (A, B and C) with five inbreds per source. Trials were set on location ZemunPolje in 2010 and 2011. Method choosen for evaluation of combining abilities was Line x tester method by Singh and Chaundary (1976). Other than GCA and SCA, trials were set in order to estimate components of genetic variance. The results of grain yield and variances of GCA and SCA discovered that there is high heterosis present within tested material. Source A proved to be the best source of good combiners, considering the fact that four of five inbreds in 2010 had significantly positive GCA values, A1 (1.76**), A2 (1.35**), A3 (1.35**), A4 (1.25**). Positive GCA values were found in 2011 in all source A inbreds, except A1 (-0.10) which had low negative GCA value, proving it's trend towards good combining abilities in different conditions. Concerning significantly positive SCA values, they were all created by crossing two opposite GCA combiners (crossing positive with negative general combiner), leading to a conclusion that negative GCA inbreds should not be discarded, since they know to create excellent hybrids. Ratio of GCA/SCA of 0.0925 in 2010 and 0.0188 in 2011 showed value far less than unity, stating that non-additive variance was far more predominant in inheritance of grain yield.

Key words: *maize, combining abilities, inbred × tester analysis*

Introduction

Maize represents one the most important agricultural species in the world. It's multiple usage and purpose as a food and as industrial raw material confirms the fact that it's significance is growing together with a area sown by this crop (Jockovi et al., 2011).Agricultural area, suitable for maize production is limited, even though it is growing, the best way to improve maize production is to increase grain yield per unit area. Increasing grain yield per unit area is capable through complex of good rearing technique and usage of high yielding hybrids.

The basis of creating new high yielding hybrids lies in capability of recognising good inbred lines-material, whose combining abilities satisfy breeders goal. Method of evaluation of combining abilities have been first represented by Sprague and Tatum (1942), who defined combining abilities as general and specific combining abilities (GCA and SCA), where GCA is used to indicate an average performance of the inbreds in hybrid combinations, while SCA was used to point out cases in which performed combinations had been better or worse than expected according to the average performances of inbreds included into such combinations. Other than Sprague and Tatum (1942), Griffing (1956), Falconer (1960) determined that GCA was result of an additive genetic variance, while SCA was result of non-additive genetic variance (dominance and epistasis). Throught XX century a number of statistical methods have been made in the course of determination of combining abilities, e.g. diallel, top-cross, polly-cross and line x tester method. Diallel method is the most reliable one, but lacks when it

comes to appliance of the model in the case of evaluation of greater number of inbreds, where the costs and manual work increase significantly (Pataki, 2010). In the case of examination of higher number of inbreds, best way to to do that is to use line x tester method. Line x tester method was first presented by Kemthorne in (1957), but was adapted by Singh and Chondary (1977). This model represents case where numbers of inbreds are crossed to more than one tester, giving half-sib and full sub-offspring, allowing calculation of GCA and SCA. Atanaw et al. (2003), Shiri et all. (2010), Abuali et al. (2012), Meseka and Ishaaq (2012) obtained in their research through line x tester analysis of maize, that non-aditive variance is predominant in inheritance of grain yield. Analysis of combining abilities of the heterozygous genetic material (populations and varietes) showed additive variance was more important than non-additive for inheritance of grain yield (Van etovi , 1992; Deli ,1993). On the other hand Atanaw et al. (2003) and Živanovi et al. (2005) obtained significant SCA values by crossing one positive with one negative general combiner. Iqbal et al. (2007) obtained significant SCA cvalues by crossing negative to negative, and positive to positive combiners. Shiri et al. (2010) menaged to get significant SCA values by crossing negative with negative, pozitive with positive and positive with negative general combiner. The importance of accurate and fast evaluation of combining abilities is of the biggest importance for maize breeder, since it gives true background of value of used material. The aim of this study was to test materials combining abilities.

Materials and methods

In this study 17 inbred lines were used, 15 mothers and 2 testers. 15 mothers come from three genetic sources (five per source) A, B and C. Source A represents inbreds pulled out of selfed hybrid, source B represents inbreds derived from crossing public inbred lines B 14 and B 84, while third source C represents inbred lines obtained from crossing public inbred line B 14 to African germplazm, since Maize Research Institute "ZemunPolje" worked for years on maize winter generation in Zambia.

Two testers are elite inbred lines marked as Z1 and Z2 of Lancaster Sure Crop background, the difference is that Z1 is maturity group FAO 400 and Z2 FAO 600. These testers represent father components in number of commercial ZP hybrids ZP 341, ZP 454, ZP 600, ZP 606 and ZP 684. Maturity group of mothers are next: lines from source A represent maturity group FAO 600, lines from source B represent FAO 500 and lines are from source C maturity group FAO 400. Field trials were set in two repetitions in random block design on location "ZemunPolje" in 2010 and 2011. Plot size per genotype was 6 m^2. The yield was calculated in tonnes per hectar (t/ha) at grain moisture of 14%.

Planting and sawing were done by hand. All calculations were done in Excel by statistical approach Line x tester analysis (Singh and Chondary, 1977). Since this statistical approach does not include year x location interaction, every location was discussed separately.

Planting and harvest were done by hand. This experiment was set in order to evaluate combining abilities of 15 mothers.

Results and discussion

Results of grain yield and GCA of used parents (mothers and fathers) are presented in Table 1. The highest yielding mothers in 2010 was B1 obtaining 7.5 t/ha, other than that inbreds C4 achieved 6.7 t/ha, while B3 and C3 reached 6.4 t/ha. Mothers from source A showed highly significant GCA results, i.e. A1 (1.76**), A2 (1.35**), A3 (1.35**), A4 (1.25**). Only two more mothers showed positive but insignificant values, A5 (0.64) and B1 (0.67), while all others were negative. 2011 year was slightly different concerning results of grain yield and GCA. From the point of average yield it was lower with 5.2 t/ha, but still very good high yielding inbreds were found including B4 (6.8 t/ha), B3 (6.1 t/ha) and C3 (6.8 t/ha). The only inbreds that showed significant positive GCA values were A3 (1.06*) and C4 (1.20*). All

other mothers from source A had positive GCA, only inbred A3 had barely negative and insignificant GCA (-0.10). Comparing the results between two years, it can be seen that only one inbred line A3 has managed to have significant positive GCA value both years, while A2, A4 also had positive GCA values, but insignificant values. Inbred A1 even had negative GCA value in 2011. Looking from the point of absolute values inbreds B3, C3 and C4 had above average, stable and high yields in both years.

Table 1. Grain yield and GCA values for inbred lines and testers for grain yield

Genotype	2010		2011	
	Grain yield	GCA	Grain yield	GCA
A1	6.0	1.76**	4.6	-0.10
A2	5.2	1.35**	5.4	0.75
A3	4.3	1.30**	5.4	1.06*
A4	6.3	1.25**	4.3	0.43
A5	4.2	0.64	3.6	0.62
B1	7.5	0.67	5.3	0.52
B2	6.4	-0.89*	5.7	-0.80
B3	6.1	-0.33	6.1	-0.01
B4	6.1	-0.32	6.8	-0.99*
B5	5.1	-0.53	3.8	-1.62**
C1	5.3	-0.96*	5.6	-0.16
C2	6.0	-0.49	5.0	0.02
C3	6.4	-0.69	6.8	0.54
C4	6.7	-1.61**	6.3	1.20*
C5	5.7	-1.17**	3.3	-1.47**
Z1	5.2	-1.05**	4.3	-0.31
Z2	7.4	1.05**	5.5	0.31
Average	5.9	-	5.2	-
LSD inbreds 0.05	-	0.747	-	0.937
LSD inbreds 0.01	-	0.998	-	1.251
LSD testers 0.05	-	0.273	-	0.342
LSD testers 0.01	-	0.364	-	0.457

The three highest yielders in 2010th year were A4 × Z2 (14.4 t/ha), A2 × Z2 (13.7 t/ha) and A3 × Z1 (13.2 t/ha), while two combinations in 2010th year had highly significant positive SCA values, A3 × Z1 (1.43**) and A5 × Z1 (1.55**). Mother A3 had not only high grain yield but also great SCA value, that was made by crossing opposite general combiners. The second hybrid A5 × Z1 was also made by crossing opposite general combiners.

In 2011th three highest yielders were C4 × Z1 (13.6 t/ha), B3 × Z2 (13.4 t/ha) and A3 × Z2 (13.3 t/ha), where B3 × Z2 only had significantly positive SCA value of 1.35*. The second hybrid that had significantly positive SCA values was C5 × Z2 (1.39*). Both significantly postitive positive SCA combiners were created by crossing two oposite GCA combiners.

Comparing the results between two years, it can be concluded that combining two opposite general combiners gives high significant SCA values, which is in accordance with Atanaw et all. (2003) and Živanovi et all. (2005), but opposite to Iqbal et all. (2007) and Shiri et all. (2010). Concerning the way of obtaning high SCA values, during the breeding process breeder should careful with discarding negative GCA combiners. Such a statment is in accordance with Živanovi et all. (2010), who in his research concluded that material with negative GCA values should be kept, because they sometimes create excellent hybrid combinations. Non of the hybrids menaged to have significantly positive SCA value in both

years. Only hybrids A5 × Z1, B3 × Z2 and C5 × Z2 had positive SCA values in both years, but significantly positive in only one year.

Table 2.Grain yield and SCA values for hybrids for grain yield

Genotype	2010		2011	
	Grain yield	SCA	Grain yield	SCA
A1 × Z1	12.1	-0.10	11.6	0.27
A2 × Z1	12.0	0.21	13.1	0.90
A3 × Z1	13.2	1.43**	12.3	-0.21
A4 × Z1	11.1	-0.59	12.9	1.02
A5 × Z1	12.6	1.55**	12.2	0.09
B1 × Z1	11.9	0.78	12.3	0.34
B2 × Z1	9.9	0.35	10.8	0.12
B3 × Z1	9.5	-0.63	10.1	-1.35*
B4 × Z1	9.5	-0.61	10.6	0.09
B5 × Z1	9.5	-0.38	9.6	-0.20
C1 × Z1	9.2	-0.28	10.6	-0.72
C2 × Z1	9.9	-0.08	11.2	-0.30
C3 × Z1	9.0	-0.78	12.3	0.35
C4 × Z1	8.7	-0.17	13.6	0.99
C5 × Z1	8.6	-0.70	8.6	-1.39*
A1 × Z2	14.4	0.10	11.7	-0.27
A2 × Z2	13.7	-0.21	11.9	-0.90
A3 × Z2	12.4	-1.43**	13.3	0.21
A4 × Z2	14.4	0.59	11.5	-1.02
A5 × Z2	11.6	-1.55**	12.6	-0.09
B1 × Z2	12.5	-0.78	12.2	-0.34
B2 × Z2	11.3	-0.35	11.2	-0.12
B3 × Z2	12.8	0.63	13.4	1.35*
B4 × Z2	12.8	0.61	11.0	-0.09
B5 × Z2	12.4	0.38	10.7	0.20
C1 × Z2	11.9	0.28	12.6	0.72
C2 × Z2	12.1	0.08	12.4	0.30
C3 × Z2	12.6	0.78	12.3	-0.35
C4 × Z2	11.1	0.17	12.3	-0.99
C5 × Z2	12.1	0.70	12.0	1.39*
Average	11.5	-	11.8	-
LSD 0.05	-	1.057	-	1.325
LSD 0.01	-	1.411	-	1.769

Results in Table 3. show relation of GCA and SCA variances. Their relation discovers true nature of crossed parents. The values of GCA/SCA of 0.0925 in 2010 and 0.0188 in 2011 showed far less value than unity, stating that non-additive variance was predominant in inheritance of grain yield. Same results were gained by Atanaw et al. (2003), Živanovi et al. (2005; 2010), Shiri et al. (2010).

Table 3. Components of genetic variance for grain yield

	ZemunPolje - 2010	ZemunPolje - 2011
Additive variance Va(F=1) GCA variance	0.0758	0.0123
Dominant variance Vd(F=1) SCA variance	0.8184	0.6557
GCA/SCA	0.0925	0.0188

Conclusion

It can be concluded that A source has the best promising combiners. Inbreds A1, A2, A3 and A4 had the best GCA values. In hybrid combinations good SCA values were gained with mothers A3, A5, B3 i C5. Mentioned mothers represent the best recommendation for further work in maize breeding. Results of grain yield and components of genetic variance showed the existence of high heterozis between used parents, which is basis for creation of high yielding hybrids.

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WHEAT VARIETY SPECIFIC AT ONCE PROTECTION OF PARASITES AND PESTS BY PESTICIDES

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Abstract

Enzymatic relist of S, P or Cl from gluten, dithiocarbamate, thiametoxam, and glyphosate by the products of genes for resistance to wheat leaf rust (Lr) was recognized across effect of consequential acids on chlorophyll. Nine wheat varieties were treated by aforementioned based pesticides at seedlings but these time infected by *Puccinia triticina* isolate. Assumed two last mentioned adequate sources result enhanced hypersensitive reaction or more prolonged the latency period. The Lr 29 in the variety Enigma accelerated degraded all pesticides except kresoxim methyl based while in varieties Simonida, Rapsodia or Tavita (Lr 1), NS 40S (Lr 3a), Metka or Gora (Lr 19) and Ilina (Lr 24) were effective to reaction type decrease when glyphosate dose was increased. Glyphosate was applied 3th while dithiocarbamate 5th June 2014th in field trial. Both pesticides reduced *Pucinia triticina* intensity and growth of *Septoria tritici*. Variety Pobeda exceptional by the difference in one week, application of sulphur containing herbicide with fungicide with fluorine and chlorine additional on C circle in March and sequenced by last mentioned elements ones late in April caused progressive yellowing during last decade of May. Behind the appearance were by heat stress viable Lr genes product, accumulated accelerate degradable residua adequate parasite and gluten. To facilitate of *Pyrenophora tritici repentis* toxin production, favour in reduction of leaf rust, application of herbicides containing S or P near heading while of neonicotinoides in the middle of grain filling appeared to be occasional economical multiple pests reducing solution focusing estimated specific Lr genes constellation.

Key words: *wheat integral protection, Lr genes*

Introduction

Grain yield potential in semiarid regions mostly below 6 t/ha made less space for aforementioned rentable efforts respecting the cost of one treatment approximately equal to 1 t of grain while of each sequenced were halved due to established permanent traces. The single late protection of wheat varieties against parasites when most frequented and damaging one was leaf rust causer was mostly not founded to be economical even when grain yields were stable over 7 t/ha. Expected losses by sustainable applied resistance to *Puccinia triticina* focusing assortment contemporary changes possibility were reduced by two also always present facultative parasites antagonism. Treatments late in grain filling and only when planed intermediate level of resistance achieved by distribution of different resistance genes to leaf rust cause was overcome in assortment part were recognized as economical only when *Pyrenophora tritici repentis* did not covered more than 10% at middle leaves (Jerkovic et al., 2012). Such interactions were for the first time involved in the forecasting model of final parasitic development and grain yield losses while simultaneous predicted was of variety specific time when should loss the green leaf area (Jerkovic et al., 2013a) necessary for of the particular pesticide last application period determination respecting residua. The effects of fungicides described to be excellent efficient to leaf rust reduction were also recognized as

very good or excellent in reducing of the antagonistic facultative parasites (Osborne and Stain, 2009) while currency period in semiarid region also determined Skerbot (2011). Discovered interactions between leaf rust resistance genes and various to pest specific efficient pesticides (Jerkovic et al., 2012a; Jerkovic et al., 2014) as well as their parasite free primary function to degrade gluten (Jerkovic et al., 2013; Jerkovic et al., 2013b) based expectation that some of them will be usable as practical solution respecting multiple effects on simultaneous present pests while hypothetical become negative effect when all factors were accumulated and viable. When focused were genetically modified wheat lines resistant to glyphosate (Castle et al., 2004) crossed with those containing effective Lr genes to parasite population homozygous products, triple interactions were described by Anderson and Kolmer (2006) while of external to plant factors ones were recognized by Huang at al. (2005). Former, confirmed was lower reaction type transformation from latency period when seedlings of leaf rust resistance genes containing near isogenic lines were treated with labelled dose of mentioned herbicide while related was to growth type controlled by accumulated nonspecific to parasites races resistance genes reducing infection efficacy trough facilitated drying of leaves upper parts (Jerkovic et al., 2014a).

However, the effects of investigated insecticides and fungicides on leaf rust reduction when interacted with responsible Lr genes for their accelerated degradations as well as consequences were not since evaluated trough preliminary effect on parasite development. Increased negative influence on growth by chlorophyll degradation also become hypothetical when residua were accumulated by sequenced treatments with adequate pesticides. Of fluorine containing ones were still not certain. Assuming possibilities facilitated by novel results and described wheat production circumstances in semiarid regions, the main aim of the study was to determine of variety specific occasional economically sustainable protection solution by pesticide.

Material end methods

The approximately 50 seeds of nine tested wheat varieties were sown in 2 dl of soil each in five replications and grown in the greenhouse during the May 2014th at air temperature around 20^oC. The infection by isolate of *Puccinia triticina* was six days after germinating while two days behind incubation in humid chamber lasting one day by hand sprayer (0,5 l) applied were 1dl of single pesticides solutions glyphosate (0,2 ml/m^2), thiametoxam, dithiocarbamate and strobilurine (0,1 ml or gr/m^2). The estimation of reaction types (Stakman et al., 1962) started seven days after incubation and was daily triple. The same varieties were sown in field trial at 6m^2 using such design that controls were 2 m distanced and parallel to treated varieties. All replications were treated by pendimethalin (5 kg/ha) at last decade of November as well as one of by glyphosate (0,5 l/ha) 3rd or dithiocarbamate (2 kg/ha) at 5th June 2014th. The attack intensity of *Puccinia triticina, Septoria tritici* and *Pyrenophora tritici repentis* was presented in percent of covered flag leaf area and estimated just before and ten days after treatments. On third replication grown nearby the attempted was total multi pest protection using simultaneous pesticides based on sulfonil-urea (25 gr/ha), fluoroxyryg (0,5 l/ha) and cyproconazole plus picoxystrobin (0,6 l/ha) at March 18th 2014th while these containing trifloxystrobine and cyproconazole (1 l/ha) and deltamethrin (0,3 l/ha) were applied at April 29th. The yellowing of the leaves was followed from the last decade of May as well as appearance of the *Puccinia triticina* spores at June 1th 2014th.

Results and discussion

The pesticides applied in lower doses of proposed except for glyphosate, previous such investigated, was relevant to facilitate recognition of interaction between genes for the resistance and various pesticides because when in labelled doses were applied differences were not recognizable (Jerkovic, unpublished data). Gluten formation in leaves in proposed

environmental conditions at seedlings was not expected by previous parasite free results. The doubled acid forming elements source from parasite isolate and dithiocarbamate based fungicide or thiometoxam insecticide decreased final RT at variety Enigma by Lr 29 on complete resistance level. Of the mentioned gene single presence was recognized by no enhanced resistance to parasite isolate and trough of these agent free interactions with glyphosate (Jerkovic et al., 2014b). Focusing prolonged LP for one day it was discovered that Lr 1 recognized in the varieties Simonida, Rapsodia and Tavita could cleave Cl from studied insecticide as well as some of S in dithiocarbamate, previous recognized only when Lr 16 or Lr 29 were present. The effect on variety Rapsodia was supported by nonspecific Lr genes accumulation and recognizable because of in May prolonged sunny periods. With no respect of Lr genes effect in variety sample someone could conclude that the strobilurin based fungicide in average had to be less preventive efficient than dithiocarbamate. Relative low entrance ability in leaves of the last mentioned pesticide was recognized by comparison to phtalamide, thiametoxam and thiaclopid based pesticides throw acid forming elements content while the practical problem was solved by increasing of labelled dose or by daily watering in the similar trial at seedlings (Jerkovic et al., 2012). Lr 20 and Lr 29 were most but different effective to thiamethoxam and thiacloprid residua degradation characterized by ringed C and N and additional Cl while the differences between genes responsible for degradation were related to approach ability defined by molecular weight of elements or units nearby accelerate relisted element. Using pesticides in decreased dose, protection by all of them become lousy without adequate Lr genes to parasite isolate confirming expected enhanced resistance of triple interactions. Much increased dose of glyphosate was LP prolonging for one while of labelled was for a half of day focusing variety Pobeda and linked to common herbicidal effect on obligate parasite development (Tab. 1).

Tab.1. Interactions of wheat varieties *Puccinia triticina* isolate and pesticides throw reaction type to parasite

Variety	K			Glyphosate			Dithiocarbamate			Thiametoxam			Kresoxim methyl		
Rapsodia	;1	4	4	0;	;			;	;		;	;	;	;1	;3
Simonida	;12	4	4	0;	;			;1	;2		;1	;1	;1	;2	;3
Tavita	;1	4	4	0;	;			;	3		;12	;3	;1	;3	;34
NS 40 S	34	4	4	0;	;		;3	;3	3	3	4	4	;23	;34	;34
Metka	34	34	4	;1	1			12	3	3	3	4	;12	34	4
Gora	34	4	4	;2	3			12	34	3	3	4	;12	4	4
Enigma	;1	3	34	0;	0;			;	;1		;	;N	;	;1	34
Ilina	34	4	4		;	;1		3	4	3	34	4	;34	34	4
Pobeda	4	4	4	;	3	4	4	4	4	4	4	4	4	4	4
Average maximal RT	3,95			0,94			2,28			2,44			2,61		

When fungicides characterized by tripled F linked to benzene CH ring, were sequential applied respecting proposed currency in spring, continual daily by rain wetting and decreased temperatures below 20 ^{0}C in second decade of May inhibited activity of Lr genes. During last decade at temperatures over 25 ^{0}C appeared daily continual, recognized were permanent progressive yellowing of the flag leaves relative less fast only et variety Ilina confirming Lr 24 product to be relative most hydrolytic instable. According to previous stated about, the effect of recently studied Lr genes on single fluorine linked to circle was not expected because

of linkage strength but on more of them directly associated was indicated. The result of formed HF acid was likely to be at last MgF_2 more hydrolytic stable of all previous discussed resulting salts from pesticides. The nitrogen acids were not founded to be stable at light (Ammann et al., 2005) while by introduction facilitated change of O with F in described circumstances solved their permanency problem by less amount of last involved element. By the pathway simultaneous was reduced fast chlorophyll recovering and of other proteins synthesis recognized when neonicotinoides were applied by no viable N trough more stable NH_4HF_2 formation reactive also to MgO expected when PDI enzymes were gluten formatting (Cumming et al., 2004) as well as of intermediate weighted elements oxidation and transformation to acids (Jolivett et al., 1992). When focused were three characters (cleaved linkage strength, hydrolytic stability and approach ability) of all discussed Lr genes accelerated degradation of external S from sulphonil-urea or Cl from fluoroxyryg was also predictable. Only at variety Pobeda recognized as of specific Lr genes free, the complete yellowing happened later in the second decade of June five days earlier than was expected by forecasting model and explained by continual even than previous stronger heath stress and of pesticides adequate energetic conditions for enzyme free hydrolytic degradation. Additionally recognized, early treatments by pesticides decreased SAGR (divided last two internodes with stem length) for 0,05 in average compared to untreated trial while appearance could be related to of herbicide effect on growth point also. Decreasing of those character value caused of *Puccinia triticina* increased infection severity (Jerkovic and Prijic, 2009). The fructification of leaf rust was also present indicating only of pesticide original active substance effect on haustorium, partially similar by structure (Harder and Chong, 1984). Related, the of benzene ring also structuring pendimethalin supported stripe rust early growth for approximately 20% in comparison to those trial when other herbicides were applied much later. Previous described, single treatments by tebuconazole containing single acid forming element (200 ml/ha) even in June were without yellowing consequences but not applicable in assortment respecting proposed currency period of one month recommended by Osborne and Stain (2009). Such, recognized yellowing of leaves was explained by simultaneous relist of acid forming elements from gluten, adequate accumulated pesticides residua and leaf rust fungi population to constellation of Lr genes distributed in the varieties respecting no such evidence in another trial when two pesticides were single later applied.

According to recognized additional nutrition by N units (Vurdue and Tonneyck, 1978) when S or Cl were not accelerate relisted by enzyme, N from ring of thiametoxam appeared to be liberated most likely by some of common proteases. Beside, while enzyme behind sulphur and magnesium from salt relist and accounted curative effect to the parasite strongly supported such solution vice versa of than expected increased gluten synthesis. However, practical adequacy of aforementioned forecasting model was increased by prolongation of period for treatment application. Of single late multi pest targeted treatments effect to obligate parasites was enhanced by variety specificity across adequate Lr genes for by both agents increased preventive effect on than low frequented leaf rust causer. If opposite by overcome of variety resistance, these yellowing factor was excluded, curative effect had to be dominant while respected currency period. By shortened time between treatment and green leaf area disappearing on two weeks in regions where average temperatures were continually below 25 ^{o}C even when resistance to *Puccinia triticina* was not overcome and Lr 20 and Lr 29 were present, could be facilitated protection from than often aphids at spike and prevented spreading of last generation of leaf rust.

When used was the herbicide with phosphorus or dithiocarbamate, similar reduction of *Septoria triticina* growth for 5% and leaf rust intensity for approximately 20% was recognized while confirmed not significant influence on *Pyrenophora tritici repentis* growth (Sharma and Pfender, 1989). Late treatment by glyphosate caused fast whitening of spike at all varieties

except Pobeda without genes for its accelerated degradation. Focusing spike in that period there was no temporary inactivated Lr genes during daily longer lasting heath stress while simultaneous gluten formation in glumes was obvious. The adequate temperature around 20 ^{0}C during drought period when Lr genes had to be activated even without parasite as was recognized at seedlings were often before heading in semiarid regions while of chlorophyll recovering ability was expected to be increased and treatment consequences less harmful. Recently achieved presence of *Puccinia triticina* isolate below 30% at first leaf of seedlings was same directed to activate Lr genes and founded not to be limiting factor while in focused period gluten formation was not expected. The essential of the effort was to eliminate of *Puccinia striiformis* and *Septoria tritici* growth and development and promote on upper leaves spreadable toxins produced by *Pyrenophora tritici repentis* when located on intermediate leaves at least 14 days before last decade of May. By recent results, suggested were further regional investigations focusing allowed residua amount in seed. The Lr 16, Lr 19 and Lr 29 were predicted to be such most restrictive when focused was glyphosate. When herbicides containing sulphur were such applied the risk had to be decreased while result was expected to be similar speculated across dithiocarbamate effect. The *Septoria tritici* adaptation to strobilurine similar to pendimethalin structure was recognized by HGCA 2003th.

Conclusion

Defined currency period of all applied pesticides was prolonged at air temperatures below 20^{0}C. Generally, of pesticides changed schedule using later those with less or no stable acid forming elements when some of discussed Lr genes were present in semiarid region had to be rejected because instead of rent ability one of two treatments, problem with benzenee ring as residua of viable pesticides for fungi reduction was solved by insecticides containing N. Another variety specific approach trough herbicide with S appeared recommendable while of glyphosate with external P without benzene ring was of conditions for some of Lr genes activity dependent and all round risky focusing regional environmental conditions. Investigations of residua in seed were abbreviated when was applied before heading in semiarid regions while earlier ones were predicted to be risky.

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ENHANCEMENT OF NUTRIENT UPTAKE IN PEACH ROOTSTOCK WITH ARBUSCULAR MYCORRHIZAL FUNGI AND PLANT-GROWTH PROMOTING RHIZO-BACTERIA INOCULATION IN NURSERY

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Abstract

Arbuscular mycorrhizal fungi (AMF) and plant-growth promoting rhizobacteria (PGPRB) contribute to plant nutrient uptake by increasing the availability of nutrients and the root adsorbing surface. The aim of this study was to determine the effect of the inoculation of two AMF (*Glomus fasiculatum* and *Gigaspora* sp.) and three PGPR (*Azospirillum+ Frateuria aurentia + Bacillus megaterium*) on development and nutrient uptake of *Prunus persica* plantlets grown in different culture substrates [sand (S1), coarse peat (S2) and a mixture of sand: coarse peat: organic matter (1:1:1, v:v:v) (S3)]. Our results demonstrate a significant positive increasing on the levels of shoot tissue N content (*p=0.05*) in response to AMF and PGPRB inoculation. The AMF inoculated plantlets grown in sandy substrate presented an increase of 12.5% and 38% of their root tissues levels of K and Mg respectively when compared to the control plantlets. In addition, leaf tissue total N, P and Mg content of the AMF inoculated plantlets were significantly higher than the non inoculated one in all substrates. Root tissue P and Ca levels increased significantly with PGPRB inoculation in S1 and S2 substrates. The Mg migration through plantlets tissues was performed by PGPRB inoculation in S1 and S2 simultaneously. In conclusion, our results confirm the suitability of the application of AMF and PGPRB to improve growth and nutrition of *Prunus persica* plantlets during the nursery phase. The absence of references about this microbial interaction in 'Garnem' allows us to propose for the first time this method for the improvement of sustainability of *Prunus* cropping systems.

Keywords: *AMF, PGPRB, mineral nutrition, Garnem*

Introduction

Peach *(Prunus persica* (L.) Batsch), an economically important plant in the semi arid area, is the third cultivated temperate fruit tree species in the world (Mamouni, 2006). The productivity and the sensorial and nutritional quality of peaches are determined through interactions between different factors such as rootstock and cultivar interactions, training system, etc. (Gullo et *al*., 2014). However, many biotic and abiotic stress factors affect plant growth and fruit quality (Pérez-Jiménez et *al*., 2014) which allowed interest to rootstocks selection. In fact, the hybrids of almond x peach are largely used as rootstocks for peach trees in the Mediterranean countries, because they are tolerant to lime induced chlorosis (Moreno et al., 1994). In Tunisia (Mediterranean country), peach rootstocks that are used because of their adaptation to climatic and soil conditions and for their survival after transplanting are: almond, and hybrids obtained from cross almond x peach. The cultivar 'Garnem' is one of the most used peach rootstock characterized with its vigor and iron chlorosis tolerance. However, Font i Forcada et al. (2012) demonstrated that 'Garnem' trees showed the highest tree mortality rate which may be essentially attributed to nutritional deficits.

In this research we are focusing on the enhancement of the mineral nutrition of 'Garnem' peach rootstocks with inoculation in nursery using Arbuscular Mycorrhizal Fungi (AMF) and

Plant Growth Promoting Rhizobacteria (PGPRB) on growth and mineral nutrition of young 'Garnem 'plantlets. Indeed, AMF and PGPRB contribute to plant nutrient uptake by increasing the availability of nutrients and the root adsorbing surface. In fact, these microbes can promote plant growth by regularing nutritional and hormonal balance, producing plant growth regulators, solubilizing nutrients and including resistance against plant pathogens (Nadeem et *al*., 2014). Inoculation of plant stock with selected bacterial or fungal strains has often demonstrated to improve its physiological quality and to ameliorate the survival and development of plants after planting (Rincón et *al*., 2006). AMF establish beneficial symbiosis with most plants and have gained a growing interest as agro-ecosystem service providers able to sustain productivity and quality (Pellegrino and Bedini, 2014) and the symbiotic association generated by fungi with plants roots (mycorrhizae) increases the root surface area, and therefore enables the plant to absorb water and nutrients more efficiently from large soil volume (Nadeem et al., 2014). PGPRB facilitate the plant growth directly by either assisting in resource acquisition (nitrogen, phosphorus and essential minerals) or modulating plant hormone levels, or indirectly by decreasing the inhibitory effects of various pathogens on plant growth and development in the forms of biocontrol agents (Ahemad and Kibert, 2014). Our aim was to determine the microbe inoculation efficacy on mineral uptake by plantlets under nursery conditions.

Materials and methods

Experiment was conducted in 2011 under nursery conditions in a commercial woody nursery in the North-Est of Tunisia (36°45'11''N, 10°13'8''E, 18 m altitude)

The experimental site is characterized with a semi-arid climate with a rainfall rate varying from 275 to 515 mm and mean air temperature varying from 6.8°C to 17.9°C.

An almond x peach hybrid [*Prunus amygdalus* Batsch x *Prunus persica* (L.) Batsch] cultivar 'Garnem' was considered in this study. All plantlets had been obtained from the *in vitro* culture. The experimental treatments consisted on commercial inoculums of two strains of AMF G*lomus fasiculatum+ Gigaspora* species (T1) and three strains of PGPRB *Azospirillum*, *Frateuria* and *Bacillus megaterium* (T2) or non inoculated=control (Tc).

Each treated young rootstock was transferred into 3 liter pots. Three different growing substrates were used (S1: sandy, S2: coarse peat and S3: (1:1:1) (v:v:v) (sand + peat + organic matter). The experiment was set as a completely randomized design with five replicates. All plantlets were placed under nursery conditions for four months and fertilized with a commercial controlled release fertilizer (Osmocote) (10 g/pot).

Four months after inoculation, whole plantlets were uprooted and cuted into roots, shoots and leaves for mineral analysis. At sampling, fine roots were rinsed, stained with Trypan bleu and observed using a microscope at 40x and 20x amplifications. 80 segments were considered for each treatment in each substrate. Three treatments [the control, non inoculated (Tc), AMF inoculation (T1) and PGPRB inoculation (T2)] were compared by the contrast method. The variation in nutrient content attributed to the effects of growing substrates and inoculums were assessed via the analysis of variance procedure using the SPSS program 19.0. When the *F* test was significant, means were separated by Duncan's multiple range test *(P   0.05)*.

Results and discussion

Based on statistical analysis of data (ANOVA) subjected to *F*-test, obtained results showed positive effects on nutrients uptake by plantlets in nursery conditions by AMF and PGPRB inoculations (table1).

Effect of the AMF inoculation

Shoots total nitrogen content was significantly improved with AMF inoculation and percentage increases were 1.39, 1.49 and 2.02% in S1, S2 and S3 respectively. In addition,

leaf total nitrogen content was significantly enhanced on inoculated plantlets growing in coarse peat and mixture substrates (3.20 and 3.33% respectively). These results confirms those enounced by Thomson et *al.* (1996) and Taylor and Lukey (2001) showing that arbuscular mycorrhizal fungi enhanced significantly the nitrogen concentration in tomatoes and strawberry tissues respectively. Moreover, mycorrhized plantlets growing in sandy substrate presented a significant increase of 12.5% and 38% of their root tissues levels of K and Mg respectively when compared with the non-inoculated plantlets. Results are inconsistent with those established in strawberry seedlings in which shoots K concentration was not affected by AMF inoculation (Taylor and Lukey, 2001). In fact, K^+ is equally important for maintaining the turgor pressure in plants under drought and salinity stresses (Heidari and Karami, 2014)

In all substrates, leaf P and Mg concentrations of the inoculated plantlets were significantly higher than concentration in leaves of the non inoculated planlets. This confirms findings of Asery et al. (2008) who attributed the highest levels of P to the enhancement of phosphatase activity, P mobilization and P absorption resulting to the atmospheric N_2 fixation increased by AMF inoculation.

Effects of the PGPRB inoculation

PGPRB inoculation enhanced significantly total nitrogen assimilation by plantlets in sand and coarse peat growing medium that may be due to the PGPRB abilities to fix atmospheric N_2 and to assist in resource acquisition (Ahemad and Kibret, 2014). In addition, nitrogen mobilization through plantlets tissues was enhanced by rhizospheric inoculation and rootstocks growing on substrate (S2) showed the greatest levels of total N in their leaf tissues. This result may be attributed to the inhibitory effects of the mineral nitrogen to the rhizobial inoculation, especially in the growing substrate with organic matter (S3) (Erman et *al.*, 2011). Root tissue P and Ca levels increased significantly with PGPRB inoculation in S1 and S2 because of rhizobacteria's role in phostphate solubilizing. This is in line with researche conducted by Dey et *al.* (2004) who demonstrated that available phosphorus content in the soil, and the total phosphorus content in shoots and kernels of peanut increased significantly due to the PGPRB inoculation. The Mg migration through plantlets tissues was performed by PGPRB inoculation in S1 and S2 simultaneously.

Conclusion

Under nursery conditions, the efficiency of AMF and PGPRB inoculation on an hybrid almond x peach rootstock cv. 'Garnem' was investigated. It was found that AMF and PGPRB inoculation significantly increased nutrient content and mobilization of potted plantlets. However, the greatest effect was obtained in substrates with low minerals concentrations. Then, results suggest that rhizospheric microbes's inoculation can significantly reduce the amount of chemical fertilizers if used as biofertilizers. However, in further research interest must be given to (i) the establishment of the potential competition between AMF, PGPRB and other rhizospheric strains (ii) the response of other rootstocks to AMF and PGPRB inoculation

Table 1: AMF and PGPRB effects on root, shoot and leaf nitrogen, phosphorus and potassium contents four months after inoculation in 'Garnem' plantlets

Substrate	Treatment	Total nitrogen (%)			Phosphorus (%)			Potassium (%)		
		Root	Shoot	Leaf	Root	Shoot	Leaf	Root	Shoot	Leaf
Sand	Control	2.23±0042d	1.29±0.000b	3.27±0.029f	0.38±0.040a	0.096±0.019a	0.25±0.045a	0.64±0.035b	1.06±0.128b	3.63±0.208b
	AMF	1.90±0.066b	1.23±0.029a	3.13±0.042d	0.80±0.070cd	0.17±0.061a	0.23±0.149a	0.93±0.011e	1.36±0.208c	3.80±0.000bc
	PGPRB	2.37±0.042f	1.32±0.028b	3.043±0.043c	0.67±0.070bc	0.14±0.016a	0.23±0.018a	0.89±0.011d	0.86±0.005b	3.40±0.200ab
Peat	Control	1.76±0.035a	1.39±0.021c	2.83±0.028a	0.38±0.112a	0.14±0.038a	0.29±0.089a	0.72±0.020c	0.55±0.010a	3.80±0.346bc
	AMF	1.90±0.056b	1.49±0.029e	3.20±0.058e	0.93±0.058d	0.13±0.065a	0.54±0.41c	1.05±0.042f	1.51±0.180d	4.10±0.360c
	PGPRB	1.93±0.008b	2.02±0.035f	3.33±0.028g	0.72±0.100bc	0.11±0.043a	0.41±0.063b	1.04±0.035f	1.037±0.075c	3.53±0.115b
Mixture (1:1:1)	Control	2.39±0.064ef	1.40±0.024c	2.94±0.000b	0.61±0.020b	0.06±0.041a	0.23±0.029a	0.57±0.011a	0.90±0.077b	3.14±0.169a
	AMF	2.09±0.021c	1.41±0.021cd	3.48±0.029g	0.73±0.146bc	0.14±0.067a	0.39±0.079a	0.83±0.052d	0.83±0.070b	3.77±0.252bc
	PGPRB	2.28±0.035e	1.45±0.021de	3.03±0.058c	0.69±0.121bc	0.11±0.077a	0.46±0.011b	0.84±0.006d	1.47±0.202c	3.73±0.231bc

Means separation within columns was done by Duncan's multiple range tests at (p $\leq$ 0.05).

Table 2: AMF and PGPRB effects on root, shoot and leaf calcium and magnesium contents four months after inoculation in 'Garnem' plantlets

Substrate	Treatment	Calcium (%)			Magnesium (%)		
		Root	Shoot	Leaf	Roots	shoots	leaves
Sand	Control	0.093±0.011b	1.35±0.473fg	0.88±0.020a	0.042±0.001a	0.030±0.036ab	0.190±0.013a
	AMF	0.033±0.011a	1.26±0.298efg	1.85±0.405c	0.058±0.003b	0.046±0.003c	0.506±0.066c
	PGPRB	0.020±0.000a	0.64±0.025bc	1.147±0.142ab	0.055±0.003b	0.032±0.033ab	0.218±0.039a
Peat	Control	0.110±0.023b	0.23±0.036ab	1.23±0.145ab	0.056±0.009b	0.028±0.128a	0.229±0.046b
	AMF	0.020±0.000a	1.14±0.193def	1.39±0.0.363b	0.059±0.005b	0.043±0.09bc	0.498±0.040c
	PGPRB	0.020±0.000a	0.80±0.080cd	1.28±0.193	0.055±0.005b	0.032±0.043ab	0.215±0.020a
Mixture (1:1:1)	Control	0.160±0.020c	0.90±0.156cde	1.089±0.126ab	0.035±0.000a	0.035±0.005ab	0.381±0.060b
	AMF	0.090±0.011b	0.117±0.029a	1.253±0.300ab	0.039±0.010a	0.038±0.013ab	0.264±0.078a
	PGPRB	0.033±0.011a	1.65±0.388g	1.21±0.163ab	0.044±0.000a	0.043±0.005bc	0.651±0.075d

AMF: Arbuscular Mycorrhizal Fungi

PGPRB: plant Growth Promoting rhizobacteria

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BREEDING OF LOCAL ALFALFA (*Medicago Sativa L.*) "GABSSIA" FOR YIELD AND IMPROVING TOLERANCE TO WATER SALINITY AND WINTER DORMANCY IN THE ARID REGIONS OF TUNISIA

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Abstract

Seed for growing a progeny performance test is obtained from one hundred clones that were selected from five genotypes of different geographic origins of alfalfa (*Medicago sativa* L.). Sixty percent selected from local cultivars "*Gabssia*" and forty percent from foreign varieties and landraces (*Sardi10, Ameristand, ABT805* and *Siciliano Ecotipo*). It was planted out in the Arid Institute of Research farm of Médenine. The objectives of this study were to assess the importance and effectiveness of progeny test used in alfalfa breeding for increased forages yield (fresh and dry matter). Results showed that the differences are highly significant (=0.05) for fresh and dry matter yields. The least significant difference (LSD$_{0.05}$) was also calculated to assess differences between progenies. Progenies were classified into two groups identified by cluster analysis.

Keywords: *Breeding, Genotype, Medicago sativa, Progenies.*

Introduction

In southern Tunisia alfalfa expansion is limited by environmental stress such as drought, water salinity and soil fertility (Mezni et al., 2002; Loumerem et al., 2007a).
A diverse range of local germplasm, from around the oasis of arid regions of Tunisia, has been collected and is being characterized and the seed multiplied in the period 2004-2007. Details of this collection, multiplication and storage were published (Loumerem et al., 2007a). Throughout those arid regions, small farmers grow local alfalfa (*Gabssia*) in areas with poor soils using traditional methods of cultivations. It is an important source of cash income to a large number of oasis farmers (Janati, 1990; Annicchiarico et al., 2011).
Sustainability of oasis farming in south Tunisia is under serious threat from the spread of soil salinity, declining soil fertility and problems with commercial introduced varieties of alfalfa. Recent studies have established local alfalfa (*Gabssia*) as the most suitable species to address those problems in the farming system of oasis (BenAbderrahim et al., 2009; Annicchiarico et al., 2011).
The aim of this project is to breed alfalfa cultivars specifically for those southern Tunisian oases. This region has an arid climate with cold and dry winter, and a long summer drought (M Timet and Escadafal, 1982). The breeding program is focusing on improving tolerance to water salinity and winter dormancy, as well as improving establishment with companion crops. Increasing yield remains an important goal in alfalfa breeding. The current method of alfalfa breeding is almost exclusively based on recurrent phenotypic selection, which involves intercrossing selected parents to produce a synthetic variety (Fotiadis, 1981 and 1988; Milic' et al., 2010; Milic' et al., 2011).

Synthetic varieties are widely used in alfalfa breeding. They are produced by growing together in an isolated plot usually 4-10 clones selected on the basis of the performance of progenies from a polycross.

Materials and Methods

This program is based on a collection of 20 accessions of local alfalfa "*Gabssia*" from oases of Tunisia. A detailed characterization of the accessions was given in the article (Loumerem et al., 2007a). For most studied variables, in particular yield, a significant difference was obtained between accessions.

Accessions were subject to a high saline environment (water of irrigation with high salinity) and plants survived and produced important economic field's yields are considered tolerant. Those plants were used to develop progenies. We included some germplasm derived from the best-performing foreign varieties and landraces in the arid oasis, considering the excellent response of some of those varieties in comparison with the local "*Gabssia*" and the other north-African cultivars. About 40% of foreign genotypes (*Sardi10, Ameristand, ABT805* and *Siciliano Ecotipo*) based on the variety responses over the second year at the site of evaluation (Annicchiarico et al., 2011). One hundred genotypes were used as parent in this experiment. Sixty best-looking plants from local "*Gabssia*" accessions and 40 plants of foreign varieties (Ten from each variety sited before) were selected for cuttings. alfalfa can be stem propagated without addition of hormones, as long as, the cuttings are taken from upper part of the stem, and they are maintained in humid environment (Combaud and Lelièvre, 2006; Loumerem et al., 2007b). Cloned plants were grown in spaced plantings and assessed in a polycross. The goal of progeny test is to assess parental components based on the value of the parents, hence their great importance in the breeding of perennial forage crops (De Araufo and Goulman 2002; Milic' et al., 2010b). Milic' et al., 2010 consider progeny test as the most suitable for breeding and developing synthetic varieties. Field trials were conducted at IRA's experimental field of El Fjé (Médenine). Seventy three progenies, for which sufficient seed was available, were used in the experiment. Each of the 73 progenies was sown on a long single row plot. They were arranged in randomized Complete Block Design with three replications. Each replication consists of 12 plants spaced 40 cm apart in a single row. Data of total fresh and dry matter yield were subjected to analysis of variance (ANOVA) of Agronomic parameters for all cuttings and for average yield for each season. The differences among the progenies were detected by LSD test. Dendrogram were used to classify progenies in similar groups by cluster analysis. During each cutting, fresh yields of all studied progenies were weighted using a precision balance. Then, from each progeny, we take a weighted fresh pattern, and then dried for 24 hours in an oven at a temperature of 105 °C (AOAC, 1973). There is no rule to follow when making the decision to cut; whereas, our decision to cut (in summer and spring) is taken just when the first flowering is seen such the vigor will be transmitted to flowers to produce seeds. But, under winter and autumn conditions (the weather is extremely cool), the growth of new shoots from the crown indicates that it is time to cut. Most authors indicate that alfalfa cut at one-tenth bloom is the best compromise between yield and quality without seriously reducing plant vigor and stand life. To retain high nutrition value of alfalfa, harvest at the proper growth stage is necessary. Harvest schedule in the range of one-tenth bloom in spring and summer to pre-bud stage in winter and autumn will result in acceptable yields of high quality feed with a minimal effect on stand persistence (Bosworth et al., 1992; Platt, 2005; Thiébeau et al., 2003; Orloff and Putnam, 2010; Undersander et al., 2011; Jennings, 2012).

Results and discussion

The aim of forage breeding programs is to maximize economic yield. "Therefore, harvest management of perennial alfalfa requires a compromise between quality and persistence. The intensity at which these forages are harvested, should depend on the nutrient needs of the livestock that will be consuming the forage, as well as, the life expectancy of the stand" (Bosworth et al., 1992).

The period between two consecutive cuttings vary from a minimum of 20 days in summer between the 8th and the 9th cuttings; and it reaches a maximum of 57 days in winter between the two last cuttings. The CV of the number of days between cuttings is 36.76% of the mean.

Calculated values of $F_{0.05}$ show that there is a highly significant difference between the studied progenies for the agronomic characters (table 1).

Calculated values of $F_{0.05}$ (Table 2) show that for a total yield of fresh matter and yield of dry matter (for all catting), inter-progenies differences are highly significant, therefore the progenies studied here are considered to be statistically different. But, for percent of dry matter, inter-progenies differences are not significant.

Table 1: ANOVA of Agronomic parameters for all cuttings

Characters	Sum of Squares	Degrees of freedom	Mean Square	F	Sig
Yield of fresh matter	89117705,08	72	1237745,90	5,20	,000
Yield of dry matter	3849900,87	72	53470,84	5,70	,000
Percent of dry matter	1579,73	72	21,94	1,27	,058

The least significant difference (LSD) is used to determine if the difference between two progenies is large enough to be considered real at a fixed level of confidence ($LSD_{0.05}$=95% confidence).

Use the appropriate $LSD_{0.05}$ value at the bottom of the (table 2) to determine true differences. Where the difference between two progenies within a column is equal to or greater than the $LSD_{0.05}$ value, it means there is a real difference between the two progenies averages.

The large $LSD_{0.05}$ values indicate that a large proportion of this variability can be attributed to genetic variability between individual plants within a progeny.

Progenies 45, 43, 40, 61, 47, 52, 66, 49, 21, 71, 60, 59, 64, 65, 42, 67, 25, 26, 10 and 16 were significantly better than all other progenies for yield of fresh matter and yield of dry matter. They represent all studied genotypes. The local progeny of the oasis cultivar "*Gabssia*" had significantly higher fresh and dry matter yields than foreign genotypes (*Sardi10*, *Ameristand*, *ABT805* and *Siciliano Ecotipo*). Six out of twenty progenies which have the higher forage yield (more than 40000g per year/8 plants) are local genotypes (table 3) followed by *Sardi10* (four progenies), *ABT805* (four progenies), *Ameristand* (three progenies) and *Siciliano Ecotipo* (three progenies). Nevertheless, the highest forge yield was given by *Ameristand* progeny 45 (55488g fresh matter and 11530 g dray matter per year/8 plants) and the lowest was given by local progeny 41 (27861g fresh matter and 6348 g dray matter per year/8 plants).

Calculated values of $F_{0.05}$ have demonstrated highly significant differences concerning both of yields of fresh matter and yield of dry matter produced by studied progenies at different seasons.

Higher yield progenies in the spring season are 45, 61, 60, 49, 71, 63, 43, 59, 64 and 65. Its scored more than 20000g per 8 plants and belongs to the following genotypes, two local "*Gabssia*", two "*ABT805*", two "*Sardi10*" and two "*Ameristand*". In winter higher yield progenies are 47, 45, 40, 71, 30, 61, 38, 19, 48, 26, 21 and 52. They are not dormant and its yield more than 5000g per 8 plants. The highest yields (5952 g, 5825 g, 5598 g and 5446 g)

were found in the progenies 47, 45, 40 and 71, while the lowest yields (less than 3000g) were recorded in the progenies 41, 15, 36 and 72. The highest yield progenies are foreign genotypes *Sardi10*, *Ameristand* and *Siciliano Ecotipo*, while the lowest yield progenies are local genotypes. This local germplasm were collected from oases. It has shown wide adaptation to arid oasis environments in Tunisia. They scored lowest yields in winter in the experimental field of IRA with different edaphic and climatic conditions than oasis "oasis effect" (Potchter et al., 2012). So we can conclude in this case they are less adapted to arid environment outside the oasis, in winter, than foreign genotypes (table 3).

Table 2: Yield of fresh and dry matter (Annual, Average, Minimum and Maximum yield) of studied progenies

Genotypes	Progenies	Yield of fresh matter (g)				Yield of dry matter (g)			
		Mean	Annual yield	Min	Max	Mean	Annual yield	Min	Max
L	1	898,38	35037	160,00	2429,00	199,07	7764	38,00	415,00
L	2	892,43	34805	390,00	2104,00	197,92	7719	105,00	398,00
S	3	853,82	33299	401,00	1941,00	198,94	7759	77,00	477,00
L	4	887,71	34621	244,00	1772,00	197,43	7700	67,00	367,00
L	5	954,64	37231	287,00	2309,00	196,02	7645	61,00	468,00
ABT	6	935,17	36472	300,00	2816,00	197,92	7719	70,00	498,00
L	7	952,43	37145	203,00	2148,00	204,89	7991	65,00	399,00
E	8	931,20	36317	360,00	2315,00	208,20	8120	82,00	403,00
S	9	841,92	32835	179,00	1905,00	189,10	7375	41,00	375,00
L	10	1032,25	**40258**	262,00	3021,00	223,82	**8729**	56,00	543,00
A	11	776,10	30268	233,00	1864,00	172,46	6726	49,00	377,00
L	12	907,94	35410	354,00	2537,00	189,02	7372	86,00	498,00
L	13	847,53	33054	89,00	2193,00	188,64	7357	16,00	449,00
E	14	940,69	36687	375,00	2443,00	201,94	7876	97,00	395,00
L	15	764,43	29813	244,00	2109,00	168,10	6556	53,00	359,00
L	16	1028,41	**40108**	276,00	2541,00	228,61	**8916**	55,00	498,00
A	17	976,66	38090	388,00	2313,00	220,23	8589	99,00	499,00
L	18	964,89	37631	384,00	2064,00	213,84	8340	85,00	421,00
L	19	899,23	35070	316,00	1730,00	200,58	7823	108,00	378,00
L	20	942,79	36769	258,00	2071,00	209,71	8179	56,00	343,00
ABT	21	1119,92	**43677**	262,00	2740,00	252,20	**9836**	60,00	697,00
L	22	826,58	32237	366,00	1601,00	183,89	7172	80,00	443,00
L	23	893,07	34830	442,00	2165,00	190,28	7421	98,00	405,00
S	24	766,07	29877	229,00	1782,00	178,92	6978	49,00	349,00
L	25	1040,23	**40569**	338,00	3578,00	227,38	**8868**	72,00	584,00
A	26	1036,97	**40442**	510,00	2036,00	225,82	**8807**	108,00	402,00
L	27	1013,89	39542	92,00	3270,00	217,48	8482	21,00	615,00
L	28	750,61	29274	262,00	1667,00	164,58	6419	79,00	359,00
ABT	29	957,33	37336	290,00	2112,00	211,41	8245	71,00	411,00
L	30	974,48	38005	309,00	2147,00	210,74	8219	86,00	401,00
L	31	916,89	35759	242,00	2750,00	203,12	7922	52,00	495,00
ABT	32	786,07	30657	233,00	1660,00	177,33	6916	51,00	358,00
L	33	1019,48	39760	533,00	2519,00	218,20	8510	121,00	390,00
E	34	1008,41	39328	410,00	2231,00	221,76	8649	83,00	497,00
L	35	767,66	29939	143,00	1911,00	171,12	6674	34,00	384,00
L	36	758,48	29581	260,00	1482,00	176,02	6865	81,00	323,00
A	37	869,41	33907	89,00	2281,00	191,43	7466	22,00	416,00
L	38	955,05	37247	431,00	2026,00	215,30	8397	96,00	449,00
L	39	897,87	35017	198,00	2122,00	199,20	7769	65,00	412,00
E	40	1183,97	**46175**	316,00	4298,00	263,71	**10285**	84,00	724,00
L	41	714,38	27861	113,00	2130,00	162,76	6348	22,00	380,00
E	42	1053,12	**41072**	276,00	2918,00	229,71	**8959**	64,00	515,00
S	43	1203,79	**46948**	192,00	4224,00	275,48	**10744**	46,00	922,00
S	44	891,12	34754	332,00	2032,00	194,58	7589	101,00	377,00
A	45	1422,76	**55488**	353,00	4108,00	295,64	**11530**	71,00	650,00
L	46	972,05	37910	381,00	2630,00	218,17	8509	88,00	574,00
S	47	1162,58	**45341**	593,00	2260,00	258,79	**10093**	113,00	535,00
L	48	980,64	38245	421,00	2590,00	211,38	8244	105,00	423,00
A	49	1126,10	**43918**	339,00	2639,00	240,07	**9363**	71,00	474,00
L	50	950,66	37076	279,00	2525,00	215,28	8396	90,00	436,00
L	51	1002,53	39099	284,00	2256,00	222,64	8683	87,00	418,00
ABT	52	1158,61	**45186**	486,00	2540,00	246,15	**9600**	104,00	420,00
L	53	1018,84	39735	276,00	2649,00	231,89	9044	56,00	475,00
S	54	909,17	35458	220,00	2685,00	203,84	7950	52,00	535,00
L	55	1001,20	39047	204,00	2370,00	219,51	8561	48,00	437,00
A	56	951,25	37099	256,00	2086,00	208,71	8140	92,00	405,00
L	57	1009,17	39358	265,00	3273,00	220,66	8606	62,00	590,00
L	58	978,00	38142	370,00	2070,00	213,76	8337	78,00	431,00
ABT	59	1089,17	**42478**	316,00	2817,00	241,46	**9417**	77,00	471,00
E	60	1089,43	**42488**	113,00	3692,00	235,15	**9171**	26,00	560,00
L	61	1175,41	**45841**	452,00	2672,00	255,89	**9980**	105,00	482,00

ABT	62	772,48	30127	252,00	2129,00	174,00	6786	58,00	317,00
E	63	1002,74	39107	318,00	3028,00	226,17	8821	72,00	600,00
L	64	1087,41	**42409**	243,00	2903,00	237,64	**9268**	84,00	501,00
ABT	65	1054,07	**41109**	202,00	2926,00	233,79	**9118**	46,00	585,00
S	66	1149,05	**44813**	266,00	3176,00	254,79	**9937**	56,00	676,00
L	67	1044,97	**40754**	341,00	2147,00	225,48	**8794**	64,00	423,00
L	68	1013,07	39510	451,00	2893,00	243,51	9497	100,00	647,00
E	69	933,30	36399	177,00	1883,00	210,02	8191	41,00	381,00
ABT	70	748,58	29195	225,00	1881,00	181,23	7068	63,00	519,00
S	71	1116,17	**43531**	273,00	3355,00	241,15	**9405**	56,00	591,00
L	72	809,76	31581	166,00	2046,00	181,89	7094	41,00	444,00
A	73	994,43	38783	248,00	2332,00	224,20	8744	59,00	472,00
LSD		218.35				43.47			

Table 3: Season yield of fresh and dry matter (average, minimum and maximum yield)

	Season yield of fresh matter (g)			Season yield of dry matter (g)		
Seasons	Average	Min	Max	Average	Min	Max
Winter	716,07	89,00	2113,00	163,55	16,00	476,00
Spring	1365,85	203,00	4298,00	295,13	65,00	724,00
Summer	884,80	151,00	3176,00	203,38	39,00	697,00
Autumn	698,21	92,00	4224,00	148,87	21,00	922,00
LSD	218.35			43.47		

The progenies 41, 15, 36 and 72 are considered dormant because during all winter season its scored between 2439 and 2995 g per 8 plants.

In summer, foreign genotypes (45, 21, 66, 40, 47 and 52) scored the highest yields. During autumn, progeny 43 (*Sardi10*) scored the highest yield (10211g) flowed by progenies 52, 40, 45, 26, 21 and 33, while the lowest yield is scored by *Ameristand* genotype (progeny 11).

Analyses of variance (ANOVA) were performed for two characters, the average season yield of fresh matter and average season yield of dry matter, between seasons showed high significant differences at $= 0.05$ (table 4).

Table 4: ANOVA of yield of fresh matter (YFM) and yield of dry matter (YDM) for different seasons

		Sum of Squares	Degrees of freedom	Mean Square	F	Sig.
Average season yield of fresh matter (g)	Between Groups	220284228.47	3	73428076.15	394.725	.000
	Within Groups	528853475.55	2843	186026.745		
	Total	749137704.02	2846			
Average season yield of dry matter (g)	Between Groups	9762676.620	3	3254225.540	460.920	.000
	Within Groups	20070599.51	2843	7060.287		
	Total	29835189.91	2846			

Concerning yields of fresh matter, the highest average was in the spring (1365.85g), while the lowest average yield recorded in autumn (698.21g).

According to Bosworth et al. (1914), during the late summer alfalfa plants are preparing for winter by developing cold resistance and storing energy reserves in their roots.

Our aim of the above analysis is to know the behavior of studied progenies during different periods. Such evaluation informs the breeder which progenies may select in accordance with criteria of productions. For that, a hierarchical multi-criteria classification seems to be necessary to succeed the breeding decision. The previous dendrogram (Fig. 1) shows that progenies can be divided into two groups. The most homogenous progenies marked on the seasonal classifications belong almost completely to the second group of the global

dendrogram. According to this classification enforced by a direct observation of vegetal material in the experimental site, we may select the superior progenies that can serve as plant material to achieve the breeding program.
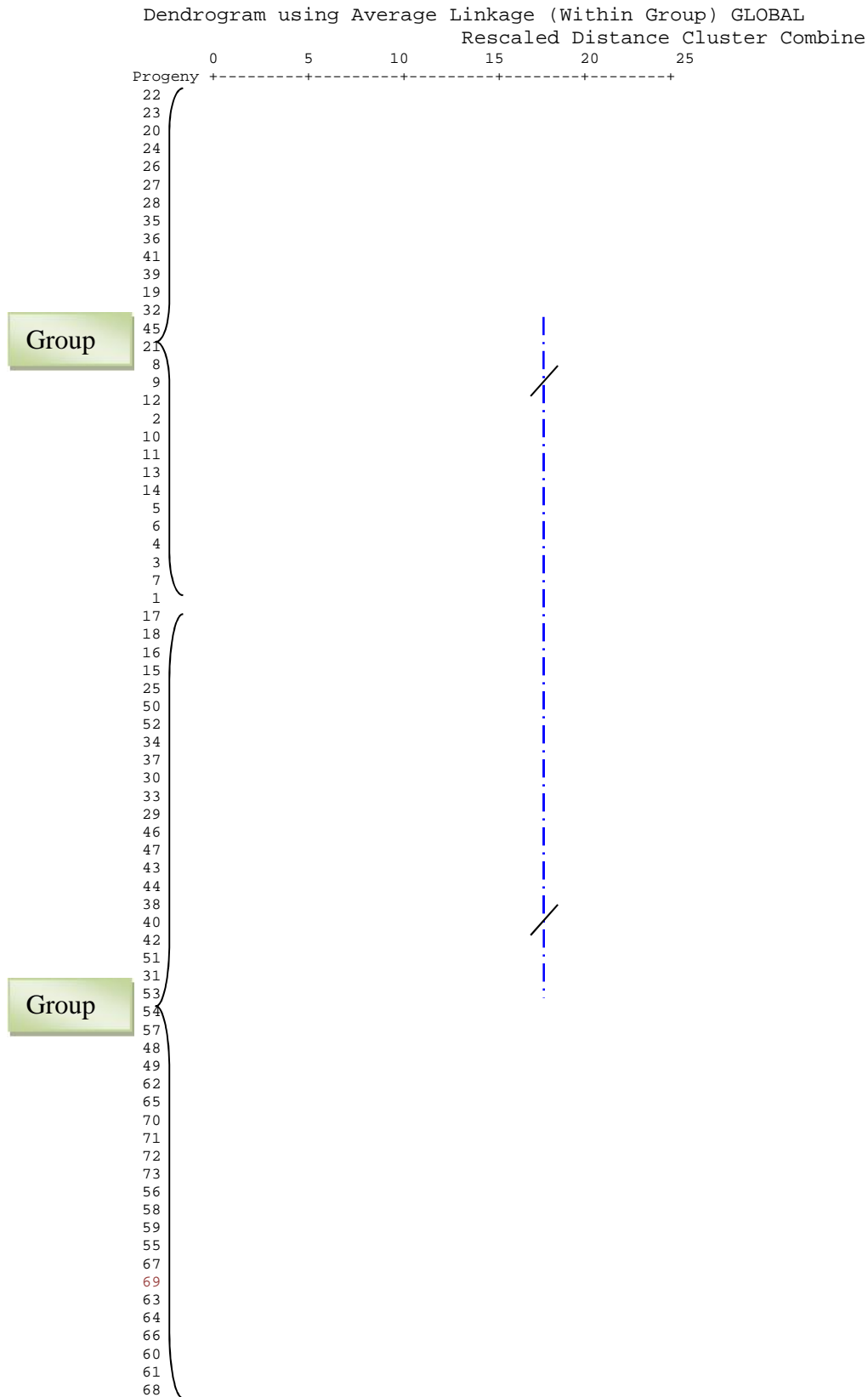
Figure 1 : Hierarchical classification of progenies for YFM, YDM and PDM

Conclusion

In spite of the agronomic and economic importance of the alfalfa, we do not have until today selected varieties adapted to the arid conditions except the oases landraces "*Gabssia*" which grows badly outside oasis. The present study consists of an agronomic and morphological evaluation of 73 progenies of alfalfa selected in IRA whose objective is to select best progenies with which the breeding scheme will be achieved. The analysis of the variances in terms of the characters of yields of fresh and dry matter show a highly significant difference between the studied progenies. An important genetic variability was noted after comparison the behavior of these progenies depending on the cutting seasons.

For all progenies, the spring yields were the most important. Summer productions are less important than spring yields for all progenies; it is in this season that alfalfa plants begin preparing for winter by developing cold resistance and storing energy reserves in their roots.

Hierarchical classification based on the criteria of yields in addition to the percentage of dry matter lets us distinguish two groups. The best group gathers the most homogenous progenies.

The 39 progenies that seem to be the best ones were selected.

For a further work, the selected progenies have to be propagated by stem cutting and transplanted in order to make the second polycross serving for the achievement of the breeding scheme.

Acknowledgements

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CRITICAL NITROGEN CURVE FOR TWO POTATO CULTIVARS UNDER SEMI-ARID CONDITIONS

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Abstract

Plant based analytical techniques of nitrogen nutrition, established on the concept of critical nitrogen can be used to diagnose the nitrogen (N) status of potato, which in turns can provide understanding of N nutrition and serve as a guide for the profitability and sustainability of agricultural production system in semi-arid conditions. Critical N concentration (Nc) was determined from three on-farm field trials in which two cultivars (Spunta and Bellini) were grown under three or four N rates. Dry matter and N concentration of shoots and tubers were measured. Nc was determined by selecting the minimum N concentration for which the highest total biomass (W), comprised of shoots and tubers, was obtained and by expressing N concentration as function of W. Nitrogen nutrition index (NNI) was determined as the ratio between measured N concentration and predicted Nc, was then related to the relative yield (RY) measured at harvest. The allometric relationship between N concentration and W for Spunta ($Nc = 3.25W^{-0.31}$, $R^2 = 0.99$) was different from that of Bellini ($Nc = 2.99W^{-0.38}$, $R^2 = 0.93$) indicating that Spunta had a greater N concentration than Bellini. These results suggest that there is intra-specific variability in potato for the relationship between N concentration and biomass. Relationships between RY and NNI of Spunta and Bellini were expressed by linear functions and accounted for 51% and 66% of variation, respectively. Our results suggest that NNI could be a reliable indicator of the level of N stress during the growing season of Spunta and Bellini.

Keywords: *Potato, Critical nitrogen concentration, Nitrogen nutrition index, Relative tuber yield, Semi-arid conditions.*

Introduction

Plant based diagnostic methods of N deficit can be used to improve the efficiency of N utilization and diminish the risks of N losses to the environment. These diagnostic methods should be based on the concept of N concentration that is the minimum N concentration required to achieve maximum crop growth (Ulrich, 1952). It is well established that the N concentration in many crops decreased with increasing plant biomass (Greenwood et al., 1990). The progressive decline of %N in shoot and tuber biomass is attributable to plant compartmentalization. Plant N content varies according to a metabolic pool, associated with photosynthesis and growth process, and a structural pool corresponding to N storage, structure and other metabolic functions. N dilution is due to two processes: self-shading of leaves and change in the leaf:shoot ratio during crop development (Yao et al., 2014). This decline in N is described by a negative power function called dilution curve. The critical N (Nc) dilution curve can be used to analyze N deficiency and to administer the N use efficiency in crop simulation model (Lemaire et al., 2008). The Nc is represented by an allometric function: $Nc = aW^{-b}$ (1) where W is the total biomass expressed in t ha^{-1}, Nc is the total N concentration in total biomass expressed in kg ha^{-1}, and *a* and *b* are estimated parameters. The parameter *a* represents the N concentration when the total biomass is at least

1t ha^{-1} and the parameter b represents the coefficient of dilution which describes the relationship of decreasing N concentration with increasing total biomass. The critical N dilution curve defined by Eq. (1) is currently used to diagnose N deficiency, to manage N fertilization, and to simulate N uptake in crop models (Lemaire et al., 2008). It enables differentiation of three levels of the crop N status: (i) values significantly below the curve represent crop growth limited by N supply, (ii) values above the curve represent growth under luxury N supply, and (iii) values on the curve represent growth at Nc. Critical dilution curves for N have been determined for grasses (Marino et al., 2004), wheat (Justes et al., 1994), rice (Sheehy et al., 1998), oilseed rape (Colnenne et al., 1998), cotton (Xiaoping et al., 2007) and tomato (Tei et al., 2002). In potato, the values of the parameters a and b are estimated using the combined biomass of shoots and tubers, and the N concentration of this combined biomass. Greenwood et al. (1990), using data from Scotland and the Netherlands, reported values of $a = 5.36$ and $b = 0.46$ whereas Duchenne et al. (1997) in France obtained values of $a = 5.21$ and $b = 0.56$. Furthermore, the parameters were obtained under pedo-climatic conditions and with cultivars different from Tunisia. Our objectives were to determine the critical N curve for potato under the growing conditions and with cultivars widely grown under semi arid conditions, and to assess the possibility of using this critical N curve based on whole plants to estimate the level of N nutrition of potato grown under different N rates.

Materials and methods

Experimental design

Data were obtained from three field experiments conducted in Technical Center of Potato and Artichoke (CTPTA) (37°North, 10°South, Altitude 238 m) and Inter-professional Group of Vegetables (GIL) (36° 35' Nord, 10° 52'Est), in which we varied N applications, potato cultivars, sites, and years, as summarized in Table 1. In all the experiments, the cultivars were arranged in a completely randomized block design with three replications. N fertilizer was applied in three phases: vegetative growth, initiation of tuberization and maturation of tubers. The amount of P and K applied to satisfy plant growth demand were based on soil test recommendations. Further crop management procedures followed common agricultural practices to ensure maximum potential productivity.

Sampling and measurement

Plants were collected using a 1m row section in each plot at different development stages (starting around 62 days after planting (DAP) until senescence in the first season, 44 DAP until senescence in the second season and 21 DAP until senescence in the third season). Shoot and tuber were weighed fresh and were collected for dry matter (DM) determination and laboratory analyses. DM was obtained by a forced-draft over drying at 75°C to constant weight. Dried samples were stored in plastic bags before laboratory analyses. The N concentration in shoots and tubers (N) was determined by kjeldahl method (Bremner, 1965) and was calculated by adding the N contents of shoots and tubers and dividing that by the total biomass. Total biomass (shoot and tuber biomass) and N concentration for each sampling date and year were subjected to analyses of variance using the STATISTIX9 (Analytical Software, 2014).

Table 1. Basic information about three experiments conducted in CTPTA and GIL.

Basic information	2007/2008 season	2008/2009 season	2009/2010 season
Experiment	CTPTA	CTPTA	GIL
Soil characteristics (40 cm)			
Type	Clay soil	Clay soil	Sandy soil
Organic matter (%)	2.5	2.4	1.4
pH	8.2	8.3	8.2
Total N (g kg^{-1})	1.2	1.4	0.8
P (mg kg^{-1})	50	74	79
K (mg kg^{-1})	767	880	343
Precipitation + Irrigation (mm)	419	340	370
Planting date	08/02/2008	02/03/2009	09/09/2009
Harvest date	01/06/2008	09/07/2009	18/01/2010
Cultivar			
	Spunta	Spunta	Spunta
		Bellini	Bellini
N rate (kg N ha^{-1})			
	0 (N0)	0 (N0)	0 (N0)
	50 (N50)	50 (N50)	50 (N50)
	200 (N200)	200 (N200)	200 (N200)
	300 (N300)		300 (N300)

Model calibration

Construction of the critical N dilution curve requires identification of critical data points at which N neither limits growth nor enhances it. An N limiting treatment was represented by treatments with significantly lower shoot and tuber biomass and in which supplementary N application led to a significant augment in DM. A non N limiting treatment was represented by treatments with significantly higher shoot and tuber biomass and in which N application led to an augment in N (Justes et al., 1994; Yao et al., 2014). In cases where more treatments was obtained with statistically the same total biomass, the treatment represented limiting N conditions when their N concentration was significantly lower and the treatment represented non limiting N when their N concentration was significantly higher (Giletto et al., 2012). On a chosen date of sampling, a critical N construction point was determined as follows: (i) each N treatment was characterized by its DM and N; (ii) the data for limiting N growth treatments were fitted by simple linear regression; (iii) the data for non limiting treatments were used to calculate the maximum DM from the averages of the observation data, (iv) the theoretical critical point was characterized by the calculated maximum DM; the N was the ordinate of maximum DM in a simple linear regression; and (v) fitting a power law regression equation to these theoretical critical points to determine the equation of the Nc curve (Justes et al., 1994). Data points were selected from non-N-limiting treatments (N200 and N300 treatments in 2007-2008 and 2009-2010 and N200 treatments in 2008-2009) for determination of the maximum N curve (Nmax); the data points from N limiting treatments (N0 and N50 treatments in 2007-2010) were used to construct the minimum N curve (Nmin).

Calculation of the nitrogen nutrition index (NNI) and the relative yield (RY)

To characterize the N status of plants, the N nutrition index was used as follow: $NNI = N/Nc$ (Eq. 2), where N is the total N concentration measured in shoots and tubers, and Nc is the critical N concentration for the same biomass. The presented results of NNI are restricted to N0, N50 and N200 treatments. The relative yield (RY) was calculated as the ratio of the final harvest tuber yield obtained at a given rate of N application and the highest tuber yield among N rates (Zhao, 2014). RY was expressed as a function of NNI and the linear function was estimated using STATISTIX9 (Analytical Software, 2014). The presented results of RY are restricted to N0, N50 and N200 treatments.

Results and discussion

Establishment of the critical N dilution curve

Data points for each sampling date from vegetative growth to maturation of tubers for both cultivars were used to determine the Nc points by following the computation method of Justes et al. (1994). Forty four data points between 0.36 and 9.70t ha^{-1} of DM allowed us to calculate Nc. The Nc points were determined by intercept between the vertical and oblique lines fitted through the data points on each sampling date for Spunta and Bellini, respectively (Fig. 1). There was a declining trend of Nc values in both cultivars with increasing DM, with determination coefficients of 0.99 and 0.93 for Spunta and Bellini, respectively (Fig. 2). This phenomenon, has to be considered as an ontogenetic process (Lemaire and Gastal, 2009) and is based on the premise that plant DM comprises two compartments: DMm, the dry matter of metabolic tissues involved directly in plant growth process (photosynthesis and meristematic activity), which has a high N concentration, and DMs, the structural tissues in plant architecture that have a low N concentration. During the growth process, the proportion of DMs is large, and the proportion of DMm is small; accordingly, the N concentration of the plant declines with growth (Lemaire et al., 2008). The trend lines were fitted as follows: Spunta: $Nc = 3.25W^{-0.31}$ (W 0.36t ha^{-1}, $R^2 = 0.99$) (Eq. 3), Bellini: $Nc = 2.99W^{-0.38}$ (W 0.36t ha^{-1}, $R^2 = 0.93$) (Eq. 4).
The trends in Nc curves were consistent between the two cultivars; a negative power function fit both. The two curves were not significantly different ($p > 0.05$) according to calculation procedures recommended by Hahn (1997). Hence, the data for two varietal groups were pooled together and a unique dilution curve was fitted as follows (Eq. 5): $Nc = 3.18W^{-0.37}$ (W 0.36t ha^{-1}, $R^2 = 0.87$) (Eq. 5).
The parameters a of 3.18% and b (0.37) in this work were lower than those reported by Giletto et al. (2012) ($a = 5.30\%$, $b = 0.42$), Bélanger et al. (2001) ($a = 4.37\%$, $b = 0.50$), Duchenne et al. (1997) ($a = 5.21\%$, $b = 0.56$) and Greenwood et al. (1990) ($a = 5.36\%$, $b = 0.46$), because the sampling period, climatic and edaphic conditions were different to these authors. Parameter b in our work (0.37) was higher than the theoretical value of 0.34 defined by Greenwood et al. (1990) based on the principle that there is a strong link between N in fescue (*Festuca arundinacea* L.), alfalfa (*Medicago sativa* L.) and wheat and its metabolic activities. When considering only the potato data, Greenwood et al. (1990) explained this difference by the presence in potato of significant quantities of N in tubers. According to Yao et al. (2014), the N dilution levels of Nc of fescue, alfalfa and wheat were less marked than that of the Nc of potato.
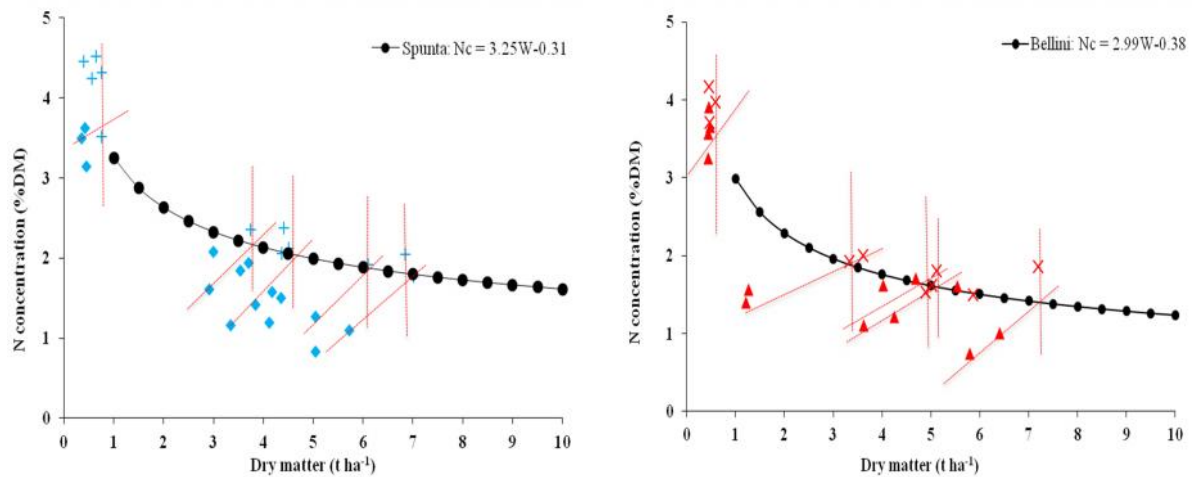
Figure 1. Critical N data points used to define Nc curves (a: 2007-2010 Spunta, b: 2007-2010 Bellini). The symbols (◇) and ( ) represent the values measured in the N-limiting treatments for Spunta and Bellini, while (+) and (x) represent the values measured in the non N limiting treatments for Spunta and Bellini. The symbol (●) represents the calculated Nc points for each date. The solid line represents Nc curve describing the relationship between Nc and DM of potato.

The model accounted for 87% of the total variance. The 95% confidence interval of the mean was 3.30% DM for a shoot and tuber biomass of 0.36t ha^{-1}, while 3.10% DM for a shoot and tuber biomass of 9.70t ha^{-1} (Fig. 3). The Nc dilution curve cannot be applied to low DM (< 0.36t ha^{-1}) due to relatively smaller decline of Nc with increasing DM during early growth stages, when plants were spatially isolated. Therefore, 18 data points, ranging from 0.36 to 0.76t ha^{-1}, were used to determine the constant Nc at low DM (< 0.36t ha^{-1}). The constant Nc was calculated as the mean value between the minimum N concentration of non limiting N points (4.51% DM) and the maximum N concentration of limiting N points (3.14% DM). The constant Nc value used here was 3.84% DM. The Nc curve and the constant Nc concentration at low DM intersected at DM value of 0.52t ha^{-1}; so, for a shoot and tuber biomass < 0.52t ha^{-1}, the critical shoot and tuber N concentration best fitted with a constant value of 3.84% DM. On the other hand, for shoot and tuber biomass > 0.52t ha^{-1}, the critical N dilution curve describes the critical N concentration.

Validation of the Nc dilution curve

The critical curve was validated both for limiting (Fig. 3-a) and non-limiting (Fig. 3-b) situations within the biomass range for which it was established. Results indicated that growth rate and cultivar did not significantly affect Nc. The wide range of pedo-climatic conditions included in our dataset (semi arid conditions of Tunisia) suggests that the potato Nc dilution curve was also independent of the growing environments. As seen in Fig. 3-a and 3-b, all the data points from the N limiting treatments were close to or below the Nc dilution curve. Whereas, those from the non N limiting treatments were close to or above the Nc dilution curve. The Nmax curve represents the maximum N accumulation capacity of the plant (luxury consumption of N); while the Nmin curve represents the lower limit at which the metabolism would cease to function (Giletto et al., 2012). The variability of N concentration at a constant DM was explained by the different availability of N in the soil. Between the Nc and the Nmax, N absorption is determined by high mineral N availability in the soil and is independent of the growth rate. Between the Nc and the Nmin curve, N absorption is limited by low mineral N availability in the soil and determines the growth rate (Justes et al., 1994).
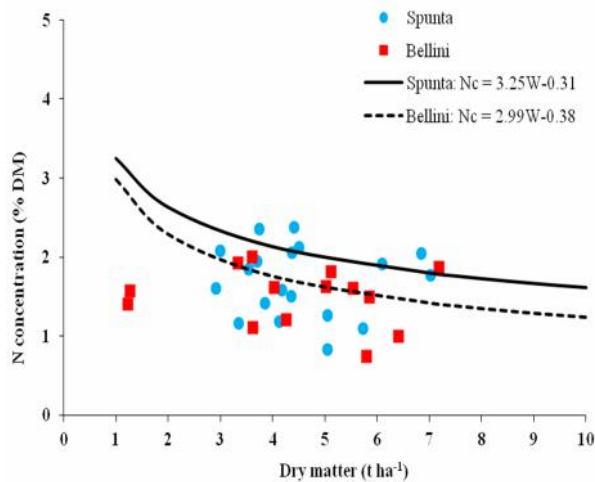
Figure 2. Critical N dilution curves for two potato cultivars (Spunta, Nc = 3.25W$^{-0.31}$ and Bellini, Nc = 2.99W$^{-0.38}$) under different N application rates.
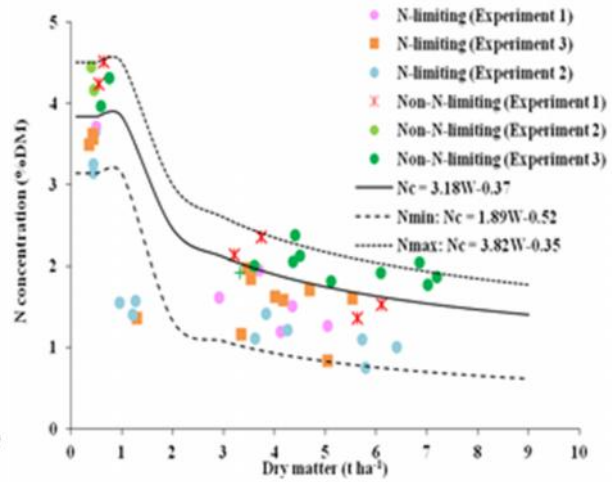
Figure 3. Shoot and tuber N concentration versus shoot and tuber biomass (DM) for potato data. Solid lines represent critical N dilution curve. Dotted lines represent the minimum N concentration (Nmin) and the maximum N concentration (Nmax).

Variability of NNI with development stage under different N rates

The Nc dilution curve allows an accurate diagnosis of potato N nutrition status (Ata-Ul-Karim et al., 2013). To characterize the N status of plants, the NNI was calculated by using Eq. 2. If NNI = 1, N nutrition is considered as optimum, while NNI>1 indicates excess N and NNI<1 indicates N deficiency. Therefore, NNI can be used to quantify the degree of N stress. Significant differences were observed for NNI across the treatments and cultivars at different sampling dates. The NNI ranged from 0.42 (N0) to 1.03 (N200) for Spunta and 0.49 (N0) to 1.04 (N200) for Bellini during 2008-2009, while 0.73 (N0) to 1.22 (N200) for Spunta and 0.86 (N50) to 1.22 (N50) for Bellini during 2009-2010 (Fig. 4). The NNI values for treatment N200 in the 2008-2009 and 2009-2010 seasons were   to 1, indicating that N levels were optimal (non N limiting treatment). The values of NNI were < 1 for treatments N0 and N50 in 2008-2010 seasons (N limiting treatments). In 2009-2010, the NNI increased in N0 and N50 at the beginning and the end of the growing cycle, probably due to N mineralization from the soil organic matter (Fig. 4).

These results confirm the robustness of NNI as a measure of shoot and tuber N status in potato under semi-arid conditions.

Relationship between the Relative Yield (RY) and Nitrogen Nutrition Index

Figure 5 shows the relationship between RY measured at harvest and NNI measured at 89 DAP in 2008-09 and at 66 DAP in 2009-10. The relation between them was expressed by a linear function and accounted for 51% and 66% of the variation for Spunta and Bellini, respectively. The relationship between RY and NNI of Spunta and Bellini appear to be similar for Shepody (R^2 = 82%) and Russet Burbank (R^2 = 71%) under irrigated conditions (Bélanger at al., 2001) and for Innovator (R^2 = 69%) (Giletto et al., 2012). For a NNI greater than 1.0, the relative yield was near 99% and 92% for Spunta and Bellini, respectively (Fig. 5). With decreasing NNI, below 1, the relative yield decreased.
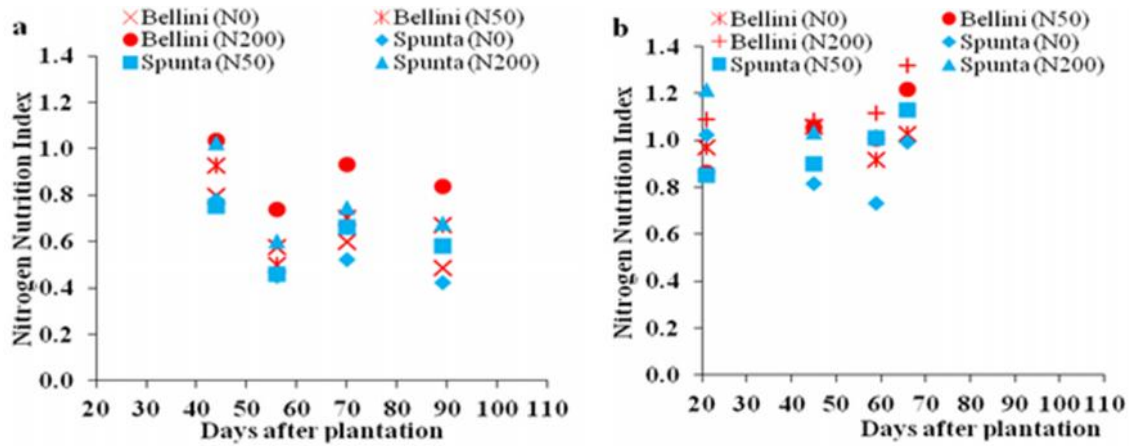
Figure 4. Changes of nitrogen nutrition index (NNI) with time (Days of plantation) for potato cultivars (Spunta and Bellini) under different N application rates in experiments conducted during 2008-2009 (a) and 2009-2010 (b).
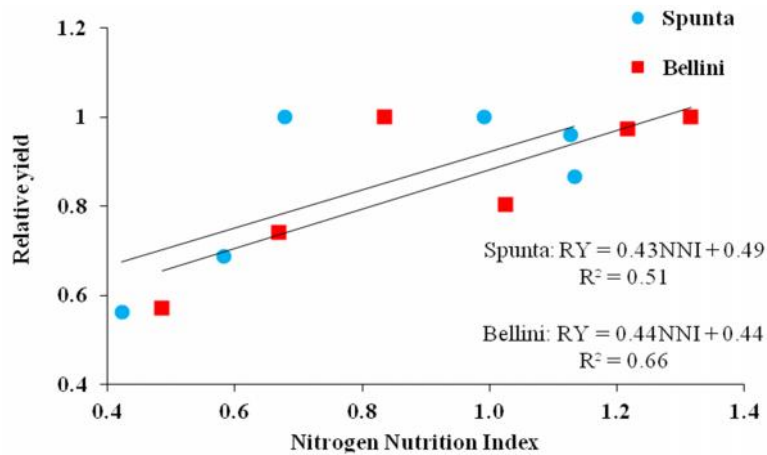
Figure 5. The relationship between relative yield and the N nutrition index of Spunta and Bellini.

Conclusion

A critical N dilution curve (Nc = $3.18W^{-0.37}$) was developed for Spunta and Bellini in northest Tunisia. This curve was different from those developed for potato in Canada, France and Argentina. The resulting NNI was calculated from this critical N dilution curve and was highly related to relative yield.. Therefore, the concept of a critical N concentration provides a reference method for assessing the status of N nutrition during crop growth in Northest Tunisia

Acknowledgments

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COMPARISON OF YIELD PARAMETERS FOR KABULI CHICKPEA (*Cicer Arietinum* L.) GENOTYPES WITH THE FERN AND UNIFOLIATE LEAF TYPES

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Abstract

This research was conducted to determine the yield parameters of ten unifoliate- and ten fern-leafed Kabuli chickpea (*Cicer arietinum* L.) cultivars and lines, during the years of 2010 and 2011, in Ankara (Turkey) conditions. The experiment was planned in a randomized, complete-block design with split-plot and three replications.

In the study, unifoliate- and fern- leafed cultivars and lines were evaluated for pod and seed number per plant, seed and biological yield per plant, seed and biological yield per hectare, and harvest index. Results showed that pod and seed number per plant, seed and biological yield per plant, and harvest index were not found to be significantly different between the unifoliate, and fern- leafed types. On the other hand, seed and biological yield between leaf types of chickpea were significantly different at the 0.01 level.

The seed yields of fern- and unifoliate- leafed chickpea cultivars and lines were 2030 kg ha^{-1} and 1560 kg ha^{-1}, respectively. The yield of the fern- leafed cultivar Inci was the highest with 2370 kg ha^{-1}. Biological yields of fern-and unifoliate- leafed cultivars were 5750 kg ha^{-1}, and 4580 kg ha^{-1}, respectively. The highest performance in biological yield was 6710 kg ha^{-1}, and was obtained with Canıtez cultivar in fern leaf.

Keywords: *Chickpea, fern leaf, unifoliate leaf, cultivars, traits*

Introduction

Chickpea (*Cicer arietinum* L.) is a self-pollinated, diploid, annual grain legume. It is one of the oldest annual grain legumes in the World. Chickpea seed is a major source of high-quality protein and carbohydrates in human diets. Chickpea maintains soil fertility through biological nitrogen fixation (Gan et al., 2003), and contributes to the agricultural sustainability of cropping systems in cereal-legume rotations (Miller et al., 2002).

Several morphological characters are used for classification of chickpea into two main market classes. The desi type, grown mainly in the Indian subcontinent, Iran and Ethiopia, is characterized by pink flowers and small (180-300 mg), usually angular, yellow-brown colored seeds. Desi cultivars account for about 85% of chickpea production, worldwide. The kabuli type is grown in countries of the Mediterranean region, West Asia, North Africa, Mexico, and more recently in Australia, and North America (FAO, 2004). It possesses white flowers, and large (200-680 mg), smooth, or wrinkled, light-colored seeds.

Kabuli chickpea has several leaf types including narrow leaflets, tiny leaflets, and bipinnate leaf, two of which are fern leaf and unifoliate leaf. The fern leaf is the most common leaf type, worldwide. The unifoliate leaf trait is controlled by a single gene (Muehlbauer and Singh, 1987). Multiple leaflets attached to a petiole characterize the fern leaf, while the unifoliate leaf is a single, large leaf attached to the petiole. The unifoliate leaf-type is associated with reduced resistance to ascochyta blight, a fungal disease caused by *Ascochyta rabiei* (Pass.) Labrousse (Gan et al., 2003). In some production areas, the fern leaf-trait may increase the green leaf area duration, compared to the unifoliate leaf trait (Anwar et al.,

2003). The distribution of genetic diversity in the kabuli is much narrower than in the more predominant, desi chickpea-type (Moreno and Cubero, 1978).

Evaluation of canopy architecture, and morphology, as selection criteria for chickpea, might increase yield. Leaf size in the upper canopy may affect yield response to plant population. Larger leaf size causing canopy closure was reported by Wells et al.(1993). Soltani et al. (2006) quantified the effects of temperature, photoperiod, and plant population, on plant leaf-area in chickpea, and developed a two-phase segmental model for leaf production per plant: Phase 1 when plant leaf number increases at a lower rate, and Phase 2, with a higher rate of leaf production per plant.

In this study, the following key questions were addressed:

Do fern and unifoliate leaf traits in kabuli chickpea differ in yield and associated traits?
Which leaf type, fern or unifoliate, is superior for seed production?

Materials and methods

Field experiments were conducted in 2010 and 2011, at Haymana Experimental Farm in Ankara (Turkey). In field trials, each plot consisted of four rows spaced 0.3 m apart. Each row was 5 m in length. The experiments were performed using a randomized complete block-design with split-plot and three replicates. Forty-five seeds were used per plot. Mean air temperature, rainfall, and relative humidity, were recorded on an automatic weather station near the plots at Haymana (Table 1). Types of soil in the experimental areas in 2010 and 2011 were clay-loam and clay, respectively.

Table 1. Rainfall (mm), mean temperature (^{o}C), and relative humidity (%): Haymana, Turkey, 2010 and 2011

Months	2010			2011		
	Rainfall (mm)	Mean temperature (^{o}C)	Mean relative humidity (%)	Rainfall (mm)	Mean temperature (^{o}C)	Mean relative humidity (%)
April	37	12	55	49	10	67
May	31	18	46	73	15	64
June	58	21	56	44	19	58
July	26	25	46	11	25	48
August	0	28	32	19	23	48
Total	152			196		
Mean		20.8	47		18.4	57

In this research, ten unifoliate-leafed (AkN 501, AkN 485, AkN 892, AkN 897, AkN 899, AkN 680, AkN 896, AkN 491, AkN 804 Küsmen 99), and ten fern-leafed (Gökçe, nci, Akçin, Sarı 98, Uzunlu 99, Er 99, Ya a 05, Damla 89, Canıtez 87 ve Dikba) kabuli chickpea cultivars and lines, were used as materials.

In the study, unifoliate- and fern-leafed cultivars and lines were evaluated for pod and seed number per plant, seed and biological yield per plant, seed and biological yields (kg ha^{-1}), and harvest index (%). Data were analyzed using analysis of variance in MSTAT-C software.

Results and discussion

Informative results indicated that significant differences (P < 0.01) were observed on the biological and seed yield between leaf type and genotypes. However, there were no

statistical differences determined between genotypes, and leaf type for pod number per plant, seed number per plant, seed yield per plant, and harvest index (Table 2).

Two-year results showed that pod-number per plant, seed-number per plant, seed-yield per plant, seed-yield, biological-yield, and harvest-index in fern leaf type were better than unifoliate leaf type, while biological yield per plant in unifoliate leaf, was higher than fern leaf type.

Table 2. Range, mean, general mean, maximum of observations in unifoliate and fern-leaf types in Haymana, Turkey, 2010 and 2011.

Traits		Types of leaf			
		Unifoliate		Fern	
		2010	2011	2010	2011
Pod numbers per plant (pods/ plant)	Range	17.7-51.3	20.0-37.0	23.0-68.7	20.7-49.0
	Mean	33.5	28.2	42.1	36.3
	General mean	30.9		39.2	
	$F_{(TL)}$	ns			
	$F_{(G)}$	ns			
	$F_{(TLXG)}$	*			
Seed numbers per plant (seeds/plant)	Range	16.3-46.3	17.0-36.3	20.0-72.7	21.7-40.7
	Mean	29.5	26.2	43.4	33.4
	General mean	27.9		38.4	
	$F_{(TL)}$	ns			
	$F_{(G)}$	ns			
	$F_{(TLXG)}$	**			
Seed yield per plant (g/plant)	Range	9.3-21.9	10.8-19.8	10.4-26.7	9.4-20.1
	Mean	14.8	13.3	19.5	17.8
	General mean	14.1		17.7	
	$F_{(TL)}$	ns			
	$F_{(G)}$	ns			
	$F_{(TLXG)}$	*			
Biological yield per plant (g/plant)	Range	31.7-57.7	47.3-70.0	25.3-61.0	49.1-60.1
	Mean	41.9	56.1	41.9	54.3
	General mean	49.0		48.1	
	$F_{(TL)}$	ns			
	$F_{(G)}$	ns			
	$F_{(TLXG)}$	ns			
Seed yield (kg ha^{-1})	Range	1150-1650	1470-2210	1500-2630	1620-2700
	Mean	1410	1710	2110	1950
	General mean	1560		2030	
	$F_{(TL)}$	**			
	$F_{(G)}$	**			
	$F_{(TLXG)}$	*			
Biological yield (kg ha^{-1})	Range	3620-5170	3980-5880	3860-6980	5310-7220
	Mean	4430	4730	5580	5920
	General mean	4580		5750	
	$F_{(TL)}$	**			
	$F_{(G)}$	**			
	$F_{(TLXG)}$	*			
(%) Harvest index	Range	27.5-42.5	30.2-57.6	35.0-43.2	26.6-38.8
	Mean	32.7	37.2	38.8	33.0
	General mean	34.9		35.9	
	$F_{(TL)}$	ns			
	$F_{(G)}$	ns			
	$F_{(TLXG)}$	*			

ns : Not significant; **: significant at 0.01,*: Significant at 0.05, TL: Type of Leaf, G: Genotype

Genotype × types of leaf interactions were significant (P< 0.05) for harvest-index, biological-yield, seed-yield, seed-yield per plant, and pod-number per plant, while genotype × types of leaf interaction for seed number per plant were all highly significant (P< 0.01).

Mean pod-number per plant in fern- and unifoliate-leafed chickpea were 39.2 and 30.9, respectively.In our study, pod number in fern-leafed types was greater than unifoliate-leafed types. Our results are in general agreement with reports by Poniedzialek et al. (2005), and Srinivasan et al. (2006) In the study, mean seed-number per plant ranged between 13.3-72.7. Kara (2003), Ba cı (2003), and Karaköy (2008) found 34.3-37.9, 22.5-28.9, and 18.0-31.4 seed-numbers per plant, respectively. Seed-yield per plant in fern chickpea was 17.7 g, while it was 14.1 g in unifoliate-leafed chickpea. Results from this research for seed-yield per plant confirm the results of the studies completed by Ba cı (2003), Kara (2003), Biçer ve Anlarsal (2004), and Çakır (2006). Mean seed yield was 1795 kg ha^{-1}. The yields were 1560 kg ha^{-1} in unifoliate-leafed, and 2030 kg ha^{-1} in fern-leafed chickpea. The yield of fern-leafed cultivars and lines in both years was more than unifoliate-leafed ones. Similar results in the yield of fern and unifoliate-leafed types were reported as 1900 kg ha^{-1}, and 930 kg ha^{-1} by Wichman et al. (2001), and as 1559 kg ha^{-1}, and 1002 kg ha^{-1}, by Short et al. (2002). And also Gan et al. (2006), reported similar results, indicating that yield of fern-leafed chickpea was 3 times more than unifoliate-leafed chickpea. In addition to this, mean biological yields were 4580 kg ha^{-1} in unifoliate- leaf type, and 5750 kg ha^{-1} in fern-leafed type (Table 2). Fern-leafed chickpea has greater mean biological-yield than unifoliate-leafed chickpea. Similarly, biological yield in fern-leafed chickpea was 306-818 g/m^2, and 300-771 g/m^2 in unifoliate-leafed ones, as reported by Vanderpuye (2010). Percentages of harvest index ranged from 32.7 % to 37.2% in unifoliate-leafed, and 33.3% to 38.8 % in fern-leafed types. Li et al. (2010) reported 33-51% of fern-leafed, and 20-35% of unifoliate-leafed chickpea for harvest index.

Correlation coefficients for yield components

Biological yield per plant had high and positive correlations with pod-number per plant (r= 0.738), seed-number per plant (r= 0.713), and seed-yield per plant (r= 0.760). Pod-number significantly correlated with seed-number per plant (r= 0.966), and seed yield per plant (r= 0.915). Seed number per plant had high positive influence (r= 0.923) on seed yield per plant. Seed yield was highly correlated with biological yield (r= 0.600), and percent harvest index (r= 0. 398). Biological yield was high and negatively correlated with harvest index (r= -0.478) (Table 3).

Table 3. Correlation coefficients for yield components

	BYP	PNP	SNP	SYP	SY	BY	HI %
BYP	1.000	0.783**	0.713**	0.760**	0.038 ns	0.022 ns	-0.013 ns
PNP		1.000	0.966**	0.915**	0.196 ns	0.012 ns	0.184 ns
SNP			1.000	0.923**	0.281 ns	0.062 ns	0.235 ns
SYP				1.000	0.242*	0.016 ns	0.237 ns
SY					1.000	0.600**	0.398**
BY						1.000	-0.478**
HI %							1.000

BYP: Biological-yield per plant (g/plant), PNP: Pod-number per plant (pods/plant); SNP: Seed-number per plant (seeds/plant); SYP: Seed yield per plant (g/plant); SY: Seed yield (kg da^{-1}); BY: Biological yield (kg ha^{-1}); HI %: Harvest index, ns : not significant; **: significant at 0.01,*: Significant at 0.05

Conclusion

The genetic base of chickpea is very narrow. For this reason, many studies are focused on expanding the genetic-base. Mutation is one of the breeding methods used to broaden the genetic base. Changes of the morphological traits for plant structure are sometimes applied as a method in plant breeding. Unifoliate-leafed chickpea developed by mutation, and fern-leafed chickpea (normal), were compared for yield and associated traits in this study.

Different plant types influence agronomical practices and yield compound. The fern-leafed chickpea is commonly grown for chickpea production, worldwide.

We conclude that the fern-leafed chickpea produced 30% more seed and 25% more biological yield compared to unifoliate-leafed chickpea. Unifoliate-leafed chickpeas can be used for increasing variation in Chickpea material.

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AN ALTERNATIVE PLANT PROPAGATION AND CONSERVATION PROCESS FOR *IRIS PAMPYHLICA* AN ENDEMIC AND ENDANGERED GEOPHYTE

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Abstract

Flowering bulbs have been used for ornamental purposes throughout history. Nearly 1000 geophytes are naturally grown in Turkey and many of them harvested from their natural habitats. Native flower bulbs are exported and this export has increased from year by year. Due to uncontrolled and excessive collection from wild, a large number of them are threatened with complete extinction. For this reason, different cultural propagation methods must be developed to assist the conservation of these plants. The genus *Iris* contains essential oils, has attractive flowers, and can be used ornamental and medicinal purposes. Vegetative or generative production is not efficient enough to reproduce *Irises*, however *in vitro* micropropagation is an alternative way to protect and propagate them. In this study, tissue culture techniques were applied for the vegetative propagation of *Iris pamphylica* which is an endemic and endangered geophyte of Turkey. Fresh bulbs and immature embryos were cultured on Murashige-Skoog (MS) medium supplemented with various combinations of BAP (6-benzylaminopurine), NAA (naphtalenacetic acid), 2,4-D (2,4-dichlorophenoxy acetic acid) or picloram (4-amino-3,5,6-trichloropicolinic acid). While plant production was achieved from bulb explants via direct organogenesis, the only callus formation or plant regeneration through indirect organogenesis was obtainable from immature embryo explants of *I. pamphylica*. The best results for shoot formation were acquired in an MS medium containing 2 mg L^{-1} BAP and 0.25 mg L^{-1} NAA for bulb explants. BAP- NAA combinations in the culture medium are more effective than 2,4-D or picloram in immature embryo culture. It was noted that immature embryo explants were more efficient than bulb explants for *in vitro* plant regeneration of *I. pamphylica*.

Key Words: *Iris pamphylica, alternative propagation, bulb, immature embryo*

Introduction

The genus *Iris* which is a member of *Iridaceae* family includes over 300 species, many of which have importance in horticultural and pharmaceutical industry (Kerasa et al., 2009; Wang et al., 1999a; Jevremovi and Radojevi , 2002). Several species of the genus contains volatile oils and xanthones that can be used for making perfume and medicine (Wang et. al., 1999a; Jevremovi and Radojevi , 2002; Al-Gabbiesh et. al., 2006). Various *Iris* species, having attractive flowers with different shades and colours, are also used for ornamental purposes in gardening and landscaping (Francescangeli, 2009; Jevremov i and Radojevi , 2002) The propagation of *Iris* species are generally performed vegetatively by splitting rhizomes or bulbs (Jéhan et. al, 1994). Large scale production of *Irises* limited due to issues such as poor seed production, germination problems, cross pollinations and the long juvenile period in the plant's development. For these reasons, vegetative production or reproduction by seeds alone, is not appropriate for commercial production of the desired *Iris* species (Boltenkov et.al., 2007; Wang et al., 1999a). *In vitro* micropropagation which is used for production of most herbaceous plants is also an alternative technique in *Iris* production, and

is, compared with conventional breeding, a more efficient and rapid method (Wang et al. 1999b; Al-Gabbiesh et. al., 2006; Boltenkov et. al., 2007). Several *Iris* species such as *Iris hollandica* (Hussey, 1976), *I. pumila* (Radojevi et. al., 1987), *Iris ensata* (Yabuya et. al., 1991; Boltenkov and Zarembo, 2005), *I. setosa* (Radojevi and Suboti, 1992; Boltenkov and Zarembo 2005), *Iris stenophylla* (Nasircilar et.al 2011) and *I. sanguinea* (Boltenkov and Zarembo 2005) have been propagated from flower stem (Hussey, 1976) mature embryos (Radojevi et.al., 1987), scapes (Yabuya et.al., 1991), different sections of flowers (Boltenkov and Zarembo, 2005) and immature embryo explants (Nasircilar et. al, 2011) via *in vitro* plant regeneration. *Iris pamphylica* (Figure 1a) which is a locally endemic and endangered geophyte of Turkey, displays beautiful purple flowers (Figure 1b). This species which has a restricted distribution between the Manavgat-Akseki districts of Antalya (Mathew, 1985; Kandemir et. al., 2011), and is listed in the endangered category of the Red Data Book of Turkish Plant (Ekim et. al., 2001). Due to its ornamental value and it is danger of extinction, strict protection and efficient production method should be developed. Although various *Iris* species were propagated via tissue culture, *in vitro* or *ex vitro* culture of *I. pamphylica* has not been to date. In this study an alternative production method, crucial for the protection of this endangered species is outlined.

Figure 1. a) *Iris pamphylica* plant in their natural habitat b) The flower of *Iris pamphylica*

Material and Methods

Plant materials

Iris pamphylica plants were collected from two different locations between the Manavgat-Akseki districts of Antalya in early spring. Two different parts; fresh bulbs and immature embryos of *I. pamphylica* were used as the explant sources for *in vitro* regeneration of the plant.

Sterilization and preparation of the bulb explants

After the bulbs of *I. pamphylica* were seperated from the plant, the roots and the outher scales were peeled and discarded. Before surface sterilization, the bulbs were washed in detergent thoroughly under running tap water. Surface sterilization of the bulbs was done in 80% commercial bleach with continuous stirring for 30 minutes and rinsed 3 times in sterile distilled water. After sterilization, bulbs containing the basal disc were cut into two or four sections depending on the size of the bulb. The explants were aseptically inoculated onto the Murashige and Skoog' s basal medium (Murashige and Skoog, 1962) supplemented with 1, 2 or 4 mg L^{-1} 6-benzylaminopurine (BAP) and 0.25 mg L^{-1} -napthalenacetic acid (NAA), 30 g L^{-1} sucrose and 7g L^{-} agar. The pH of all media was adjusted to 5.7 before autoclaving at

121ºC for 20 min. The cultures were kept at 25^0C±1 and under a 16-h (day)/8-h (night) photoperiod. Explants were transferred to fresh medium every month.

Sterilization and preparation of the immature embryo explants

Fruits containing immature zygotic embryos were immersed in 80% commercial bleach for 20 minutes and rinsed 3 times in sterile distilled water for surface sterilization. Immature zygotic embryos were removed aseptically from immature seeds using forceps under dissection microscope. The explants were placed on MS basal medium containing 1, 2 or 4 mg L^{-1} 6-benzylaminopurine (BAP) and 0.25 or 0.5 mg L^{-1} -napthalenacetic acid (NAA), 1.0, 2.0 mg L^{-1} 2,4-D or 1.0, 2.0 mg L^{-1} picloram, 30 g L^{-1} sucrose and 7 g L^{-1} agar. The pH of all media was adjusted to 5.7 before autoclaving at 121ºC for 20 min. The cultures were kept at 25^0C ±1 and under a 16-h (day)/8-h (night) photoperiod. Explants were subcultured every month. All the treatments were replicated three times with 3 explants per replication. Callus and shoot formation rates from both explant types are expressed as a percentage.

Results and Discussion

Some plant species are faced with complete extinction due to destruction of their natural habitats with various reasons and excessive amount of illegal collection from the nature (Kesici et.al., 2010; Karagüzel et.al., 2012). *I. pamphylica*, an endemic *Iris* species, is endangered due to the same reasons. It has a restricted distribution area and propagates limited numbers of seeds. During the three years of this study, only a small number of seed bearing plants have been found in the field trips. *In vitro* cultivation techniques were developed as an alternative system to protect rare and endangered species, including *Irises.* In previous studies*, in vitro* plant regeneration via embryogenesis or organogenesis after callus induction had been reported in various *Iris* species (Hussey,1976; Wang et. al., 1999a; Al-Gabbiesh et.al., 2006; Boltenkov et. al., 2007; Kerasa,et.al., 2009;). In this study two different parts, fresh bulbs and immature embryo of *I. pamphylica* were used the explants sources.

Shoot Regeneration from Bulb Explants

Due to an endangered species, only a few bulbs of *I. pamphylica* were collected in their natural habitats and a limited number of examinations were performed. The explants which were prepared by cutting two or four pieces with basal disc were cultured on MS medium supplemented with various concentrations of BAP (6-benzylaminopurine) and NAA (naphtalenacetic acid). Shoot regeneration was formed on the basal disc of the bulb explants and plant production was achieved via direct organogenesis. The percentage of shoot regeneration varied according to the medium which were supplemented with different amount of BAP and NAA (Table 1). The highest shoot formations were obtained in the MS medium containing 2 mg L^{-1} BAP and 0.25 mg L^{-1} NAA. Shoot formation frequency was 50 % in this medium.

Table 1. The percentage of shoot formation from bulb explants of *I pamphylica*

Plant growth regulators (mg L^{-1})		Frequency (%) of shoot formation
BAP	**NAA**	
1	0 .5	33.33
2	0.5	33.33
4	0.5	16.66
1	0.25	0.00
2	0.25	50.00
4	0.25	16.66

Van der Linde et al. (1988) obtained *in vitro* shoot formation from bulb scale explants of *Iris hollandica* on a half concentrations of MS salts at 20°C in the dark. Nasircilar et.al (2011) also achieved *in vitro* plant regeneration from bulb explants of *Iris stenophylla* on MS medium supplemented with 1,2,4 mg L^{-1}BAP and 0.25 mg L^{-1} NAA. 1 mg L^{-1} BAP and 0.25 mg L^{-1} NAA was found the best hormonal composition for shoot regeneration in their study. Although bulb explants are commonly used as an explants sources to produce many geophytes, bacterial and fungal contaminations were the main problem in *in vitro* plant propagation from the bulbs (Mirici et. al., 2005). Because the same problem, no shoot regeneration was obtained on MS medium containing 1 mg L^{-1} BAP and 0.25 mg L^{-1} NAA from the bulb explants of *I. pamphylica*.

<div align="center">Callus and Shoot Regeneration from Immature Embryo Explants</div>

The *in vitro* tissue culture system provides an artificial microenvironment for different explant types to develop and grow. Factors such as media composition, light, humidity, temperature and explant type affect to callus and plant regeneration *in vitro* conditions (Al-Gabbiesh et.al., 2006). Culture mediums of auxin and cytokinin combinations are especially effective in callus formation and plant regeneration (Wang et.al., 1999a; Al-Gabbiesh et.al., 2006) In our study; BAP, NAA, picloram and 2,4-D were used as the plant growth regulators for callus and shoot formation from immature embryo explants. Although callus formation (Figure 2) was achieved in all tested media, shoot regeneration through indirect organogenesis (Figure 3b) were obtained only on MS medium supplemented with BAP and NAA (Table 2). BAP and NAA combinations in the culture medium resulted in higher callus and shoot formation frequency in comparison with picloram or 2,4-D (Table 2). The colour, structure and growth characteristics of the callus may differ according to the plant species (Al-Gabbiesh et. al., 2006). In our study, after two months of culture initiation, yellow (Figure 2), creamy or white (Figure 3a) rigid callus structures were obtained in different hormonal combinations. Previous studies reported that the presence of 2,4-D and kinetin in the culture medium stimulated callus formation in some iris species (Boltenkov et.al., 2007; Shimizu et al.1997; Wang et.al., 1999a). After callus formation, shoots were developed on callus surface and plant regeneration was acquired via indirect organogenesis (Figure 3b). No shoots were obtained in the presence of 2,4-D or picloram. Boltenkov et. al. (2007) also reported that adventitious shoot formation from the callus of *I.ensata* required the absence of 2,4-D in the medium similarly, thus cytokinins are more important than auxins in the regeneration of this species.

Table 2. Callus and shoot formation from immature embryo explants of *I pamphylica*

Plant growth regulators (mg L^{-1})		Frequency (%) of callus formation	Frequency (%) of shoot formation
BAP	**NAA**		
1	0.5	66.66	33.33
2	0.5	100.00	100.00
4	0.5	100.00	100.00
1	0.25	100.00	100.00
2	0.25	100.00	100.00
4	0.25	100.00	100.00
Picloram			
1		22.22	0.00
2		44.44	0.00
2,4-D			
1		66.66	0.00
2		66.66	0.00

Figure 2. Callus formation from immature embryo explants of *Iris pamphylica* on MS medium containing 2 mg/l picloram
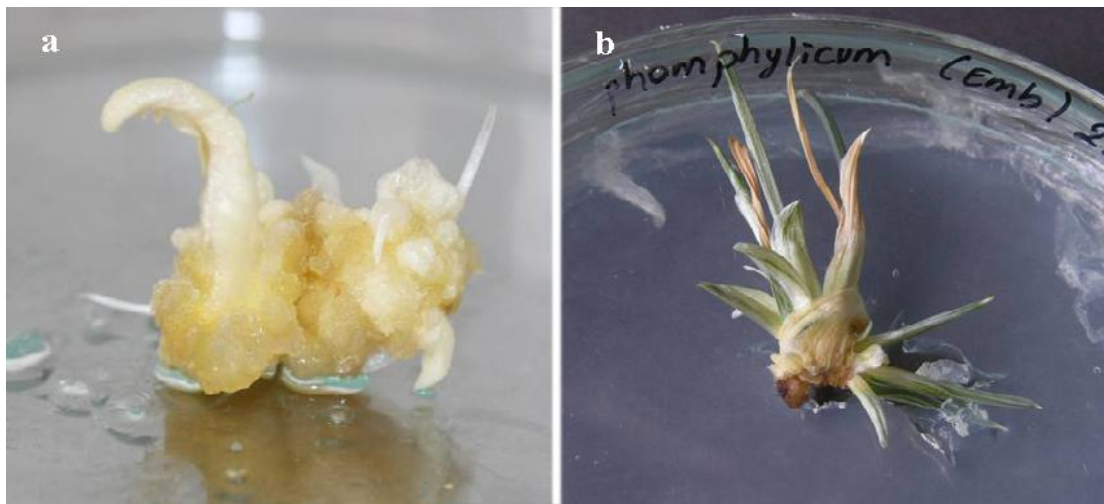
Figure 3. a) Callus and b) shoot formation from immature embryo explants of *Iris pamphylica* on MS medium containing 2 mg L^{-1} BAP and 0.25 mg L^{-1} NAA

Conclusion

The objective of this study was described as an alternative plant production system for conservation of *Iris pamphylica* via *in vitro* micropropagation. The results showed that the immature embryo explants were more efficient than bulb explants for in vitro plant regeneration of *I. pamphylica.*

Acknowledgement

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DETERMINATION OF YIELD AND YIELD COMPONENTS OF SOME VARIETY AND POPULATIONS ON FALSE FLAX (*Camelina Sativa* L. Crantz.) IN TURKEY

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Abstract

The aim of the study was to compare yield and yield components of a variety and populations of false flax obtained from Directorate of Thrace Agricultural Research Institute under Ankara ecological conditions. Although variations in number of branches attached to main stem and number of seeds in the pod among genotypes were found statically insignificant. Variations in blooming date, initial flowering date, plant height, number of pod, seed yield, thousand seed weight, crude oil content and oil yield among genotypes were found statistically significant. Number of branches attached to main stem ranged 8.00 (Giessen Nr.3 variety) to 10.66 (CSS-CAM37 genotype). The number pod in the main stem varied from 22.33 to 29.00 and the highest number of pod was noted on CR 476/65 and CS-163-2073-72 genotypes. The highest number of seeds per pod was determined as 13.33 (CS-CR1670 genotype). The seed yield of false flax genotypes ranged 107.20 to 149.50 kg/da (CR 476/65). Thousand seed weight of genotypes differed from 0.67 g to 0.87 g; and crude oil contents varied from 39.91 – 49.47 % (CR 476/65). Also, the highest oil yield (74.28 kg/da) was determined in the same genotype. In conclusion, CR 476/65 genotype showed the best performance in terms of seed yield, crude oil content and oil yield point of view among to genotypes. Moreover, Giessen Nr.3 false flax variety and CS-CR1676, CS-CR1670 and NE2006-1 genotypes also followed CR 476/65 genotype respectively.

Key Words: *False Flax, Camelina sativa L. Crantz., Crude Oil Content, Seed Yield, Oil Yield*

Introduction

Production of oil seed is inadequate and oil deficit is met through imports in Turkey. Although there exists suitable climatic and soil conditions for growing alternative oil crops. the desired production level has not reached in Turkey,. Camelina (*Camelina sativa* L.) grown in a warm climate zone, with 85 to 100-day vegetation is an oil plant. It is germinated at low temperatures and its freezing tolerance is high. Because its input are far less compared to many plants and it is easy to grow. The crop is resistant to drought conditions. Therefore, areas receiving low rainfall are more suitable for crop compared to other oilseed crops (Vollmann et al., 1996). It demands smaller amount of humidity and nutrients, so it can be also grown easily in fallow areas. False flax is extensively grown in the North West Montana of the United States of America (USA). The studies conducted in the USA, Germany, Estonia and England show that the seed yield of false flax varies between 80-400 kg/da depending on the climate and soil of the region, sowing density and nitrogen fertilization. (Agegneh and Honermei 1997; Akkar and Iluma 2005; Koncıus and Karcauskı 2010; Pan et al., 2011). In addition, false flax, has a high adaptability, can be grown in different regions. The oil obtained from the seeds of false flax, contains high linolenic acid (35%) and omega-3 fatty acid. False flax seeds, meal and flour rich in protein is used in cattle feed. The seeds can be consumed as appetizer. Also, it is a valuable green manure crop (Jones and Valamot, 2005).

Short-chain fats in the presence of the catalyst reacts with an alcohol releases a product. The product is called as biodiesel fuel. In recent years, due to increase in world oil prices the developed countries   have started to find alternative new fuel sources.   False flax is a promising sustainable alternative energy crop.   False flax is a promising sustainable alternative energy plant. The highly abundant oil of its seeds can be converted into high-quality   diesel and jet fuel. Ataki i (1991) reported that, false flax plants grown in the summer season has vegetation period of 130-150 days, plant height (40-70 cm), around 32% of the oil in the seed, thousand seed weight of 0.7-1.6 g and seed yield of 100 kg /da.

Zuber (1997) stated that false flax could be grown in marginal areas and is adaptive to extreme climatic conditions and is also drought-resistant plant. Karahoca and Kırıcı (2005), investigated effects of different nitrogen and phosphorus doses on seed yield and oil content of false flax under Adana ecological conditions as an alternative oil plant. Up to applications of 15 kg / da nitrogen and 10 kg / da, seed and oil yield increases were not found. The highest seed yield (256 kg / da) was determined in to 20 kg / da nitrogen and 20 kg / da phosphorus applications. Kurt and Seyis (2008) reported that false flax thousand grain weights varied between 0.8-1.8 g, plant height fluctuates between 25-100 cm and number of seed per pod changed between 8-16 units. Johnson et al. (2008) studied optimal sowing density of false flax lines at different locations in Western Canada. This trial made use of 12, 25, 50, 100, 200, 400, 800, 1600 seeds / m² of false flax sowing. Seed yield increased with increasing sowing density, However when 400 seeds / m² was applied seed yield was stabilized. Seed yields dramatically decreased at 800 and 1600 seeds / m² applied.

Katar et al. (2012), determined the yield and some agronomic characters of 11 false flax varieties under Ankara conditions. In two years, the highest thousand seed weight and seed yield were obtained from a variety of Ames 26673, the highest values in other yield components were determined in Vniimk 17 varieties. Koç (2014), stated the highest seed yield of 5.78 g/ plant per plant   on harvesting on 20th of September and the the lowest seed yield of 0.25 g / plant   on 10th April sowing time. The highest oil percent   (37.55 %) was determined on 19th of October sowing time and the lowest oil percent   was 22.72 % planted on 10th of April. The aim of the study was to compare yield and yield components of a variety and populations of false flax obtained from Thrace Agricultural Research Institute under Ankara ecological conditions.

Materials and methods

In the study, one false flax cultivar (Giessen Nr.3) and 10 different false flax lines (Vniimk 17, No.402, C 476/65, CS-163-2073-72, CS-CR1670, CS -CR1676, CPS-CAM10, CSS-CAM30, CSS-CAM37, NE2006-1) were collected from different countries and conserved in USA. gene bank were used as material. The seeds were obtained from Thrace Agricultural Research Institute, Edirne, Turkey.

This research was conducted using randomized block design with 3 replications at the experimental fields of Ankara University, Faculty of Agriculture and Department of Field Crops, Ankara University, Turkey in 2013. The seed were sown to seed bed opened using marker at 35 cm row spacing. Each plot consisted of 3 m length and 4 row spacing's. Trial was conducted in 33 plots. The plants were harvested and threshed y hand.

Temperature and relative humidity values of 2013 were greater compared to average of long years. Although annual rainfall of 2013 is higher than long-term average low rainfall has been in May and June. Therefore irrigation has been required in May and June of 2013. Soil structure of trial areas is clay loam with slightly alkaline characteristics.

The seeds were sown by hand on 11 April 2013. The sown seeds were covered with soil and to provide better contact and to prevent bird damage, trial area was quenched by the cylinder. During the sowing, 4 kg /da pure nitrogen to be (DAP fertilizers applied) and 3 kg / da of

phosphorus (P2O5) as base fertilizer and prior to flowering and 4 kg / da pure nitrogen (ammonium nitrate fertilizers) top fertilizer by hand sprinkling were applied. The seed started to germinate from 27 April 2013. The plants were harvested on July 4 2013 considering cracking of pods and physiological maturity level. The data were analyzed with a randomized block pattern (Duzgunes et al., 1987) using the MSTAT-C statistical software package. Duncan' s multiple comparison method was used in the determination of different groups. Variations in blooming date, initial flowering date, plant height, number of pods, seed yield, thousand seed weight, crude oil content and oil yield among genotypes were found to be statistically significant, although variations in number of branches attached to main stem and number of seeds in the pod among genotypes were statistically non significant.

Results and discussion

The measurement and observations related to the examined characters were performed according to the literatures (Dogan and Polity, 1985; Ozer 1996; Karahoca and Kırıcı 2005; Kurt and Seyis 2008; Mason, 2009). Analysis of variance of the results related to germination days, (day), beginning of flowering (days), plant height (cm), number of branches on the main stem (units); number of pod on the main stem, number of seed on the pod (unit), seed yield (kg / da); thousand grain weight (g); crude oil percent (%) and oil yield (kg / da) of different false flax genotypes sown under Ankara ecological conditions, are given in Table 1. Statistical differences among germination dates of genotypes were significant at p<0.01 level. The earliest germinated genotype was CSS –CAM with 15.67 days.

The latest germinated genotype is CS-CR1676 with 19.00 days. Statistical differences among beginning of flowering dates of the genotypes were statistically significant at p<0.01 level. The earliest days of the flowering is CSS with 45.67 days. The latest flowering genotype is CS-cr1676 with 48.67 days. Differences among the genotypes with respect to plant height were statistically significant at the 0.05 level. Vniimk has the longest plant height 17 (63.33 cm) and the shortest plant height (52.67 cm) was obtained from NE2006-1.

Genotype differences in terms of the number of branches on the main stem were not statistically significant. When compared to genotypes; The maximum number of branches on the main stem with 10.66 was obtained from CSS-CAM 37, least number of branches on the main stem with 8:00 was determined in Giessen Nr.3 variety. Number of branches on the main stem of the other genotypes was ranked between these two values.

Table 1 Variance analysis results in germination date (days), flowering date (days), plant height (cm), number of branches per main stem, number capsules of per main stem, number of seeds per capsule, seed yield (kg/da), 1000 seed weight (g), crude oil contents (%) and oil yield (kg/da) of false flax genotypes

Source of variation	DF	Date of germination	Flowering date	Plant height	Number of branches per main stem	Number capsules of per main stem
Blocks	2	0.758	1.121	54.758	1.909	3.364
Cultivars	10	3.024**	2.230**	29.455*	1.285	18.406*
Error	20	0.224	0.321	11.891	1.676	7.797
Grand total	32					
CV (%)		2.81	1.21	5.88	13.56	11.21

Source of variation	DF	Number of seeds per capsule	Seed yield	1000 seed weight	Crude oil contents	Oil yield
Blocks	2	0.121	2646.798	2646.798	14,825	692.526
Cultivars	10	3.352	501.850*	501.850**	28,110*	170.356**
Error	20	2.888	162.323	162.323	9,172	41.535
Grand total	32					
CV (%)		15.16	10.13	7.10	6.60	11.16

*p<0.05   **p<0.01

Differences among genotypes in terms of number of pod on the main stem were statistically significant at the 0.05 level. Considering number of pod on the main stem; C 476/65 and CS-163-2073-72 genotypes had the maximum value of 29.00 and the least number of pod on the main stem (22.33) were identified in Vniimk 17. Differences among the genotypes number of seed in the pod were not statistically significant. Number of seed in the pod were obtained from genotype were CS-CR1670 with 13:33 and NO.402, NE2006-1 varieties with 10:00 unit. Seed yield differences among the genotypes were found to be statistically significant at p< 0.05 level. The highest seed yield (149.49 kg / da) was obtained from CR 476/65, while the lowest seed yield (107.24 kg) were determined in CSS-CAM30. Giessen R.3 (139.00 kg / da), CS-CR1676 (135.14 kg / da), CPS-CAM10 (132.72 kg / da), NE2006-1 (129.11 kg / da) and CS-CR1670 (126.33 kg / da) had genotypes with high seed yield when compared to other genotypes. NO.402 (123.23 kg / da), CS-163-2073-72 (115.82 kg / da), Vniimk 17 (114.41 kg / da) and CSS-CAM37 genotypes (111.45 kg / ha) had the less seed yield genotypes respectively. Thousand grain weight in terms of genotype differences were statistically significant at p<0.01 level Vniimk 17 had the highest thousand seed weight (0.8733) g and the lowest thousand seed weight (0.6667 g) was determined in CSS-CAM37 genotype. Differences among the crude oil percent of genotypes were significant at the p<0.05 level. The highest oil percent (49.47%) was found in C 476/65, the minimum oil percent (39.91%) was determined in NO.402 genotype. Other genotypes in terms of crude oil percent lied between these two values were ranked. CS-CR1670, (49.00%), NE2006-1 (48.11%), CSS-CAM30 (47.97 %), CS-163-2073-72 (46.39%), CS-CR1676 (46.32%) and CSS-CAM37 (46.18%) gave the best crude oil rate; whereas, Giessen Nr.3 (45.16%), Vniimk 17 (44.90%) and CPS-CAM10 (40.97%) were identified low oil content genotypes. Genotypes in terms of oil yield differences were also statistically significant at p<0.01 level. The maximum oil yield (74.28 kg / da) was found in C 476/65 and the lowest oil yield (49.36 kg/da) was determined in NO.402. Genotypes which have high oil yield were CS-CR1676 (62.54 kg / da), Giessen Nr.3 (62.41 kg / da), NE2006-1 genotype (61.95 kg / da) and CS-CR1670 genotype (61.79 kg / da).

Conclusion

It can be concluded that CR476/65 genotype showed the best performance in terms of seed yield, oil content, oil yield, and crude oil percent compared to other genotypes tested under Ankara ecological conditions. Giessen Nr.3, CS-CR1676, CR1670 and NE2006-CS-1 genotypes had high seed yield followed by other genotypes.
As a result of the study, false flax was determined as a crop which was highly adaptive to extreme conditions in terms of plant nutrients deficiency. There is less need to use chemical herbicides, because it competes well with weeds. The crops can be grown as a good rotational crop with cereals such as wheat under Central Anatolia Region conditions. The high fat content in seeds can be too converted to high quality fuels such as diesel and jet fuel.

Considering all these advantages; the crop can be easily grown once suitable regions are determined for characteristics like sowing time, sowing, fertilizer doses and correct farming techniques. The best regions of false flax plant, sowing time, sowing, fertilizer doses, the correct farming techniques, and providing seeds of false flax varieties to farmers is desirable. Therefore, it is recommended that researches and studies should be done on false flax by the universities, both at public and private sector and local research organizations to determine suitable varieties, cultivation techniques and to induce strategies for increasing seed yield that will definitely end up in increased oil yield.

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EFFECT OF PLANT VARIETY AND GROWING METHODS ON YIELD AND QUALITY IN SUMMER SQUASH

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Abstract

The impact of different growing methods on yield and quality of some summer squash varieties was carried out at Küçük Menderes Basin conditions (38° 16' North and 27° 59' West), in Ege University, Ödemis Vocational College (altitude 123 m) –(sandy loam soil).
This study was conducted one production season, three different cultivation methods and three different squash varieties yield and quality characteristics in randomized block design with three replications. Each plot had 15 plants. Cultivation of squash varieties was carried out in order to determine the performance. Results of this study, the varieties had statistically significant effects on yield; on the other hand cultivation methods did not affect the yield statistically significant. Maximum efficiency was obtained from under cover of the type of ST-07-6001. However, under cover of the cultivation methods was the most important application. The highest yield was obtained from V1. Moreover, increasing the yield of fruit in fruit diameter increased. Applications with the highest fruit yield had higher diameter. Also the increase in fruit length also increased fruit diameter.As a result, these two characters are related to the increase in fruit size also increased yield. Highly efficient ST-07-6001, V1 and cultivation under cover as a result of this study is defined as two applications that can be recommended to local farmers.

Keywords: *Cucurbita pepo L., cultivation methods, varieties, yields*.

Introduction

Squash is a vegetable included in *Cucurbita* genus of the family *Cucurbitaceae*. Squash growing season and evaluated according to their characteristics in terms of which differ significantly from other vegetables is a summer vegetable. In squash, fruits, shapes, sizes, colors, and pulp characters are significantly differs among the varieties. Sakız and Girit were summer squash varieties long considered the normal harvest the fruits vegetables circuits are required diameter of 10-25 cm (Vural et al., 2000; Yolda et al., 2000; Kaygısız et al., 2006). In Turkey, annual squash production is 293,709 tons (Anonymous, 2013). Hybrid varieties have higher yield and earliness than open-pollinated varieties. In spring, summer squash can be planted in the field after danger of late frost. In the production of vegetable species and varieties differ due to their adaptation to the local culture is a very important pre-adaptation of the work done (Robust and Fidan, 1995). Summer produced, with strong vegetative growth, as in many types of vegetables on a regular and timely irrigation and fertilization significantly affect yield. Mohammad (2004), application of high nitrogen levels and the limited number of fruit juice and fruit number and decreased yield are reported to be a strong relationship between the yields. The consumption of fresh berries of summer squash seeds fresh and soft because it is more preferable compared to large fruit (Handenburg et al., 1986; Kaygısız et al., 2006). The study was conducted to determine the yield and quality under field conditions with three different cultivation type and three different squash varieties.

Materials and Methods

The study, under the conditions of Küçük Menderes Basin (38° 16' North and 27° 59' West), Ege University, Ödemis Vocational College (altitude 123 m) with sandy loam soil was carried out on the land.

Squash varieties (*Cucurbita pepo* L. var. STR-07-6001 F1-V1-, Eskendery-V2-and black squash-V3-) and different breeding shape (under cover seeding-UCS-, open conditions sowing-OCS-and seedling production with-SP-) seed were used in this study which was conducted in spring (on March 22).

Sowing the seeds of tubes peaks was carried out by placing the seeds drop by 2 seeds.

In the undercover production, after sowing, lines were covered by a thin polyethylene film (which is used early watermelon production to cover tunnel) and when the polyethylene film was touch the plants, small holes opened on the coating material, then coating material on plants was completely removed.

The production of seedlings was also carried out on the same day. Seedlings of the squash were planting in plots. Each plot was consist of 15 plants. Plants were planted on 100×50 cm distances. There was 2 m distance between each parcel and border squash plants were planted around the each parcel.

Study was carried out according to a randomized complete block design in 3 replications. 250-300 kg/ha 33% Ammonium Nitrate, 200-250 kg/ha TSP, commercial fertilizer was applied with 200 kg/ha of potassium sulfate in plots. In the study, during plant growth and manually cleaned weeds, watering was performed regularly.

Soil samples were taken from the experimental area and analyzed by standard methods (Lindsay et al., 1978; Bremner, 1965; Bouyoucos, 1962; Bingham, 1949). Physical and chemical properties of soil of experiment field are given in Table 1.

Table 1. Physical and chemical properties of soil.

		(0-30cm)	**(30-60cm)**
pH		7,15	6,86
Salt	(%)	0,03	0,03
O.M.	(%)	0,57	0,77
CaCO$_3$	(%)	0,56	0,64
Sand	(%)	84,92	76,92
Clay	(%)	2,72	2,72
Silt	(%)	12,36	20,36
Structure		Sandy	Sandy
Total N	(%)	0,12	0,13
Available P	(ppm)	0,22	0,25
Available K	(ppm)	71	70
Available Ca	(ppm)	1500	1486
Available Mg	(ppm)	485	480
Available Fe	(ppm)	4,92	4,80
Available Mn	(ppm)	2,81	2,15
Available Zn	(ppm)	3,22	2,85
Available Cu	(ppm)	0,49	0,52
Available Na	(ppm)	9	9

According to Table 1, soil test area is neutral reactions. Available K contents of soil are normal; the amount of available P was deficient. Calcium content was determined as medium in the field trial; Mg contents are in good condition. Fe, Cu, Mn and Zn were found satisfactory.

In the experiment, the yield (kg/ha), weight of per plant (g), number of fruit per plant, the average fruit weight (g), fruit diameter (cm), fruit length (cm), and dry matter (%) determining values was detected. The data is rated from TAR ST statistical package program (Açıkgöz et al., 1993).

Results and Discussion

Yield and Yield Criteria

Yield and yield criteria of the experiment are presented in Table 2.

Table 2. Yield and yield criteria

Applications	Total yield (kg / ha)	Weight of per plant (g)	Number of fruit per plant (units)	Fruit weight (g)	Fruit diameter (cm)	Fruit length (cm)	Dry matter (%)
Cultivation method							
UCS	61942,1	3097,10	18,33a	175,99	4,44	16,02	6,62
OCS	52116,1	2605,81	16,63a	160,92	5,09	16,22	7,22
SP	40027,1	2001,36	9,96b	197,67	5,28	16,881	5,32
LSD%5	Ns	Ns	5,58*	Ns	Ns	Ns	Ns
Variety							
V1	64556,3a	3227,82a	19,66a	175,91	5,11	15,75	4,29b
V2	52723,7a	2686,19a	15,20ab	183,91	4,87	16,29	8,45a
V3	35805,3b	1790,27b	10,07b	174,77	4,83	17,09	6,43a
LSD%5	17858,7*	892,93*	5,68*	Ns	Ns	Ns	2,12**
Interactions (Growing method x cultivar)							
UCS X V1	79721,1	3986,06	27,00	147,86	4,40	15,19	4,59
UCS X V2	63664,9	3183,25	16,07	196,98	4,57	15,05	9,80
UCS X V3	42440,2	2122,01	11,93	183,14	4,37	17,00	5,47
OCSX V1	63473,2	3173,66	20,00	172,48	4,90	16,13	4,22
OCS X V2	53579,5	2678,98	19,77	128,03	4,97	15,64	10,04
OCS X V3	39295,6	1964,78	10,13	182,26	5,40	17,09	7,40
SP X V1	50474,6	2523,73	11,97	207,39	6,03	16,75	4,07
SP X V2	43926,8	2196,34	9,77	226,71	5,07	17,97	5,50
SP X V3	25680,1	1284,01	8,13	158,92	4,73	16,55	6,40
LSD%5	Ns	Ns	Ns	44,93**	Ns	Ns	Ns

As the total yield characters, variety of factors was found statistically significant, growing method x variety interaction was not significant statistically (Table 2). Growing method

factors examined, the highest yield of UCS (61942,1 kg/ha), while the lowest value was 40027,1 kg has the SP.

V1 took first line with 64556,3 kg. The others varieties V2 and V3 have been followed (52723,7 kg and 35805,3 kg, respectively).

As for interaction, the highest values are obtained from the UCSxV1 (79721,1 kg). The lowest value was obtained from the interaction SPxV3 (25680, 1 kg).

Yolda et al. (2000), in their study, the total yield was found 6856-10033kg / da. These values were recorded as higher than our study. Ertek et al. (2004) were investigated the effects of irrigation on the yield of squash (*Cucurbita pepo* L.), 22.40 to 35.00 t / ha were obtained between the values. These yields were recorded lower than the values obtained in our study. Rulevich et al. (2003) investigated the effects in field conditions black polyethylene mulch and well established on the polyester coating on low plastic tunnels with two squash varieties. These applications and combinations create in comparison with the control plot goes, early and total yield of fruit have.

In the study, control parcel gets better results (45% yield increase). The obtained data are not correlated with our results. However, application of mulch to control rates of 19% in the plots, with the use of cover material provides a 16% increase in efficiency. SP increase the number of fruits per plant of applications that have defined. These results obtained in this study are consistent with the results.

Weight of per plant, the total yield showed similar values; the highest values were obtained in UCS and V1 applications (3097.10 and 3227.82 g, respectively).

In the character number of fruit per plant, weight per plant and total yield results were parallel with the values obtained. The highest values of UCS, V1 with applications UCSXV1 interactions were obtained from V1 (respectively 18.33, 19.66, 27.00). However, there was no statistically significant interaction. Important factor in increasing the number of fruits that increase yield, increased fruit yield also increased with the number was determined.

Dunwell et al. (2001) stated the necessity of regular watering in the growing season to increase efficiency to prevent the size and shape of the weak plants.

Average fruit weight in terms of character compared to growing method; The SP had the first place with 197.67 g value, while it was 175.99 g and 160.92 g in UCS following OCS took last place, statistically significant difference was found between applications. When assayed for this property of varieties, fruit weights obtained as 174.77 g - 183,91g of this character in terms of interaction between the recorded and noted to be statistically significant (Table 2).

Ercan and Kurum (2003) viewed plants, flowers, fruits and seed characters in summer squash, and fruit weights were detected between 112.60 - 162.40 g; Ertek et al (2004) found fruit weights between 186 to 219 g; Yolda et al. (2000) have the record of fruit weight between 319-396 g.

Nerson (2005), investigated fruit shape and plant density on seed yield and quality in their study, and the effect of the average fruit weight were determined as 0.8 to 1.4 kg.

Growing method practices are detected in terms of fruit diameter as 4.44 to 5.28 cm, and the length of the fruit between 16.02 to 16.88 cm, when it comes to variety of applications; fruit diameter determined from 4.83 to 5.11 cm, and growing method variety applications; the length of fruit from 15.75 to 17.09 cm. When investigated for application interaction 4.37 to 6.03 cm and the length of the fruit from 15.05 to 17.97 were recorded as centimeters.

Ertek et al (2004), were detected fruit diameter from 4.09 to 4.44 cm; and fruit size as 15.26 to 15.87 cm. Ercan and Kurum (2003), were determined fruit diameter from 3.70 to 4.55 cm; and fruit size as 13.64 to 15.32 cm. Yolda et al. (2000) had measured 3.40 to 5.97 cm diameter of the fruit; 13.6 to 22.8 cm in length. Applications with high fruit diameter and high efficiency is achieved is recorded. Also the increase in fruit length increased fruit diameter. As a result, the increase in both the yield increased characters.

Dry matter (%) character is analyzed, and the variety factors found statistically significant effect on these character, breeding and growing method x variety interaction was not significant statistically (Table 2). The highest value of OCS with the value of 7.22 %, the lowest value had measured with the SP (5.32 %,).

Conclusion

Küçük Menderes Basin and in conditions of cultivation of squash varieties carried out in order to determine the performance results of this study. The varieties that yield statistically significant effects, cultivation methods did not affect the yield statistically significant.

However, under cover of the cultivation methods, the most important application in obtaining high yields, respectively. The highest yield was obtained from V1. The increase in fruit length also increased fruit diameter. As a result, these two characters are related to the increase in fruit size also increased yield.

As a result of this study, ST-07-6001, V1 and cultivation under cover is defined that can be recommended to local farmers in Küçük Menderes Basin.

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EFFECTS OF DIFFERENT NITROGEN DOSES ON THE NUTRITIONAL MINERAL CONTENT OF FIELD PEA SEEDS

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Abstract

The purpose of this study was to determine the effects of different nitrogen doses (0-30-60-90 kg ha^{-1}), applied at different growth periods, on the nutritional ingredients of field pea seeds. In this experiment, Furkan cv. pea (*Pisum sativum ssp.* a*rvense*) as the plant material and ammonium sulfate (21% N) fertilizer as the nitrogen source were used. This study was established as a randomized complete block experimental design and was carried out in irrigation conditions in 2013. Plants were irrigated four times during the growing period; the first irrigation as sprinkler and the others as drip irrigation. Nitrogen applications were made, 30 kg ha^{-1}, at three different growing stages; one week after sowing, at the stage when the first bunch was flowering and at the time when 50% of the plots were flowering. According to result of this study, effects of the application of nitrogen doses were found significantly important ($P < 0.05$) on calcium content of field pea seeds. The effects of the application of nitrogen doses were not significant ($P > 0.05$) on the content of cobalt, molybdenum, boron, cadmium, copper, iron, potassium, magnesium, manganese, sodium, nickel, phosphorus, sulfur, zinc, and nitrogen in field pea seeds.

Key words: *Field pea, nitrogen doses, nutritional minerals, seed*

Introduction

The population of Turkey is increasing as is also the world population. Malnutrition of human causes health and social problems in all over the world. In a balanced diet program 1g protein per kg needs to be consumed daily (Avcıo lu et al., 2000). The products of animal origin are coming from 14.5 million bovine (cattle, cow etc.) and 38.5 million caprine in order to get a balanced diet for this ever increasing population (sheep or goats) (Anonymous, 2013). Turkey has 23.8 million hectares of arable land in total and 2.7 million hectares of this land is used for forage crops production (Anonymous, 2012). Most of the hay needed comes from forage crops in this country.

In Turkey mostly grown forage crops are silage maize, alfalfa, vetch and sainfoin. In recent years, some field pea varieties have been released in our country and field pea is started to become an important forage crop.

Field pea is a cool season plant and its adaptation ability is relatively high (McPhee, 2003). During field pea cultivation it does not need to use fertilizing support and also it is an important rotation crops with the ability of fixing into soil 5-15 kg per ha and leaving a clean land for the following crops. Field pea can be used as a dual purpose, as a forage and as a grain. Besides, it can be grown just as it is or as a mixture with wheatgrass for grazing, hay or silage production (McKenzie and Sponer, 1999). It is true that the hay harvested with highest protein and moisture content of leaves can be eaten well by animals (Tekeli and Ate , 2007).

The seeds of field pea are highly nutritive because of their high quality protein and energy. Protein content of field pea vary between 21-32% and its digestibility is relatively high, at

78% (Nikolopoulou et al., 2007; Ünver et al., 1999; Wang et al., 1998). On the other hand, its hay and seeds are rich in terms of vitamins (A,B,C,D) and some minerals (Fe, P, Ca) (Açıkgöz et al., 1985; Yıldırım et al., 2005). Especially soybean has been used as an important source of energy and protein for feed rations, but since most of the soybean products are considered GMO the field pea could be a reasonable alternative (Bourdillon, 1999).

Ecological conditions affect so much the yield and protein content of field pea seeds. The chemical composition of field pea grown in different ecologies have variations due to climate differences, soil types, agronomy practices and their genetic structures (Szwejkowska, 2005).

Aim of this study was to investigate the effects of different nitrogen applications, at various growing stages, on nutritional contents of field pea seed compositions.

Material and Method

This study was conducted at the experimental field of the Selcuk University, Sarayönü Vocational High School from May 2nd to August 16th in 2013. Altitude of experimental location is 1055 m.

Climatic data of the experiment field (Table 1) were provided by T GEM *((Konuklar Agricultural Institution) meteorology station- data of DMGM)* and soil analysis (Table 2) was made in soil laboratory of the chamber of agriculture in Sarayönü, Konya.

According to climatic parameters in experimental year, mean temperatures were usually below than long term temperatures. Annual rainfall was also lower compare to long term rainfall during the experiment season.

Table 1. Climatic data of the experiment field

Climatic parameters	*Years*	*Months*								
		1	2	3	4	**5**	**6**	**7**	**8**	9
Average maximum Temperature (°C)	2013	11.5	17.8	24.7	26.9	**30.1**	**34.4**	**33.4**	**27.4**	32.5
	Long years	4.7	6.8	12.0	17.4	**22.2**	**26.8**	**30.2**	**30.0**	26.1
Average temperature (°C)	2013	2	4.9	7	10.6	**17.2**	**20.1**	**21.2**	**19.8**	24.2
	Long years	-0.2	1.2	5.7	11.0	**15.7**	**20.2**	**23.6**	**23.0**	18.6
Average minimum temperature (°C)	2013	-11.5	-6.1	-9.4	-0.1	**5.3**	**6.7**	**7.9**	**11.4**	2.4
	Long years	-4.1	-3.3	0.0	4.5	**8.6**	**12.9**	**16.2**	**15.7**	11.2
Rainfall (mm)	2013	22.0	25.3	26.9	39.5	**57.0**	**28.8**	**5.0**	**0.0**	11.0
	Long years	35.3	28.2	27.1	34.0	**43.6**	**23.2**	**6.9**	**5.6**	11.2

Source: T GEM (Konuklar Agricultural Institution) meteorology station- data of DMGM

The soil of the experimental side had a clay-loam texture, and it was slightly alkaline and salty, with medium level of organic matter but highly calcareous (Table 2).

Table 2. Soil characteristics of the experimental fields *

Texture	**pH**	**EC (mS/cm)**	**Lime (%)**	**Organic matter (%)**	**Phosphorus (kg ha^{-1})**	**Potassium (kg ha^{-1})**
Clay loam	7.75	4.34	18.91	2.35	63.3	2016.0

: Soil laboratory of the chamber of agriculture in Sarayönü, Konya

Furkan winter field pea variety was used as the research material. Field experiment was made according to "Randomized Blocks Design" with four replications (Düzgüne et al. 1987). Plot sizes were 9 m^2 (3 m x 3 m).

Sowing was made by hand and seeding rate was 100 seeds per m^2 with 50 cm row space. 50 kg per ha phosphorous was applied during the sowing time in the form of triple superphosphate (Zabuno lu and Karaçal, 1986). The nitrogen doses were applied as 30 kg ha^{-1} doses in three different periods; at one week after sowing, at the stage when the first bunch was flowering and at the time of 50% plot flowering.

Nutrition was applied at three different growing stages. First one was after one week from planting, whole of N3 (30 kg ha^{-1}) dose, half of N6 (60 kg ha^{-1}) dose and 1/3 of N9 (90 kg ha^{-1}) dose. Second one was when flowering started at first branch half of N6 (60 kg ha^{-1}) dose, and 1/3 of N9 (90 kg ha^{-1}) dose. Third one was 50% flowering of plot 1/3 of N9 (90 kg ha^{-1}) dose. Ammonium sulphate fertilizer was used as the nitrogen source.

Experimental site was irrigated with sprinkler after sowing in order to get emergence. After that according to the needs of field pea the experimental site was irrigated three more times with drip irrigation. After all pods matured, plants were harvested manually on 16th of August 2013 for grain. ICP were used to analyze the contents of elements within the grain in order to identify the possible effects due to nitrogen applications. The nitrogen ratio was determined by Kjedahl method.

Statistical analyses were made by using MSTAT-C computerized program.

Results and Discussion

This study was investigated the effects of application of three different nitrogen dosages at various growing stages on macro and micro nutritional contents of seed composition of field pea Furkan cv. The results of this research are shown in Table 3.

Table 3. The nutritional minerals content of seeds composition of field pea Furkan cv.

Application	N (%)	Ca (%)	B (ppm)	Cu (ppm)	Fe (ppm)	K (%)	Mg (%)	Mn (ppm)	Na (ppm)	P (%)	S (%)	Zn (ppm)
N0	3.64	0.11 AB	9.66	8.03	49.30	1.11	0.13	9.91	319.15	0.31	0.23	31.67
N3	3.69	0.10 B	9.41	8.02	45.58	1.07	0.12	8.74	296.75	0.31	0.25	30.16
N6	3.60	0.12 A	10.41	7.75	45.53	1.14	0.12	9.24	306.60	0.32	0.20	31.43
N9	3.63	0.13 A	10.36	7.91	49.20	1.12	0.13	9.66	310.23	0.32	0.20	30.81
Average	3.64	0.12	9.96	7.93	47.40	1.11	0.125	9.39	308.18	0.315	0.22	31.02
Variation Range	3.60 3.69	0.10 0.13	9.41 10.41	7.75 8.03	45.53 49.30	1.07 1.14	0.12 0.13	8.74 9.91	296.75 319.15	0.31 0.32	0.20 0.25	30.16 31.67
P	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV(%)	4.18	9.30	7.76	11.60	6.84	3.06	4.52	7.43	8.42	4.36	16.00	7.23
* P<0.05, NS: nonsignificant												

The effect of nitrogen doses on the contents of calcium (Ca) was found statistically important (P<0.05). The highest Ca content was obtained with application of N9 nutrition dose (90 kg ha^{-1}). However, the differences among N0 (0 kg ha^{-1}), N6 (60 kg ha^{-1}) and N9 (90 kg ha^{-1}) nitrogen doses at P>0.05 level were not significant. It was also found that the effects of nitrogen doses on the contents of the other elements were not significant (P>0.05). The contents of those elements due to nitrogen application varied between 0.11 - 0.13% for Ca, 12 - 0.13% for Mg, 1.07 - 1.14 for K, 0.31 - 0.32% for P, 45.53 - 49.30 ppm for Fe, 30.16 - 31.67 ppm for Zn, 8.74 - 9.91 ppm for Mn and 7.75 - 8.03 ppm for Cu. All the findings at the variations of minerals in this research were in agreement with the results of Grusak et al. (2004). On the other hand, results of the contents of elements in this research compared to the results of Bastianelli et al. (1995); content of Ca ad Na are higher, content of P, Mg, Zn, Cu and Fe were lower, and content of K and Mn were the same. According to the results of

Kotlarz et al. (2011) where the effects of variety and harvest year on protein contents, chemical compositions of pea, Ca and P levels of the seeds were investigated our results demonstrated similarity while Na and K levels were found lower in this study.

Conclusions

The effect of the application of different nitrogen dosages at various growing stages on Ca content of seed composition of winter field pea Furkan cv. was found significant; however, there were no significant effects of the applications that analysed the other elements.

Acknowledgements

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EVALUATION OF HYBRID STOCKS ON VIGOR, YIELD AND QUALITY OF WATERMELON

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Abstract

In this study, the influence of two hybrid rootstocks with different scions on watermelon plant vigor, fruit yield and quality were studied. Also, grafted plants were compared with non-grafted ones. The present research was conducted in Odemis, Izmir, in western Turkey. The trials were set up in randomised complete block design with four replications. The watermelon cultivars Crisby and Crimstar were grafted onto Ferro and RS 841, commercial hybrids of *Cucurbita. maxima x Cucurbita moschata*. Grafted plants increased root length (80-95%), main stem length (36-67%) and number of lateral vine (36-42%). It was determined that grafted plants had 115 % more yield and 27 % more fruit weight than control. There was a difference among hybrid rootstock-scion combinations, grafting Crimstar onto Ferro produced the highest main stem length and yield. There were not detected any significant effect of grafting and rootstock-scion combinations on fruit index, rind thickness and total soluble solids. It can be concluded that grafting, in watermelon plants positively affected plant growth and yield without quality losses. These effects were changed by rootstock-scion combinations being used. Therefore rootstock-scion combinations should be carefully selected for specific climatic and geographic conditions. Appropriate selection can help increase yield and improve plant vigor in commercial watermelon fields.

Keywords: *Grafting, rootstock-scion combinaton, yield, quality*

Introduction

Watermelon is an important vegetable with a global production of 103.0 Mt and it's being cultivated in wide areas thorough the world with an area of 3.50 M ha^{-1}. Turkey is one of the main producers of watermelon along with China, Iran, Brazil, Egypt and United States (FAO, 2011).

One of the problems related to intensive watermelon yield is the increase of soil-borne diseases. There are different ways to prevent soil-borne diseases such crop rotation, breeding programs, soil fumigant (methyl bromide). These management practices have some disadvantages. The grafting technique seems to be an effective solution when genetic and chemical approaches for disease management are not available (Oda, 2002a,b). Except controlling soil-borne diseases, grafting may enhance tolerance to abiotic stresses, increase yield and result in more efficient water and nutrient use; extend harvest periods, and improve fruit yield and quality (Shimada and Moritani, 1977; Romero et al., 1997; Oda 2002a,b; Trionfetti-Nissini et al., 2002; Lee and Oda, 2003; Rivero et al., 2003; Hang et al., 2005). For

these purposes, watermelons are grafted on *C. maxima, C. moschata, C. pepo, B. hispida, L. siceraria,* squash interspecific hybrids and *Sicyos angulatus* species (Davis et al., 2008a). The effects of rootstocks can show great differences with different scion cultivars. Martinez-Ballesta et al. (2010) reported that graft incompatibility usually occurs at early stages, when vascular connections are forming, but it can appear as late as the fruiting stage, when the

plant has high demand for water and nutrients. Graft incompatibility and decrease in the fruit yield and quality may appear depending on the combination of scion and rootstock. The scion variety obviously affects final size, yield and quality, but rootstocks effects drastically alter these characteristics (Tamada, 1989; Lee, 1994; Edelstein, 1999; Lee and Oda, 2003; Hagihara, 2004).

The objective of this study was to evaluate the influence of two hybrid rootstocks with different scions on watermelon plant vigor, fruit yield and quality.

Materials and methods

The study was carried out in the experimental fields of Odemis Vocational Training School, Ege University, Izmir (38°16 'N; 27°59 'E; 123 m above sea level) during 2007. Climatic conditions during the experiment were given in Figure 1. The experiments were conducted in the plastic greenhouse (Experiment 1) and in the field (Experiment 2). The watermelon cultivars (Crispy and Crimstar) which are widely grown in the area, were grafted onto 'Ferro' and 'RS-841', commercial hybrids of *C. maxima x C. moschata*. Non-grafted plants were used as control in both experiments. The soil was neutral in reaction, without problems of total salt, loamy sand in structure, and low in lime and organic material.
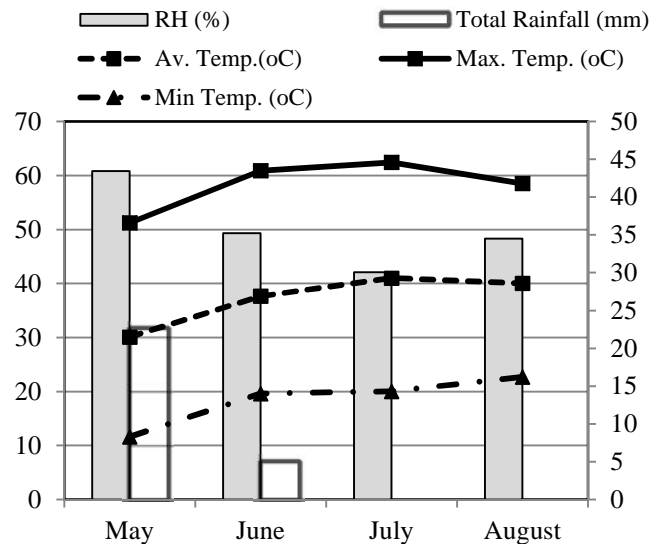
Figure 1. Climatic conditions during 2007.

In experiment 1, the grafted and non-grafted seedlings were planted to the 8 l plastic bags under plastic greenhouse on 15 May. These plants were used for plant growth measurements. A randomized complete block design was followed by three replicates, each consisting of 10 plants. Three plants representing each replicate were rooted for 30 days after planting as recommended by Yeti ir and Sarı (2004). Root length (cm), main stem length (cm) and number of lateral vine were determined.

In experiment 2, the grafted and non-grafted seedlings were planted to the soil on 18 May under open field conditions. Plants were spaced at 2 m between plants and 2 m between rows, with a density of 2500 plants/ha. Plants were fertilized with equivalent to 150 kg N, 120 kg P_2O_5, 200 kg K_2O and 150 kg $Ca(NO_3)_2$ per hectare during growing season. The furrow irrigation was applied as needed and other cultivation practices were conducted. The experimental design was a randomized complete blocks. Each treatment was replicated four times, with 15 plants in each replicate. Ten fruits from each replicate were chosen to determine the yield and quality measurements. Harvests were performed 3 times from the end of the July to the end of the August. Marketable fruits were collected at ripening and the

following measurements were recorded: fruit yield (t/ha[-1]), fruit weight (kg/fruit), fruit index (fruit length/fruit diameter), thickness of rind (mm) and total soluble solids concentration (°Brix). The soluble solids content of the juice obtained from the central endocarp was determinated with the use of a refractometer.

Analysis of variance was performed using SAS statistical program (SAS, 1996) and significant differences between applications were compared using orthogonal statistical design.

Results and Discussion

The vigor, yield and quality performances of grafted and non-grafted plants are given in Table 1. The results showed that growth performance of grafted plants was significantly influenced by grafting and main stem length affected by rootstock-scion combinations. Control plants had the shortest root length with 20.7 cm when compared to the grafted plants. No differences were found between rootstock-scion combinations for root length. Main stem length significantly affected grafting and also Ferro/Crimstar at 312 cm produced the highest main stem length. Number of lateral vine was significantly influenced by grafting and rootstock-scion combinations had similar number of lateral vine. Grafted plants produced more lateral vine (5 lateral vine/plant) than non-grafted control plants (3 lateral vine/plant).

Yield characteristics of grafted and control watermelon plants are presented in Table 1. Yield affected by grafting and rootstock-scion combinations. Control plants had the lowest yield with 15.82 t/ha[-1] when compared to the grafted plants. Yield of Crimstar on to Ferro at 36.05 t/ha[-1] was significantly higher than other grafted plants. The mean fruit weight was also significantly affected by grafting but non-significant differences in fruit weight were found between rootstock-scion combinations (Table 1). The highest fruit weight was obtained from the grafted plants with a weight of 4.8/4.9 kg, whereas fruit from the control plants weighed 3.8 kg. The results of the effect of grafting and rootstock-scion combinations on watermelon plants represented that grafting enhanced vigorous root system resulting in growth promotion and yield. Many authors stated that grafting affected growth and yield (Chouka and Jebari, 1999; Salam et al., 2002; Yeti ir et al., 2003; Yeti ir and Sarı, 2004; Miguel et al., 2004; Alan et al., 2007). These increases can be explained advantages of grafting plants; tolerance of low temperature, tolerance of salinity, enhanced water and inorganic nutritient uptake (Rivero et al., 2003). On the other hand, these positive effects of grafting influenced by rootstock-scion combinations. Present results supported that Crimstar on to Ferro had the highest main stem and yield. Most reports on grafting suggest that changes in the scion are controlled by the rootstock through controlled uptake, synthesis and translocation of water, minerals and plant hormones (Davis et al., 2008a). On the other hand, plant hormones are important endogenous factors which regulate aspects of plant vegetative and reproductive development and thus are believed to be important player in root-shoot communication. Hormonal factors affecting rootstock contribution to the scion performance and rootstock-scion interactions under abiotic stresses (Aloni et al., 2010).

Fruit quality characteristics such as fruit index, rind thickness and soluble solids were not significantly affected by grafting and rootstock-scion combinations (Table 1). There were significant differences between cultivars for rind thickness. Rind thickness of Crisby at 14.0 mm was significantly higher than Crimstar (12.3 mm). There are many conflicting reports on changes in fruit quality resulting from grafting. It has been reported that grafting may have adverse effects on fruit quality, especially depend on rootstocks (Lee, 1994; Nissini et al.,

Table 1. The vigor, yield and quality characteristics of grafted and non-grafted watermelon plants.

	Root length (cm)			Main stem length (cm)		
Treatments	Crisby	Crimstar	Mean	Crisby	Crimstar	Mean
Control	21.2	20.2	20.7	194	148	171
Ferro	36.8	43.8	40.3	258	312	285
RS 841	39.6	34.8	37.2	230	234	232
Mean	32.5	32.9		227	231	
T:p<0.01 C:n.s T*C:n.s.				T:p<0.01 C:n.s. T*C:p<0.05		
No. of. lateral vine				**Yield (t/ha^{-1})**		
Control	3.2	3.4	3.3	17.22	14.41	15.82
Ferro	4.4	5.0	4.7	32.69	36.05	34.37
RS 841	4.5	4.4	4.5	33.90	33.62	33.76
Mean	4.0	4.3		27.94	28.03	
T:p<0.01 C:n.s T*C:n.s				T:p<0.01 C:n.s. T*C:p<0.01		
Fruit weight (kg/fruit)				**Fruit index**		
Control	3.6	3.9	3.8	1.10	1.11	1.11
Ferro	4.5	5.0	4.8	1.13	1.17	1.15
RS 841	4.9	4.8	4.9	1.16	1.13	1.15
Mean	4.3	4.6		1.13	1.14	
T:p<0.01 C:n.s. T C:n.s.				T:n.s. C:n.s. T*C:n.s.		
Rind thickness (mm)				**TSS (%)**		
Control	13.3	11.3	12.3	8.7	8.8	8.7
Ferro	13.3	12.7	13.0	8.2	8.7	8.5
RS 841	15.3	13.0	14.2	9.0	8.7	8.9
Mean	14.0	12.3		8.6	8.7	
T:n.s. C:p<0.05 T*C:n.s				T:n.s. C:n.s. T*C:n.s.		
T: Treatments C:Cultivar n.s: Non significant				T*C:Treatments*Cultivar		

2002; Traka-Mavrona et al., 2000; Davis et al., 2008b) but in our experiments, we could not determinate any detrimental effect of grafting and rootstock-scion combinations on fruit quality. Similar results were also reported by Yeti ir et al. (2003) and Miguel et al. (2004). The differences in reported results may be attributable in part to different production environments, type of rootstock-scion combination used and harvest date. It was suggested that this discrepancy in the literature demonsrated the importance of optimizing rootstock-scion combinations for each cropping environment (Ruiz et al., 1997).

Conclusion

It can be concluded that grafting, in watermelon plants positively affected plant growth and yield without quality losses. These effects were changed by rootstock-scion combinations being used. Therefore rootstock-scion combinations should be carefully selected for specific climatic and geographic conditions. Appropriate selection can help increase yield and improve plant vigor in commercial watermelon fields.

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DETERMINATION OF FORAGE QUALITY COMPONENTS ON LESSER BURNET CULTIVARS UNDER CONDITIONS OF CENTRAL ANATOLIA, TURKEY

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Abstract

Influenced by various factors information of forage quality is essential for determination of grazing capacity. The main objective of this research was investigation on effects of phenological stages (six diffrent cutting time) on values of forage quality indices of *Sanguisorba minor* Cv. Altınova, Bunyan and Gozlu used as materials. The samples were collected from Forage Crops Experimental Gardens of the Ankara University, Turkey. They were dried, grained and analyzed against various parameters. Acid detergent fiber (ADF), NDF (neutral detergent fiber) and ADL (acid detergent Lignin Total digestible nutrients (TDN), dry matter intake (DMI) were significantly ($P<0.01$) different cultivars and six different cutting time. DMI, TDN and ADF, NDF, ADL decreased for all cultivars with plant growth development. Considering forage quality indices values among three cultivars, cv. Altınova had highest forage quality.

Keywords: *Reaping periods, sanguisorba, crude protein, crude cellulose, dry matter digestibility*

Introduction

As a perennial forage crops, Sanguisorba minor Scop. is a native plant of Turkish natural meadows. This plant begins to grow in early springs and is one of the rare plants that keeps green colour until the first day of winter. Early development of this plant during the period with a shortage of food in winter is of great value for feed-strapped animals. Its well tolerance of winter and drought, helps in preserving the bright green color during the summer and rapidly growing feature after cut, it is one of the recommended feed crops for our drought regions (Acikgoz, 2001).

The factors, effecting crop quality of plants, can be counted as cultivars of plant, the propotion of leaf/shoot, growing period, the structure of soil in use for cultivation, climate, method of harvesting, morbidity and pests (Arzani et al., 2008; Harrocks et al., 1999; McDonald et al., 1995).

It is reported that digestibilty of plants is at least 80 %, but this proportion decrases when the plant completes its growth. Fiber and lignin, increase with the period of crops' ripening, reduce the digestibility, metabolizable energy and digestible energy value of feed crop grass. In the researches of Behnamfar et al. 2009 and Holchek et al. 2004, with the plant's completing its ripening, crude protein and digestibility of feed decrease but at the same time, the proportion of ADF and NDF increases. Jafari (1993) presented in his researches that differentiation of proportion between organs in phenological growth period of plant causes this situation. Plant shoot part of plant is short and propotion of leaf/shoot is too much in early growth period. However, during the maturity, scapuses (shoot) make up significant part of total feed (Langer et al., 1979).

In general, ripening or aging of plant cell and proportion of leaves/shoot change are the reasons of change of chemical substances in plant structure, and this is able to affect grass

quality. Studies on forage poaceae and legumes support this situation. Therefore, with the increase in number of leaves/shoot the quality in terms of crude cellulose also increases in parallel way (Açıkgoz 2001).

In this research, changes in grass quality of three cultivars of Sanguisorba were tested in 6 different phenological developmental stages of plant growth.

Material and methods

The research was carried out at Forage Crops Experimental Gardens of the Ankara University, Turkey. Lesser burnet cultivars Altınova, Bunyan and Gozlu, were used as experimental material. The cultivars Altınova and Gozlu are native cultivars provided by TIGEM (Directorate General of Agricultural Products Processing). Bunyan 80 is a certificated cultivars and it was provided by Central Field Crops Research Institute.

The experimental material was planted as 3 replications using randomized complete block design on 28 March 2007 on Plot area of 5 m x 3.5 m = 17.5 m^2. Each plot contained 5 lines with line to line spacing of 70 cm. Seeds were sown by hand using 3 kg seeds in one – tenth of a hectare. Lesser burnet was harvested at 6 different phenological periods of growth during 2007-2008. The analysis was made on the samples taken from this harvest. Harvest times are presented in Table 1.

Table 1. Harvest times of study

Years	1rd Cutting	2rd Cutting	3rd Cutting	4rd Cutting	5rd Cutting	6rd Cutting
2007	14 April	30 April	9 May	11 May	13 June	16 June
2008	18 April	25 April	02 May	14 May	13 June	18 June

According to soil analysis report, the soil has clayey- loamy structure, mild alkaline and mild limy. It is in harmless level in terms of salt. It is rich in potassium, poor in phosporus and very poor in organic substance. According to distribution of precipitation during long years, the year 2007 was dry and the year 2008 was very dry.

Some climatic values of study area are presented in Table 2, 3 and 4;

Table 2. Precipitation L m² and Temperature,°C (1975-2008)

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Precipitation, L m^2	41.8	36.9	38.7	49.0	1.2	35.4	14.5	10.9	18.5	30.2	33.9	46.9
Temperature °C	0.3	1.8	6.1	11.3	16.1	20.2	23.5	23.3	18.7	13.1	7.1	2.7

Source: General Directorate of State Meteorology Monthly Climatology Observation Scale (Anonim, 2009b)

Table 3. Precipitation, L m² (2007-2008)

Years	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2007	39.0	16.4	37.5	23.8	17.9	31.7	3.9	9.8	0.0	19.7	66.7	44.4
2008	20.1	6.5	54.9	32.7	45.4	10.3	0.0	0.7	61.6	18.6	43.6	28.8

Source: General Directorate of State Meteorology Monthly Climatology Observation Scale (Anonim, 2009b)

Table 4. Temperature (°C) in 2007 and 2008 Years

Table 4. Temperature (°C) in 2007 and 2008 Years	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2007	1.2	2.5	7.3	9.6	21.0	23.1	27.3	26.7	21.2	14.4	6.8	2.0
2008	3,9	0,2	10.3	14.0	16.0	22.3	25.2	27.2	20.1	13.3	8.7	2.1

Resource: General Directorate of State Meteorology Monthly Climatology Observation Scale (Anonim 2009b).

ADF, NDF, ADL
Fiber analysis was made in samples by Ankom Technology measured in conditions of ADF (acid detergent fiber), NDF (neutral detergent fiber) and ADL (acid detergent Lignin) laboratory.

TDN, DMI
Total digestible nutrients (TDN), dry matter intake (DMI), are indicator of noted grass quality, and noted were calculated with improved formula shown below (Aydın et al., 2010);
TDN = (-1.291 x ADF) + 101, 35
DMI = 120% NDF % dry matter basis

In testing, it is founded that there are 2 levels of year factor, 6 levels of harvest period factor and 3 levels of cultivars factor. Features, noted in research, were evaluated by analysis of variance technique on factorial order (SPSS, 20) and Duncan test was used while different groups was being determined. $P<0.05$ and 0.01 levels of significance.

Results and discussion

ADF (Acid Detergent Fiber)
Year x cutting x cultivars interaction among ADF value, noted from 3 different cultivars of lesser burnet in 6 different period, were found significant in ($P < 0.01$) level**.**

Table 5. Multiple comparision results related to subgroups of year x cutting x cultivars in terms of ADF value.

Years	Cultivars	1 [rd] Cutting	2 [rd] Cutting	3 [rd] Cutting	4 [rd] Cutting	5 [rd] Cutting	6 [rd] Cutting
2007	1.Altınova	26.7 ±0,1 Af$_A$	28.3 ±0,1 Ae$_A$	30.0 ±0,3 Ad$_A$	35.7 ±0.3Ac$_A$	40.9 ±0,4 Ab$_A$	45.3 ±0,3 Ba$_A$
2007	2.Bünyan	25.8 ±0,1 Bf$_A$	26.7 ±0,3 Be$_A$	28.3±0,2 Bd$_A$	33.4 ±0,3 Bc$_A$	37.4 ±0,2 Bb$_B$	46.3 ±0.2Aa$_A$
2007	3.Gözlü	25.6 ±0,1 Bf$_A$	26.6 ±0,2 Be$_A$	27.8 ±0,3 Bd$_A$	33.2 ±0,5 Bc$_A$	37.4 ±0,2 Bb$_B$	45.9 ±0,2 ABa$_A$
2008	1.Altınova	26.1 ±0,1 Af$_A$	28.1 ±0,1 Ae$_A$	29.8 ±0.3Ad$_A$	35.6 ±0,2 Ac$_A$	40.7 ±0,3 Ab$_A$	45.3 ±0,3 Aa$_A$
2008	2.Bünyan	25.8±0.04 Ae$_A$	26.5 ±0,2 Be$_A$	28.3 ±0.2Bd$_A$	33.5 ±0,3 Bc$_A$	40.3 ±0,3 Ab$_A$	46.0 ±0,3 Aa$_A$
2008	3.Gözlü	25.8±0,1 Af$_A$	26.6 ±0,1 Be$_A$	27.9 ±0,2 Bd$_A$	33.5 ±0,5 Bc$_A$	39.0 ±0,1 Bb$_A$	45.5 ±0.3Aa$_A$

Capital letters were used in comparing cultivars in subgroups of year x cutting time. ($P<0.05$)
Small letters were used in comparing cutting time in subgroups of year x culture variety. ($P<0.05$)
Subscripts were used in comparing years in subgoups of cultivars x cutting time. ($P<0.05$)

When Table 5 was analyzed, in subgroups of year x cutting x cultivars, on comparing the cultivars both during first year and second year in all types the highest ADF value was noted in 6 [rd] cutting time which is the maturity period of plant and the lowest ADF value was noted in seedling period which is the youngest period of plant. On comparing cultivars, only in a year apart from 6 [rd] cutting time, we see that Altınova cultivars gives out more than other 2 cultivars in terms of ADF in all cutting times. .

The results of ADF showed significant differences in phenological stages. Also, ADF showed an increasing trend during the development stages which is in accordance with Heshmati et al (2006).

Young plant cells have one external layer called a primary cell wall, but when they become mature, a secondary cell wall is also formed. Because of storage tissues in seeds, ADF and NDF contents varied with seed maturity between phenological stages and species. Arzani et al. (2008) also reported that with progress of plant growth, ratios of protector and firmness tissues, which mostly consist of structural carbohydrates such as celluloses, hemicelluloses and lignin, are increased. Therefore, maturity of plants and an increase in structural carbohydrates cause higher fiber amounts in forage late in the growing season.

Cassida et al. (2000) reported that, with the riping the substances like ADF and NDF, that their digestibility is hard, increase and crude protein decreases. Behnamfar et al. (2009) and Holchek et al (2004) in their research reported that ADF and NDF proportion of feed crop increase. Asaadi and Yazdi (2011), in different phenological periods, in their research which they carried out it with Sanguisorba minor and legume fodder crops, determined that as the ripening of plant increase, ADF increases, especially in seed ripening stage sanguisorba minor reaches the maximum value (50.28 %), at vegetative growth stage with 24.77 % is lowest. At flowering stage it is 35.65 %.

ADL (Acid Detergent Lignin)

Year x cutting x cultivars interaction among ADL value, noted from 3 different cultivars of lesser burnet in 6 different period, were found significant in (P < 0.01) level.

As it is seen in Table 6, both in first and second testing year, with the ripening of plant in continuing times we see that ADL value increases in 3 cultivars. Isselstein et al. (2003) in their research determined that a big clear difference in terms of NDF in legumes and poecea NDF value noted in summer time as regards to noted in spring as there was a very small difference between substances of crude protein related to time between legume and poecea. As NDF proportion was less than legumes forage in other family plants in terms of both cutting time, this situation in ADL value was confirmed exact opposite.

Table 6. Multiple comparision results related to subgroups of year x cutting x cultivars in terms of ADL value.

Year	Cultivars	1rd Cutting	2rd Cutting	3rd Cutting	4rd Cutting	5rd Cutting	6rd Cutting
2007	1. Altınova	4.7 ± 0.04 Af$_A$	4.8± 0.03 Ae$_A$	5.2±0,1 Ad$_A$	5.9 ±0,1 Ac$_A$	6.4 ±0,1 Ab$_A$	7.4 ±0,1 Aa$_A$
2007	2. Bünyan	4.3 ± 0.03 Be$_A$	4.5± 0.06 Be$_B$	4.9±0,1 Bd$_A$	5.7 ±0,1 Bc$_B$	6.3±0.1 Bb$_A$	7.2±0,1 Aa$_B$
2007	3. Gözlü	4.2 ± 0.02 Be$_B$	4.3±0.05 Be$_B$	5.0±0,1 ABd$_A$	5.7 ±0,1 Bc$_A$	6.3 ±0,1 Bb$_A$	7.1±0,1 Aa$_A$
2008	1. Altınova	4.8 ±0.06 AeA	4.9 ±0.03 Ae$_A$	5.4±0,2 Ad$_A$	6.0±0,1 Ac$_A$	6.6±0,1 Ab$_A$	7.5±0,2 Aa$_A$
2008	2. Bünyan	4.5±0.08 BeA	5.0±0.07 Ad$_A$	5.2±0,1 Ad$_A$	6.1±0,1 Ac$_A$	6.5±0,1 Ab$_A$	7.4±0,1 Aa$_A$
2008	3. Gözlü	4.8±0.05 AeA	4.9±0.06 Ae$_A$	5.2±0,1 Ad$_A$	5.7±0,1 Bc$_A$	6.4±0,1 Ab$_A$	7.1±0,1 Ba$_A$

Capital letters were used in comparing cultivars in subgroups of year x cutting time. (P<0.05)
Small letters were used in comparing cutting time in subgroups of year x culture variety. (P<0.05)
Subscripts were used in comparing years in subgoups of cultivars x cutting time. (P<0.05)

NDF (Neutral Detergent Fiber)

Year x cutting x cultivars interaction among NDF value, noted from 3 different cultivars of Lesser burnet in 6 different cutting periods, were found significant in (P < 0.01) level.

In Table 7. in terms of NDF value and datum of the different cutting times in two different testing years in lettering subgroups of year x cutting time interaction, in both years as it is reached to the

highest NDF value in 6rd cutting time which is the last cutting time (1. Year 54, 4 %   and 2. Year 54, 4 %), the lowest NDF value (1. year 36, 2 %   and 2. year % 36, 4 %) is determined early spring in both years.

Table 7. Multiple comparision results related to subgroups of year x cutting time in terms of NDF value.

Year	1rd Cutting	2rd Cutting	3rd Cutting	4rd Cutting	5rd Cutting	6rd Cutting
2007	36.2±0,2 Fa	37.7±0,1 Ea	38.6±0,2 Db	40.6± 0.2Cb	45.1±0,5 Ba	54.4± 0,2 Aa
2008	36.4±0,1 Fa	38.0± 0.1Ea	38.9±0,2 Da	41.3±0,2 Ca	44.9±0,5 Ba	54.4±0,2 Aa

Capital letters were used in comparing cultivars in subgroups of year x cutting time. (P<0.05)
Small letters were used in comparing years in subgroups of year x culture variety. (P<0.05)

As it is seen in Table 8, on comparing cultivars in cutting time x cultivars interaction, we see that Altınova cultivars gives out more value than other two cultivars in terms of NDF in all cutting times. On comparing cutting times in all three cultivars the lowest NDF value was determined in early spring that is the first cutting time and it was confirmed that NDF value increased through the late summer. With the beginning of plant ripening it is seen an increment in NDF value like in ADF and ADL. However, it is given in literature that less values is reached in other family plants in terms of NDF than legumes and poecea in any case.

Table 8.Multiple comparision results related to subgroups cutting time x cultivars in terms of NDF value

Cultivars	1rd Cutting	2rd Cutting	3rd Cutting	4rd Cutting	5rd Cutting	6rd Cutting
1. Altınova	36.9±0,1 Af	38.4±0,1 Ae	39.8±0,2 Ad	41.9±0,2 Ac	47.6±0,3 Ab	54.9±0.2Aa
2. Bünyan	36.1±0,1 Bf	37.6±0,1 Be	38.3±0,1 Bd	40.6±0,2 Bc	43.7±0,3 Bb	54.2±0,1 Ba
3. Gözlü	35.9±0,1 Bf	37.5±0,1 Be	38.1±0,2 Bd	40.3±0,2 Bc	43.7±0,2 Bb	54.1±0,2 Ba

Capital letters were used in comparing cultivars in subgroups of year x cutting time. (P<0.05)
Small letters were used in comparing cutting time in subgroups of cutting time x culture variety. (P<0.05)

Isselstein et al. (2003) in their research, as there is a small difference among substances of crude protein related to time in between legumes and poecea. There is a clear difference in NDF values noted in summer period in legumes and poecea in terms of NDF as compared to early spring.

DMI (Dry Matter Intake)
Year x cutting x cultivars interaction among DMI value, noted from 3 different cultivars of lesser burnet in 6 different period, were found significant in (P < 0.01) level.
As it is seen in Table 9, in year x cutting time interaction in first and second testing year, as it is not seen a difference as statistical on dry matter intake between first cutting time and the last two cutting times, a difference is determined on behalf of first testing year among years in 2. , 3rd and 4rd cutting times.

Table 9. Multiple comparision results related to subgroups of year x cutting time in terms of DMI value.

Year	1rd Cutting	2rd Cutting	3rd Cutting	4rd Cutting	5rd Cutting	6rd Cutting
2007	3.31±0.014 Aa*	3.19±0.009 Ba	3.11±0.019 Ca	2.96±0.016 Da	2.67±0.028 Ea	2.02±0.007 Fa
2008	3.30±0.013 Aa	3.16±0.010 Bb	3.08±0.015 Cb	2.91±0.013 Db	2.68±0.029 Ea	2.21±0.006 Fa

Capital letters were used in comparing cutting times in subgroups of year x cutting time.(P<0.05).
Small letters were used in comparing years in subgroups of cutting time x year(P<0.05).
*subscript

As it is seen in Table 10, that shows the results of interaction between cutting time x cultivars, the 3. Cultivar Gozlu gives out a higher value of dry matter intake than other two cultivars in all cutting times. However, we follow that this value indicates a decline in per cultivars following harvest dates.

Table 10.Multiple comparision results related to subgroups of cultivars x cutting time in terms of DMI value

Cultivars	1rd Cutting	2rd Cutting	3rd Cutting	4rd Cutting	5rd Cutting	6rd Cutting
1. Altınova	3.25±0.005 Ca*	3.12±0.007 Bb	3.02±0.013 Bc	2.86±0.011 Bd	2.52±0.016 Be	2.19±0.007 Bf
2.Bünyan	3.33±0.013 Ba	3.19±0.008 Ab	3.13±0.010 Ac	2.96±0.011 Ad	2.75±0.018 Ae	2.22±0.006 Af
3.Gözlü	3.35±0.012 Aa	3.19±0.009 Ab	3.15±0.014 Ac	2.98±0.013 Ad	2.74±0.012 Ae	2.22±0.008 Af

Capital letters were used in comparing cultivars in subgroups of cultivars x cutting time (P<0.05).
Small letters were used in comparing cutting times in subgroups of cutting time x culture variety (P<0.05).
*subscript

Drerup (2008) in the research that he carried out in forage poeceae, determined big differences among noted grass quality in terms of feeding although he made both two harvest in May. It is determined that there is a higher dry matter intake (DMI) in early harvest (in the beginning of May) than in the last of the May because of substances of crude protein and it offers a higher digestibility. However it is determined that one of the handicaps in the earliest harvest is the low proportion of sugar in fodder, it is necessary a supporting for bacteria using this sugar in rumen, and in this situation it is probable that a high feed consumption. For instance; it is determined an aging tendency in second harvest distinctly made only 6 weeks after first harvest.

As the proportion of plant cell wall in the diet increases, both these rates decrease; in the diet increases, both these rates decrease; therefore, the amount of cell wall accounts for a large proportion of the variation in intake (Van Soest, 1982; Waldo, 1986).

TDN (Total Digestible Nutrients)

Year x cutting time x variety interaction among TDN values obtained from 3 different lesser burnet cultivars in 6 different periods is considered significant at a level of (P < 0.01).

As is seen from Table 11, in year x cutting x variety interaction, Bunyan and Gozlu cultivars have fallen within the same subgroup statistically in both experimentation years with the except of the last harvest-time; only in the second experimentation year every tree cultivars have fallen within the same subgroup. For every 3 cultivars, the decrease is determined in the rates of Total digestible nutrients procurement from the harvest-time in early period to the harvest-time in ripening period.

Table 11. Multiple comparisons results of Year x cutting x variety subgroups in regard to TDNvalue

Year	Cultivars	1rd Cutting	2rd Cutting	3rd Cutting	4rd Cutting	5rd Cutting	6rd Cutting
2007	1.Altınova	66.9 ± 0.155 B a$_{A*}$	64.8 ± 0.2 Bb$_A$	62.6 ± 0.4 Bc$_A$	55.4 ± 0.4 Bd$_A$	48.6 ± 0.5Be$_A$	42.9 ± 0.4 Af$_A$
	2.Bünyan	68.1 ± 0.104 Aa$_A$	66.9 ± 0.3 Ab$_A$	64.8 ± 0.3 Ac$_A$	58.2 ± 0.4 Ad$_A$	53.0 ± 0.3 Ae$_A$	41.5 ± 0.2Bf$_A$
	3.Gözlü	68.2 ± 1.00 Aa$_A$	67.5 ± 0.2 Ab$_A$	65.5 ± 0.3 Ac$_A$	58.5 ± 0.6 Ad$_A$	53.1 ± 0.2Ae$_A$	42.2 ± 0.3ABf$_A$
2008	1. Altınova	67.6 ± 0.161 Aa$_A$	65.1 ± 0.2 Bb$_A$	62.9 ± 0.4 Bc$_A$	55.4 ± 0.3 Bd$_A$	48.8 ± 0.4 Be$_A$	42.9 ± 0.3 Af$_A$
	2 .Bünyan	67.9 ± 0.056 Aa$_A$	67.1 ± 0.3 Ab$_A$	64.8 ± 0.2 Ac$_A$	58.0 ± 0.4 Ad$_A$	49.3 ± 0.4 Be$_B$	42.0 ± 0.3 Af$_A$
	3.Gözlü	68.1 ± 0.135 Aa$_A$	66.9 ± 0.1 Ab$_A$	65.3 ± 0.2 Ac$_A$	28.1 ± 0.6 Ad$_A$	51.1 ± 0.2 Ae$_B$	42.7 ± 0.4 Af$_A$

Capital letters are used for the comperison of year x cutting time subgroup varieties (P<0.05)

Lower case are used for the comperison of year x cutting time of variety subgroups (P<0.05)

Subcripst are used for the comperison of variety x cutting time of supgroups (P<0.05)

 *subscript

Total digestible nutrients report the % age of digestible material in forage. Total digestible nutrients are calculated from acid detergent fiber and express differences in digestible material between forages (Henning et al 1991). TDN is often used as an estimate of the energy value of forage and can be used in ration formulation.

Typically, the greater the value, the more energy-dense the feedstuff is considered. Typically, lower quality hays are in the 40 to 50 % TDN range, while higher quality hays are in the 50 to 60 % TDN range. In some cases, certain hays and legumes can be in the 60 to 70 % TDN range.

Conclusions

Range forage quality has spatial and temporary variations. The chemical analysis of range forage plants serves as a comparative measure of differences between species and changes with season or phenology.

By this experiment on 3 different lesser burnet cultivars in 6 different cutting time which the variation of hay quality of forage is studied in conditions of Ankara,   stated that, mainly hay quality of forage and nutritional value, how the plant depends on the harvest date and and an increase would be provided at the animal performance with a proper harvest date by going with the phonological periods of the plant.

As plants mature, they increase in fiber and lignin content. Increasing fiber (ADF and NDF) reduces digestibility and intake potential. Lignin is essentially indigestible and therefore, the increasing lignin content that comes with increasing maturity also reduces digestibility. For each one percentage unit increase in lignin, digestible dry matter (DDM) decreases three to four percentage units. Increase in crude fibre ratio influence highly the crude protein ratio and caused for decline in general.

This study suggests that Phenological stage of growth had a significant influence on forage quality. The close matching of nutrient requirements and feed quality is necessary for efficient animal production. Higher forage quality was recorded for the 1st stage of growth.

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EFFECT OF SUPPORTING CULTURE AND INOCULANT ON QUALITY OF COMBINED VETCH SILAGES WITH OATS AND ITALIAN RYEGRASS

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Abstract

The biomass of mixture of winter vetch K-10 and supporting crops (oats and Italian ryegrass) were ensiled in Institute for forage crops in 2012. Ensilaging was conducted in the form of two factorial experiment 2 x 2 in three replications: the first factor A – type of supporting culture (a_1 - oats, a_2 - Italian ryegrass) and the second factor B - application of bacterial inoculants (b_1 - no inoculant, b_2 - with the addition of inoculant). The suitability for ensiling and the chemical composition of the initial material and silages were established by laboratory methods, and the energy value of the silages (NE_L and NE_M) was calculated by computation. The lactic acid fermentation process was monitored via the level of dry matter content, pH, ammonia and soluble nitrogen and lower fatty acids. Silages were evaluated/scored according to the methods of Deutsche Landwirtschafts-Gesellschaft (DLG) and Flieg. The biomass of Italian ryegrass is more suitable for silage because it has a better WSC/BC ratio. It was found that the type of supporting culture significantly influenced the level of CP in silages, with a mixture of vetches and Italian ryegrass, compared to the mixture with oats had by 41.5 gkg^{-1}DM more CP (171.9:130.4), but at the same time had significantly higher crude fat content, Ca and P. The inoculants had no significant impact on changes in the chemical composition of silage, except for the reduction of the crude fat content and increase of BEM. Italian ryegrass contributed to greater production of lactic and acetic acids compared to the oats. The inoculant had a significant effect on the decreased production of butyric acid in average by about 6.0 gkg^{-1} (7.85:1.86). All silage treatments with inoculant, according to the methods of DLG and Flieg, were given/scored more points in relation to the treatment without inoculant.

Key words: *silage, vetches, inoculant, fermentation, proteins*

Introduction

One of the most common problems of modern animal husbandry is the continuous provision of sufficient quantities of high-quality plant proteins in animal nutrition. The fastest and easiest way to meet the protein needs of animals in the diet is the use of large amounts of concentrated feed, but this way is also the most expensive, which greatly affects the profitability of livestock production. These expensive proteins in concentrated feed can be very effectively replaced through production of quality fodder legume crops in the form of hay, haylage or silage. One of the potential solutions to partially overcome this problem and compensate a substantial portion of protein in the diet of animals is cultivation of annual forage legumes as a source of high quality plant protein. Among the most important crops in the group of annual forage legumes are winter and spring varieties of vetches, whose cultivation is of great importance generally in agriculture in and livestock sector from the point of feeding of farm animals. There are numerous ways of utilization of vetch biomass from the use as green forage to the form of hay, haylage, silage and straw. However, unlike some other annual legumes, vetch can be used for grazing (Miki et al., 2006). In addition,

economic and ecological aspects of growing vetch are very important. The vetch legume species supplying soil with a certain amount of nitrogen through nitrogen fixation, which provides part of the need for this mineral nutrient for cultivation of the subsequent crops, which reduces the use of expensive nitrogen fertilizers.

In animal nutrition, vetch as roughage can be used in several ways, but the best way recommended is ensiling of vetch in mixtures with small grains. The justification for this attitude is reflected in the fact that during the ensiling of vetch the losses of the highest quality plant parts (leaf, husk) are the lowest, and therefore the loss of nutrients is lower than in preserving by drying in the form of hay. Well prepared silage can be used during the entire period of the year, thus avoiding frequent change of diet composition which is a very important fact in ruminant nutrition. Earlier mowing of green biomass in the flowering stage or early forming of the first pod, the sowing of subsequent crops (e.g. corn of short growing season) is enabled so that the same plot can be used two times in one productive year for the production of animal feed.

Results of some studies suggest that it may still get relatively good quality silage from pure vetch crops with the prior wilting (Muck and Gostiša, 1963-b), with the use of inoculants based on lactic acid bacteria, or chemical preservatives (or evi and Dini , 2007). In order to obtain a good quality silage, the last few years has been working on the application of bacterial inoculants containing selected homo and heterofermentative strains of lactic acid bacterial cultures, aimed at better utilization of sugars from biomass ensile and directing the flow of fermentation in the right direction, towards reducing the content of harmful, such as butyric acid to increase the content of lactic or acetic acid.

Vetch can be grown as a pure culture, but because of the tendency towards flattening and deterioration due to rotting of the highest quality plant parts, it is commonly grown in mixtures with some supporting crop such as small grains (Karagi et al., 2011). In this way the flattening and decay are reduced, but a biomass is obtained more suitable for conservation/preservation by method of ensiling due to higher content of easily fermentable sugars and lower buffer capacity in relation to the pure vetch crop.

The aim of this study was to investigate the effect of type of supporting culture and inoculant on the quality and process of lactic acid fermentation of vetch silage combined with oats and Italian ryegrass.

Materials and Methods

The experiment was conducted in 2012 at the Institute of forage crops, Kruševac (Serbia). Mixtures of winter vetch K-10 with oats, and Italian ryegrass were sown on a plot of 4 m^2 in three replications. The biomass was harvested when the vetch was in the phase of forming the first pod. The yield of biomass, suitability for ensilaging, botanical composition of mixture and quality of starting material was determined. The biomass is ensiled in plastic containers volume 65dm^3. Experiment was conducted as two-factorial 2 x 2 in three replications. The first factor A – type of supporting culture (a_1 - oats, a_2 - Italian ryegrass) and the second factor B - application of bacterial inoculants (b_1 - no inoculant, b_2 - with the addition of inoculant).

As inoculant, BioStabil Plus of Austrian company Biomin was used. The inoculant contains homo fermentative lactic acid bacteria (*Lactobacillus plantarum* i *Enterococcus faecium*) and hetero fermentative lactic acid bacteria (*Lactobacillus brevis*). These bacteria provide better use of water-soluble carbohydrates (WSC) in the biomass, optimal pH and aerobic stability of silage after opening the silo. Opening of experimental containers and sampling of silage was done 90 days after ensiling. Chemical analyses of the starting material and silage were performed in the laboratory of the Institute for Forage Crops, Kruševac, according to standard methods (AOAC, 2002).

In starting material, parameters of biomass suitability for ensilage- buffer capacity (BC), monosaccharides (MS) and water-soluble carbohydrates (WSC) were determined using laboratory methods. Also, in starting material and silage, the chemical composition was determined using analytical methods. Chemical composition analyses included dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE), NDF, ADF, Ash, Ca, P, and NFE values were calculated. The chemical analyses in silage of the process of lactic acid fermentation were performed, where pH, ammonium (NH_3-N) and soluble nitrogen (H_2O-N), content of organic acids, acetic, butyric and lactic acids were determined. The quality of silage was evaluated by the methods DLG and Flieg (or evi and Dini , 2003). Energy values (NE_L i NE_M) were calculated using methods by Obra evi (1990).

The analysis of variance was conducted using the results of chemical analysis of silage quality. The statistically significant differences for all tested parameters between treatments were tested by LSD test (Statsoft, 2006).

Results and discussion

By cutting green forage mixture in the stage of forming of first vetch pods, cultivar K-10 the average yield of mixtures, the share of the components in biomass and their chemical composition were determined. It was found that the average realized yield of green mass of the mixture of vetch with oats was 50.2 t tha[-1] (13.90 tha[-1] DM), with the share of vetch, in percentages, in relation to the oats observed in the green mass was 59:41, i.e. observed in DM 63:37. Mixtures with Italian ryegrass had an average yield of 42.5 tha[-1] green mass (11.09 tha[-1] DM) with an average ratio of vetch to Italian ryegrass 68:32 in green biomass, i.e. 71:29 observed in DM.

The chemical analysis of the starting material of cut biomass has shown that the level of crude protein (CP) in a mixture with the Italian ryegrass was relatively higher by 39.7 gkg[-1]DM (170.9:131.2) compared to a mixture with oats, whereas in absolute terms, the achieved level of protein per hectare was higher by as much as 72 kg (1823:1895 kgha[-1]). Chemical analyses of biomass have shown that the level of CP in mixtures with Italian ryegrass was, relatively, higher by 39.7 gkg[-1]DM (170.9:131.2) compared to the mixture with oat. Slightly lower values of CP 119.1 gkg[-1]DM in the mixture of vetch and oats in a similar biomass ratio of 58:42 has been obtained by Lithourgidis et al. (2006). In both mixtures somewhat higher level of CF was observed from 380.4 to 387.1 gkg[-1]DM which can be interpreted as the response of crops to prolonged drought and extreme weather conditions in 2012. Other chemical parameters of both mixtures were quite uniform, and one could see that the mixture of Italian ryegrass had more EE 43.7:30.8 gkg[-1]DM, while the mixture with oats was richer in calcium by about 2.3 gkg[-1]DM (Table 1).

Table 1. Suitability for ensilage and chemical composition of starting material gkg[-1]DM

The starting material	Buffer capacity meq Lactic acid (LA) 100g[-1] DM			Monosaccharides gkg[-1]DM		WSC gkg[-1]DM		Ratio WSC / BC	
Vetch K-10	82.29			46.60		59.40		0.72	
Oat	63.08			66.70		75.60		1.19	
Lolium	31.61			64.00		85.50		2.71	
The chemical composition of starting material gkg[-1]DM									
Mixture	DM	CP	CF	EE	Ash	NFE	ADF	NDF	Ca	P
Vetch / lolium	261	170.9	387.1	30.8	102.4	308.8	505.5	630.3	9.5	3.9
Vetch / oat	277	131.2	380.4	43.7	105.9	338.8	481.5	699.7	7.2	3.2

The analysis of the individual components of the mixture showed that vetch as a main crop in the mixture had a high BC 82.29 meq LA100g[-1] DM and low level of WSC 59.40 gkg[-1]DM. This ratio WSC/BC of only 0.72 is unfavourable for silage, so it is not possible to obtain high-quality silage from pure vetch crop, which is consistent with the statements of Dini et

al., (2008). Supporting cultures (oats and Italian ryegrass) have significantly lower BC and higher level of WSC resulting in more favourable WSC/BC ratio (1.19 and 2.71 respectively). The results of WSC/BC ratio in Italian ryegrass, although favourable, are significantly lower than the results that are obtained by Dini et al. (2002), which may be due to slightly later harvesting or influence of weather conditions on the chemical composition and content of certain substances in the biomass of Italian ryegrass. Consequently, the resulting mixtures of vetch with oats, especially with Italian ryegrass had significantly better WSC/BC ratio compared to a pure vetch crop.

The results of the chemical composition of silages are shown in Table 2. It was established that the type of supporting culture significantly influenced the level of CP in the silage, where the mixture of vetch and Italian ryegrass had more CP by 41.5 gkg^{-1}DM in relation to the mixture with oats (171.9:130.4) as a result of a greater share of oats, and a higher CP content in the biomass of Italian ryegrass. The achieved level of CP in the mixture with oats of 131.4 gkg^{-1}DM was significantly lower than the values stated by Miki et al., (2006).

Table 2. The chemical composition and energy values (NE$_L$ i NE$_M$) of silage gkg^{-1}DM

Mixture	Inoculant	CP	EE	CF	NFE	NDF	ADF	Ash	Ca	P	NE$_L$	NE$_M$
(a$_1$) Vetch/ Oat	(b$_1$)Without	128.7	41.0	387.0	336.9	676.6	493.7	106.4	7.27	3.10	4.65	4,40
	(b$_2$)With	132.1	33.4	384.2	348.1	669.7	503.0	102.2	6.60	2.80	4.66	4.40
(a$_2$) Vetch/ Lolium	(b$_1$)Without	172.7	56.1	378.4	277.4	603.8	490.9	115.3	8.60	4.03	4.37	3.99
	(b$_2$)With	171.1	37.0	376.6	308.5	601.2	497.5	106.8	9.77	4.07	4.33	3.95
Average for A$_1$		130.4[b]	37.2[b]	385.6[a]	342.5[a]	673.2[a]	498.4[a]	104.3[a]	6.94[b]	2.95[b]	4.65[a]	4.40[a]
Average for A$_2$		171.9[a]	46.6[a]	377.5[a]	292.9[b]	602.5[b]	494.2[a]	111.1[a]	9.18[a]	4.05[a]	4.35[a]	3.97[b]
Average for B$_1$		150.7[a]	48.6[a]	382.7[a]	307.1[b]	640.2[a]	492.3[a]	110.8[a]	7.94[a]	3.57[a]	4.51[a]	4.20[a]
Average for B$_2$		151.6[a]	35.2[b]	380.4[a]	328.3[a]	635.5[a]	500.3[a]	104.5[a]	8.18[a]	3.44[a]	4.49[a]	4.18[a]

Significance LSD 0,05

Italian ryegrass, as a supporting crop was directly influenced by the chemical composition of silage, so in this mixture significantly higher EE, Ca and P were observed, i.e. decreased values of NFE and NDF compared to the mixture with oats. The inoculant had no significant impact on change in the chemical composition of silage, except on the decrease of EE and increase of NFE. Type of supporting culture and inoculant did not have a significant impact on changes in the content of CF, ADF and Ash. The energy value of the silage was significantly different depending on the type of supporting culture and its share in the mixture, so the NE$_L$ and NE$_M$ values of the silage made from mixture with oats were significantly higher than in the silage obtained from mixtures with Italian ryegrass. This may be explained by partial participation of milky-waxy oats grain in the biomass, which increased the energy value of oats as a supporting culture.

Table 3. The parameters of the fermentation process in silages

Mixture	Inoculant	DM gkg^{-1}	pH	% NH$_3$-N/dN,	% H$_2$O-N/dN,	Acetic acid gkg^{-1}DM	%TA	Butyric acid gkg^{-1}DM	%TA	Lactic acid gkg^{-1}DM	%TA
(a$_1$) Vetch/ Oat	(b$_1$)Without	286.7	5.07	18.51	63.71	55.73	40.1	6.83	4.9	76.40	55.0
	(b$_2$)With	280.0	4.77	12.94	51.14	57.73	45.0	0.03	0.1	70.50	54.9
(a$_2$) Vetch/ Lolium	(b$_1$)Without	266.7	4.87	17.66	61.72	72.23	40.7	8.87	5.0	96.37	54.3
	(b$_2$)With	270.0	4.56	14.73	50.63	92.93	45.4	3.70	1.8	107.97	52.8
Average for A$_1$		283.4[a]	4.92[a]	15.73[a]	57.42[a]	56.73[b]	-	3.43[a]	-	73.45[b]	-
Average for A$_2$		268.4[b]	4.71[a]	16.19[a]	56.18[a]	82.58[a]	-	6.28[a]	-	102.17[a]	-
Average for B$_1$		276.7[a]	4.97[a]	18.09[a]	62.72[a]	63.98[a]	-	7.85[a]	-	86.38[a]	-
Average for B$_2$		275.0[a]	4.66[a]	13.84[b]	50.88[b]	75.33[a]	-	1.85[b]	-	89.23[a]	-

Significance LSD 0,05., %TA- share of total acids

Based on the analysis of the parameters of the fermentation process (Table 3), we can conclude that both these mixtures contained relatively satisfactory average level of dry matter (268.4 to 286.7 g/kg), with a significantly higher dry matter content in the mixture with oats

which can be interpreted as the result of different rates of maturation of supporting crops (oats and Italian ryegrass) in mixtures with vetch. The addition of inoculant did not significantly affect the changes of dry matter in silage. The degree of acidity in all tested treatments varied in the range typical for this type of silage from 4.56 to 5.07, which is similar to the results for pH that were obtained by Kasapovi et al. (1994) for silage mixture of vetch and oats. Type of supporting culture and adding the inoculant had no significant influence on the change in pH in any of the treatments. Noticeable are the relatively lower pH values of the treatments with the addition of the inoculant compared to the treatments without it (4.66:4.97), indicating the necessary application of the inoculant in the process of ensiling of biomass. The mixture with Italian ryegrass had slightly lower pH, i.e. more acidic silage compared to the mixture with oats (4.71:4.92), indicating that the biomass of Italian ryegrass had a better WSC/BC ratio. The inoculant has contributed to the reduction of protein degradation in the process of ensiling and obtained significantly lower values of ammonia nitrogen and water soluble nitrogen in the silage with the addition of the inoculant (Table 3). The biomass of supporting crops had no significant effect on the concentration of ammonia- and soluble nitrogen expressed as total nitrogen. The type of supporting culture had a significant impact on the production of lactic and acetic acids in the silages, hence, in the silage mixture with Italian ryegrass, in average, more acetic acid by 25.85 $gkg^{-1}DM$ was produced (82.58:56.73), or more lactic acid by 28.72 $gkg^{-1}DM$ (102.17:73.45) in relation to the silage obtained from the mixture of oats. Larger production of acids in a mixture with the Italian ryegrass may be due to somewhat lower levels of dry matter in the starting material, but also a more favourable ratio of the total sugars, and the buffer capacity of the supporting crop relative to the oats. Significantly lower production of butyric acid was observed in silage with the addition of inoculant in relation to silage without inoculant (1.85:7.85) $gkg^{-1}DM$, which had positive effects on the quality of silage. This trend of decreasing production of butyric acid is a consequence of increase of the number and of the competitiveness of homofermentative and heterofermentative lactic acid bacteria compared to butyric bacteria, and of better utilization of easy fermentable sugars by lactic acid bacteria.

The quality of silages was assessed by methods according to Flieg and DLG (Table 4), which are based on an assessment of the relative shares of lactic, acetic and butyric acids in the total acid content, whereas DLG method, as a relevant parameter for the assessment, takes into account the pH value of silage (or evi and Dini , 2003).

Table 4. The silage quality assessed

Mixture	Inoculant	FLIEG		DLG	
		Poeni	Klasa	Poeni	Klasa
(a₁) Vetch / Oat	(b₁) Without	65	II	36	III
	(b2) With	80	I-II	39	II
(a₂) Vetch / Lolium	(b₁) Without	65	II	37	II
	(b₂) With	70	II	39	II

According to the Flieg method, all treatments were evaluated and categorized as II class - good quality, with silage of vetch with oats with the addition of inoculant, according to the number of points, is on the border between very good and good quality - I and II classes. Both treatments with the inoculant had more points compared to the treatments without inoculant (80:65 mixtures with oats, 70:65 mixtures with Italian ryegrass). Rating method according to DLG, placed treatments without the inoculant on the verge between class III (36 points) and class II (37 points) - satisfactory and good quality. Treatments with inoculants were rated class II, with both treatments with inoculants receiving 39 points.

Conclusion

Vetch as an annual forage legume can be successfully grown and ensiled in combination with oats and Italian ryegrass as a supporting culture, to provide a relatively good quality silage. Ensiling of such mixtures reduces the nutrient losses in relation to the method of preserving by drying, and the quality obtained is similar to the quality of the starting material. In this way, a significant portion of plant proteins needed to meet the needs of specific types and categories of animals can be provided. Chemical composition and content of certain nutrients, especially protein, depends largely on the type of supporting culture. Adding bacterial inoculants to the biomass significantly affects the increase of competitiveness of lactic acid bacteria in relation to butyric bacteria, and thus to the greater production of lactic and acetic acids, and reduced production of butyric acid.

Acknowledgments

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PHENOTYPIC AND GENETIC EVALUATION OF SOME APPLE SEEDLINGS ROOTSTOCKS TO WOOLLY APPLE APHID (*Eriosomalanigerum Hausm*) RESISTANCE IN SYRIA.

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Abstract

Woolly apple aphid is the main important pest which attacks apple trees and causes severe damages. This investigation was conducted to evaluate some apple seedling rootstock genotypes established through apple breeding program in Syria. One year old apple seedlings rootstocks from 5 genotypes (A, B, C, S2, H) selected through apple breeding program were infested with woolly apple aphid (*Eriosomalanigerum*Hausm) to investigate their susceptibility to this pest. The results showed that S2 was the most susceptible genotype, followed by A and C, with infestation rates of 92.2%, 90% and 90%, respectively. On the other hand, H genotype was the least susceptible to woolly apple aphid followed by B (59.4% and 85.4% infestation rate, respectively).For genetic studies, the resistant plants and some of susceptible one from each genotype, in addition to the mother plants were used to detect the tolerant genes to woolly apple aphid by using 8 markers related to suggested tolerant genes, for integral combination with phenotypic selection. As a result, NZsn_O05 and NZSc_E01 markers were more efficient to distinguish resistant plants. Likewise, NZms_EB145764, NZms_EB106753 and NZSc_A01 revealed bands in both tolerant and susceptible plants as monomorphic bands, while, NZsc_C20, NZsc_GS327 and NZsc_O05 (linked to *Er1*) did not reveal any PCR product. Consequently, it is important to select the resistant apple rootstocks for woolly apple aphid at early stage in apple rootstocks breeding program. On the other hand, it is necessary to develop new markers tightly linked to the resistant genes depending on studied plant material.

Key words: *Apple, Woolly apple aphid, seedling rootstock, resistant genes.*

Introduction

Woolly apple aphid (WAA) *Eriosoma lanigerum* (Homoptera: Aphididae) is the most destructive and common pest around the world, as in Syriaespecially it distributes in all apple regions and grouped as the second important pest after codling moth (Al-Matni, 1997; Mansour, 2006). WAA can feed on both roots and vegetative parts of apple trees, root infestation can cause the death of the tree in extreme cases. However, vegetative infestation can be controlled by insecticide treatments, while the root infestation cannot be chemically controlled (Klimstra and Rock, 1985). On the other hand,using chemical insecticide with large doses can increase the residual effect in the fruit, pollute soil and water, destroy natural enemies, increase insect resistance, and cause health risks to the workers (Reganold *et al.,* 2001). Nowadays, breeding programs is aiming to produce resistant rootstocks to biotic stress and to achieve sustainable agriculture objective in reducing the use of chemicals to the lowest limit (Hrotko, 2007). "Northern spy" cultivar was used in the past as an apple rootstock due to its resistance to WAA, then introduced into apple rootstock breeding program as a parent in East Malling institute in cooperating with John Innesinstitute, so they produced the MM series and Merton Immune of resistant apple rootstocks to WAA (Preston, 1955; Webster and

Wertheim, 2003), the MM106 and MM111 still the most common resistant rootstocks throughout the world (Webster *et al.,* 2000).

The success of rootstock breeding program depends on the selection of parents for hybridization (Cummins and Aldwinckle, 1995). Rootstock MM106 is used in many breeding programs, especially for the resistance to WAA, in such programs the infestation with the insect is done at early stage to exclude the susceptible plants (Johnson *et al.,* 2001).

Rootstocks with genetic resistance that usually considered as field immune to the pest are used to prevent infestation of the belowground parts (Bus *et al*., 2008). Traditional breedingforapple rootstock is time and labor consuming, due to the long juvenile period, so MAS is expected to be a useful tool to identify characters of fruit tree at the seedling stage (Ban *et al.,* 1999). As new multi-allelic markers (SSRs, SNPs) become available for the analysis of apple germplasm the prospect of utilizing them in tandem with phenotypic data on breeding population is becoming a reality (Fazio and Mazzola, 2004).

Our research aimed to evaluate and identifysome of apple rootstock genotypes have the genetic resistance to WAA for rootstock breeding program in Syria depending on phenotypic and genetic evaluation.

Materials and methods

The present investigation was carried out at the agricultural scientific research center – GCSAR- in Sweida province, which located at 1525m altitudeinthe south of Syria, 20.36 to 21.36atitude and 40.3-40.4 longitude.

Plant material

One year old seedlings from 5 apple genotypeswere introduced into apple rootstock breeding program in Syria: A, B and C genotypes produced by open pollination, S2 is local apple cultivar(Sukari), and H is a hybridgenotype between the rootstock MM106 and the local apple cultivar Sk (Skarji).

Phenotypicfor resistance to WAA

Seedlings from each genotype (A: 30, B:55, C:44, S2:24 and H:32 seedlings) were planted in lines, the planting distance was 25 cm between plants and 70 cm between lines, all the agricultural processes (irrigation, fertilization and weeding)were achieved.The infestation was done in late June 2010 by placing shoot pieces with heavily infested WAA colonies in each seedling, the infestation was repeated twice in interval two weeks, the seedlings were not subjected to chemical control all the season.

WAA infestation was assessed 4 months after inoculatingat the first season, and at the end of second season using 6- point scales according to(Bus *et al.,* 2008):

0: No infestation

1: Light infestation consisting of several small, separate colonies

2: Medium infestation and galling with some colonies starting to coalesce

3: Many colonies coalescing and up to 2 shoots completely infested and galled

4: Heavy infestation and galling on 2-5 shoots

5: Heavy infestation and galling on more than 5 shoots

The percentage of infested seedlings in each scale within each genotype was calculated. For phenotypic evaluation seedlings classified as 0 or 1 to be resistant and those scoring 2-5 to be susceptible.

Genetic evaluation

DNA extraction was achieved using CTAB protocol according to Porebski *et al.,* (1997),by collecting leaves from the resistant plants and some of susceptible ones from each genotype, in addition to the mother plants.

PCR amplification was achieved using 8 markers (Table 1) linked to the resistant genes for woolly apple aphid according to Bus *et al*., (2008).

The reaction was performed with volume (10 µl) consisted of: 1 µl 10 X buffer + 1 µl dNTPs + 1 µl forward primer + 1 µl reverse primer + 3 µl DNA + 0.1 µl taq + 2.9 µl dH$_2$O. The cycling profile for the markers NZsc_G327, NZsc_O05, NZsc_E01 and NZsc_A01 consisted of an initial denaturation step of 3 min at 94 c, followed by 35 cycles of 30 s at 94C, 30 s at 55 C and 1min at 72C, the amplification process was finished with 5 min at 72C. For the markers NZms_EB145764, NZms_EB106753, NZsn_O05 and NZsc_C20 were used touchdown PCR consisted of an initial denaturation step of 5 min at 94 c, followed by 10 cycles of 30 s at 94C, 30 s at 70 C and 45 s at 72C, the temperature was reduced 1C every cycle, followed by 20 cycles of 30 s at 94C, 30 s at 60 C and 45 s at 72 C, the amplification process was finished with 10 min at 72 C.

Table 1: markers linked to the resistant genes to woolly apple aphid, the sequence of forward and reverseprimers, and the product size (bp).

Marker name	Marker type	Original RAPD /EST	WAA gene	Forward primer	Reverse primer	Product size (bp)
NZsc_C20	SCAR	OPC20	Er1	TCTCTAACTCAATAACTCCCAAGAC	ACTTCGCCACCATTATCACTCCTGA	2,000
NZsc_GS327	SCAR	GS327	Er1	GCCAAGCTTCAATGTCGGAGTAGAT	CAAGCTTCCCCTAAGGCTATTGCCA	1,600
NZsc_O05	SCAR	OPO05	Er1	CCCAGTCACTAACATAATTGGCACA	CCCAGTCACTGGCAAGAGAAATTAC	1,700
NZsn_O05	SNP	OPO05	Er1 Er3	AACGTCATGTCAATAT	CCCAGTCACTGGCAAGAGAAATTAC	880
NZsc_E01	SCAR	OPE01	Er3	CCCAAGGTCCGAACACAAATGAGAG	CCCAAGGTCCAAAACTATCCCGAAG	1,350
NZSc_A01	SCAR	OPA01	Er3	CAGGCCCTTCAGCAAAGAGGTGTCT	CAGGCCCTTCACTACTAATAAGAAC	1,250
NZms_EB106753	SSR	EB106753	Er1 Er3	TCTGAGGCTCCCAAGTCC	TAGGAGCAGAAGAGGTGACG	175
NZms_EB145764	SSR	EB145764	Er2	TTCCAGCGATCCAAAACAAT	GCTCAGGAACACCTCGTTCT	198

The PCR productswere detected by electrophoresis on 1% agarose gel in 1X TBE buffer, stained with ethidium bromide and visualized by UV light and photographed using gel doc. NZms_EB106753 and NZms_EB145764 markers detected by running PCR products on a 8% polyacrylamide gel in 1X TBE buffer.

Results and discussion

Phenotypic evaluation

The results of seedlings infestation with WAA showed differences between the two seasons of assessment and among studied genotypes. At the first season all seedlings from genotype H were presented in scale 0 and 1 (100% resistant), followed by the genotype S2 which the

percentage of resistant seedlings was 91.7% ,while the susceptible seedlings were in scale 3.The percentage of resistant seedlings in genotypes B, A and C were 90.9, 86.6 and 80% respectively, and the susceptible seedlings was in the scales 2 and 3 for genotype B, and in the scales 2,3 and 4 in the genotypes A and C (Table 2). At the second season the percentage of resistantand susceptibleseedlings were changed among genotypes. However, the percentage of resistant seedlings in the genotype H still the highest one (40.6 %), and its susceptible seedlings became in the scale 3, while the percentage of resistant seedlings decreased clearly in all other genotypes to 14.6, 10, 10 and 8.3 % in B, A, C and S2, respectively.Likewise, the susceptible seedlings in these genotypes became more excessive than the previous season, especially in genotype C which 32.5 % of seedlings were in the scale 5. These results were in agreement with Fazio and Beers (2010) that the resistant rootstocks did not change, while the infestation increased within the susceptible onesin the second season. The genotype H showed the highest percentage of resistant seedlings due to the main role of the rootstock MM106 as a parent takes its resistance property from Northern spy cultivar which has the resistant gene $Er1$ for WAA (Webster et $al.$, 2000).

Table 2: the percentage of infested seedlings for each scaleamong studied genotypesduring the two seasons.

genotype	Season of assessment	Percentage of infestation %					
		0	1	2	3	4	5
A	2010	63.3	23.3	3.3	3.3	6.7	0
	2011	0	10	0	63.3	0	26.7
B	2010	72.7	18.2	3.6	5.5	0	0
	2011	7.3	7.3	0	76.4	0	9
C	2010	47.5	32.5	10	5	5	0
	2011	0	10	0	57.5	0	32.5
S2	2010	79.2	12.5	0	8.3	0	0
	2011	0	8.3	0	75.5	0	16.7
H	2010	81.2	18.8	0	0	0	0
	2011	28.1	12.5	0	59.4	0	0

Genetic evaluation

At the end of the second season the susceptible seedlings were excluded from the applerootstock breeding program and the resistant seedlings were genetically evaluated to insure the presence of considered resistant genes for WAA .The results showed that the marker NZsn_O05 linked to $Er1$ and $Er3$ genes was the most efficient marker, it gave alleles have the predictable size 880 bp according to Bus et $al.$, (2008) in 15 seedlings (Figure 1)5 of them from the genotype H (3 in the scale 0 and 2 in the scale 1), in addition to the rootstock MM106 which used as control for the gene $Er1$, 5 seedlings from genotype B (2 in the scale 0, 2 in the scale 1 and 1 in the scale 5) in addition to the mother plant, the C mother

plant and 2 seedlings from genotype S2 (1 in the scale 1 and the other in the scale 5).However, this marker could not distinguish all the resistance seedlings in the genotype H, this result was in agreement with Bus *et al.,* (2008) which they found that this marker discriminated 70 plants from 77 ones showed the resistance property. On the other hand, from 15 seedlings were detected just 2 seedlings was susceptible (1 from genotype B and the other from genotype S2), this indicated the possibility of the presence of the gene *Er*3 in this two seedlings because the plants which carrying the gene*Er*1 or *Er*2 have a higher level of resistance than those carrying the gene *Er*3 which show high susceptibility to WAA (Sandanayaka*et al.*, 2003).
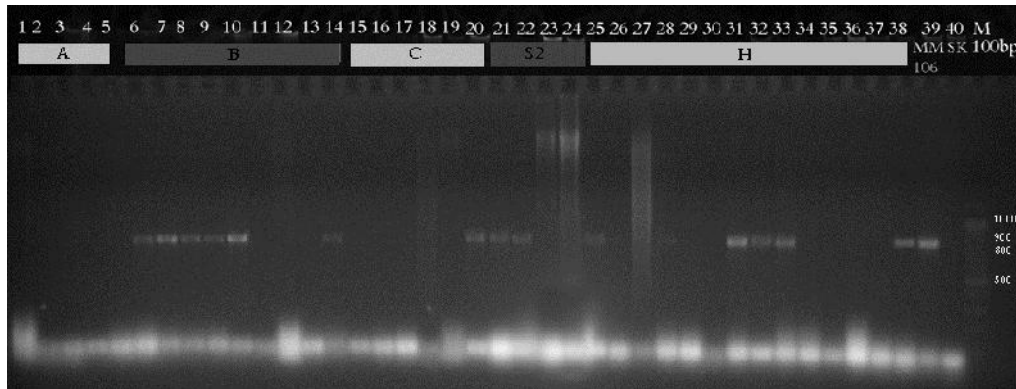
Figure 1: PCR products using the marker NZsn_O05

The marker NZSc_E01 linked to the gene *Er*3 gave three polymorphic alleles, one of them was 1350 bpas the same of predictable size by Bus *et al.,* (2008) which was noticeable in the most studied seedlings (resistant and susceptible ones), while the remaining seedlings have two otheralleles size(700 and 500 bp respectively), most of seedlings were light infestation and susceptible ones except one resistantseedling.Therefore, it was so difficult to identify seedlings which have the gene *Er*3.

The markers NZsc_C20, NZsc_O05 and NZsc_GS327 linked to the resistant gene *Er*1 did not give any PCR products. On the other hand, the markers NZms_EB145764 (linked to the gene *Er*2), NZms_EB106753 (linked to the genes *Er*1 and *Er*3) and NZSc_A01 (linked to the gene *Er*3) gave monomorphic alleles so they were not able to distinguish between resistant and susceptible seedlings. Although, these markers gave the same expected sizeasmentioned by Bus *et al.,* (2008) except NZSc_A01. This is possibly due to the apple species, which were used in primers designing, were different from the studied genotypes origin. On the other hand, these markers were may not tightly linked to the resistant genes.

Conclusion

As a result the studied genotypes showed high susceptibility to WAA except the genotype H followed by the genotype B.Genetic evaluation of resistant seedlings from all genotypes showedthat the studied markers could not discriminate between all resistant seedlings and susceptible ones except the marker NZsn_O05. Therefore, it is necessary to develop new linked markers to WAA resistant genes depending on studied plant material, through using available techniques such SNPs and SSR. In addition, breeding programs should depend onthe strategy of pyramiding the reresistant genes to give durable resistance to WAA. hybridization caused the presence of two genes or more in the produced progenies.

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THE EFFECT OF DEFICIT IRRIGATION ON THE GROWTH OF SOME APPLE SEEDLINGS ROOTSTOCKS

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Abstract

The present investigation has done at the Agricultural Scientific Research Center in Sweida, Syria to study the effect of deficit irrigationon the growth of five apple seedlings rootstocks genotypes in the nursery, to estimate their ability to drought tolerancein the lack of water resources and the hold of rain, by applying two irrigation levels: 100% of water requirement (control), the second 75% of water requirement (deficit irrigation treatment). Many parameters were measured: shoot length, leaves number, leaflength and width, main and secondary root lengths and dry matter partitioning in leaves, shoots, stem and roots at each level. The results showed the effect of deficit irrigation treatment on studied genotypes by the reduction of shoots length, leaves number and leaf length and width at deficit irrigation treatment comparing with the control. On the other hand, the main root length was insignificantly higher at the deficit irrigation treatment in the genotypes A, B and H than the control, and the secondary roots length were significantly higher in the genotypes A, C and S2 at the deficit irrigation treatment than the control. The dry matter partitioning decreased in leaves, shoots and stem and increased in the fine and coarse roots at the deficit irrigation treatment as a response to drought condition. However, there was a difference between studied genotypes due to the difference of their vigor. Consequently, all studied genotypes responded to deficit irrigation treatment, so it is necessary to test these genotypes under 50% of water requirement to select the most tolerance genotype.

Key words: *apple, deficit irrigation, seedling rootstock*

Introduction

The Mediterranean region is the most vulnerable to climate change because of its sensitivity to drought, rising temperatures and water scarcity. Drought is the major problem for agriculture and leads to the reduction of crop yield (Farooq *et al*., 2009) especially in fruit trees. Apple is one of the main trees in Syria and play an important role in commodities balance. As in most of plants, water relations are critical to the function of the apple tree, as water is the greatest component of the tree by mass, and even essential processes can be limited by inappropriate water status (Lakso, 2003), so the current production systems should be modified to preserve fruit trees and conserve the limited water resources (Sun *et al*., 2012), in addition to improve water use efficiency (Bassett *et al*., 2011). Irrigation management strategies shift from emphasizing production per unit area towards maximizing the production per unit of water consumed (Fereres and Soriano, 2007). Deficit irrigation is one of the new irrigation techniques that applied by adding water below the full crop requirements, and considered as an important strategy to increase the efficiency of using available irrigation water (Kirda, 2002; Marsal *et al*., 2002) Many researchers applied deficit irrigation on apple trees to study its effects on different growth indicators like trunk diameter, vegetative growth, fruit traits and productivity (Lancu, 1985; Mpelasoka*et al*., 2001; Caspari*etal*., 2004; Einhorn and Caspari, 2004; Connell and Goodwin, 2007).

Recently, deficit irrigation researches on apple trees are concerned with the role of the rootstock and its response to deficit irrigation which lead to increase the efficiency of water use.Vegetative and seedling apple rootstocks grafted with commercial cultivars were subjected to determine the effect of deficit irrigation on fruit quality and quantity by applying three irrigation levels ;100%, 75%, and 50% of water requirement (Sakalauskaite *et al*., 2006; Hasani *et al*., 2009). Likewise, apple rootstocks showed different responses to drought tolerance when exposed to gradually reducing water irrigation until natural soil drought conditions at the early stage of vegetative growth (Atkinson *et al*., 1999). On the other hand, apple seedling rootstocks derived from different apple species showed an important traits to improve the ability to drought conditions due to the root architecture system (Wertheim and Webster, 2003;. Webster and Wertheim, 2003). According to the main role of apple rootstocks breeding program in Syria to produce drought tolerant rootstocks, the present investigation was carried out to evaluate the response of apple seedling rootstocks to deficit irrigation at early stage of growth under limited water resources.

Materials and methods

The present investigation was carried out at the agricultural scientific research center – GCSAR- in Sweida province, which is located 1525m altitude at the south of Syria.

Plant Material
One year old apple seedlings from five apple genotypes were introduced into apple rootstock breeding program in Syria: A, B and C genotypes produced by open pollination, S2 is local apple cultivar (Sukari), and H is a hybrid genotype between the rootstock MM106 and the local apple cultivar Sk (Skarji).

Cultivation and Water Treatments
Three seedlings from each genotypes were planted in each replicate, in an average 3 replicates in each treatment, the planting distance was 25 cm between plants, 1 m between lines and 3 m between treatments. Seedlings were pruned after a period of growing with keeping 3 shoots on each seedling. Two levels of water treatment were attained by applying two irrigation regimes: 100% of water requirement (control), and 75% of water requirement (deficit irrigation treatment).

After irrigation was stopped, the following measurements were applied:
- shoot length, leaf number, leaf length and width and main and secondary root length were calculated for each genotype and its seedlings in the two treatments.- Dry matter partitioning: plants were divided into leaves, roots, stem and shoots then dried at 80º C to constant weight (except root). Roots were washed gently and then separated by hand into fine roots (< 2 mmin diameter) and coarse roots (> 2 mm in diameter) according to Atkinson *et al.,* (1999), then roots were dried at 80º C to constant weight and the amount of dry matter in both size classes was determined.

Experimental Design and Statistical Analysis
Factorial experiment in a simple randomized block design to compare the five genotypes at two levels of irrigation. The analysis of variance was done using two way ANOVA to compare means of measured parameters by LSD test (p < 0.05).

Results and discussion

Shoot length
Data showed that the shoot length was higher in control than deficit irrigation treatment except genotype H which reflected the response of seedlings to drought conditions by decreasing the vegetative growth then reduction water lose throw transpiration (Atkinson *et*

al., 1999). The studied genotypes revealed different responses against the two irrigation treatments (Figure 1), The genotypes C and S2 revealed high significant shoot length (74,7 and 70.7 cm at the control, then 60 and55 cm at the deficit irrigation treatment, respectively) than genotypes A (59 cm and 45 cm, respectively), B (52 cm and 37.3 cm, respectively), and H that showed low variance of shoot length between the two treatments (44 cm at the control and 47 cm at the deficit irrigation treatment) which related to its parentage as a hybrid between semi vigor (MM 106) rootstock and vigor parents (Skarji) cultivar.
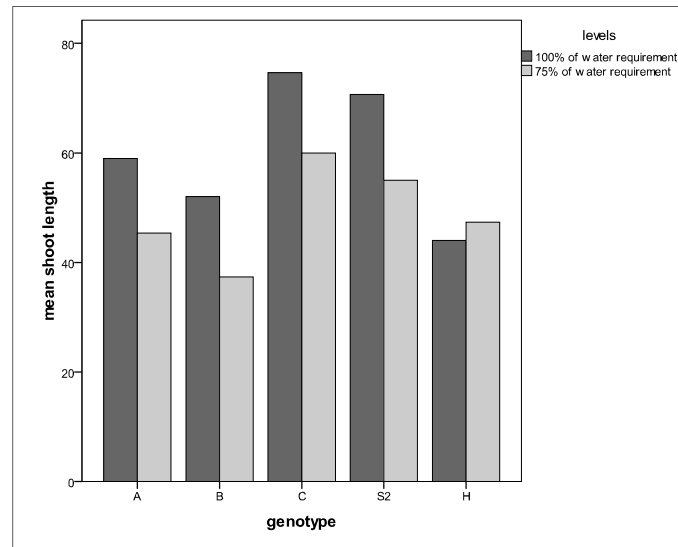
Figure 1: Shoot length at the two irrigation treatment within studied genotypes.
LSD5% = 6.8 between the two treatments, LSD5% = 15 among genotypes.

Leaves number

The number of leaves was higher at the control than at the deficit irrigation treatment for all seedlings of studied genotypes except H genotype (112 at the control and 150 leaves at the deficit irrigation treatment) as a response of plants to deficit irrigation. All genotypes revealed noticeable decreasing of leaves number at the deficit irrigation treatment in the comparison with the control except H genotype which related to the architecture system of each genotype, number of leaves related to internodes length and differ in compact growth system than standard growth system (Figure 2), seedlings of genotype C gave the highest number of leaves (220 and 175 at the control and at the deficit irrigation treatment, respectively). On the other hand, except genotype H, all other genotypes showed different responses to the reduction of leaves number; Genotype A showed limited reduction of leaves number at the deficit irrigation treatment, followed by genotypes S2, C, and B respectively. The reduction of leaves number considered as an indicator to the response to drought conditions (Atkinson et al.,1999).
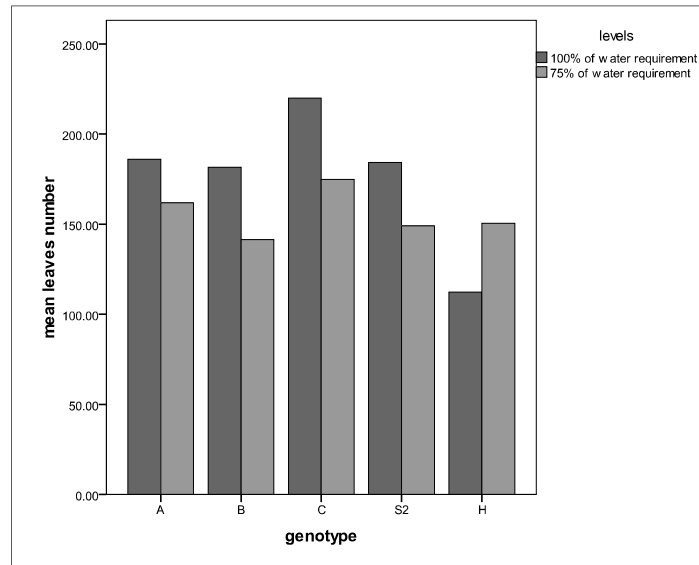
Figure 2: Leaves number at the two irrigation treatment within studied genotypes. LSD5%= 22.7 between the two treatments, LSD5%= 35.2 among genotypes.

Leaf length and width

Data showed that the control significantly revealed higher leaf length and width for all studied genotypes than the deficit irrigation treatment except S2 genotype due to the response of plants to drought conditions (Atkinson *et al.*, 1999; Sakalauskaite *et al.*, 2006). The studied genotypes were varied in their response to deficit irrigation (Figure 3), genotypes C, S2 and H significantly revealed high leaf length and width than A and B genotypes which related to the growth habit for each genotype (Al-Halabi *et al.,* 2012).
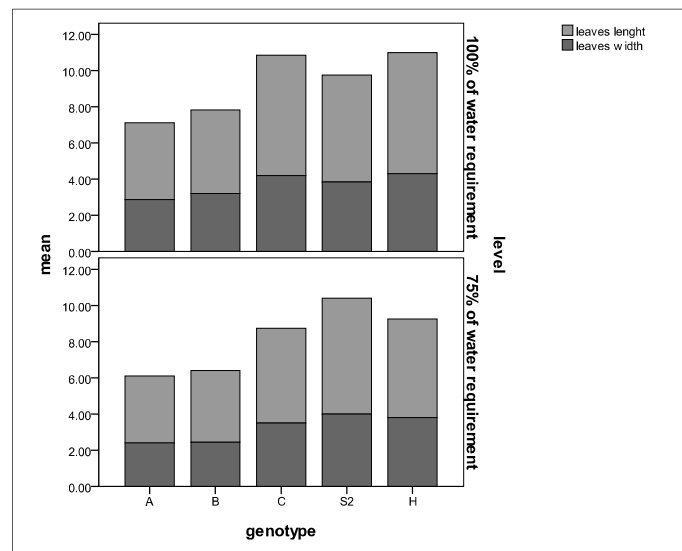
Figure 3: Leaves length and width at the two irrigation treatment within studied genotypes. LSD5% = 0.5 and 0.4 for leaf length and width respectively between the two treatments, LSD5% = 0.8 and 0.6 among genotypes for leaf length and width respectively.

Main and secondary root length

The main root length was higher at the deficit irrigation treatment in the genotypes A, B and H than the control, but these differences were insignificant, while the main root length in the

genotype S2 and C was insignificantly shorter in deficit irrigation treatment than the control. The main root length of genotype C was the highest one of all studied genotypes in the control, while the genotype H showed the highest main root length of all studied genotypes in deficit irrigation treatment (Table 1). On the other hand, the secondary roots length were significantly higher in the genotypes A, C and S2 at the deficit irrigation treatment than the control. Table 1 showed that the genotype S2 distinguished by the highest secondary root length (29.8 cm) of all studied genotypes at the deficit irrigation treatment. These results indicated the response of studied genotypes to deficit irrigation condition through deepening their root system into the soil (Dudley, 1996).

Table 1: The main and secondary root length at the two irrigation treatment within studied genotypes

Genotype	Main root length (cm)		Secondary roots length (cm)	
	Control treatment	Deficit irrigation treatment	Control treatment	Deficit irrigation treatment
A	43	53	21.3	28.5*
B	42.2	53.2	18.5	17
C	63	53.5	18.5	28.4*
S2	56.8	54	21.7	29.8*
H	37.3	58.7	25.8	28
LSD5%			4.4	

*indicated to significant difference between treatment

Dry matter partitioning

Figure 4, showed that the dry matter significantly decreased in leaves in A, C and H genotypes at the deficit irrigation treatment than the control, while genotypes B and S2 showed insignificant differences between two treatments. In addition, the dry matter of shoots and stem significantly decreased in all genotypes at the deficit irrigation treatment than the control, except genotype B. These results were in agreement with Atkinson *et al*. (1999) and Sakalauskaite*et al.* (2006) that the response to drought condition occurred through decreasing dry matter in leaves, shoots and stem. In contrast, the differences in dry matter partitioning in fine and coarse roots were insignificant between the two treatments. This indicated that the dry matter partitioning decreased in leaves, shoots and stem and increased in the roots at the deficit irrigation treatment as a response to drought condition according to Wilson (1988). On the other hand, the studied genotypes were differed in dry matter mass due tothe ability of rootstocks to decrease the dry matter partitioning in leaves, shoots and stem according to their growth vigor (Atkinson *et al*., 1999).
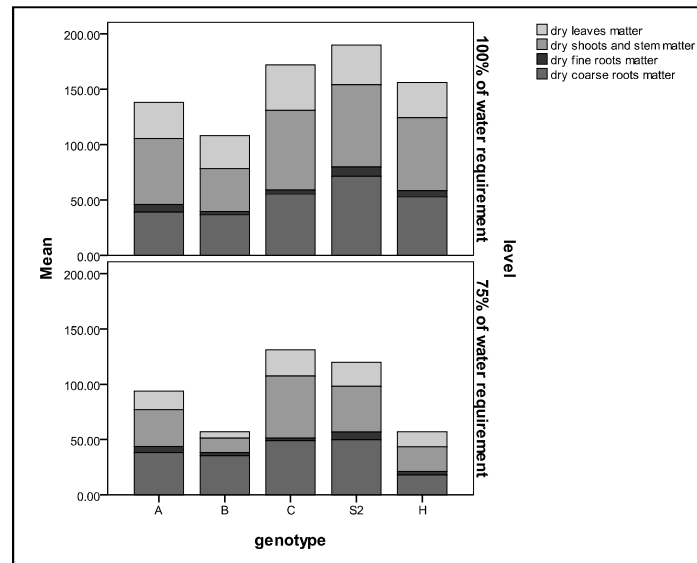
Figure 4: Dry matter partitioning at the two irrigation treatment within studied genotypes LSD5% = 14.1 and 16.3 for leaves dry matter and shoots and stem dry matter respectively between the two treatments, LSD5%= 25.8 among genotypes for shoots and stem dry matter, LSD5%= 2.3 and 11.5 among genotypes for fine roots and coarse roots respectively.

Conclusion

As a result the studied genotypes showed the ability to tolerate the deficit irrigation conditions in early stage through deepening their root system, on the other hand, shortening shoots length, reducing leaves number and leaf length and width. In addition to decrease dry matter partitioning in leaves, shoots and stem, in contrast, to increase dry matter partitioning in fine and coarse roots in comparison with the control. Although, genotypes behaved in the same way under deficit irrigation treatment but they showed differences among each other due to the different in growth vigor. Therefore, it is necessary to test these genotypes under 50% of water requirement level to select the most tolerance genotypes.

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THE EFFECT OF SOIL MULCHING ON THE QUALITY OF THE BULB AND THE YIELD OF DIFFERENT AUTUMN GARLIC GENOTYPES

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Abstract

The effect of soil mulching (covering) on the quality of the bulb and the garlic yield was tested. The experiment served to test the properties of five genotypes (four population and Bosut sort) originating from the Institute of Field and Vegetable Crops, Novi Sad, Serbia. The tested garlic was grown on black polyethylene sheeting, wheat straw and non mulch soil (control). The field experiment was set up in a randomized complete block design in four replications (Ma va, Serbia). The following factors were analyzed: number of cloves per bulb, weigh of clove (singl), weight of bulb and bulb yield. Mulch significantly affected the analyzed garlic properties, specifically the quality and yield of the bulb. In this regard, the emphasis is on the polyethylene sheeting where the values of the above mentioned factors were the most favourable ones. Significant differences were recorded between the tested genotypes. The differences between them were significantly expressed in the mulching varieties. The results accomplished in this experiment indicate that by mulching the soil and with the appropriate genotype selection, the yield achieved in the garlic production can be significantly increased with quality bulbs.

Key words: *garlic, bulb, yield, soil mulching*.

Introduction

The production of garlic (*Allium sativum* L.) in Serbia is based on the autumn and spring subtypes of garlic. Spring garlic is planted early in the spring (March) and it has smaller bulbs, higher number of cloves, higher dry matter content. Because of these properties, the spring garlic bulbs can be kept longer in comparison to the autumn subtype of garlic. Autumn garlic has an attractive, larger bulb, which is primarily caused by the length of the growing season (October-July).

At the territory of Serbia, garlic is grown on around 9 thousand hectares. Average yields are about 4 t ha^{-1} (FAO, 2014). The production technology is conditioned by its biological specificity, vegetative method of reproduction, resistance to low temperatures and other requirements according to agroecological conditions. Because of these characteristics, it is particularly taken into account the introduction of planting material, which must originate from a similar geographic area (similar agroecological conditions). Selection of local garlic genotypes in Serbia is small and the level of production technology is low (Kamenetsky et al., 2004; Gvozdanovi -Varga et al., 2009; Morav evi et al., 2011b). When selecting the planting material one takes into account the aforementioned particularities that limit its production, there is an answer to the question of why our garlic yield is several times lower (about 3 times) when compared to the global yield (around 13 t ha^{-1}).

A variety of natural and industrial materials for mulching (covering) the soil are being used in the plant production. Harvest residues of certain plants (wheat, corn, soybean) and various

foils, mainly polyethylene (PE) are dominant. The advantage of mulching is reflected primarily in the easy maintenance of optimal moisture and soil temperature, weed control, as well as reducing the incidence of diseases and pests on cultivated plants. Even though this agrotechnical measure mainly positively affects the cultivated plant, it has not found its application in the production of garlic in Serbia. In particular, we emphasize the fact that no domestic science is not going towards this direction even though a large number of foreign research showed that garlic mulching gave a positive effect (Haque et al., 2003a; Jamil et al., 2005; Najafabadi et al., 2012).

For all the above mentioned reasons, and for the purpose of increasing the volume of domestic garlic production, this team of researches chose the testing that will answer the question of the extent that the soil mulching in the autumn garlic production has on its quality and the yield. The paper also shows the behavior of different genotypes of the autumn garlic.

Material and methods

Autumn garlic testing in the agroecological conditions of Ma va (Western Serbia) was performed during the vegetation seasons of 2011/12 and 2012/13. Thereby, we used a method of field experiments that were set in a random block system in four recurrences. The size of the elementary plot size was 4 m^2 (2x2 m).

Table 1 shows the following meteorological parameters: average monthly air temperatures and the amount of monthly rainfall for the years in which the experiment was conducted (RHMSS, 2014).

Table 1 Mean monthly temperature and monthly rainfall, Sremska Mitrovica, Serbia

Month/Year	Temperature [ºC]				Rainfall [mm]			
	2011	2012	2013	2000-2013	2011	2012	2013	2000-2013
Jan	0.10	1.50	3.10	0.40	32	41	55	39
Feb	0.10	-4.50	4.40	1.72	32	53	48	35
March	6.30	7.90	6.50	7.01	16	4	64	41
April	13.20	12.90	13.40	12.58	20	86	32	50
May	16.60	17.10	18.10	17.77	63	71	113	68
June	20.60	22.70	20.20	20.74	70	27	60	80
July	22.20	24.90	22.00	22.39	94	40	44	52
Aug	22.40	23.70	23.20	22.03	6	0	18	51
Sept	20.30	19.50	16.10	16.81	19	13	61	54
Oct	10.40	12.80	14.70	12.11	27	48	71	59
Nov	3.00	9.10	9.00	7.06	6	30	34	45
Dec	3.80	0.40	1.70	1.69	45	40	5	41
Average/Sum	11.58	12.33	12.70	11.86	430	453	605	615

The crop preceding the garlic was broccoli in both tested years. The primary type of tillage (plowing) was performed in both tested years, at the end of September at a depth of 30 cm. Together with the seedbed preparation, we performed a basic fertilization with 500 kg ha^{-1} mineral fertilizer of formulation 8:24:16 +4% S. At the beginning of April, we also performed a top dressing of 300 kg ha^{-1} of nitrogen fertilizers KAN (27%). Regular weed, disease and pest control was performed. The experiment was conducted without irrigation. The soil was of cambisol type, with the following chemical properties: pH -5.60 (KCl), humus content 2.1%, total nitrogen content - 0.2%, phosphorus 13 mg and potassium - 24 mg per 100 g of soil.

The experiment tested the properties of five autumn garlic genotypes (Bosut variety and four other populations) that originate from the Institute of Field and Vegetable Crops of Novi Sad, Serbia. Garlic is grown on black polyethylene foil, wheat straw and soil without mulch (control). Polyethylene mulch foil is set just prior to planting while mulch of wheat straw (3 cm layer thickness) is placed immediately after planting the garlic.

Garlic was planted by hand in mid-October in the density of about 250 thousand plants ha^{-1} (30x13 cm). Garlic harvest (removal), was carried out, in both years, in July (1st and 6th), when it was observed that the false tree completely softened, while the plants have not yet begun to massively lodge. Immediately before planting garlic (three months after the removal), the following parameters were analyzed: the number of cloves in the bulb, clove weight (individual, in grams), bulb weight (g) and the bulb yield (t ha^{-1}).

The results were statistically analyzed according to the model of two-factor analysis of variance (ANOVA) and the LSD test (Excel 2007, DSAASTAT 2011).

Results and discussion

The highest number of cloves in the bulb was noticed at the soil that was mulched with a black PE foil (11.37) while the lowest number was noticed in the variant without mulch (8.53). Statistically, mulched variants had the significantly higher number of cloves when compared to the controlled variant (without mulch). Statistically, significant differences in regards to the number of cloves were also noticed in the genotypes. The highest number of cloves, in all variants, had the genotype B (16.45), while the lowest number of cloves in a bulb was noticed in the genotype D (8.33). Slight variations of this parameter (maximum stability) were observed in the bosut variety. In our agroecologic conditions, the autumn garlic forms a smaller number of cloves when compared to the spring garlic form. According to the number of cloves we can distinguish genotypes with low (3-6), medium (7-15) and strong branching (more than 15). The number of cloves in a bulb depends on the genotype, growing conditions, ways of preserving the bulbs (IPGRI, 2001; Rahim and Fordham, 1988; Morav evi et. al., 2011a, Mathew et al., 2011).

The average weight of an individual clove had values that ranged from 3.26 g (genotype B) to 10.27 g (bosut). The first value was achieved in the controlled variant (without mulch) while the second, which is the largest in the experiment, was achieved in the soil that was mulched with black PE foil. The average clove weight that was obtained on the black PE foil was statistically significantly higher only when compared to the weight of cloves that was obtained in the controlled variant. When compared to other two variants, the differences achieved in the variants where the soil was mulched with straw were not significant. When observing genotypes, we can state that the average weight of cloves in the variety Bosut, varied the most (from 4.70 to 10.27 g), while the least variation was observed in the genotype C (5.07 to 5.78 g). This parameter directly depends on the bulb weight and the number of cloves in the bulb (positive correlation), and therefore the conditions that lead to the development of larger bulbs have a positive impact on the weight of a single clove (Morav evi , 2012). Also, the clove weight also represents a varietal characteristic, while the separation of cloves from bulbs (before planting) is a lot faster if they are composed of a small number of larger cloves (Stahlschmidt et al., 1997; Gvozdanovi -Varga et al., 2004; Stavelikova, 2008).

The bulb weight ranged from 29.23 to 87.80 g. The first value was achieved in the controlled variant (genotype C), while the second value was observed in the variant where the soil mulching was performed with PE foil (Bosut variety). Statistically, we achieved significantly higher values of the bulb weight on the mulched soil when compared to the ones that were achieved in the controlled variant (without mulch). Besides, it is necessary to pint out that the values achieved for the bulb weight from the soil mulched with PE foil, when compared to

the soil with straw, were statistically also significantly higher. Statistically significant differences in the values of bulb weight were observed in the genotypes. Since this parameter represents the most important productive characteristic of the garlic which defines the yield and determines its market value, it is necessary to point out that soil mulching positively affected that characteristic. Similar results, but in different agroecologic conditions, were obtained by a number of other researches (Haque et al., 2003b; Karaye and Yakubu, 2006; Mirzaei et al., 2007; Faradonbeh et al., 2012).

Table 2. The effect of soil mulching on the quality of the bulb and the yield of different autumn garlic genotypes

Mulching system (A)	Genotype (B)	Number of cloves per bulb	Weight of clove (singl) (g)	Weight of bulb (g)	Bulb yield (t ha^{-1})
Black polyethylene sheeting	Bosut	8.33	10.27	87.80	16.9
	A	10.00	7.26	74.67	14.6
	B	18.67	4.05	78.33	15.3
	C	8.33	5.50	48.33	9.4
	D	13.33	4.95	68.13	13.4
Average		11.73	6.41	71.45	13.9
Wheat straw	Bosut	10.00	8.20	84.17	15.8
	A	13.00	5.52	74.53	14.1
	B	15.00	4.75	73.33	13.8
	C	9.00	5.07	47.60	8.8
	D	7.67	5.25	42.30	8.1
Average		10.93	5.76	64.39	12.1
Non mulch soil (control)	Bosut	10.00	4.70	48.70	9.2
	A	8.33	5.91	51.70	9.8
	B	15.67	3.26	53.37	9.9
	C	4.67	5.78	29.23	5.7
	D	4.00	6.85	29.40	5.6
Average		8.53	5.30	42.48	8.0
	LSD				
A	0.05	1.18	0.72	4.06	0.7
	0.01	1.59	0.97	5.46	0.9
B	0.05	1.53	0.93	5.23	0.9
	0.01	2.05	1.25	7.05	1.2
A x B	0.05	2.64	1.61	9.07	1.6
	0.01	3.56	2.17	12.21	2.1

The average bulb yield, in the whole experiment, was 13.3 t ha^{-1}. The lowest yield was achieved by genotype D (5.6 t ha^{-1}), while the highest was achieved by the Bosut variety (16.9 t ha^{-1}). The first value was observed in the controlled variant (without mulch), while the second value was observed in the variant where the soil mulching was performed with PE foil. The average yield achieved at the soil mulched with PE foil was the highest one (13.9 t ha^{-1}), while the lowest yield was achieved at the soil without mulch (8.0 t ha^{-1}). These achieved differences are statistically very significant. Differences between tested genotypes were also demonstrated in the same manner. In average, in all mulching variants, the highest yield was achieved by the Bosut variety (13.9 t ha^{-1}), while the lowest was achieved by the genotype C (8.0 t ha^{-1}). Manifesting the genetic potential of the garlic, through achieved

yield, is directly connected to the agroecological conditions and applied agrotechnics (Mirzaei et al., 2007). Due to the favorable water regime, in both tested years, mulching has made a significant positive effect. This effect is mainly caused by the influence of mulch on the soil water regime, wherein the thermal conditions were significantly enhanced. This has directly influenced the increase of the soil microbial activity, and thus its fertility (Bhuiya et. al., 2003; Kabir et al., 2013).

Conclusion

Soil mulching (covering) favorably affected the quality and the bulb yield of the autumn garlic in the agroecological conditions of the western Serbia (Ma va). The increase in yield of some genotypes, at the mulched soil, compared to the one without mulch, was even up to 140% (genotype D). Bosut variety, which demonstrated the greatest yield stability, had the yield increase of 83% which was caused by mulching. From the above mentioned, we can conclude that the autumn garlic should be preferably grown at the mulched soil and that further research should focus on the variety of materials which can be implemented by this agrotechnical measure.

Acknowledgement

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QUALITATIVE CHARACTERISTICS OF BUCKWHEAT

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Abstract

During the two-year study (2011-2012) buckwheat samples from individual agricultural producers from the area of municipalitiy Cajnice were taken. Production of buckwheat in area of this municipality is carried out under the supervision of consulting services. To test the quality of buckwheat, samples were taken from four farms on which the same agricultural practices were applied and the grown variety was Gray. Analyses of samples were carried out in the accredited laboratory *System Qualitas* Pale. The analysis included moisture content, mineral matter content, fat content, protein, crude fiber, carbohydrate content. We analyzed the biogenic elements (K, P, Ca, Mg, Fe).
In terms of content of moisture, protein, crude fiber and carbohydrates there were no significant differences in years of research and the research areas in which buckwheat was grown. Highly statistically significant differences have been found in mineral content and fat content in the fruit of buckwheat. The quality of hulled buckwheat fruit has been affected by location because buckwheat has been grown at different altitudes, and the quality of the soil on which it was grown varied. In 2012, the buckwheat was of poor quality compared with buckwheat grown in 2011.

Key words: *buckwheat, quality, fats, proteins, carbohydrates*.

Introduction

Buckwheat is grown for grain used in human nutrition, and crop residues are used as animal feed or bedding, and the above-ground portion is used for extraction of rutin. In addition to grain and flour as a food product, buckwheat honey is also valued. Due to its favorable chemical composition buckwheat is suitable nutrition for diabetics and children. Nutritionists classify it in the group of plants suitable for the production of biologically valuable food and as such they have declared it a health beneficial food. Hulled fruit of buckwheat contains 9.07% of total protein, 70.98% of BEM, 3.7% cellulosic material, 1.73% oil, 1.72% mineral salts, I2,8% water (Glamo lija, 2004). The most important ingredients of plant are flavonoids (Arsic et al., 2008). Seeds of buckwheat contains flour endosperm, and the shell of the fruit makes from 25% to 40% of the total mass (Jev ovi et al., 2012). Buckwheat is a plant with modest requirements to environmental conditions, grown on poor soils, it is suitable when it comes to crop and we do not use chemicals for its protection (Glamo lija et al., 2011). It is suitable for growing in ecological or organic farming system (Vera Popovic et al., 2013; Vesna Milic et al., 2013). It is of particular importance for people with diabetes because food grain buckwheat impact on reducing blood sugar and blood fat levels. The aboveground biomass of buckwheat contains a bioflavonoid rutin which is of great importance in the pharmaceutical industry to obtain drugs that lower blood pressure, stop capillary bleeding, and reduce cholesterol in the blood. Because of these qualities buckwheat was declared the medicinal herb in Germany in 1999 (Gadžo, 2009).

Material and methods

Two-factorial study included the effect of location (A) and of the year (B) on the quality of buckwheat. Seeding of variety Gray was conducted on 20th May 2011 and 15th May 2012. Area of elementary plot was 12 m2 (4 m long and 3 m wide). Experiments have been conducted in 4 repetitions on private farms in the municipality Cajnice.

Municipality ajni e is on the border of the Republic of Srpska, Serbia and Montenegro. It is located in the upper part of the Drina valley. Municipality ajni e is located on extremely rough terrain. The lowest elevation in the river valleys is 400 meters and the highest 1,491 meters at Vucevici (top of Maple Hill). Land in the region where the municipality is located differs from one another, and the most common are younger and moderately developed area of land. Younger land is generally shallow, dry and relatively secured with nutrients. Moderately developed land is medium deep to deep, relatively dry and mostly poor with nutrients. In the municipality of Cajnice, sub-alpine and mountainous climate is represented. The winters are slightly cooler than average winter in moderate-continental climate in the upper Drina valley, and they last longer, depending on location and altitude. Summer temperatures are regularly lower than in other climate areas. Humidity is high even in the warmer part of the year. In the summer period, the relative humidity is slightly lower than in the winter, so the fluctuation is not big. Cajnice boasts with the thing that it is brighter than the area in the valley of the Drina River (which can be explained with small thickness of fog, and because it is located directly behind the high mountain barriers). With the increase of altitude, there is more precipitation, while the short summer rains are very typical in this region. This area, as a whole, is not windy and is not characterized by strong winds. Regarding farming areas, those sown with cereal crops are negligible, mainly the area from 0.2 to 0.3 hectares that are planted with wheat, barley, corn and buckwheat, primarily for personal needs.

Production of buckwheat in area of this municipality is carried out under the supervision of consulting services. To test the quality of buckwheat, samples were taken from four farms on which the same agricultural practices were applied and the grown variety was Gray:

1. Kulelija Esad's farm (Miljeno, Kapov Han),
2. Ismail Vahid's farm (La evci, Ledine),
3. Ristanovi Radoš's farm (Miljeno, lend near river)
4. Maši Darko's farm (Luke, Luke)

Analyses of samples were carried out in the accredited laboratory System Qualitas Pale. The analysis included moisture content, mineral matter content, fat content, protein, crude fiber, carbohydrate content. We analyzed the biogenic elements (K, P, Ca, Mg, Fe).

Table 1. The parameters examined in the laboratory and methods

No.	Parameters	measure	Method
1.	moisture content	%	Sl.l. SFRJ : 74/88 M.BR.8,II-1
2.	mineral matter content	%	Sl.l. SFRJ : 74/88 M.BR.10
3.	fat content	%	Sl.l. SFRJ 74/88 M.BR.I-15
4.	protein content (N x 6,25)	%	ISO 20483:2006
5.	crude fiber content	%	JUS ISO 5498:1996 Identi an sa ISO 5498:1981
6.	carbohydrate content	%	Sl.l. SFRJ 74/88 M.BR.28
7.	potassium content (K)	mg kg–1	EN 14082:2003
8.	phosphorus content (P)	mg kg–1	EN 14082:2003
9.	Calcium content (Ca)	mg kg–1	EN 14082:2003
10.	magnesium content (Mg)	mg kg–1	EN 14082:2003
11.	Iron content (Fe)	mg kg–1	EN 14082:2003

The results were analyzed using the analysis of variance of two-factorial experiment (ANOVA) using SPSS 4.5 software. The significance of differences in mean values of treatments was tested with LSD test.

Results and discussion

In terms of content of moisture, protein, crude fiber and carbohydrates there were no significant differences in years of research and the research areas in which it is grown buckwheat (Table 2). Highly statistically significant differences are found in mineral content and fat content in the fruit of buckwheat. A highly statistically significant difference we found in mineral content, which was the largest on the site 1 (3.1%), and lowest at the site 3 and 4 (2.5%), and in 2011 was (2.85%), compared to 2012 (2.65%). The fat content ranged from 1.8% (site 4) to 3.1% (site 2). In 2011, the fat content was 2.35% and in 2012 2.15%. In studies of Vera Popovic et al. (2013) the average starch content in the grain was 52%, the average protein content of 12.6% and 2.25% fatty oil. According to the literature (Fachmann-Souci-Kraut, 1989/90) shelled fruit of buckwheat contained 9.1% of crude protein and 1.73% of fat oils. In our experiments, the contents of protein and fat was higher.

Table 2. Influence of locality and year on the content of moisture, mineral matter, fat, protein, crude fiber, carbohydrate of buckwheat

Location	moisture (%)			Mineral matter (%)			Fats (%)			Proteins (%)			crude fiber vlakna (%)			carbohydrate (%)		
	201	20	Pro	201	201	Pr	201	201	Pro	201	201	Pr	201	201	Pro	20	201	Pro
1	9,0	9,2	9,1	3,2	3,0	3,1	2,4	2,0	2,2	14,2	13,6	13,9	1,1	1,5	1,3	64,1	63,5	63,8
2	8,9	9,3	9,1	3.1	2,7	2,9	3,0	3,2	3.1	12,3	11,9	12,1	1,3	1,5	1,4	63,2	63,8	63,5
3	9,1	9,5	9,3	2,4	2,6	2,5	2,2	1,6	1,9	11,8	12,1	11,9	1,7	1,3	1,5	63,3	63,5	63,4
4	9,0	9,4	9,2	2,7	2,3	2,5	1,8	1,8	1,8	11,5	10,7	11,1	1,6	1,4	1,5	63,6	63,0	63,3
average	9,0	9,34	9,17	2,85	2,65	2,75	2,35	2,15	2,25	12,5	12,1	12,3	1,43	1,43	1,43	63,5	63,4	63,45
Lsd	0.05	0.01			0.01		0.05	0.01			0.0	0.01		0.0	0.01		0.0	0.01
A	0.194	0.264		0.1	0.191		0.13	0.182		2.6	3.604		0.1	0.151		1.1	1.524	
B	0.137	0.186		0.0	0.135		0.09	0.129		1.8	2.548		0.0	0.110		0.7	1.077	
Ax / AxB	0.274	0.373		0.1	0.270		0.18	0.258		3.7	5.097		0.1	0.213		1.5	2.155	

Table 3. Influence of locality and year on the content of biogenic elements (K, P, Ca, Mg, Fe), mg kg–1

Location	potassium (K)			phosphorus (P)			Calcium (Ca)			Magnesium (Mg)			iron (Fe)		
	2011	2012	Pros	2011	2012	Pros.	2011	2012	Pros.	2011	2012	Pros.	2011	2012	Pro
1	290,0	287,0	288,6	257,0	240,2	248,6	42,2	41,8	42,0	71,4	75,0	73,2	6,7	6,3	6,5
2	250,0	260,1	255,1	244,0	252,9	248,9	32,0	33,6	32,8	82,7	86,1	84,4	5,0	5,2	5,1
3	210,0	224,0	217,4	236,0	241,6	238,8	44,6	44,0	44,3	67,0	60,0	63,5	4,4	3,8	4,1
4	301,0	308,0	305,1	218,0	220,2	219,4	46,1	44,3	45,2	74,4	70,0	72,2	3,2	3,8	3,5
aver.	263,08	270,02	266,55	239,13	238,73	238,93	41,23	40,93	41,08	73,88	72,78	73,33	4,83	4,77	4,8
	Lsd 0,05 0,01			Lsd 0,05 0,01			Lsd 0,05 0,01			Lsd 0,05 0,01			Lsd 0,05 0,01		
A	2.66	3.650		2.22	3.022		0.90	1.234		1.83	2.413		0.13	0.187	
B	1.90	2.589		1.57	2.138		0.64	0.873		1.29	1.765		0.09	0.132	
AxB	3.80	5.178		3.14	4.276		1.28	1.746		2.59	3.531		0.19	0.265	

413

Table 3 provides an analysis of biogenic elements (potassium, phosphorus, calcium, magnesium and iron) in shelled fruit of buckwheat. The potassium content was statistically influenced with locality and year, the content of phosphorus, calcium and magnesium was statistically influenced with the location/site, while the iron content was not affected with the site and year. The minimum content of potassium was at the site 3 (217,4 mg kg-1), and the largest at the site 4 (305,1 mg kg-1). In 2011 the average potassium content was 263,08 mg kg-1, and in 2012 it was 270,02 mg kg-1. The minimum content of phosphorus was at the site 4 (219,4 mg kg-1), and the largest at the site 2 (248,9 mg kg-1). The minimum content of calcium was at the site 2 (32,8 mg kg-1), and the largest at the site 4 (45,2 mg kg-1). The minimum content of magnesium was at the site 3 (84,4 mg kg-1),), and the largest at the site 2 (63,5 mg kg-1).

Conclusion

With the achievement of high and stable yield of buckwheat special attention should be paid to the quality, especially due to the fact that the buckwheat has found extensive application in the diet of man, but also as a medicinal herb, and the surface on which it was grown cannot even remotely satisfy the needs of consumers. In our country buckwheat is mostly grown in rural, mountainous areas, where the land is of poor quality and where the ecological conditions are worse. In experiments in the area of   ajni e we obtained buckwheat of good qualitative traits. The quality of hulled buckwheat fruit is affected with site because buckwheat is grown at different altitudes, and the quality of the soil on which it was grown varied. Such research in this area is necessary to be continued in the future, but because of the importance of this kind it is needed to include multiple genotypes to determine which genotypes in these areas give high yields and buckwheat fruit of good quality.

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VARIABILITY OF β-GLUCANS CONTENTS IN GRAIN OF BARLEY CULTIVARS

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Abstract

Barley is one of the most important cereal species which has been used in human nutrition for a very long time ago. The aim of this investigation is estimation variability of barley cultivars on the base of analysis of -glucan concentration in grain. The contents of -glucans in grain of six genetically divergent barley cultivars (Erich, Atlas, Nonius, Horizont, G-3003 and Djerdan) were determined. The grain samples were grinded by laboratory grinder. Particles of <500 µm size were used in the experiment The contents of -glucans were determined by ICC standard Method No 168. The value of -glucans varied and indicated differences among analyzed cultivars. The highest content of -glucans had barley cultivar Djerdan (7.012%) and the lowest content had Erich (5.214%).

Key words: *barley, -glucans, content, cultivars*

Introduction

Barley is one of the most important cereal species which has been used in human nutrition for a very long time ago. Barley grain is not much different from the other grains, but the assortment of nutrients it contains is definitely superior (Kneževi et al., 2011). The barley grain contain carbohydrates up to 73.4%, protein 12%, fat 1.8%, and also very high content of minerals (K, P, Mg, Ca, Na, S, Fe, Cu, Zn, J) and vitamins (the quantities of vitamin B12 and vitamin E, as well as vitamins A and D, are higher than in other grains). Grains are an essential part of human nutrition and the main source of complex carbohydrates (Mandi and Nosi , 2009). They are widely used in primary human nutrition, but are also used as fodder (Pržulj et al., 2010).

Grain of barley contain -glucans - soluble plant fibers which are concentrated exactly in aleurone and sub-aleurone layers which enclose endosperm. The contents of -glucans in grains depend on various factors which act in the period of endosperm development: effects of 1,3-1,4- glucanase enzyme which enables degradation of endosperm cell wall in germination period, nitrogen level, temperature, precipitations etc. Barley and oat contain larger quantities of -glucans than any other grain. -glucans have positive influence on human health make barley an important raw material in the functional food production (Dodig et al., 2007). The -glucans are dietary fibers (oligosaccharides, polysaccharides and their derivatives) which cannot be decomposed to absorbable components by human digestive enzymes).

Our ancestors have been using whole grains since ancient times, but mass production of white flour has taken place in due course. However, it has been scientifically confirmed that nutritive values of whole grains are considerably higher than those of refined grains from which all the nutritive substances have been removed, since grain membrane also contains

nutrients necessary for development, growth and preservation of organism. In the grinding process, the aleurone layer (the prismatic cells layer that encloses endosperm, but is more similar to a shell due to its mechanical properties) is isolated together with the shell. That is how bran is made, while endosperm is used for obtaining powdered products of various granulations. The presence of two types of glucosidic bonds [-(1-3) and -(1-4)] in -glucans molecules influences their physical and chemical properties, such as viscosity and solubility (Chen et al., 2014). Viscosity depends on soluble -glucans concentration and on their molecular mass. In relatively small concentrations (1%) -glucans have high viscosity which is present in wider pH range (Havrletova et al., 2011).

In comparison with all other fibres, -glucans have the most positive effect on human health, that is estimated on the base of positive effect on metabolism and reduction of cholesterol and sugar in blood (Haggard e al., 2013; Park et al., 2009) risk of cardiovascular diseases as well as in prevention and treatment of allergies (Pereira et al., 2004; Taketa et al., 2011).

Investigation of biological activity of -glucans (Rondanell et al., 2009; Ka-Lung et al., 2013) have confirmed their potential application in functional food production, but also in pharmaceutical industry and medicine due to physiological effects. In addition to that, there were no reports of harmful effects of food rich in beta-glucans from oat or barley flour or their extracts. On the base of these fact in the last few decades are increased interest in -glucansas because of its functional and bioactive properties.

The aim of this investigation is estimation variability of barley cultivars on the base of analysis of -glucan concentration in grain.

Materials and methods

In this paper, grain samples of six various barley cultivars (Erich, Atlas, Nonius, Horizont, G-3003 and Djerdan) were used for analysis. The grain samples were grinded by laboratory grinder. Particles of <500 µm size were used in the experiment.

The contents of -glucans were determined by Megazyme method (ICC Standard Method No 168). The assay is specific for mixed-linkage [(1-3)(1-4)- -D-glucan]. Method principle is: Samples are suspended and hydrated in a buffer solution of pH 6.5 and then incubated with purified lichenase enzyme and filtered through Whatman No.41. An aliquot of the filtrate is then hydrolyzed to completion with purified -glycosidase. The produced D-glucose is assayed using a glucose oxidase/peroxidase reagent. Then the absorbances were measured at 510 *nm* for each sample A1, A2 and blank. The contents of -glucan were calculated by using the factor for the conversion of absorbance values to µg of glucose and factor for the conversion from free D-glucose, as determined, to anhydro-D-glucose, as occurs in -glucan (McCleary and Codd, 1991).

Results and discussion

The results indicate that there is genetic diversity in content of dietary fibers among tested genotypes. The contents of -glucans in analyzed barley cultivars varied in ratio from 5.214% in cultivar Erich to 7.012% in cultivar Djerdan (tab. 1). Values of -glucans concentration for other analyzed barley cultivars vary between those values.

The contents of -glucan in grain barley reported so far, have ranged from less than 2% to more than 10%, and variation is not only caused by genetics and environment, but is also due to the analysis methodology.

Table1. The values of concentration of -glucans in analyzed barley cultivars

No.	Barley cultivars	Absorbances (510nm)			-glucan
		A 1	A2	A	% (w/w)
1.	Erich	0.938	1.020	0.979	5.2143
2.	Atlas	1.168	1.182	1.176	6.4243
3.	Nonius	0.784	0.802	0.812	5.5834
4.	Horizont	1.228	1.188	1.236	6.5421
5.	G-3003	0.964	0.922	0.958	5.8455
6	Djerdan	1.289	1.245	1.298	7.0120

 -glucans are genetically determined and its value can be increased by cultivation (and application of proper agro-technical measures), the aim of our researches was determination and comparison of -glucan contents in 6 barley genotypes and selection of cultivars with higher contents of -glucans, as a modest contribution to barley cultivation.
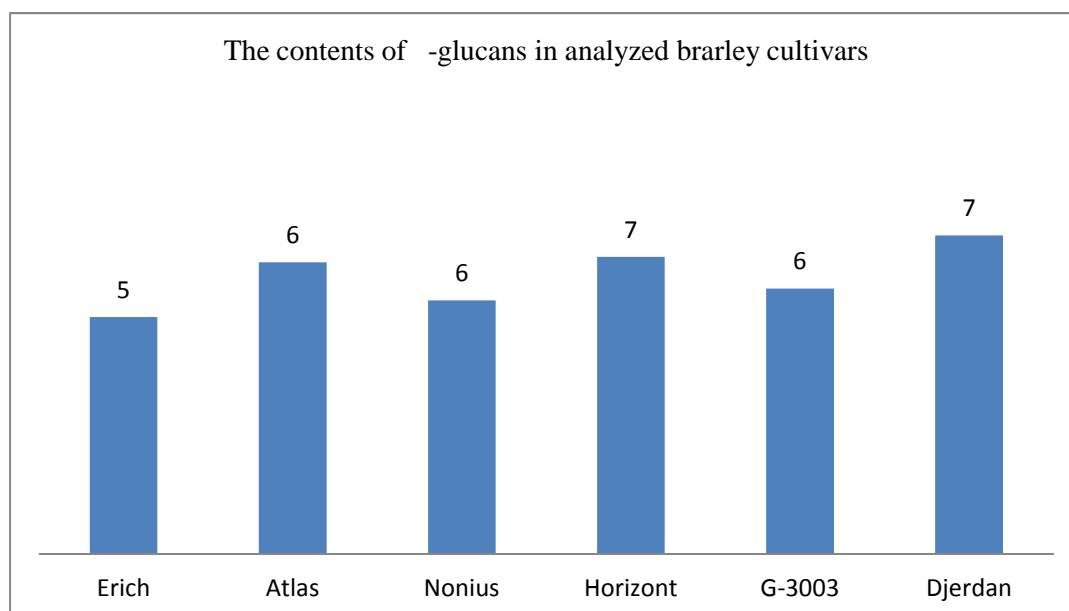
Figure 1. Variability of -glucan contents in analysed barley cultivars

In this investigation established diferences anong analyzed cultivars (Fig. 1). Barley cultivar Nonius (5.583%) and G-3003 (5.845%) had more similar value of -glucan contents to Erich (5.214%) cultivar with the least value of protein content, while Atlas (6.424%) and Horizont (6.542%) had more similar value of -glucan contents to Djerdan (7.012%).

The environmental factors have influence to grain -glucan content. Grain -glucan increased with increasing N application. There are differences among cultivar according to responses to N nutrition as well in expression of correlation -glucan with other traits. So, grain with low -glucan concentration usualy have lower hectolitre mass, low value of protein content while there are no correlation between grain -glucan and average grain weight, malt extract etc. (Blakely and Harasymow, 2010). Therefore, some barley genotypes 1,3;1,4)- D-glucanless mutants showed cold-sensitive phenotype, as well a reduction in plant height, plant vigour and yield (Taketa et al., 2012).

However, during the maturation (1,3 and 1,4)- -D-glucan continually deposited in the seeds, even after the enzyme activity gradually decreased (Tsuchiya et al., 2005) while the reason is not yet clearly explained (Tonooka et al., 2009). The wider range of -glucan content for the barley collections in another studies may be attributed to more samples and the greater differences in the environments of a particular cultivar origin. For example, higher -glucan content in Tibet barley cultivars may be at least partly related to their hulless type and is desirable in light of their use as feed. Also, the barley grown in Zhejiang had a much lower -glucan content (Chen et al., 2014). In the same study showed that -glucan contents is similar in barley genotypes from Canada and Australia, indicating that -glucan content is not a predominant factor in determining quality and productive traits of barley. The earlier analytical method, by measuring viscosity gave high values, while the enzymatic method, developed by McCleary and China; it grows in widely ecological locations and finds manifold uses. Commonly, it is used as a material for malting and feed processing while, in Tibet, barley is a stable food crop. However, there has been little research on -glucan content in China

Conclusion

In this study established differences among barley cultivars according to contents of -glucan in grain. By biochemical analysis of -glucan contents in six genetically divergent cultivars of barley we have established variability in -glucan contents. Cultivar Djerdan has the highest contents of -glucans 6.597% (w/w). Cultivar are most similar to it and are the richest in -glucans. The positive effects of barley in human nutrition are the consequence of high biological value of its nutritive components and dietary fibres (-glucans). The -glucans correlation with other grain traits indicate importance of study their ineraction and use as a criteria in breeding program. The, exploitation of germplasm potential and revealing the formation nature of grain quality in barley will aid in the development of better cultivars with desirable dietary traits.

Acknowledgements

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POMOLOGICAL PROPERTIES OF CULTIVAR "ČAČANSKA RODNA" IN CONDITIONS OF SARAJEVO

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Abstract

The paper presents results of two – year study of some pomological properties of cultivar of plum " a anska rodna" grafted on GF 655/2 and Fereley rootstocks. The research was carried out in the plum orchard for cultivar testing of Federal Bureau of Agriculture of Bosnia and Herzegovina. Obtained results showed that the average earlier time of maturation was on rootstock GF 655/2 (04.09.). Cultivar " a anska rodna" had the lowest fruit weight on rootstock Fereley in 2012 (27,48 g), while the highest fruit weight was on rootstock GF 655/2 in 2012 (30,53 g). There are significant differences between rootstocks and years which were included in the research. During of the research, the highest yield was on rootstock Fereley (2013), while the lowest yield was on same rootstock in 2012. The obtained results have confirmed that agro – environmental conditions of Sarajevo are favorable for growing the above mentioned cultivar of plum " a anska rodna" grafed on GF 655/2 and Fereley rootstocks.

Keywords: *plum, rootstock, pomological properties.*

Introduction

Plum is one of the dominant fruit species in our and neighboring countries. The total production of plums is on the ninth place in the world. The average annual production of 36151.25 t represents about 45.67% of the total fruit production in Bosnia and Herzegovina. The yield of plum was 35,312 t in 2012, which was about 38% less in quantity of produced plums compared to 2011. The reason for this was the unfavorable weather conditions, long dry periods accompanied by high temperatures.In Bosnia and Herzegovina there are very suitable agro - ecological conditions for the production of plums, but even so, the actual production does not meet the needs of the domestic market due to extensiveness of production, old plantations, inadequate rootstock, protection and very low agricultural technology and pomotechnical. The largest amount of produced fruit is processed into brandy, a small amount has been dried and only a small percentage of produced fruit is used in fresh form. Fresh fruits of plum have a better price on the market, but this cultivar has not an important place in the production in Bosnia and Herzegovina. One of the most important factors in the production of fruit is a cultivar, but also the rootstock (Ogasanovic et al., 2005), because the whole success of in fruit production depends of rootstock (Misic, 2006). Plum production is characterized by extensiveness, and the use of generative rootstocks, primarily use of seedling rootstock. Seedlings are usually lush and with uneven increase compared with rootstocks for plum.To achieve the intense plum production, it is necessary to introduce new varieties and vegetative surfaces, which has less vigor, more uniform growth, earlier yield in combination with adequate variety for obtaining higher yields. The aim of this work was to study some of the pomological properties of the cultivar ''Cacanska rodna'' grafted on rootstocks Fereley and Julijanka GF 655-2.

Material and method

The research was carried out on the location of Sarajevo, in the plum orchard for cultivar testing of Federal Bureau of Agriculture of Bosnia and Herzegovina located in Butmir – Ilidza. Test plantation was bulit in the spring of 2007, at the altitude of 600 meters above sea level. Mentioned area is characterized by subalpine climate (Hydrometeorological Institute of Bosnia and Herzegovina), with colder winters that are longer than in the continental zone. The winds are frequent, summers are moderately warm with large annual fluctuations in temperature. The average annual air temperature is below 10°C.

We studied a cultivar '' acanska rodna'' grafted on two rootstocks: Fereley and Julijanka GF 655-2.

Fereley is a French, temperate vigor rootstocks. It has a good adaptability to alkaline soils.

Julijanka GF 655-2 is vegetative rootstock of medium exuberance and has a good affinity with many cultivars of domestic plums. Cultivars grafted on this rootstock have early, regular and good yield. This rootstock tolerates well heavy, moist soil and frost.

Experiment was designed as block system with two replications of 10 trees, with planting space of 4.0 x 2.5 meters. Type of soil is fluvisol (alluvial soil). During research standard agrotehnical and pomotechnical measures, including irrigation were applied. Research was carried over a period of two years (2012 – 2013). Research included time of maturation, the physical properties of the fruit and obtained yield. Time of maturation was determined by the date of harvest.

Properties of the fruit or fruit weight was determined on a sample of 30 fruits, on the analytical scale 'Adventurer - Ohaus', with an accuracy of 1/10 g, and the values are expressed in grams. Yield of the cultivars was registered by the determination expressed as yield per tree (kg/tree) and yield per hectare (kg/ha).

The results were statistically analyzed using analysis of variance for a two factorial experiment, and significance between the mean values was determined using the LSD test probability 0.05 to 0.01.

Results and discussion

Time of maturation depends on the genotype and agro ecological conditions. Agro ecological conditions influence the earlier and later time of maturation.

The average time of maturation of cultivar 'Cacanska rodna', grafted on rootstocks Fereley and GF 655-2, is shown in Table 1.

Table 1. Time of maturation cultivar " a anska rodna" in conditions of Sarajevo (2012 – 2013)

Rootstock	Time of maturation		
	2012	2013	Average
Fereley	07.09.	05.09.	06.09.
GF 655 - 2	04.09.	04.09.	04.09.

The results of time of maturation showed that the average early ripening of cultivar was observed on the rootstock GF 655-2 (04.09.). *Bozovic et Jacimovic* (2011) say that cultivar '' a anska rodna'', on the seedling rootstock in the conditions of Montenegro, had average time of maturation a little later than in our results. The reason for earlier time of maturation in conditions of Sarajevo can be explained by the influence of vegetative rootstock. The results of time of maturation we obtained in our research show a later time of maturation compared to the results of *Minev et Stoyanova* (2012). *Nenadovi – Mratini et al.* (2007) recorded an early time of maturation of cultivar '' a anska rodna'' on seedling rootstock in area of Belgrade. *Popovic et al.* (2006) came to similar results when it comes to time of maturation.

Weight of the fruit was measured immediately after harvest. The characteristics of the fruits were determined on a sample of 30 fruit. We used the standard morphometric methods to determine these properties, and the results are presented in Table 2.

Table 2. Weight of the fruit cultivar " a anska rodna" in conditions of Sarajevo (2012 – 2013)

Rootstock	Weight of the fruit		
	2012	2013	Average
Fereley	27,48	29,92	28,70
GF 655 – 2	30,53	29,64	30,08
Average	29,01	29,78	29,39

LSD	A rootstock	B year	AB interaction
0,05	0,258	0,258	0,366
0,01	0,341	0,341	0,483

The weight of fruit is one of the most important characteristics of pomological properties, which affects the whole range of other properties, primarily yield of which is the utmost objective of any production. Cultivar '' a anska rodna'' had the highest fruit weight in 2012, grafted on rootstocks Julijanka GF 655-2, while the lowest fruit weight was in 2012, also, grafted on rootstocks Fereley.

Average higher fruit weight was in cultivar grafted on rootstocks Julijanka GF 655-2.

Year and rootstocks, as factors, had a statistically significant effect on fruit weight.

Comparing the weight of the fruit of the cultivar " a anska rodna" with the results by Popovic et al. (2008), there is a slightly higher value in our studies.

Slightly lower values of fruit weight of cultivar '' a anska rodna" reported Minev and Stoyanova (2012).

The weight of fruit cultivar 'Cacanska gender' in condition of Sarajevo has shown a higher or lower fruit weight, depending on the planting spaces that were included in the study by authors Miletic et al. (2011).

Walkowiak-Tomczak et al. (2008), made classification of plum fruits according to fruit size as: very small (5-10 g), small (10-20 g), medium (20-40 g), medium (40-50 g), large (50-60 g) and very large (60-80 g). According to this classification, the fruits of the cultivars in our studies belong to the medium in size.

Many factors affect the yield and quality of plum cultivars, which primarily depends on the genotype (cultivar and rootstock), planting density, and physical and chemical properties of the soil, maintenance of soil structure in the orchard and the use of irrigation.

Biological potential of yield of fruit trees is conditioned by the genetic basis of cultivars, environmental growing conditions and applied pomotehnical and agrotehnical measures. The knowledge of the characteristics of yield is of paramount importance, particularly in the selection of cultivars and rootstocks for intensive production.

Intensive production depends on the characteristics of cultivars and rootstocks, and their interactions.

The yield of plum 'Cacanska gender', grafted on rootstocks Fereley and GF 655-2, in conditions of Sarajevo are present in Table 3.

Table 3. Yield of cultivar " a anska rodna" in conditions of Sarajevo (2012 – 2013)

Rootstock	Yield					
	2012		2013		Average	
	kg/tree	kg/ha	kg/tree	kg/ha	kg/tree	kg/ha
Fereley	16,20	16.200,00	21,4	21.400,00	18,80	18.800,00
GF 655 – 2	17,80	17.800,00	19,70	19.700,00	18,75	18.750,00

The highest yield of the cultivar " a anska rodna" was obtained on those trees grafted on rootstocks Fereley, in 2013. The same combination had the lowest yield in 2012. In average, during these years there was no significant difference in yield in the studied rootstock.

Comparing our results with the results of the authors Miletic et al. (2011) for the yield, it is evident that the variety '' a anska rodna'' showed a better yield in the agro-ecological conditions of Sarajevo.

Conclusion

On the basis of two-year investigations of the time of maturation, fruit weight and yield of plum cultivar " a anska rodna" grafted on GF 655/2 and Fereley rootstocks in region of Sarajevo, we have made the following conclusions:

- Average time of maturation was from 04.09. to 06.09. depending of rootstocks.
- Average weight of fruit ranged from 28,70 g (" a anska rodna" grafted on Fereley) to 30,08 g (" a anska rodna" grafted on GF 655/2).
- The highest fruit weight had cultivar " a anska rodna" grafted on GF 655/2 in 2012., while the lowest fruit weight, had cultivar " a anska rodna" grafted on Fereley in 2012.
- The highest yield had cultivar " a anska rodna" grafted on Fereley in 2013.
- The lowest yield in 2012 year had the cultivar " a anska rodna" grafted on Fereley
- Taking all into account, cultivar of plum " a anska rodna" grafted on GF 655/2 and Fereley rootstocks in region of Sarajevo can be recommended for the advancement of Bosnia and Herzegovina plum assortiment.

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THE INFLUENCE OF QUALITY OF PLANTATIONS AND AGRO-TECHNICAL MEASURES ON A YIELD OF LETTUCE (*Lactuca Sativa* L.)

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Abstract

The experiment has been set up in the plain of Zeta (in the region of Podgorica) with a goal to determine the influence of time of planting, fertilizers (Slavol, WUKSAL super 8:8:6+me i Poly-Feed MAR 20:20:20+me) and substrates (Profi-substrat i Blumenerde) on a cultivation of lettuce. The examined parameters were height of the head, diameter of the head, total leaf number of the head, the number of damaged head leaves and the dry matter inside of lettuce. When it comes to the lettuce treated with Poly-Feed MAR, on both substrates, the biggest height of a head (17,55cm), the biggest diameter of a head (25,7cm), the biggest mass of a head (173,2g) and the biggest number of damaged head leaves has been noticed. The dry matter inside of every examined lettuce ranged from 5,40% to 6,24%. The smallest amount of dry matter inside was measured on Profi-substrat with plants treted with Poly-Feed MAR (5,51%) and the biggest with plants treated with Wuksal (5,93%). Based on the obtained results for growing lettuce on an open field, in the examined specified climatic and edaphic conditions in the plain of Zeta, using 30 % of shadows, it is recommended to do the early planting (first time), to use Blumenerde substrate and for plantation nutrition the Poly-Feed MAR.

Key words: *lettuce, head, Nadine F1, yield, dry matter*

Introduction

The success of growing lettuce depends on many interrelated factors. To achieve high quality and yield, is very important to choose the optimal sowing period (planting), which provides optimal weather conditions. The choice of a suitable substrate or soil to normal root development and adoption of available nutrients while the type and composition of fertilizers impact on yield level and time of maturity for harvesting of lettuce. Lettuce is a culture that has special requirements in terms of length of day-light, and in the summer and autumn periods of sowing (planting) should choose a day-neutral types. If the sowing period (planting) does not adjust to lettuce varieties, leads to earlier efflorescence (sometimes they do not form a head) while improper choice of substrate and fertilizer decreases yield and quality of lettuce. To form a compact head optimum temperatures are 15-20^{0}C, over 25^{0}C appears slowed growth, and above 30^{0}C growth stops and initiates a rapid transition in the the generative phase (Matotan, 2004). Todorovic et al. (2003) reported that initiates blossoming with a lack of water and a temperature of 20^{0}C. According to abilovski et al. (2009), yield and chemical composition depend on the variety, the conditions of production, mineral nutrition, planting dates and harvesting. According to Maksimovi (2007) the value of lettuce yield ranges from 15 to 20 t/ha. Matotan (2004) states that in Croatia lettuce yield is approximately 7 t/ha in gardens and yards, and intensive production is approximately 30-40t/ha. According to Gvozdenovi (2007), the yield of winter varieties is around 15t/ha, of spring 15-30t/ha, while of autumn 30-40t/ha.

Materials and methods

In order to determine the impact of sowing time (term), fertilizer and substrate on lettuce Nadine F1, the experiment is set up in the region of Zeta (near Podgorica). The experiment was three factorial and conducted by split-plot design with three repetitions.

Sowing was done on 3th VII and 1st VIII 2009 in containers with a 126 apertures (volume 22cm3). Planting seedlings was done four weeks after sowing as follows: 31.VII and 29.VIII 2009 in plots of 6 plants in 3 rows with distance 25x25cm in 3 repetitions in a split-plot design.

Treatment of Slavol consisted of pre-sowing seed treatment with a 3.3% solution and feeding sedlings twelve and seventen days old with a 1% solution. WUKSAL is aplied foliar twelfth and sevententh day in the concentration of 1%, while Poly-Fed MAR is aplied with 0.5% solution. After planting, fertilizing was done with same types and the same concentrations of fertilizers, on 10th and 17th day after planting with the crop overshadow using 30% overshadow. Control is irigated with water without any fertilzers. Examined substrates were Profi-substrate and Blumenerde.

After 37 days of planting (65 day of seedling) from each repetition was taken the five plants and measured: the head height, head diameter, head weight, total leaf of head, number of damaged leaves, dry matter content. The influence of the aplied measures was analyzed using the F-test.

Results and discusion

In the production of seedling should use very high quality seed with high biological value (Markovi , 2002).

For the height of lettuce head statistically significant effect had the factor of substrate, while the significant effect had a factor of term and fertilizer and the interaction of term/fertilizer.

Maximum height of the lettuce head was measured in the first term of planting on both substrates (16,5cm and 16,8cm), while the application of Poly-feed MAR gave the best results on both substrates (17,3cm and 17,8cm).

The lowest average value of the treatment was measured on both substrates with Slavol (14,4cm).

Table 1: The dependence the head height lettuce of term, substrate and fertilizers

	Head height of lettuce Nadine F1(cm)						
	Profi-substrat			Blumenerde			Average
Fertilizer	I term	II term	Average	I term	II term	Average	
Slavol	16,0	12,2	14,1	15,8	13,4	*14,6*	*14,4*
WUKSAL super	15,6	14,8	15,2	17,2	14,6	*15,9*	*15,6*
Poly-Feed MAR	17,8	16,8	**17,3**	17,2	18,4	***17,8***	**17,55**
Control	15,2	14,6	14,9	16,8	15,0	*15,9*	*15,4*
Average	*16,5*	*14,6*		*16,8*	*15,3*		

	Term	Fertilizer	Substrat	Term / Fertilizer	Term / Substrat	Fertilizer / Substrat	Term / Fetilizer/ Substrat
F calculated	**23,8****	**19,5****	**4,98***	**4,78****	0,061	0,152	2,59

The largest diameter of the lettuce head was measured in the second term of planting on both substrates (25,3cm and 25,8cm) and the best results are provided by applying fertilizer Poly-feed MAR (25,7cm). According to Edelštajn (1950), varieties of lettuce occupy limited nutrient space up to 400-500cm^2, while in our research it was 295,5-598cm^2.

Table 2: The dependence the diameter lettuce head of term, substrate and fertilizers

The diameter lettuce head Nadine F1 (cm)							
Fertilizer	Profi-substrat			Blumenerde			Average
	I term	II term	Average	I term	II term	Average	
Slavol	22,2	23,4	22,8	23,0	25,2	*24,1*	*23,5*
WUKSAL super	24,2	25,6	24,9	22,8	23,6	*23,2*	*20,1*
Poly-Feed MAR	24,6	26,0	**25,3**	25,2	26,8	***26,0***	**25,7**
Control	19,4	26,0	22,7	23,4	27,6	*25,5*	*24,1*
Average	*22,6*	***25,3***		*23,6*	***25,8***		

	Term	Fertilizer	Substrat	Term / Fertilizer	Term / Substrat	Fertilizer/ Substrat	Term / Fetilizer/ Substrat
F calculated	**38,2****	**5,73****	3.9	**6.48****	0,329	**5,68****	0,859

Factors planting term, fertilizer, interaction of factors term/fertilizer and term/substrate have highly significant influenced on the diameter of the lettuce head. Towards ***Gvozdenovic (2007),*** head size may be small (6-8 cm), medium (8-12cm) and large (over 12cm), so that in our case, all the heads belong to the group of large.

The minimum weight heads of lettuce was observed in the application of Wuksal on the Profi-substrate (88,3g) and Slavol gave on average lowest value of head mass on both substrates, the 95,38g. The highest weight of lettuce head Nadine F1 was measured in the first planting term (123,6g and 139,3g), and the use of Poly-feed MAR has given the highest yields of lettuce on both substrates (173,2g). Towards Maksimovic (2007), heads were usually weighing from 300 to 500 grams, while in our tests the hardest heads were about 204,95 grams which is below the the mentioned range.

Table 3: The dependence the weight of lettuce head of term, substrate and fertilizers

Weight of lettuce head Nadine F1 (g)							
Fertilizer	Profi-substrat			Blumenerde			Average
	I term	II term	Average	I term	II term	Average	
Slavol	100,64	80,08	90,36	107,62	93,21	*100,4*	*95,38*
WUKSAL super	95,11	81,39	88,3	137,13	111,95	*124,5*	*106,4*
Poly-Feed MAR	204,95	147,36	**176,2**	190,19	149,99	***170,1***	**173,2**
Control	93,50	117,64	105,6	122,32	125,84	*124,1*	*114,9*
Average	***123,6***	*106,6*		***139,3***	*120,2*		

	Term	Fertilizer	Substrat	Term / Fertilizer	Term / Substrat	Fertilizer/ Substrat	Term / Fetilizer/ Substrat
F calculated	**7,93****	**29,5****	**5,29***	**4,02***	0,028	1,91	0,448

Table 4. Lettuce yield Nadine F1 (t/ha)

Yield of lettuce Nadine F1 (t/ha)							
Fertilizer	Profi-substrat			Blumenerde			Average
	I term	II term	Average	I term	II term	Average	
Slavol	16,10	12,81	14,46	16,96	14,91	*15,94*	*15,20*
WUKSAL super	15,22	13,02	14,12	21,94	17,91	*19,93*	*17,03*
Poly-Feed MAR	32,79	21,58	**27,19**	30,43	24,00	***27,22***	**27,21**
Control	14,96	18,82	16,89	19,57	20,14	*19,90*	*18,40*
Average	***19,77***	*16,56*		***22,23***	*19,24*		

Factors term and fertilizer, also the interaction term/fertilizer have statistically highly influenced the the mass of lettuce head, while the factor of the substrate had a statistically significant effect.

In our research yields have been in the range between 12,81-32,79t/ha, which is in line with the results of Maksimovic (2007) and Gvozdenovic (2007).

Also, our tests have shown statistical dependence of yields of the substrate and the high dependence of factors: term, fertilizers as well as the interaction term/fertilizer, which is in accordance with the arguments of abilovski et al. (2009).

The results of the total number leaves per head of lettuce is in line with the values of the mass lettuce head, so the best results obtained following application of fertilizer Poly-feed MAR (30,1) in the first term of planting on both substrates (27 and 30.5) . Minimum number of leaves was observed in treatment with Wuksal (23,7).

Table 4: The dependence the total number of leaves of the lettuce head of term, substrate and fertilizers

Total number of leaves of the lettuce head Nadine F1							
	Profi-substrat			Blumenerde			Average
Fertilizer	I term	II term	Average	I term	II term	Average	
Slavol	26,4	20,8	23,6	29,0	20,0	*24,5*	*24,1*
WUKSAL super	23,0	20,6	21,8	29,2	22,0	*25,6*	*23,7*
Poly-Feed MAR	34,6	24,8	**29,7**	36,2	24,6	***30,4***	***30,1***
Control	24,0	23,4	23,7	27,6	22,6	*25,1*	*24,4*
Average	***27,0***	*22,4*		***30,5***	*22,3*		

	Term	Fertilizer	Substrat	Term / Fertilizer	Term / Substrat	Fertilizer/ Substrat	Term / Fetilizer/ Substrat
F calculated	**93.0****	**20.6****	**6.56***	**6.59****	**7.36****	1.16	0.254

The total number of leaves of lettuce head (Nadine F1) is statistically is dependent of substrate, and highly dependent of factors: term, fertilizer, as well as the interaction of term/fertilizer and term/substrate.

The biggest number of damaged leaves of lettuce head Nadine F1 was observed in the second term on both substrates (2,9 and 2,6), as well as in variants of application Poly-feed MAR fertilizer (2,9).

Table 5. The dependence the number of damaged leaves of lettuce head of term, substrate and fertilizers

The number of damaged leaves of lettuce head Nadine F1							
	Profi-substrat			Blumenerde			Average
Fertilizer	I term	II term	Average	I term	II term	Average	
Slavol	1,4	2,4	1,9	2,8	2,6	*2,7*	*2,3*
WUKSAL super	2,0	3,2	2,6	1,2	1,8	*1,5*	*2,1*
Poly-Feed MAR	2,4	3,2	**2,8**	3,4	2,6	***3,0***	*2,9*
Control	1,4	2,8	2,1	1,0	3,2	*2,1*	*2,1*
Average	*1,8*	**2,9**		*2,1*	**2,6**		

	Term	Fertilizer	Substrat	Term / Fertilizer	Term / Substrat	Fertilizer/ Substrat	Term / Fetilizer/ Substrat
F calculated	**11.3****	**2.87***	0.012	**2.84****	1.99	**2.96***	1.3

Highly significant differences to the number of damaged leaves of lettuce were observed depending on the term, while statistically significant differences were caused by the application of various types of fertilizer and interaction by factors term/fertilizer and fertilizer/substrate.

The dry matter content in lettuce Nadine F1 was in the interval from 5,40% (control and plants fertilized with Poly-MAR feed on the Profi-substrate in the second term) to 6,24% (treatment with Slavol in the first term on Blumenerde substrate).

The lowest average dry matter content was measured on Profi-substrate at plants treated with Poly-Feed MAR (5,51%) and highest at plants treated with Wuksal (5,93%). On Blumenerde substrate application of Poly-Feed MAR (5,44%) also gave the lowest average value of dry matter, while the highest measured in the lettuce treated with Slavol (5,92%). In the first term, on both substrates are obtained higher average values of dry matter content (5,74% and 5,78%).

Table 6: The dependence the dry matter content of lettuce of term, substrate and fertilizers

	The dry matter content of lettuce F1 (g/100g SvM)						
	Profi-substrat			Blumenerde			Average
Fertilizer	I term	II term	Average	I term	II term	Average	
Slavol	5,64	5,86	5,75	6,24	5,60	*5,92*	*5,84*
WUKSAL super	5,68	6,18	**5,93**	5,70	5,74	*5,72*	*5,83*
Poly-Feed MAR	5,62	5,40	5,51	5,26	5,62	*5,44*	*5,64*
Control	6,00	5,40	5,7	5,92	5,62	*5,77*	*5,74*
Average	*5,74*	*5,71*		*5,78*	*5,65*		

Towards *Maksimovic (2007)* lettuce leaf contains from 4,58 to 11,6% dry matter, while Gvozdenovic (2008) shows the data of 4,8%, Djuric et al. (2005) give the scope of dry matter content from 4 to 12%, which is in accordance with the data obtained in our tests (5,4 to 6,24%).

The dry matter content depends on the variety, growing conditions and term (*Djuric et al., 2005),* in our results, achieved higher content in the first term.

In studies *Djuric et al. (2005)*, the highest dry matter content of lettuce in both terms achieved in the variant without fertilization. In our tests the dry matter content was not significantly different between the treatment and control of fertilization.

Table 6. F test for the tested treatments and characteristics of lettuce head Nadine F1

Sources of variation	F-calculated				
	Height	Diameter	Weight	Total number of leaves	Number of demaged leaves
A	**23,8****	**38,2****	**7,93****	**93,0****	**11,3****
B	**19,5****	**5,73****	**29,5****	**20,6****	**2,87***
C	**4,98***	3,9	**5,29***	**6,56***	0,012
A x B	**4,78****	**6,48****	**4,02***	**6,59****	**2,84***
A x C	0,061	0,329	0,028	**7,36****	1,99
B x C	0,152	**5,68****	1,91	1,16	**2,96***
A x B x C	2,59	0,859	0,448	0,254	1,3

Factor A- Term; Factor B- Fertilizer; Factor C- Substrat

Length of vegetation of lettuce varies from 30 to 90 days (Gvozdenovic, 2007) while in our research growing season was 65 days. According to Edelštajn (1950), mineral fertilizer speed up production of lettuce and greatly increase the average weight of heads, which is in line with our results.

The application of microbial fertilizers achieved better results than the control and may be used as a replacement or supplement mineral fertilizers, which is in line with the results of Illmer et al. (1995), Djordjevic et al. (2005), Simic et al. (2005) and Govedarica et al. (2002). Cardinal points of soil acidity (pH) within which is possible to cultivate lettuce are a

minimum (5.5), optimum (6.0-7.0) and maximum (7.5) (Para ikovi et al., 2008; Gvozdenovic, 2008) so we provided excellent growing conditions on a plot of pH 7.

Conclusion

Results of the research impact of period, the substrate of fertilizer on growing of lettuce Nadine F1 show:

- In the first term is reached greater/higher height of heads, head mass, number of leaves and higher dry matter content.
- Application of Poly-Feed MAR has affected greater/higher height head, head diameter, head mass, number of leaves and number of damaged leaves.
- On Blumenerde substrate was observed significantly greater/higher head height, head diameter, head mass and number of damaged leaves of lettuce.

Based on the results obtained for the production of lettuce in the open field, in the investigated area using 30% overshadow, it may be recommended sowing of seed treated with Slavol, early sowing (first term), Blumenerde substrate and fertilization with Poly-Feed MAR.

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POSSIBILITY OF SUMMER PLANTING OF POTATO IN AGROECOLOGICAL CONDITIONS OF PODGORICA

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Abstract

The paper presents results of two-year study of the possibilities of summer growing potatoes in agro ecological conditions of Podgorica (Montenegro). Two potato varieties were tested: Kennebec and Monaco. Research was carried out during 2011 and 2012, in the vicinity of Podgorica, at an altitude of 40 m. Field trials were carried out using the standard methodology in a completely randomized block design with four replications.

In two-year study both varieties had approximately the same number of formed tubers per plant - Kennebec 5.2 and Monaco 4.9. Variety Kennebec had significantly higher tuber weight - 140 g. The average weight of tubers in variety Monaco was - 126.5 g.

On the plots on which was cultivated variety Kennebec yield was 31.3 t.ha^{-1}, while the variety Monaco yielded 26.6 t.ha^{-1}. The differences in the yield of tubers from the varieties studied were highly significant.

Statistically very significant differences in the average yield of tubers were influenced by the interaction variety x year. Variety Kennebec had a significant increase in yield in 2011 compared to the variety Monaco in 2012.

The results showed that the agro ecological conditions of wider region of Podgorica area under irrigation conditions are ideal for summer planting of potatoes.

Key words: *potato, summer planting, agro ecological conditions, yield*

Introduction

Potato is grown on 11000 ha in Montenegro (http://www.monstat.org). Although there is a tendency of decreasing of arable land, the potato production in Montenegro is constantly increasing. In the production structure of the arable land, potato accounts for more than 20% and it is a leading agricultural plant in Montenegro (Jovovi et al., 2012a; 2013a). Production intended for fresh consumption is about 16.8% of total production and is mainly located in the Zeta-Bjelopavlici and the coast. Dominant form of potato production in Montenegro is the production of potatoes for storage (83.2%) and is related to the central and mountainous area. Yield of potatoes in Montenegro is still low (16.5 t.ha^{-1}), very unstable and strongly influenced by weather conditions. Differences in yields of potatoes between production regions are also highly expressed (Muminovi et al., 2014).

The main area of production of early potatoes in Montenegro is located in the wider area of the municipality of Podgorica and the coast with the surrounding hilly areas up to 600 m of altitude. This area is represented in the Mediterranean and modified Mediterranean climate with long, hot and dry summers and mild and rainy winters. The average annual temperature in this climatic zone is 13-15 °C, in Podgorica from 16 to 17°C, with relatively high annual sum of precipitation - from 1300 to 2500 mm. Due to the uneven distribution of

rainfall during the year, this zone is characterized by a pronounced aridity, with long drought periods (Jovovi et al., 2013b).

The problem of food production in biggest part of the world is becoming more important and requires urgent action. In conditions when the total area of arable land cannot significantly increase the only option for increasing food production remains increase of production on existing surfaces. This increase includes obtaining a higher yield per unit area and establishing a system of two harvests a year, and in all that irrigation plays a crucial role.

Very favourable climate around Podgorica allows organization of a very intensive plant production system with two or more harvests per year. As here is predominantly present soil of medium production capacities it is necessary to ensure proper fertilization and irrigation to obtain high and stable yields in summer season. Water is one of the most important factors of successful potato production. Only in terms of well-organized irrigation, which requires a sufficient amount of water during the entire growing period, it is possible to obtain high yield and good quality potatoes (Kashyap and Panda, 2003; Yuan et al., 2003; Onder et al., 2005).

As it is assumed that Podgorica is the area with the highest average monthly temperatures during the summer and the highest average number of tropical days a goal was set to test the possibility of summer planting of potatoes in given agro-ecological conditions and to find genotypes which will in these conditions give a satisfactory and stable yields.

Materials and methods

Studying the possibility of growing potatoes in two seasons was conducted in 2011 and 2012. We tested two varieties of potato early tuberisation: Kennebec (leading variety of potatoes in Montenegro, early main crop, white flesh colour) and Monaco (early variety, yellow flesh colour). Soil type on which experiments were conducted is Terra rossa and it is located on 40 m of altitude. Experiments were carried out using field trials in a randomized block design with 4 replications. The plot size was 28 m^2. Planting density was 70x33 cm, achieving 43300 plants per hectare. Planting was done in third decade of July (26th July in 2011 and 20th July 2012). Seed for spring planting was used, that was stored in refrigerator at 4°C until beginning of sprouting (use of seeds from spring planting is complicated and for breaking of seed dormancy requires the use of chemicals - gibberellic acid). Germination on the diffuse light started a month before planting at a temperature of 15°C. Tubers used for planting were weighing approximately 60-70g.

In both years, two days before planting was done soil drench. The crop of potatoes was regularly treated with products against late blight and one against Colorado potato beetle (due to the high temperature possibility for the emergence of Colorado potato beetles is much lower than in the spring planting). During the hilling potato plants (plant height 20-25 cm) fertilization with nitrogen was done. Irrigation of potatoes was done when the technical minimum was reached at humidity of soil of 75-80% of FWC. Irrigation was done using Microjet irrigation system and irrigation norm was 15 mm.m^{-2}.

Table 1 - Chemical characteristics soil on experimental field (Terra rossa)

Depth (cm)	Locality	pH		CaCO$_3$ %	Humus %	Soluble mg/100 g	
		H$_2$O	nKCl			P$_2$O$_5$	K$_2$O
30	Podgorica	6.0	4.97	1.43	4.56	4.3	15.0

Few days before harvesting of potatoes, sampling was done by taking 10 potato plants per replication to determine the number and weight of tubers. Potato harvesting was done manually after full maturation of canopy (1st December in 2011 and 20th November in 2012).

The potato yield in the experiment was determined by measuring the tubers at each elementary plot and then the yield per hectare was calculated.

The analysis of variance was calculated according to randomize complete block design with two factors: variety (A) and year (B). The significant differences among the means were evaluated according to least significant difference (lsd) test (Maletić, 2005).

Table 2 - Meteorological conditions during the experiments

Year	Month					Average vegetation period	Average annual
	July	August	September	October	November		
Air temperature (^{0}C)							
2011	27.2	29.3	26.3	16.3	9.9	21.8	17
2012	30.4	29.7	23.9	18.2	13.3	23.1	17
Amount of rainfall (mm)							
2011	31.4	2.1	43.3	75.6	37.1	189.5	896.9
2012	11.3	0.5	86.6	296.3	285.8	680.5	1763.6

The soil on which experiments were performed is type terra rossa (tab. 1). It is characterized by low carbonate content and low soil acid reaction (pH). Phosphorus content is low and moderately supplied by potassium. It contains a high percentage of humus. Meteorological conditions during performance of the experiment are shown in table 2.

Results and discussion

The possibility of growing crops in two or more seasons is a gift of nature that allows more extensive and therefore cheaper production at the same field during the same year. In the agro ecological conditions of Podgorica water is a limiting factor for summer planting of potatoes and irrigation occurs as the only option to eliminate the negative effects of the summer heat and deficit of rainfall.

Table 3 - Results of the investigation

Parameter	Average tuber number			Average tuber weight (g)			Tuber yield (t.ha^{-1})		
Year (B)	2011	2012	Average	2011	2012	Average	2011	2012	Average
Variety (A)									
Kennebec	4.9	5.4	**5.2 a**	149	131	**140 a**	31.8	30.7	**31.3 a**
Monaco	4.5	5.2	**4.9 a**	138	115	**126.5 b**	27.1	26.0	**26.6 b**
Average	**4.7**	**5.3**	**5.1**	**143.5**	**123**	**133.3**	**29.5**	**28.4**	**29**

	A			B		A*B	
	LSD 0.05	LSD 0.01	LSD 0.05	LSD 0.01	LSD 0.05	LSD 0.01	
Average tuber number	0.563	0.789	0.563	0.789	0.796	1.116	
Average tuber weight (g)	12.151	17.036	12.151	17.036	17.185	24.092	
Tuber yield (t.ha^{-1})	3.916	5.490	3.916	5.490	5.538	7.764	

Number of potato tubers is influenced by the number of potato shoots formed by a single plant. If the number of the primary shoots is bigger, the number of tubers formed is

bigger, but their mass is less and vice versa (Bugarči, 2000b; Butorac i Bolf, 2000; Jovović, 2002). Results in Table 3 show that in the two-year research both varieties had approximately the same number of formed tubers per plant - Kennebec 5.2 and Monaco 4.9. Kennebec and Monaco are varieties that are characterized by a medium level of tuberisation. A smaller number of tubers recorded in the experiments are a consequence of high temperatures during August when plants of potatoes are in tuberisation phase (23.9 in 2011 and 29.7 °C in 2012). Optimal soil temperature in the phase of formation of tubers according to Muminović et al. (2014) is between 15 and 18°C, and air temperature between 18 and 22°C. As the air temperature in Podgorica during this period was higher these results were expected.

Weight of tubers is an important parameter of productivity and quality and it significantly affect the viability of the plant and also affects the final yield (Rykbost and Locke, 1999). The importance of the size of the tubers is expressed through the number of sprouts and their biological potency, and is closely associated with the physiological age of the tubers (Poštić, 2006). Table 3 shows that the higher average weight of tubers was measured in crop variety Kennebec – 140 g (149 g in 2011 and 131 g in 2012). Average weight of tubers in variety Monaco was – 126, 5 g (138 g in 2011 and 115 g in 2012). Differences in the average weight of tubers from the varieties of potato were statistically significant. The optimal temperature of the air at the period of intensive tuber growth is 21-25°C (Muminović et al., 2014). Table 2 shows that the potato plants at this stage had very favourable thermal conditions that along with good supply of plants with water caused the formation of relatively large tubers.

Results presented in Table 3 show that the highest yield of tubers in the experiments was measured in crop variety Kennebec in 2011 – 31.8 t.ha^{-1}, while the lowest yield had the variety Monaco in 2012 – 26.0 t.ha^{-1}. In two years average variety Kennebec had yield of 31.3 t.ha^{-1}, and Monaco 26.6 t.ha^{-1}. In comparison with the variety Monaco, variety Kennebec gave a significantly higher yield of tubers.

In the two years studies slightly higher average yields of potatoes were measured in 2011 – 29, 5 t.ha^{-1}. Average yield of potato in 2012 was 28.4 t.ha^{-1}. Between the years studied there were no statistically significant differences with respect to this parameter.

Statistically very significant differences in the average yield of tubers were formed and influenced by the interaction variety x year. Variety Kennebec in 2011 exhibited a significant increase in yield compared with the yield of variety Monaco in 2012. Such an expressed influence of meteorological conditions on the yield of potatoes is in accordance with the results of previous research (Jovović at al, 2012b; Hassanpanah, 2011).

Bearing in mind that this was a summer production of potatoes and potato cultivation in the second season, yields was more than satisfactory. Yields were at the level of spring planting yields and those obtained by growing potatoes in the continental part of Montenegro. Jovović at al., (2012c) trough studying the productivity of a large number of varieties of potatoes in a number of localities in the mountainous regions of Montenegro established average yield of variety Monaco of 27.2 t.ha^{-1}, meaning that this yield was at the level of yields obtained in previous studies. The yield of variety Kennebec obtained in this study (31.3 t.ha^{-1}) was higher than yields obtained in continental area – 28.3 t.ha^{-1} (Jovović at al., 2013c). Summer planting of potatoes allows production of 50 or more tons of potatoes per hectare in one year in the southern area of Montenegro which is significantly higher than average yields that have the most developed countries in the world.

Conclusions

Based on two years of studying the possibility of summer planting of potatoes in agro ecological conditions of Podgorica area can be concluded:

1. The agro ecological conditions of Podgorica are very favourable conditions for summer planting of potatoes. To obtain high and stable yields in summer production it is necessary to provide irrigation. In such conditions, the success of this production is guaranteed.
2. Both varieties studied had approximately the same number of formed tubers per plant - Kennebec 5.2 and Monaco 4.9. No statistically significant difference between the varieties was determined in terms of these properties.
3. Variety Kennebec (140 g) in comparison with the variety Monaco (126.5 g) had a significantly higher average weight of tubers.
4. Highest tuber yield in the experiments was measured in crop varieties Kennebec - 31.3 t.ha-1, while the lowest yield was in variety Monaco - 26.6 t.ha -1. The differences in the yield were statistically highly significant.
5. Summer planting potatoes in Podgorica in irrigation allows very satisfactory yields. For these reasons, growing potatoes in this method should be paid more attention in the future.

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SEED GERMINATIONS OF 20 WILD SPECIES GROWING IN ANTALYA (TURKEY) WITH OUTDOOR ORNAMENTAL PLANT POTENTIAL

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Abstract

Among the very rich plant genetic resources of Turkey, many plant species have the potential of outdoor landscape usage due to their aesthetic and functional characteristics. However, this diversity could not be evaluated well and cultivated enough. This study was carried out in Batı Akdeniz Agricultural Research Institute in Antalya (Turkey) between 2007 and 2009, under the project of TUBITAK-KAMAG-105G068-106G020. It was aimed to cultivate 20 wild plant species (some of them are endemic) via generative production method. For this aim, the seeds of the species of *Crataegus monogyna, Daphne sericea, D.gnidioides, D.oleoides, Erica manipuliflora, E.sicula* subsp. *libanotica, Ferula communis, F.tingitana, Iberis attica, Limonium angustifolium, L.gmelinii, L.sinuatum, Rosularia sempervivum* subsp. *sempervivum, Smilax aspera, Vaccaria hispanica, Vitex agnus-castus* and the endemic species of *Conringia grandiflora, Erica bocquetii, Gypsophila bitlisensis* and *Ricotia carnosula* were sown in different times without pretreatment, except than soaking them in tap water for 6 hours. According to the results of 35 germination trials tested in 20 species, 6 species (*Crataegus monogyna, Daphne sericea, D.oleoides, Erica sicula, Rosularia sempervivum, Smilax aspera)* did not germinated under the present germination conditions, whilst 14 species germinated at different ratios ranging from 2% to 98%. Among the germinated species, *Conringia grandiflora, Gypsophila bitlisensis, Ricotia carnosula, Vaccaria hispanica and Vitex agnus-castus* were determined to be the most regenerative species germinating above 85% when their fresh seeds were sown. The germination results of this work were found quite promising for the cultivation and domestication of most of the focused wild plant species. Also, it is possible to increase the germination rates by different pretreatment applications in the forthcoming studies in particular non-germinated species.

Keywords: *Genetic resource, Outdoor ornamental plant, Endemic plant, Domestication, Cultivation*

Introduction

In the recent landscape designs in Turkey, mostly imported plants have been used due to their contibutions to the designs in terms of the aesthetic image and the species diversity. It is not possible to predict exactly today how these extremely demanded plants will have influence upon the flora and fauna of the country in the future. However, some emerging problems in the recent times proved that imported plants should be used in the controlled manner. In this case, to tend to the existing natural plants with outdoor ornamental plant potential in Turkey's rich flora and to evaluate them seems to be a correct approach (Arı et al., 2010). However, the success of this approach is closely related with the domestication of the targeted plants.

As known, cultivation of wild plants is an essential step for domestication of new crops. As the current stage of our extensive studies on domestication of new ornamental plants from the wild plants naturally grown in Antalya (Turkey) conducted since the year of 2000, we have now aimed to screen 20 plant species (*Conringia grandiflora, Crataegus monogyna* subsp.

monogyna, Daphne sericea, D.gnidioides, D.oleoides subsp. *oleoides, Erica bocquetii, Erica manipuliflora, E.sicula* subsp. *libanotica*, *Ferula communis* subsp. *communis, F.tingitana, Gypsophila bitlisensis, Iberis attica*, *Limonium angustifolium, L.gmelinii, L.sinuatum*, *Ricotia carnosula, Rosularia sempervivum* subsp. *sempervivum, Smilax aspera, Vaccaria hispanica* and *Vitex agnus-castus*) with outdoor ornamental value for their reproduction abilities by the germination tests. Among the plant species screened, *Conringia grandiflora, Ricotia carnosula* and *Erica bocquetii* are the endemic species to Antalya and the literature about them are quite limited with the flora-based studies. We have noticed the first two endemic species' potential for being seasonal flower (Arı et al., 2010) and also nutraceutical plant (enol et al., 2013) and began to domestication studies recently. *Gypsophila bitlisensis* is another endemic species to Bitlis and it was included to a *Gypsophila* breeding program under the project of TUBITAK-TOVAG-104O364 carried out in BATEM. *Crataegus monogyna, Iberis attica, Limonium sinuatum* and *Vitex agnus-castus* are the well-known species for especially using in landscape designs to be small tree and bedding plants while *Ferula* spp., *Smilax aspera, Vaccaria hispanica* and *Vitex agnus-castus* are the important species for pharmaceutical industry. All these species have been cultivated and bred in the world. Although most of the mentioned plant species are known and desired also in Turkey regarding ornamental or pharmaceutical plant potential, they are not cultivated and so, their produced plantlets are not available in ornamental and medicinal markets. Therefore, revealing of the production methods of the species mentioned above is an important necessity in order to meet the supply for them in the related sectors of Turkey.

Introducing a new plant is a complex process covering a number of steps from establishing a market to providing the plant's requirements (Seaton et al., 2014). Domestication of the plant comes first among all the steps. Since domestication of the wild plants is primarily associated with their cultivation in the most proper environment, firstly the production systems of the involved species should be revealed either generatively or vegetatively. Hence, the seeds of 20 wild plant species thought to be cultivated generatively were subjected to the initial scale germination tests in this work set up *in vivo* greenhouse conditions.

Materials and Methods

This study was performed in Batı Akdeniz Agricultural Research Institute (BATEM) in Antalya, Turkey, in 2007-2009,under the project of TUBITAK-KAMAG-105G068-106G020.

For the screening of 20 wild plant species (Table 1) with primarily outdoor ornamental plant potential for their germination abilities, the seeds of them were collected from their different distribution areas in Antalya in different dates (Table 2) and stored at room temperature until used. Seeds were sown into the viols containing peat or peat and perlite mixture in 3:1 ratio in an unheated greenhouse in the specified dates in Table 2. Except the seeds of 3 *Erica* and 3 *Limonium* species, all seeds were sown individually to the viols. However, 0.10 g seeds of mentioned 6 species had to be sown with scattering due to their very small sized seeds. All seeds in the study were soaked in distilled water for 6 hours before sowing. Germination conditions were not equal for each species since their seeds were collected from different locations in diverse field surveys performed in different times. Therefore, germination trials were set up in different dates with the changing seed numbers for each species and so, statistic analysis of them could not be performed. Some of the species were more privileged for us because of their importance. Thus, their germination tests were repeated. The germinated and survived seedlings were transferred to pots containing peat, perlit, soil mixture in 2:1:2 ratio.

Table 1. Taxonomic information, plant growth habit and potential ornamental use of 20 wild plant species studied in the work (from Arı 2009; Davis 1965-1985; TUBIVES, 2014)

No	Species	Family	Endemism (+ / -)	Plant Growth Form	Flowering Time	Potential Ornamental Plant Use
1	*Conringia grandiflora* BOISS. ET HELDR.	*Brassicaceae*	+	Herbacious, seasonal	March – May	Bedding plant
2	*Crataegus monogyna* JACQ. subsp. *monogyna* JACQ	*Rosaceae*	-	Woody, small tree	April - June	Small tree
3	*Daphne sericea* VAHL	*Thymelaeceae*	-	Semi-woody, evergreen shrub	February -May	Shrub plant
4	*Daphne gnidioides* JAUB. ET SPACH		-	Semi-woody, evergreen shrub	May - August	Shrub plant
5	*Daphne oleoides* SCHREBER subsp. *oleoides* SCHREBER		-	Semi-woody, evergreen shrub	May - September	Shrub plant
6	*Erica bocquetii* (PEÃMEN) P. F. STEVENS	*Ericaceae*	+	Perennial woody, creeping shrub	July	Rock garden plant
7	*Erica manipuliflora* SALISB.		-	Perennial woody, evergreen shrub	July - November	Shrub plant Golf course plant
8	*Erica sicula* GUSS. subsp. *libanotica* (C. ET W. BARBEY) P. F. STEVENS		-	Perennial woody, evergreen, creeping shrub	April	Rock garden plant
9	*Ferula communis* L. subsp. *communis* L.	*Apiaceae*	-	Perennial, shrub	April-June	Bedding plant, Foliage plant
10	*Ferula tingitana* L.		-	Perennial, shrub	April-June	Bedding plant
11	*Gypsophila bitlisensis* BARK.	*Caryophyllaceae*	+	Herbacious, seasonal	June - July	Bedding plant
12	*Iberis attica* JORD.	*Brassicaceae*	-	Herbacious, seasonal	March - May	Bedding plant
13	*Limonium gmelinii* (WILLD.) O. KUNTZE	*Plumbaginaceae*	-	Herbacious, seasonal	May-October	Bedding plant
14	*Limonium sinuatum* (L.) MILLER		-	Herbacious, seasonal	May-June	Bedding plant
15	*Limonium angustifolium* (TAUSCH) TURRILL		-	Herbacious, seasonal	May-October	Bedding plant
16	*Ricotia carnosula* BOISS. ET HELDR.	*Brassicaceae*	+	Herbacious, seasonal	March -April	Bedding plant Rock garden plant
17	*Rosularia sempervivum* (M. BIEB.) BERGER subsp. *sempervivum*	*Crassulaceae*	-	Herbacious, seasonal	June-September	Bedding plant, Rock garden plant
18	*Smilax aspera* L.	*Smilacaceae*	-	Perennial, creeping shrub	April-June	Rock garden plant, Hedge plant
19	*Vaccaria hispanica* (Mill.) RAUSCHERT	*Caryophyllaceae*	-	Herbacious, seasonal	April - July	Bedding plant
20	*Vitex agnus-castus* L.	*Lamiaceae* (formerly: *Verbenaceae)*	-	Woody, decidious small tree	June-September	Shrub – small tree plant

Results and Discussion

The seeds of 14 wild species germinated at different ratios ranging from 2% to 98%, while the seeds of 6 species did not germinate under the available conditions in the present study. Germination rates and number of the grown plants obtained from 35 germination tests conducted on the seeds of 20 wild plant species were shown in Table 2.

Endemic *Conringia grandiflora* has a good potential for being a late winter - spring annual plant because of its bright, charming, yellow flowers and natural form (Ari et al., 2010). In the 3 germination tests performed for this species at different dates, the most successful germination rate (98%) was acquired from the second one in which the first germination happened in the 5th day in peat medium from the-3-months-old seeds. Interestingly, the fresly harvested seeds collected from Kemer gave the lowest germination rate (18%) and the first germination took place in the 20th day. The possible reason of this might be the genetic origin as well as the seed growing medium consisted of peat and perlite mixture. Consequently, winter seed sowing for *C.grandiflora* was found much more successfull than summer one.

Table 2. Germination rates and number of the grown plants obtained from 35 germination trials conducted on the seeds of 20 wild plant species

No	Plant Species	Location in Antalya	Altitude (m)	Date of seed collection	Date of seed sowing	Number of sown seed	Germination medium	Germination rate (%)	Number of grown plant
1	*Conringia*	Kemer	78	08.07.2008	17.07.2008	100	Peat+Perlite	18	16
2	*grandiflora*	Manavgat	968	31.07.2008	05.11.2008	500	Peat	98	323
3		Manavgat	968	31.07.2008	12.11.2009	300	Peat	95	68
4	*Crataegus monogyna*	Titreyen Göl	73	23.10.2007	05.11.2007	100	Peat	0	0
5	*Daphne gnidioides*	Gazipa a	250	01.11.2007	05.11.2007	100	Peat	33	33
6	*Daphne oleoides*	Manavgat	1759	08.07.2008	17.07.2008	100	Peat+Perlite	0	0
7	*Daphne*	Masada ı	27	30.04.2008	02.05.2008	100	Peat	0	0
8	*sericea*	Manavgat-Serge	1638	19.06.2008	07.11.2008	150	Peat	0	0
9	*Erica bocquetti*	Elmalı	1787	09.07.2008	05.11.2008	*	Peat	**	4
10	*Erica*	Kemer	7	02.04.2008	10.04.2008	*	Peat	**	8
11	*manipuliflora*	Kumköy	5	10.11.2008	20.11.2008	*	Peat	0	0
12	*Erica sicula*	Kemer	74	06.02.2008	10.04.2008	*	Peat	0	0
13		Kemer	63	15.05.2008	07.11.2008	*	Peat	0	0
14	*Ferula communis*	Akseki	1462	31.07.2008	04.11.2008	100	Peat	3	3
15	*Ferula tingitana*	Akseki	1509	31.07.2008	04.11.2008	50	Peat	60	25
16	*Gypsophila bitlisensis*	BATEM Origin: Digor, Kars	32	10.04.2008	10.04.2008	100	Peat	14	12
17		BATEM	32	26.06.2008	20.11.2008	200	Peat	86	50
18	*Iberis attica*	Alanya	1348	08.07.2008	17.07.2008	100	Peat+Perlite	17	17
19		Alanya	1452	08.07.2008	04.11.2008	100	Peat	44	44
20		Alanya	1297	08.07.2008	04.11.2008	200	Peat	52	76
21	*Limonium angustifolium*	Denizli	1134	05.10.2008	19.12.2008	*	Peat	**	2
22	*Limonium gmelinii*	Küçük Çaltıcak	4	05.11.2008	19.12.2008	*	Peat	**	3
23	*Limonium sinuatum*	Kumluca	0	19.08.2008	19.12.2008	*	Peat	**	128
24	*Ricotia*	Kemer	36	17.04.2007	08.10.2007	400	Peat	98	260
25	*carnosula*	Kemer	42	31.05.2007	10.04.2008	100	Peat	60	50
26		Kemer	29	29.05.2008	15.06.2008	100	Peat	61	42
27		Tekirova	69	29.05.2008	19.12.2008	100	Peat	78	65
28		Kemer	36	08.11.2009	12.11.2009	200	Peat	93	76
29	*Rosularia sempervivum*	Manavgat	549	16.04.2008	20.11.2008	*	Peat	0	0
30	*Smilax aspera*	Side	19	23.10.2007	05.11.2007	150	Peat	0	0
31	*Vaccaria hispanica*	Elmalı	659	07.06.2007	08.10.2007	300	Peat	97	240
32	*Vitex agnus-*	Kaledran	57	01.11.2007	05.11.2007	2000	Peat	96	300
33	*castus*	Gebiz	42	27.11.2007	10.04.2008	100	Peat	72	50
34		Korkuteli	344	12.08.2008	04.11.2008	150	Peat	58	57
35		Korkuteli	344	12.08.2008	16.12.2008	100	Peat	62	45

[*]: The seed numbers were not counted due to the very small sized seeds and 0.10 g seeds were sown sprinkling.
[**]: Since the seeds were not counted, the rate of germination could not be calculated.

Daphne gnidioides was the only *Daphne* species germinating at 33% ratio. *D.sericea* was one of our focused species, but we could not germinate it under present conditions. According to Piotto et al. (2003) and Barbie (2008), the seeds of *D.sericea* and other *Daphne* species had deep dormancy and required both physical and chemical pretreatments.
Among the *Erica* species (Heathers), the seeds of *E.manipuliflora* and endemic *E.bocquetii* germinated in a very low numbers. Since *Erica* seeds were could not be counted due to their small sizes and so, they were sown sprinkling, the rate of germination could not be

calculated. Pipinis et al.(2006) also sowed the seeds of *E.manipuliflora* with scattering and achieved quite high germination record (181 seedlings/0.15 gr seed) from the one month of prechilling treatment. In our germination tests in *Erica* species, only 8 seedlings in *E.manipuliflora* and 4 seedlings in *E.bocquetii* could be acquired from 0.10 gr seed samples without prechilling. On the other hand, Piotto et al. (2003) reported *E. arborea* seeds could be germinated after being exposed to smoke and high temperatures up to 120°C for 10 minutes. Accordingly, extra pretreatments are required for germination of this valuable wild species which gained more importance lately especially for landscape designs in particular golf courses and the conservation of ecosystems due to its less water and fertilizer need as well as fire-resistance.

From *Ferula* species, *F.tingitana* (60%) showed much higher germination than *F.communis* (3%). Nikolaeva (1969) reported cold stratification requirement of some other *Ferula* species for germination and effective temperature for this requirement was 0-3°C (Baskin and Baskin, 1989). Thus, *F.communis* also might have seed dormancy and need prechilling treatment. In endemic *Gypsophila bitlisensis*, the autumn seed sowing resulted higher germination rate (86%) than the spring seed sowing (14%). Likewise, the autumn seed sowings (52 and 44%) was found more successfull than the spring seed sowing (17%) in *Iberis attica*. However, the germination medium comprised from peat and perlite might also be effective on the lower result just like the germination test conducted on the summer seed sowing of *C.grandiflora*.

The seeds of *Limonium* species were also sown with scattering and the germination rates of them could not be calculated like *Erica* species. All 3 *Limonium* species were germinated and *L.sinuatum* was the most regenerative (128 seedlings/0.10 gr seed) species among them. Endemic *Ricotia carnosula* has a good potential for being a winter annual plant, because of its odorous, small, white flowers and natural form (Ari et al,2010). Rather high germination rates were achieved varying from 60 to 98% in the 5 germination tests conducted in this species.

We acquired high germination rate(97%) in *Vaccaria hispanica* from the-4-months-old seeds. As to *Vitex agnus-castus,* Belhadj et al. (1998) and Travlos and Karamanos (2007) reported that the seeds of this species have certainly physiological dormancy whilst Dirr and Heuser (1987) said that the seeds of *V. agnus-castus* could germinate without any pretreatment. In our 5 germination tests, we obtained 58 to 96% germination rates and the most successful rate was achieved from the freshly sown seeds collected from Kaledran (Figure 1).
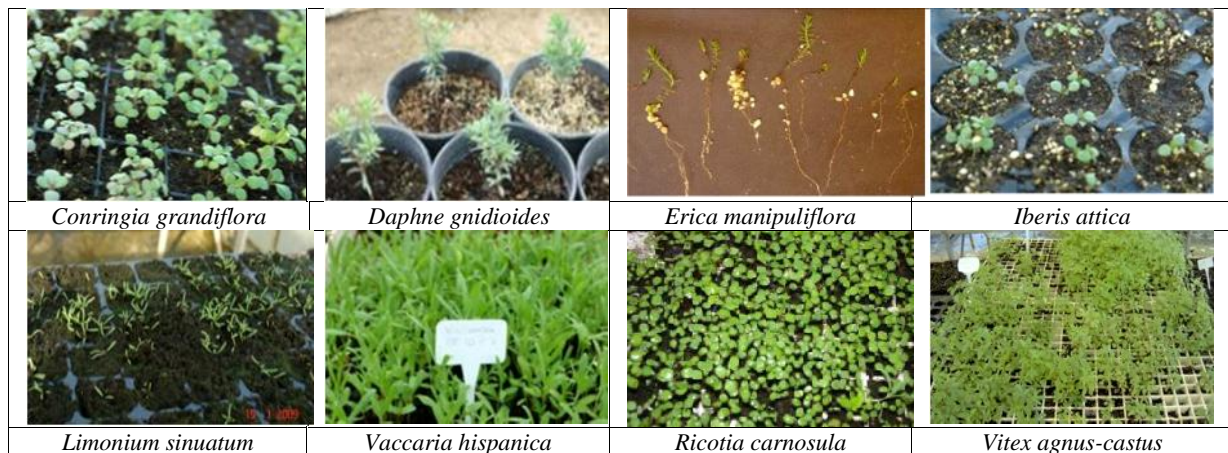

| *Conringia grandiflora* | *Daphne gnidioides* | *Erica manipuliflora* | *Iberis attica* |
| *Limonium sinuatum* | *Vaccaria hispanica* | *Ricotia carnosula* | *Vitex agnus-castus* |

Figure 1. Germinated seedlings and grown plants of some wild plants obtained in the study

On the other hand, the seeds of *Crataegus monogyna, Daphne sericea, D.oleoides, Erica sicula, Rosularia sempervivum* and *Smilax aspera* failed to germinate under the present

germination condition in which the only pretreatment was to soak the seeds for 6 hours. The possible reason of the germination failure for them is most probably different types of dormancies varying according to species. For example *C.monogyna* was reported to have deep physiological dormancy (Flemion, 1934; Baskin and Baskin, 1989) and it may take 1, 2 or 3 years for seeds to germinate (Bujarska-Borkowska, 2002). For the production of *D.sericea*, we believe a mycorrhizal symbiosis is required (Arı et al., 2011). Piotto et al. (2003) pointed out the combination of warm stratification + cold stratification before sowing could improve the percentage of germination in *S.aspera*. To conclude, these results should be evaluated to be initial results of our preliminary tests and it is possible to break dormancies and to increase germination rates by different pretreatments in the subsequent studies.

Conclusion

20 wild plant species with outdoor ornamental plant value were screened in this study in order to determine their germination abilities. Among the scanned species, *Conringia grandiflora, Daphne sericea, Erica manipuliflora, Iberis attica*, *Limonium sinuatum*, *Ricotia carnosula*, *Vaccaria hispanica* and *Vitex agnus-castus* were our most targeted species because of their higher ornamental potential. Except from *D.sericea* and *E.manipuliflora,* we achieved quite high germination rates from the others. Hence, the germination results of this work, in which some of the species were investigated and cultured for the first time, were found quite promising for the cultivation and domestication of them. However, it is possible to increase the germination rates by different pretreatment applications in the forthcoming studies in particular non-germinated species.

Acknowledgement

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2. PLANT PROTECTION AND FOOD SAFETY

STUDY OF TECHNOLOGICAL CHARACTERISTICS OF SELECTED OENOLOGICAL YEASTS FOR DIRECTED FERMENTATION

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Abstract

In this study, 9 strains of yeast (8 strains *Saccharomyces cerevisiae*, 1 strain *Kloeckera apiculata*) selected by authors in 2012 - 2013, were tested to study their technological characteristics by densimetric method. The experiment was carried out in Erlenmeyer flasks containing 100 mL of grape juice (variety Merlot) with 265 g/L sugar. Studied technological characteristics were fermentation power, fermentation energy, and resistance to sulphur dioxide, fermentative ability at low temperatures as well as the dynamics of fermentation. Regarding fermentative power of yeasts 5 strains were distinguished with high alcohol production capability over 12 %vol., 1 strain with average alcohol production capability about 11 %vol. and 3 strains showed low alcohol production capability. Regarding the energy fermentation, 6 strains were distinguished to have high fermentation energy over 1.3 %vol. alcohols/day during the first week of fermentation. Also, 2 yeast strains were distinguished with high fermentative power (over 12 %vol.) in presence of SO_2 and 1 yeast strain with good fermentative ability (over 12 %vol.) at low temperatures. In conclusion, the strains that showed good fermentative ability, will serve to further work for microvinifications with directed fermentation to determine the most competitive and productive strains aimed at standardizing the wine.

Keywords: *selected yeast, oenology, and fermentation.*

Introduction

The conversion into wine of the grape must is a fermentative process performed by the microorganisms, whose composition notably contributes to the quality of the wine. Spontaneous fermentations produce wine characterized by peculiar aromas and flavour due to complexity of the natural micro-flora, which depends upon a number of external environmental factors like temperature, humidity etc, mainly composed by non-*Saccharomyces* yeasts (FAO). Before, wine production was the result of spontaneous fermentation carried out by the micro flora of the grapes but nowadays the winemaking practices are modified by using starter cultures, especially for large quantity wine productions (Rainieri *et al.,* 2000). The selection of yeasts for winemaking consists of identifying those cultures that can ferment grape juice efficiently and produce good quality wines. The use of selected yeasts in wine production technology is very important, because they provide a quick fermentation and safe, and reduce the risk of slowing or stopping fermentation and microbial pollution (Maifreni *et al.,* 1999). Wine fermentation is not carried out by single yeast but from a set of selected yeast which being combined in the right way can provide a qualitative product and sustainable wine (Fugelsang, 1997; Fleet & Heard, 1993). Selection of yeast destined for wine production, depends on their technological features such as fermentation power, fermentation energy, resistance to sulphur dioxide, the ability to ferment at low temperatures (Delfini, 1982). The aim of this study was to the individuation of selected yeast strains useful in the improvement of the quality of the wine. In this work we study the

characteristics of these strains, which attribute the improvement of wine quality and the possibility of winemakers to control the fermentation process and the acquisition of some specific characteristics of the wine.

Materials and methods

Microorganisms

In this study, eight (8) strains of *Saccharomyces cerevisiae*, isolated and identified in the Laboratory of Microbiology and Food Biotechnology in 2012 – 2013 at the Agricultural University of Tirana labelled: KS1', MP4, MS5', KS7', KB2, KB1, KL1, M1 and one (1) strain of *Kloeckera apiculata* labelled MS5, are used(Lamçe, F. and Sini, K. 2013).

Microfermentation

The study of technological characteristics of yeasts was determined using the densimetric methods as described by Zambonelli (1998) in Merlot grape variety with 26.5% sugar content. Fermentation tests were carried out in 250 ml Erlenmeyer flasks equipped with corks conceived by Pasteur pipette, which contained 100 ml of must. After steam – sterilizing the flasks at 90 ºC for 15 minutes, 10^6 cells/ ml culture 48 hour PD Broth (potato-dextrose) were inoculated, in sterile conditions and each yeast strain was carried out in triplicate. Tests were placed in different fermentation conditions: microfermentation at 25 ºC, microfermentation at temperatures 12-19 ºC, microfermentation in the presence of SO_2.To control weight loss by CO_2 liberation, weights were made every day until no more weight change, and that means the end of fermentation.

Analytical determinations

The dynamics of the fermentation was determined as the amount of alcohol produced during fermentation, in all the days until the end. The fermentation energy is related to the speed with which a yeast strain begins fermentation and ends it. The fermentation energy was determined as the sum of the amount of CO_2 produced in 7 and 11 first days of fermentation converted to alcoholic degrees (%vol.). Resistance to SO_2 expresses the ability of yeast strains to give fermentation in the presence of activity of this antiseptic, which was calculated with the total amount of CO_2 produced, converted into alcoholic degrees. Fermentation at low temperature is related to the ability of yeasts to ferment the musts at low temperatures. Alcohol produced during fermentation was determined indirectly by multiplying the weight loss (in %) with 1.292 factor (Zenelaj 2004).

Results and Discussion

The following are the results which refer to the technological indicators studied as dynamics of fermentation, fermentation energy, fermentation power, resistance to SO_2 and the ability to ferment at low temperatures. Results of the work are processed by Baranyi model.

Performance of fermentation dynamics (fermentation curve)

Fermentation dynamics,which means the performance fermentation in time, is presented graphically in Figure 1.
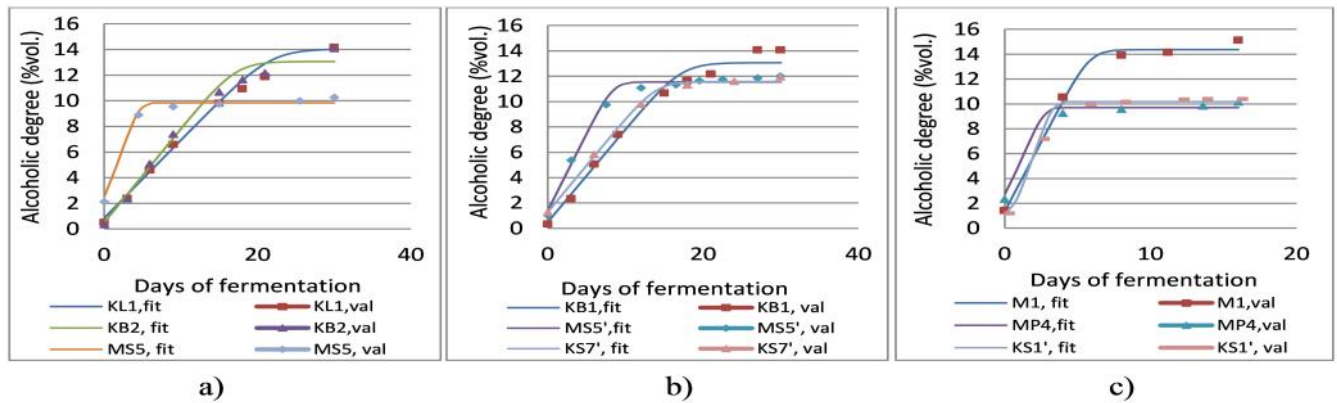
Figure.1. Performance of fermentation dynamics

a)   b)   c)

Table 1.Performance of fermentation dynamics

Strains	yDatMin	yDatMax	rate	lag	y0	yEnd	se(fit)	R^2_stat
KL1	0,51	14,18	0,60		0,85	14,03	0,54	0,98
KB2	0,38	14,39	0,62		0,66	14,24	0,56	0,98
KB1	0,35	14,07	0,73		0,49	13,06	0,61	0,97
M1	1,44	15,12	2,23		1,36	14,36	0,35	0,99
MS5'	1,03	12,01	1,82		1,40	11,54	0,43	0,98
MP4	2,36	10,18	3,51	0,70	1,49	9,70	0,43	0,96
MS5	2,11	10,27	3,79	0,71	1,19	9,83	0,38	0,97
KS7'	1,28	11,96	1,47		1,28	11,57	0,29	0,99
KS1'	1,2	10,39	3,75	0,46	1,11	10,18	0,26	0,99

From the fermentation performance in Figure 1 and Table 1, it is clear that some strains as MP4, MS5 and KS1', have adaptation phase and their fermentation began with delay, compared with other strains. The alcohol produced by these strains is in small amounts. The strains KL1, KB1 and KK2 develop gradually fermentation being extended from 20 to 22 days, associated with high alcoholic degrees and small residual sugar. The strains KS7'and M1 develop a fast fermentation which last up to 15 days, strain M1 gives a high alcoholic degree with a small residual sugar and the strain KS7' ends alcoholic fermentation with an average alcoholic degree, leaving a higher residue of sugar than strain M1.

The fermentation energy
The speed of fermentation is presented as a very important indicator of oenological skills of yeast strains which helps in selection of proper strains which will be used for fermentation in relation to competitiveness with other microorganisms present in the fermentation substrate. In our tests, this indicator is calculated to strains after 7 days and 11 days of fermentation. The data are presented in the table below.

Table 2. The fermentation energy

Strains	Fermentation energy (at first 7 days)	Fermentation energy (at first 11 days)
KS1'	1.44 ± 0.02	0.94 ± 0.02
MP4	1.36 ± 0.02	0.89 ± 0.03
MS5	1.39 ± 0.03	0.90 ± 0.07
MS5'	1.39 ± 0.02	1.04 ± 0.03
KS7'	1.40 ± 0.02	1.04 ± 0.04
KB2	0.62 ± 0.03	0.65 ± 0.02
KB1	0.72 ± 0.02	0.73 ± 0.04
KL1	0.65 ± 0.03	0.65 ± 0.03
M1	**1.92 ± 0.02**	**± 0.03**

Table 2 shows that strains, KL1, KB2, and KB1 present constant value of the fermentation energy compared with other strains, which is distinguished starting even from Figure1. These strains were distinguished even for a longer time of fermentation, compared to other strains. The strains KS1', MP4, MS5, MS5', KS7' and M1 in the first 7 days of fermentation had a high fermentation energy, compared with the other strains but this fermentation energy declined in coming days. However from Figure 1 and Table 1. It is clear that alcohol produced by strains MS5', KS7' and M1 is in average levels. The strains KS1', MP4, and MS5 despite of having high fermentation energy, the alcohol produced by these strains is low.

Resistance to SO_2.

The reaction of yeasts against SO_2 is very heterogeneous. Some species demonstrate a high degree of sensitivity towards this compound, while others are resistant. The following are the results of this study that clearly shows the sensitivity of yeasts to SO_2.

Table 3. Yeast fermentative performance depending on the resistance to SO_2

Strains	yDatMin	[1]yDatMax +SO_2	[2]yDatMax -SO_2	rate	lag	y0	yEnd	se(fit)	R^2_stat
KS7'	0,24	**11,96**	**11.96**	1,66	1,76	0,15	11,61	0,30	0,995
KL1	0,33	12,47	14.18	0,59		1,09	12,34	0,54	0,981
KB2	0,26	**12,96**	**14.39**	0,60		1,17	12,84	0,59	0,978
KB1	0,06	11,66	14.07	0,73		0,14	11,34	0,39	0,990
MS5'	0,00	0,00	12.01	0,00		0,00	0,00	0,00	0,000
M1	0,00	**0,00**	**15.12**	0,00		0,00	0,00	0,00	0,000
MP4	0,57	10,61	10.18	3,02		0,25	10,24	0,34	0,989
MS5	0,45	10,83	10.28	3,22		0,26	10,42	0,31	0,991
KS1'	0,59	10,01	10.39	3,01		0,41	9,80	0,48	0,973

[1]yDatMax +SO2: maximal value of alcohol produced in presence of SO_2
[2]yDatMax -SO2: maximal value of alcohol produced in absence of SO_2

Figure 2. Yeast fermentative performance depending on the resistance to SO_2

| (a) | (b) | (c) |
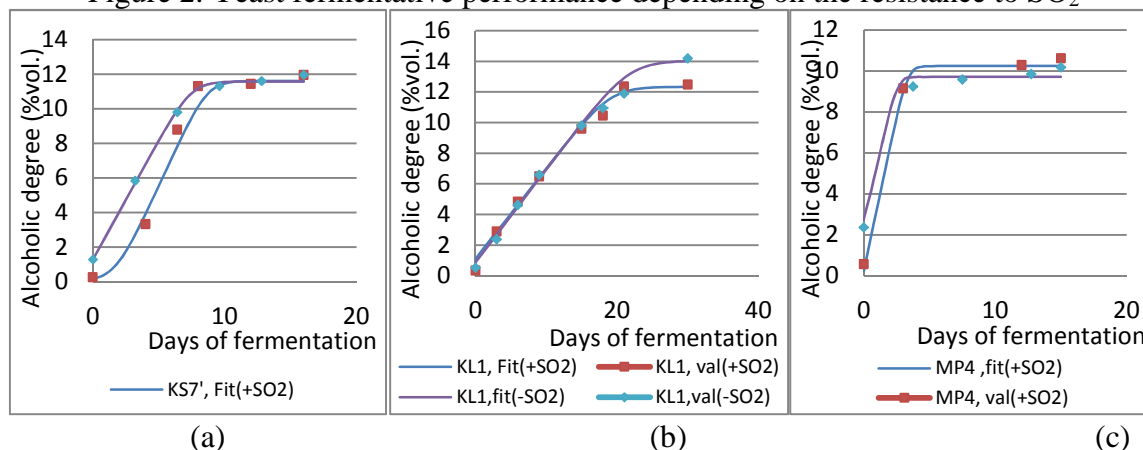
From Table 3, we can see that six strains show sensitivity to the use of SO_2 in must compared with fermentation in its absence. The strain KS7' resulted slightly sensitive to SO_2, although it had adaptation phase and its fermentation started later than other strains, alcohol produced by this strain was in average level (Figure 2.a). The strains MS5' and M1 exhibited a high degree of sensitivity to SO_2, therefore these strains didn't ferment in his presence. The strains KL1, KB1 and KB2 showed that they were less sensitive to SO_2, develop slower fermentation but they provided high alcohol content and a small residual sugar. (Figure 2.b). The strains MP4 and MS5 were appeared more active against SO_2; they provided a higher alcoholic degree than in conditions of its absence. (Figure 2.c).

Influence of temperature to fermentation
An important indicator for the progress of fermentation is the temperature at which it happens. The results of influence of temperature to fermentation are given in Table 4

Table 4. Influence of temperature to fermentation

Strains	Alcoholic degree (%vol.) in 25 °C	Alcoholic degree (% vol.) in 12 - 19 ° C
KS1'	10.40± 0.03	10.08 ± 0.03
MP4	10.18 ± 0,03	9.89 ± 0.03
MS5	10.28 ± 0,02	9.99 ± 0.03
MS5'	12,01 ± 0,02	11,45 ± 0.02
KS7'	11,96 ± 0,02	11,52 ± 0.04
KB2	14,39 ± 0,03	11,63 ± 0.04
KB1	14,07± 0.02	10,19 ± 0.19
KL1	14,17 ± 0.03	11,81 ± 0.08
M1	15,12 ± 0.02	13,93 ± 0.07

Table 4 shows that all strains are affected by low temperatures in fermentation, because all strains have faster stopped fermentation compared with fermentation in temperature 25 °C. The strains KS1', MP4, MS5, MS5', M1dhe KS7' are less active in low temperatures (they produce about 1% vol. less alcohol compared to fermentation at temperature 25 °C). While the strains KB2, KB1 and KL1 are not very active at low temperatures.

Conclusions

As a result of this study performed in the laboratory and the results obtained from it, we can draw some conclusions:

The strains KS1', MP4 and MS5 were not very active at low temperatures, while regarding to resistance to SO_2, the strains MS5 and MP4 were totally resistant. These strains also showed high fermentation energy but alcohol produced by them, was at low levels and this coupled with a relatively high residual unfermented sugar.

The strain KB1 was distinguished for high fermentation power and medium fermentation energy. This strain was not very active at low temperatures and showed sensitivity to the treatment of must with SO_2 interrupting more quickly the fermentation compared with normal conditions.

The strain M1 was distinguished for high fermentation power and energy. This strain was not very active at low temperatures and showed a very high sensitivity to SO_2, not giving fermentation in its presence.

While the strains KB2 and KL1 were distinguished for high fermentation power, with a small residue of unfermented sugar and medium fermentation energy. These strains were easily sensitive to low temperatures and to SO_2, so they can serve for vinification with directed fermentation and in case of a positive result, the extent of directed fermentation in wine industry in our country.

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IMPACT OF SOIL CALCIFICATION TO THE MORPHOLOGICAL AND PRODUCTIVE INDICATORS OF SAGE

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Abstract

Sage (Salvia officinalis L.) is the most important medicinal plant in Albania(Ahmetaj, H. & Çeku, K. 1988; Albanian Research Institute for Forests and Pasture (ARIFP). 1988; Bardhi, N. 2008; Demiri, M. 1971; Hyso, M., Çobaj, P. 2005; Paparisto, K., Demiri, M., Mitrushi, I., Qosja, Xh. 1988), as from the natural surface, and as from the cultivated surface, too. Albanian production of sage is the most demanded in international markets. (Clebsch, B., Barner, C. D. 2003; Marko, O., Dishnica, T. 2002; Ndoja, H. 2001) Suffice it to mention that over 42% of sage consumed in the U.S. is imported from Albania. In the recent years, it has been increased the demand for production of sage, (Lorraine, H. 2012; George, E. F. 1996)and therefore increasingly it is cultivated even more being subsidized by the Albanian government. Moving from the natural growth to the cultivated growth, there are benn arise problems, regarding the chemical composition of herbs under the influence of cultivation technology(Kintzios, S. E. 2000; Kongjika, E., Zekaj, Zh., Çaushi, E. & Stamo, I. 2002). Sage is highly influenced by the presence of lime in the soil, as for the production, for its longevity, and especially in the chemical composition of the herb(Asllani, U. 2000; Asllani, U. 2002; Akhondzadeh, S., Noroozian, M., Mohammadi, M., Ohadinia, S., Jamshidi, A. H., Khani, M. 2003). Given the fact that the value of sage essence lies in the content and its chemical constituents(Kongjika, E., Zekaj, Zh., Çaushi, E. & Stamo, I. 2002; Lorraine, H. 2012), the experiment was set up to study the impact of lime on the morphological indicators, the productive indicators, chemical composition and the correlations between them. In this reference will be presented the data for morphological and productive indicators, chemical composition and correlations between them. There were been included four variants of study with doses of calcification: 0 quintals / ha, 40 q / ha, 80 q / ha and 120 q / ha. The lime is been spread on the soil before the last soil preparation process (milling).

Key words: *Sage, morphological indicators, yield, cultivation, condition, ecotype, herb.*

Introduction

Sage is highly influenced by the presence of $CaCO_3$ in the soil, as for the production, as well as to chemical composition and the content of the essence. Given the fact that the value of sage lies in the content of the essence and its constituents, the experiment was set up to study the impact of lime on the morphological and the production indicators, and the chemical composition of the sage essence. The study included four variants: 0 quintals / ha, 40 q / ha, 80 q / ha and 120 q / ha of ground and powder lime. The lime is been spread before last milling.

Material and methods

It includes four variants: 0 quintals / ha, 40 q / ha, 80 q / ha and 120 q / ha of ground powder lime. Variant size was 60 m2 (10m x 6m), by planting 10 rows for each variant, providing 330 plants / variant or 55,000 plants / ha. In the experiment are four variants, included in four repetitions, according to randomized block scheme.
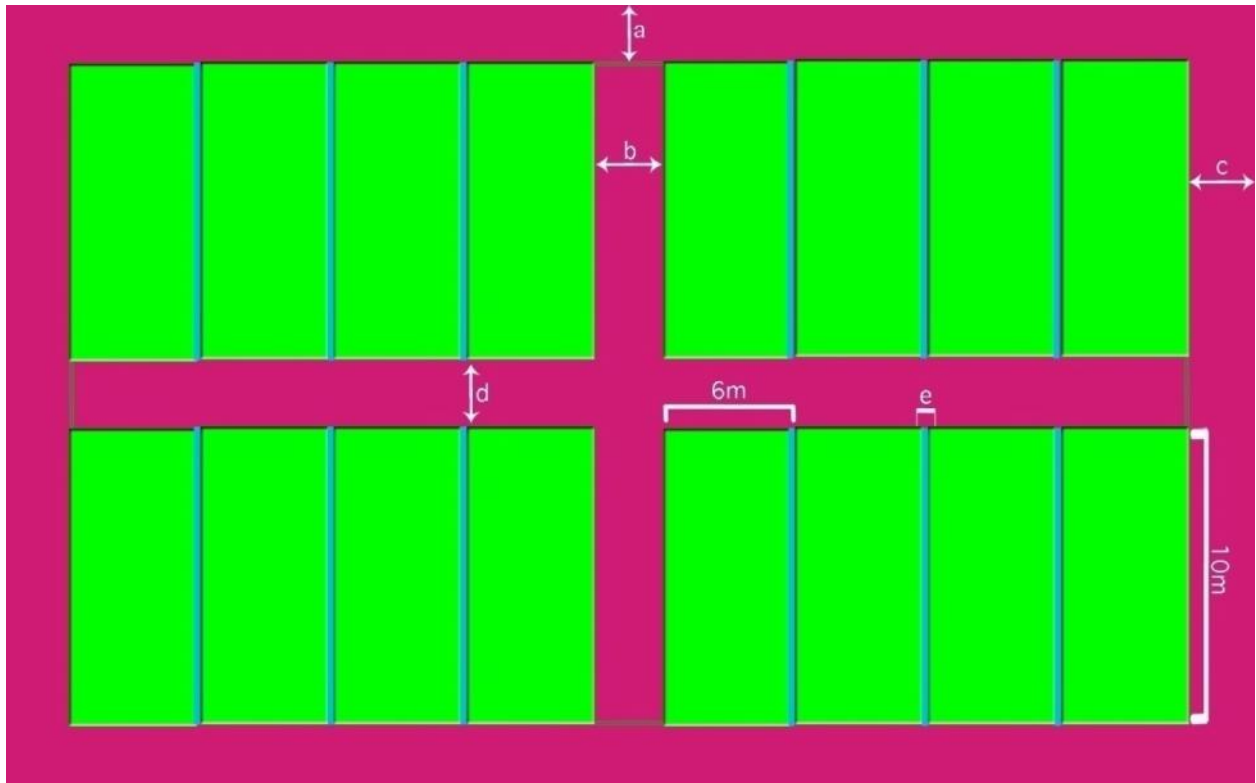
Scheme No.1 Setting up the experiment to study the impact of land calcification

Before the establishment of the experiment were made the soil analysis: water ph 6.95, salt pH 6.7, humus 2.2 %, nitrogen 0.14%, phosphorus 11.6 mg/100 g soil, potassium 13.27 mg/100 g soil, $CaCO_3$ 1.64 %. The lime is distributed before last milling. In the study are included ecotypes of Dibra region. Seedlings are produced in solar greenhouses, in Lushnja region. The planting in the field is made in 5 April 2010. In the first year is realized only one mowing, the first in 10 -12 September, and the second 5-10 September, while in the other three years were taken two mowing, the first in June 5 to 10 and the second in 5-10 September. 40 plants are selected (4 repeats of 10 plants each), in which the biometric measurements were made. During the vegetation and the production harvesting and the measurements and calculations were made for morphological and production indicators, as follows:

The number of shoots/plant
The height of plants
The length of shoots
The length of leaves
The width of leaves
The number of leaves/plant
The contain of shoots in herbs (%)

The yield of the first mowing
The yield of the second mowing
Annual productivity (first and second mowing)
The correlation coefficients between the indicators.
Measurements for the height of the plant (main stem), leaf length, leaf width, leaf length of the tail, the numbering of the shoots / stalks per plant and number of leaves per shoots were conducted in a representative sample of 20 plants selected in order random for each variant, in each repetition. These were labeled with stationary labels throughout the study period. The measured data were recorded, analyzed and the average value was calculated for each variant and four-year average.

Statistical analysis. The data obtained were analyzed using statistical analysis of variance, ANOVA, and differences between variants were tested using LSD test (0.05 and 0.01). (Papakroni, 2001)

Results and Discussion

Average data from four years of the study show that there are differences in morphological indicators statistically validated.

Table 1. The four-year average data of morphological indicators

| No | Calcification | Indicator | | | | |
		Number of shoots/plant	Plant height (cm)	Height of harvested shoots	Leaf length (cm)	Leaf width (cm)
1	0 q/ha lime	27.83125	76.875	10.1025	6.41625	1.8
2	40 q/ha lime	31.0	80.375	10.7125	7.33475 *	2.04375
3	80 q/ha lime	34.075	82.5	11.48625	7.4765**	2.25625 **
4	120 q/ha lime	36.675**	85.4375**	12.10625**	7.73625 **	2.50625
LSD 0.05*		1.342	1.671	0.452	0.316	0.0364
LSD 0.01**		1.827	2.103	0.437	0.473	0.0615

The number shoots for plant, plant height and length of shoots were harvested at higher levels in the fourth variant, ie dose of calcification 120 quintals / ha. Similarly, the width of the leaf is higher at this variant for both probability levels. The length of the leaf, almost isn't changed by change of the calcification dosage.
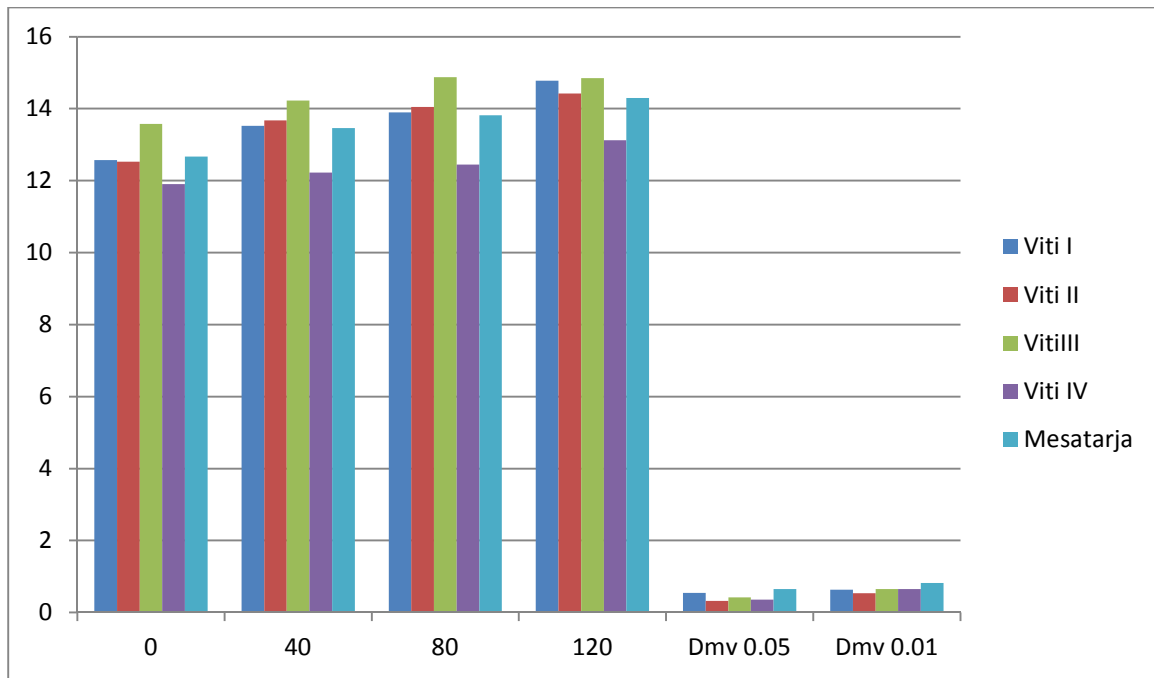
Figure 1. The impact of soil calcification in the number of leaves

The number of leaves per plant is the most important indicator that influences the quality of herb and the yield of sage. In the first year there is a high number of leaves in the fourth variant. Likewise, even during the second and third year, are been presented with the highest values of two last variants. The fourth year has the lowest value in all variants compared with the other years, and again the fourth variant has the higher values. The average of four years results that the variants with 80 and 100 q / ha lime show the impact of increasing doses of lime in the number of leaves.
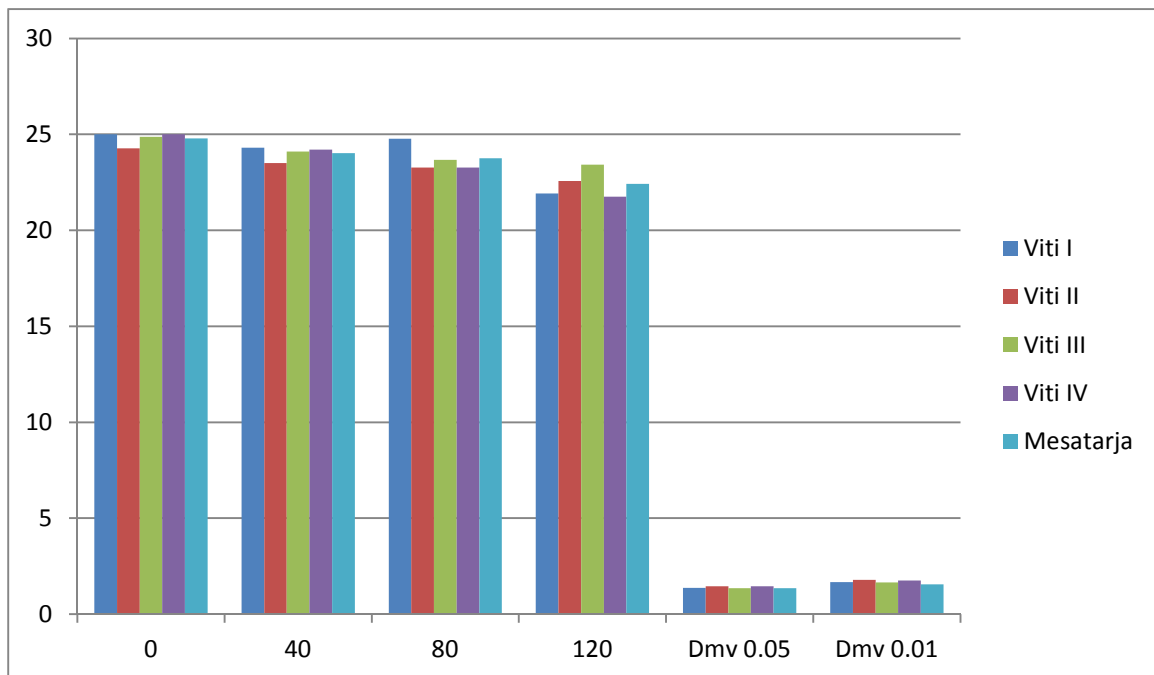
Figure 2. The impact of soil calcification on the content of stalks in the herb

The stalk content is the indicator that often is evaluated as in the technical aspect, but also in the commercial aspect that determines the quality coefficient after cleaning the herb. How to be lower this indicator, the better will be the herb. This indicator is depended on the technology of cultivation the way and time of the plant harvesting. In the first and fourth years, the values are lower because the plants are less developed, while in the second and third year, the values are higher because plants are more developed and especially, the stalks create the cellulose more and earlier. For four years (each separately), as well as four-year average, the variant with 120q/ha results in lower content of stalks, for both probability levels, and the variant 80 quintals / ha for one probability level.
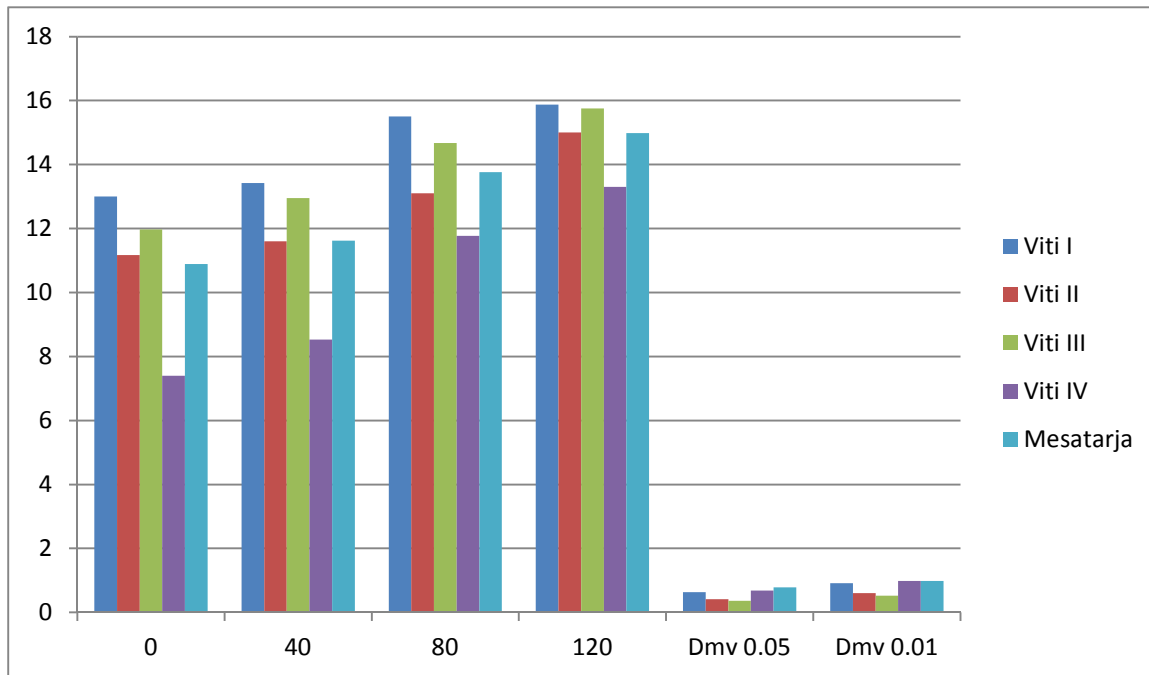

Figure 3. The impact of soil calcification in the sage yield. The first mowing

The herb yield for the first mowing is different during the years and between doses of soil calcification. In the first year, the highest yield is observed at two variants with the highest doses of soil calcification, for both probably levels. For the three other three years results the variants of 120 q/ha lime for both probably levels, but the fourth year, generally, has the lowest values, and the difference is greater in the lower doses of soil calcification. Clearly, this shows that the lime significantly affects in avoidance of the sage degradation. In the first variant without lime it is observed that the yield is lowered about 50%, and for other years gradually is decreased. In the fourth year, the yield is lowered only 8-10%. This is the reason why to soils with high content of lime, or lands with calcification, sage can live up to five years
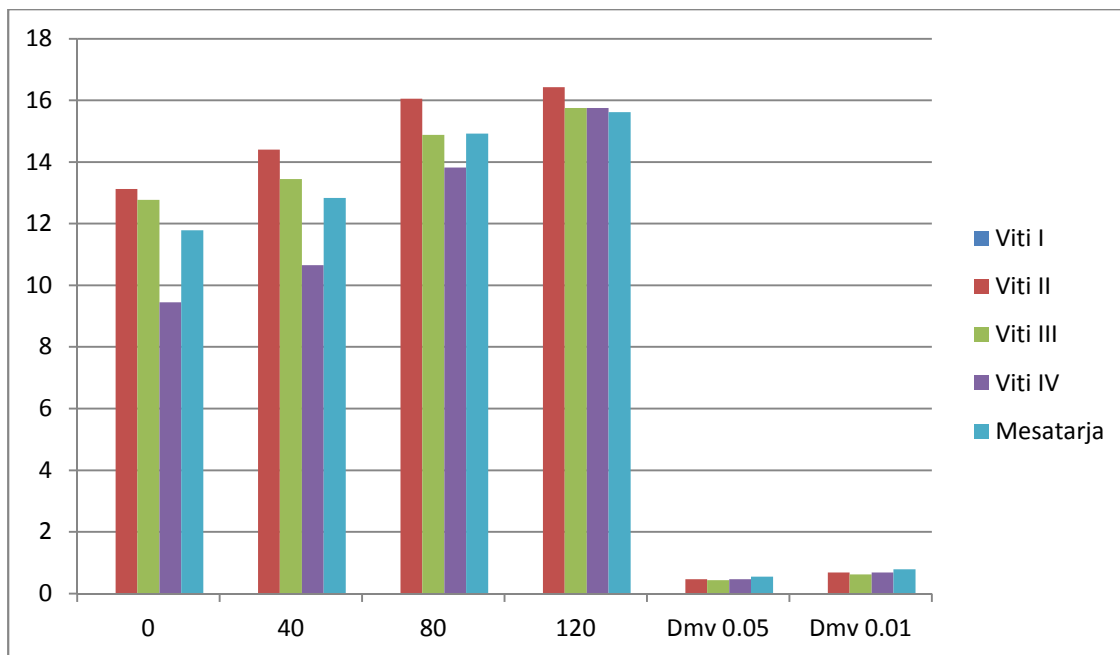
Figure 4. Impact of the soil calcification in the yield of sage. The second mowing

In the first year is harvested only one mowing which is usually taken later than the first mowing of the next years and earlier than the second mowing of the next years. This is done in order to the plant to winter with a fully formed bush and the shoots to form much buds. In the second year it is received a higher yield by the second mowing than in the next years. Actually, two variants with higher doses of calcification of the soil have the highest yield. In the third and the fourth years it is a close in performance, and the variant of 120 q/ha lime has given the higher productivity for both years. The average of four years show that the variant with 120 q / ha has given the highest yield for the two probably levels, and the variant with 80 q / ha only to one probably level.
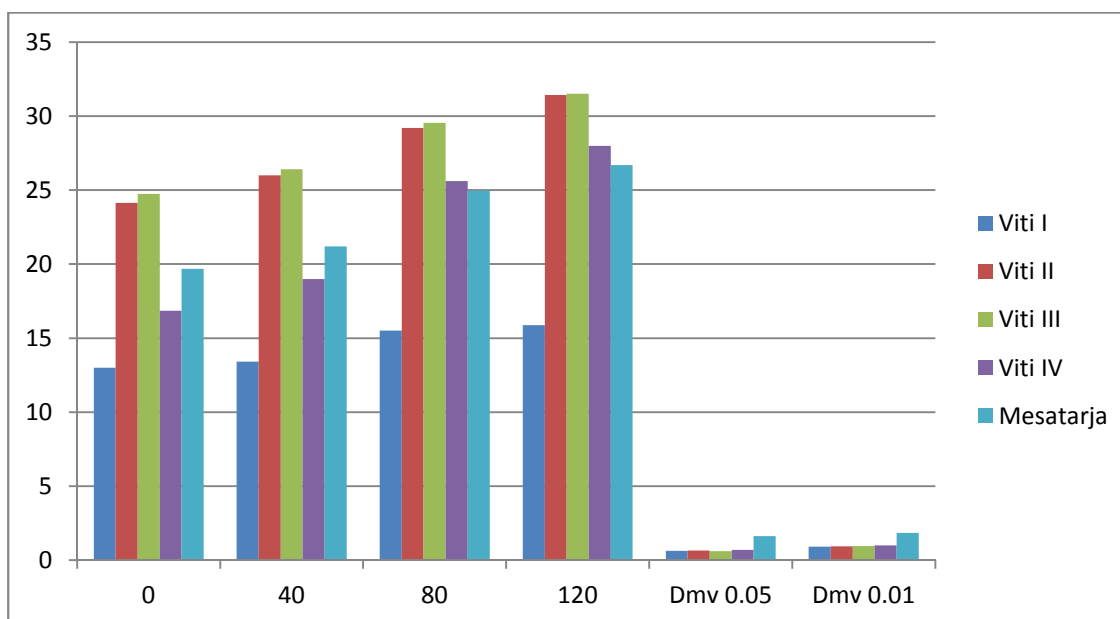

Figure 5. The impact of soil calcification in the sage yield. The mowing I+II

In the four-year cultivation of sage there are been achieved the high yields in the production of herb and its quality. By comparison of the data it is resulted that in the second, third and fourth year, the highest yields is achieved in the variant with 120 q / ha lime. From the four-year average is resulted that two variants with higher doses of the soil calcification, for both probably levels are the best. The performance over the years of the total yield of sage appear higher level in the second and third years, with over 30 quintals / ha, but in the fourth year is decreasing to 4 quintals / ha compared with the average of the second and third year. This is why, in many cases it is required that sage to be held in cultivation even in the fifth year, bringing failures to income because it often has significant reduction in productivity of the fifth year.

Table 2. The correlation coefficients between characteristics under the influence of soil calcification.

No.	The characteristics	The yield	Number of stalks	Height of plant	Number of leaves /plant	Leaf length	Leaf width
1	Yield	1					
2	Number of stalks	0.79	1				
3	Height of plant	0.68	0.58	1			
4	Number of leaves/plant	0.89	0.86	0.87	1		
5	Leaf length	0.71	0.75	0.85	0.92	1	
6	Leaf width	0.74	0.77	0.79	0.89	0.94	1

The analyzed indicators are linked between them and they influence in different scale in the performance of the sage. The number of shoots hasn't a strong connection with the yield (0.79), indicating that it does not appear decisive in the final yield of sage. The height of the plant represents a lower impact on the productivity of sage having a correlation coefficient not higher (0.68). The number of leaves / plant represents the main impact on the yield of sage. This indicator has a coefficient very high (0.89), so the highest coefficient of the other indicators. From this viewpoint, this is the factor that determines fully the yield and the quality of sage. Two other indicators of leaf, length and width, don't present a strong connection with the yield, affecting comparatively better in the herb yield.

Conclusions

The impact of soil calcification is high and statistically proven to morphological and productive indicators of sage. Between the morphological and productive indicators of sage there are strong qualitative relations. Based on the results obtained from this study, we may recommend the soil calcification with 80 and 120 q / ha lime. Meanwhile, it results that the soil calcification has affected the growth of productive lifetime of sage

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DISTRIBUTION MAPPING OF JAPANESE KNOTWEED (*Fallopia Japonica* (Hout.) Ronse Decre.) IN NORTH WESTERN AREA OF REPUBLIC OF SRPSKA

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Abstract

One of the most invasive plant species in Europe, Japanese knotweed is also broadly regarded as one of the top one hundred invasive species of global concern. Considering factors such as climatic and soil conditions, Republic of Srpska is definitely one of the area for potential distribution of japanese knotweed. In this sense main goal of this study was to carry out distribution mapping of Japanese knotweed in north western part of Republic of Srpska (RS). Distribution and abundance parameters were done for 15 Fallopia stands based on Blanque Braun (1964) method and GIS software. A wide-spread distribituion reveal a high spreading and renewal potential of the species which turns it into a real threat to infrastructure, native flora and wildlife habitats, watercourses etc. By current research in the north western part of RS japanese knotweed is in significant expansion, resulting in negative ecological, economic and social impact. Regarding to those research priorization process for mentonied area on local level is of a great importance.

Key words: *Japanese knotweed, distribution, mapping, Republic of Srpska*

Introduction

Japanese knotweed is naturalised in many European countries (Sukopp and Sukopp, 1988), up to at least 68 degrees N latitude (Jalas and Suominen, 1979), and also in south European countries like Croatia, Macedonia, and Bosnia and Herzegovina (Trinajstic, 1990) (photo 1, http://www.cabi.org/isc/datasheet/23875). Also known as *Polygonum cuspidatum* or *Reynoutria japonica*, Japanese knotweed is a clonal, herbaceous, fast-growing perennial plant (Aguilera *et al*., 2010). Knotweeds are native to eastern Asia (Japan, Korea, northern China and Taiwan) (Pysek, 2006) whence they were introduced in the Unites States in the 1877s for ornamental purposes (Aguilera *et al*., 2010) and in Europe, starting with the Netherlands in 1823 followed by Germany in 1872, Poland in 1882, United Kingdom in 1886, Norway in 1901 etc. (Alberternst and Böhmer, 2006), thus becoming the most widespread and troublesome alien species on both continents (Weber 2003 cited by Barney, 2006). The species is broadly regarded as one of the most invasive plant species in Europe, also listed by the World Conservation Union and FP6-DAISIE project as one of the top one hundred invasive species of global concern (Lowe *et al*., 2000 cited by Kabat *et al*., 2006; DAISIE, 2005-2008; Lambdon *et al*., 2008).
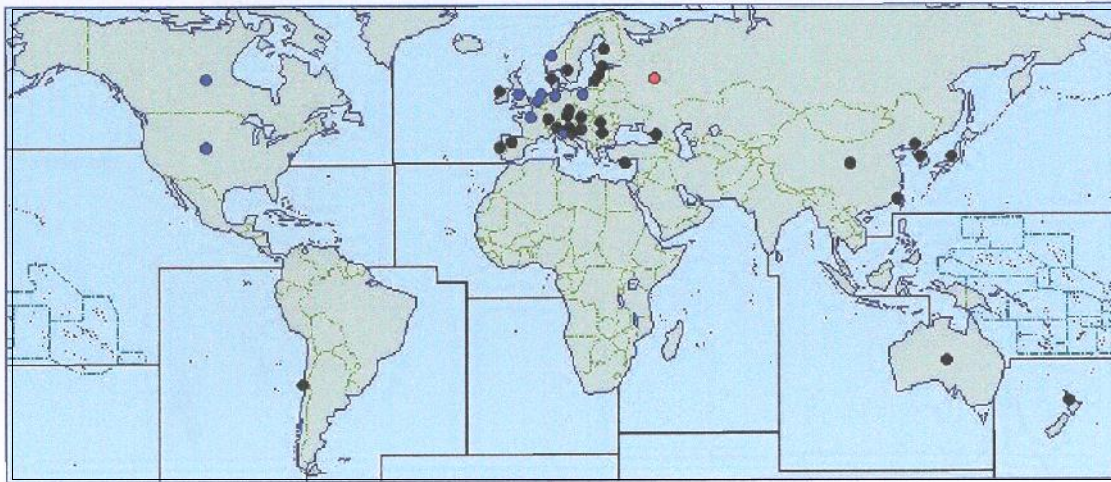
Photo 1. Naturalised distribution of Japanese knotweed: ●= Present, no further details; ●= Widespread; ●= Localised; ●=Confined and subject to quarantine; ●= Occasional or few reports; ● = Evidence of pathogen; ●= Last reported; ●= Presence unconfirmed; ●= See regional map for distribution within the country (source http://www.cabi.org/isc/datasheet/23875)

Hence biological invasions are considered one of the key components of global change (Arim *et al*., 2006) with significant impacts on populations, communities, and even ecosystems (Bailey *et al*., 2007), in RS among the spreading invasive plant species, *F. japonica* is one of the leading threats to biodiversity, natural habitats and their surrounding areas.

Considering factors such as climatic and soil conditions, RS is definitely one of the area for potential distribution japanese knotweed not only because it is generaly a temperature species (Maruta, 1983) but also because it grows on various terrains and soil type (Locandro, 1973), most of wich are present in RS (photo 2).
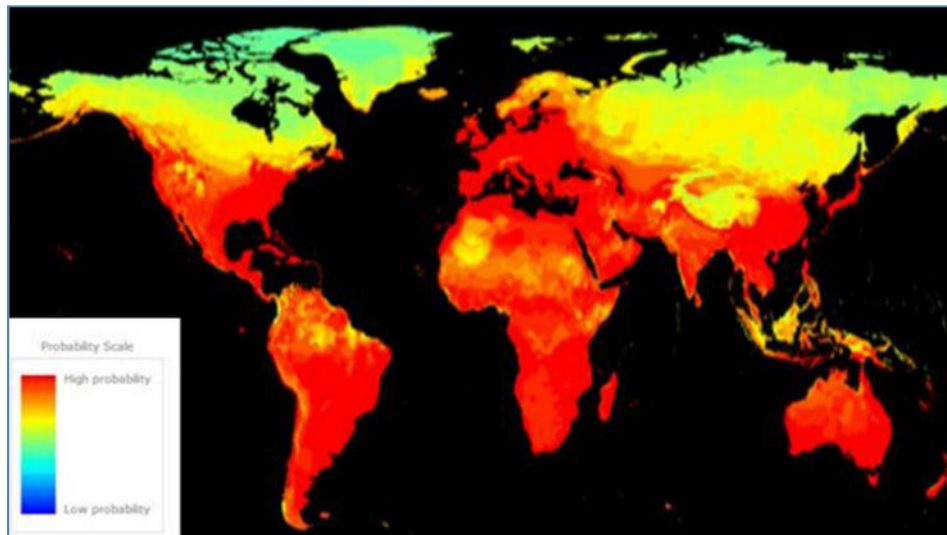

Photo 2. Area of potential distribution of *F. japonica*, considering factors such as climatic and soil conditions

Spreading potential, aggressiveness and invasiveness of Japanese knotweed, as well as all facts mentonied above were the background to the main goal of this study which was to carry out distribution mapping of Japanese knotweed in north western part of RS with priorization process for mentonied area.

Material and method

The current research mainly focuses on the north western part of RS in relation to species habitat requirements and main environmental features. Field survey was conducted during the vegetation period (May to September) 2013. Assessment of the occurrence and distribution of Japanese knotweed were taken along the roads in the urban areas, between the settlements in ruderal and less arable land, and on the edges of farmland, along the river Sava, in ditches and on the edges of forests. Quantitative distribution, study species density measure was assessed based on Blanque Braun (1964) method. During fieldwork Fallopia stands were mapped and recorded with GPS, while polygons were digitized using GIS software. All stands have been assigned to size classes (0-10m^2; 10-100m^2; 100-1000m^2; 1000-10000m^2; >10000m^2).

Species habitat requirements and main environmental features

The Japanese knotweed can usually tolerate a wide variety of environmental conditions ranging from high shade, high temperatures (even drought) to high salinity. In its native range, Japanese knotweed is a pioneer species on volcanic slopes and as invasive it invades disturbed habitats, tolerating a variety of soil structures and textures and pH levels, ranging from 3 to 8 (Pysek, 2006). It frequently occurs in riparian habitats (e.g. along river banks), but because of its invasive nature it also tolerates disturbed habitats, such as railroad tracks and roadsides (Forman and Kesseli, 2003). Other studies undertaken on *F. japonica* also revealed its preference for: boundary walls in farmlands, urban non-industrial land, ruderal habitats, meadows, natural/semi-natural forests, roadways etc. (Tiébré *et al*., 2008). The species usually installs in open places, its growth and abundance being seriously affected by shading. The rhizomes are very resistant to low temperatures, thus permitting its survival in harsh climatic conditions (up to absolute minimum temperature of -30.2° C) (Barney *et al*., 2006).

Results and discussion

A wide-spread distribituion of invasive weed species Japanese knotweed was observed in the number of municipality of Republic of Srpska, specialy in the urban parts of Banja Luka, Prnjavor, Gradiška, Srbac and Derventa but as well between the above mentioned municipalities along the roads in populated areas, between settlements in ruderal and less arable land, and on the edges of farmland, along the river Sava in the trenches and on the edges of forests (photo 3,4,5,6).

Photo 3. *F. japonica* between Srbac and Derventa - monodominant

Photo 4. *F. japonica* in orchard near reaver Sava community

Photo 5. *F. japonica* in urban area of Derventa   Photo 6. *F. japonica* around arable land

The abundance, estimated based on the number of steams, points to a high density of individuals on sq.m, e.g. up to 50 steams/sq.m. in the Sava river flood plain as well between Srbac and Derventa along the roads in populated areas, in ruderal and less arable land, on the edges of farmland, and on the edges of forests. It is widely recognized that this species forms dense patches, significantly reducing the diversity of native species, shading up other plants and slowing nutrient cycling (Barney *et al*., 2006). Also this invasive weed species causes flood hazards (Edward and Howel, 1989) inceasing the risk of river bank erosion, while its rhizomes can displace foundations, walls, pavements and drainage works (Lucandra, 1973; Beerling, 1991). Topsolil mineral contet is significantaly greater under *F. japonica* stands than under native vegetation, especially K and Mn content (Vanderhoeven *et al*., 2005).

Only in the north western part of RS was recorded 15 Japanese knotweed stand with covering area of 30.624,23 m^2. Two polygons less than 100 m^2 were recorded in urban part of Banja Luka, six polygons (100-1000 m^2) were recorded betwen Srbac and Derventa, as well as seven polygons (1000-10.000 m^2) (Photo 7_{1-15}).

Photo 7_{1-15}. 15 Fallopia stand in the north western part of Republic of Srpska: 7_1-$_{14}$ - Areas between Srbac and Derventa polygons less than 1000 m2 and from 1000-10.000 m^2; 7_{15} Urban part of Banja Luka polygons less than 100 m^2.

Conclusion

With a great impact potential, Japanese knotweed is preventing the growth and development of other plant species forming large monodominatne community which directly and adversely affect natural habitats, threating to open and riparian areas and dramatically reduces species diversity.

In the north western part of Republic of Srpska Japanese knotweed stand occurs in wet grassy lowland areas but is also found on hillsides, sunny sites in coastal areas, wetlands and riparian areas, but predominantly it is found near human settlement, along river banks and in waste areas.

Considering the current research in the north western part of Republic of Srpska japanese knotweed is in significant expansion, resulting in negative ecological, economic and social impact. Regarding to those research priorization process for mentonied area on local level is of a great importance. Under the given circumstances, undertaking comprehensive studies on the species characteristics and distribution potential on one hand and developing eradication and control methods, on the other are highly recommended.

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DETERMINATION OF TOTAL PHENOLS IN SOME SPICES IN DIFFERENT PACKAGING

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Abstract

In this study total phenol content of some spices was determined. Determination was performed on nine different samples of spices, such as: rosemary, pepper, garlic, oregano, basil, clove, dill, cinnamon and parsley. Analyses were conducted on spices in two different packages: glass bottles and laminated paper bags with metal film. The total phenols (TP) content was determined spectrophotemetrically using a method which is based on colour reaction of phenol with Folin-Ciocalteu reagent at 760 nm. The obtained data shows that highest total phenols content expressed as Gallic acid Equivalents (GAE) in spices in laminated bags, was found in oregano (457.05±0.23), and the lowest content was in garlic 19.80±4.42 mg GAE/g of DW. Total phenols content in spices packed in glass bottles was found for oregano (333.80±0.53) and 26.20±1,37mg GAE/g of DW (for garlic). It can be concluded that most of tested spices showed higher total phenol content in laminated bags than those in glass bottles.

Key words: *Spices, total phenol content, glass bottles, laminated bags*

Introduction

Spices and herbs have been researched for their antioxidant properties for reason that they have a variety of antiooxidative effects and properties (Shobana and Naidu, 2000; Zheng and Wang, 2001). Spices like vegetables, fruits and medicinal herbs, are known to have different phenolic compounds. Phenolic compounds in these plant material are closely associated with their antioxidant activity. It is known that these compounds play an important role in inhibition of oxidizing enzymes and stabilization of lipid peroxidation (Laughton et al., 1991). The antioxidant activity of phenols is mainly due the to their redox properties, which allow them to act as reducing agents, donor of hydrogen and quenching of singlet oxygen. After all, they also have a metal-chelation potential (Rice-Evans et al., 1995). These multiple potential mechanisms of antioxidant activity make different group of phenolic compounds an interesting target in the search for health-beneficial bioactive compounds and also offer a possibility to use phenolic compounds or pextracts rich with them, to extend shelf life of lipid rich foods. (Yanishlieva et al., 2001).

Many studies indicated that sage, oregano, rosemary, and thyme show high antioxidant activity (Cuvelier et al., 1994; Zheng and Wang, 2001; Pizzale et al., 2002).

Spices are known to significantly contribute to the aroma, taste, and medicinal properties of food. They are aromatic and pungent food ingredients and may be added to foods in several forms: as whole spices, as grounded spices, or as isolated from their extracts (Suhaj, 2006).

The objective of this study was to determine and compare total phenol content in nine different spices depending on different packaging (laminated bags and glass bottles).

Materials and methods

Materials

Samples of spices, such as: rosemary (*Rosmarinus officinalis)*, pepper (*Piper nigrum L),* garlic (*Allium sativum L*), oregano (*Origanum vulgare*), basil (*Ocimum basilicum L*), clove (*Syzygium aromaticum*), dill (*Anethum graveolens*), cinnamon (*Cinnamomum zeylanicum*) and parsley (*Petroselinum crispum*), were collected and purchased from local supermarkets. Spices were packaged in different packaging material: laminated bags (9) and glass bottles (9). Samples were stored in dry, dark and cool places before analysis.

Sample preparation

Spice samples were homogenized in fine powder and about 1 g of the powder was extracted with 40 ml of hot distilled water at 90-95°C for 15 min using reflux. The resulting extract was filtered into a volumetric flask of 50 ml ,with the addition of distilled water to the mark.

Determination of total phenols content

The total phenols content was measured using the Folin Ciocalteu reagens (FC), by a method based on colored reaction of phenols with FC (Ough and Amerine,1998), with slight modification. 250µl of extract and 1,25 ml dillution of Folin Ciocalteu reagents (diluted with distilled water in ratio 1:4) was added in a volumetrick flask (25 ml). After five minutes 3,75 ml of saturated solution of Na_2CO_3 was added, and distilled water was poured to the mark. After that the resulting mixture was incubated at 50°C for 20 min. In the same way the blank was prepared, and distilled water was used instead of the extract. The absorbance of resulting blue color was measured at 760 nm (Shimadzu 2200 UV-VIS spectrophotometer). Quantification was done with respect to the standard curve of gallic acid (300 mg/L). The results were expressed as gallic acid equivalents (GAE) miligram per g of dry weight (DW). All measurements were performed in triplicate.

Statistical analysis

All data were evaluated statistically in excel by one–way analysis of variance (ANOVA).

Results and discussion

The total phenols content of some spices purchased from local supermarkets from Sarajevo Canton were analysed and statistically evaluated. The summarised results of analysis of spices are presented by figures 1 and 2.
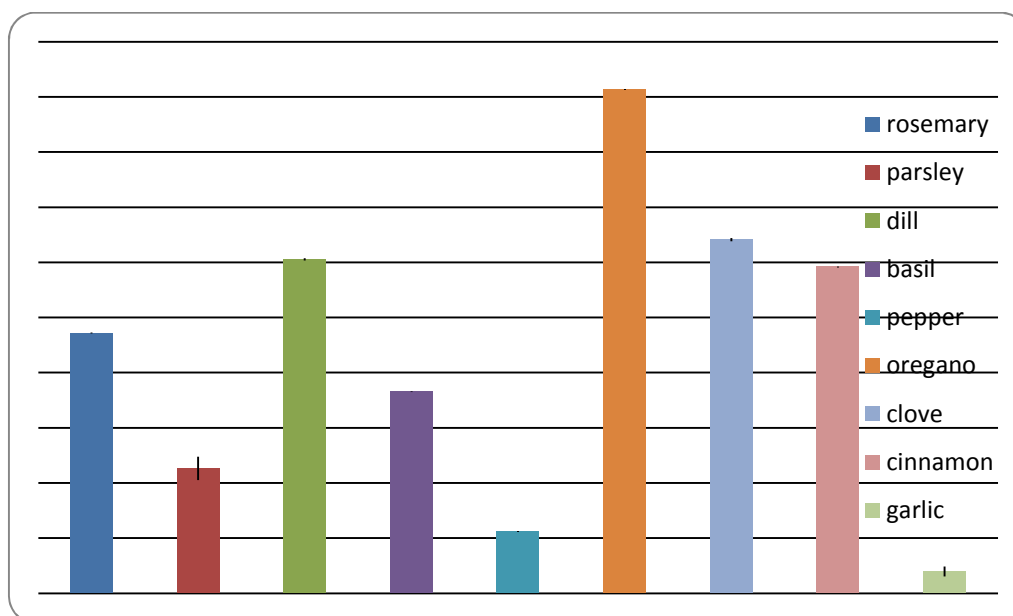

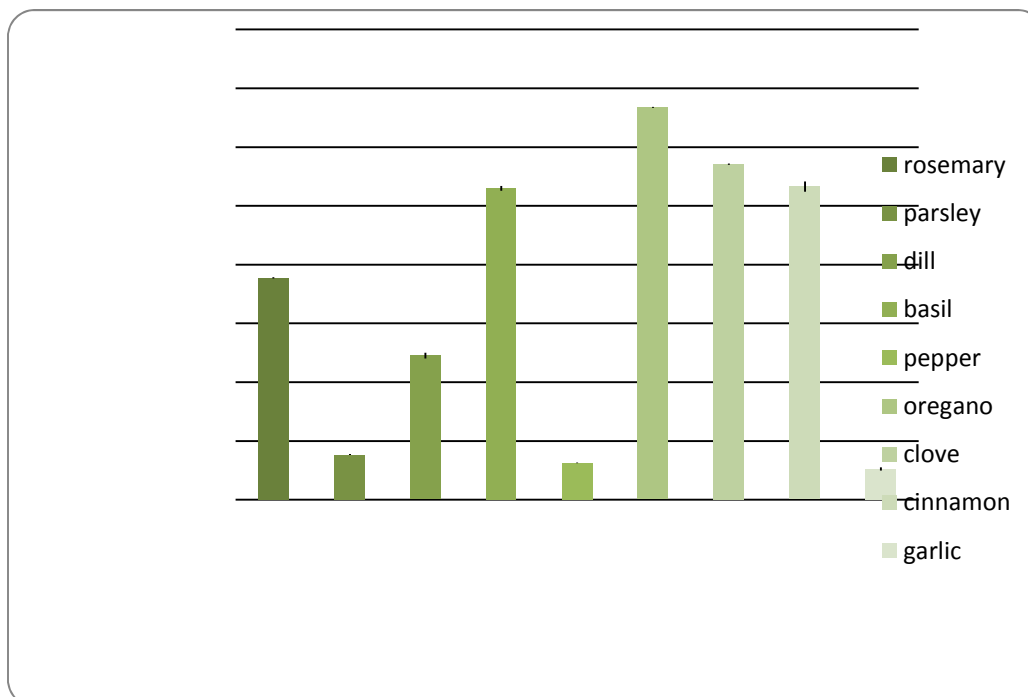Figure1: The total phenols content in spices in laminated bags (mean ± st.dev).

Figure 2: The total phenols content in spices in glass bottles (mean ± st.dev).

The analysis of total phenols content of nine spices in different packaging showed higher values for oregano for the both of packaging. Our results showed that the amount of total phenols in spice samples varied widely and they are ranged from 19.8 – 457.05 mgGAE/g dry material (Fig1-2).

Statistical analysis of variance (ANOVA) showed that TP content in investigated spices were statistically different according to different packaging, ($p<0.001$) for oregano, rosemary, dill, clove and pepper; for the cinnamon significance was ($p<0.05$), and for the basil and garlic there was no significant difference.

In our study the TP content for rosemary was 235,90±0.51 (laminated bags) and in glass packaging was 188.85±0.5 mgGAE/g. Our results are in range found by Ünveret al., (2009). They found that TP content in methanolic extract of rosemary, expressed as 214.21±1.14[c] mgGAE/g. Our results are higher than TP content in methanolic extract for rosemary 5.070±0,036 gGAE/100g, which presented by Shan et al., (2005).

The values of TP for parsley were higher in laminated bags (113.20±10.51) than in glass bottles 38.25±0.13 mgGAE/g. Shan et al., (2005) found that TP content in methanolic extract of parsley was 0.97±0.002 gGAE/100g. Also, for dill values of TP were higher more than twice in laminated bags (302.65±0.96), than in glass bottles 122±2.44 mgGAE/g. Shan et al., (2005) found 0.98±0.002 gGAE/100g for TP content for dill methanolic extract.

The obtained data for basil showed that TP content for basil were (182.75±0.33) for laminated bags and higher in glass bottles, 265±2.07 mgGAE/g. Values of TP methanolic extract of basil got lower 3.64 ± 0.014 gGAE/100g by Shan et al., (2005).

Our results showed that the of pepper level of TP was ranged from 31.35 (glass bottles) to 56.15 mgGAE/g in laminated bags. Shan et al., (2005) reported that TP content of black pepper methanolic extract was 0.3±0.002 gGAE/100g.

The results obtained for oregano were higher from the other analysed spices in both of packaging: 457.05±0.23 (laminated bags) and 333.8±0.53 mgGAE/g for this spice in glass bottles. Ünveret al., (2009) reported that TP content oregano methanolic extract was

420.51±2.44[f] mgGAE/g. Shan et al., (2005) found lower values for oregano TP content in methanolic extract (10.17 ±0.01 gGAE/100g), than our values.

The TP content in clove was 320.55±1.50 (laminated bags) and 285±0.55 mgGAE/g for clove in glass bottle. Bamdad, et al., (2006) reported that total phenol content of caraway and clove extracts determined by the Folin-Ciocalteu method, were 13.76 and 243.91 mg /g dry matter respectively, expressed as tannic acid equivalents. Medhat and El-Sayed (2013) showed that total phenol content of acetone, ethanol and water clove extracts was (31.88, 10.06, 28.7 mg GAE/100g respectively).

The obtained results in our study for cinnamon for TP content showed 295.75±0.33 in laminated bags and 266.40±4.37 mgGAE/g in glass bottle. Monica Gallo et al., (2010) reported that TP content for cinnamon obtained by microwave assisted extraction (MAE) was 1679.201±65.33 mgGAE/100g in ethanol/water extracts (50:50 v.v) at 50°C for 18 min.

Of all the tested spices in our study, garlic had the lowest content of TP and 19.80±4.42 in laminated bags and 26.20±11.37 mgGAE/g in glass bottles (Fig. 3).
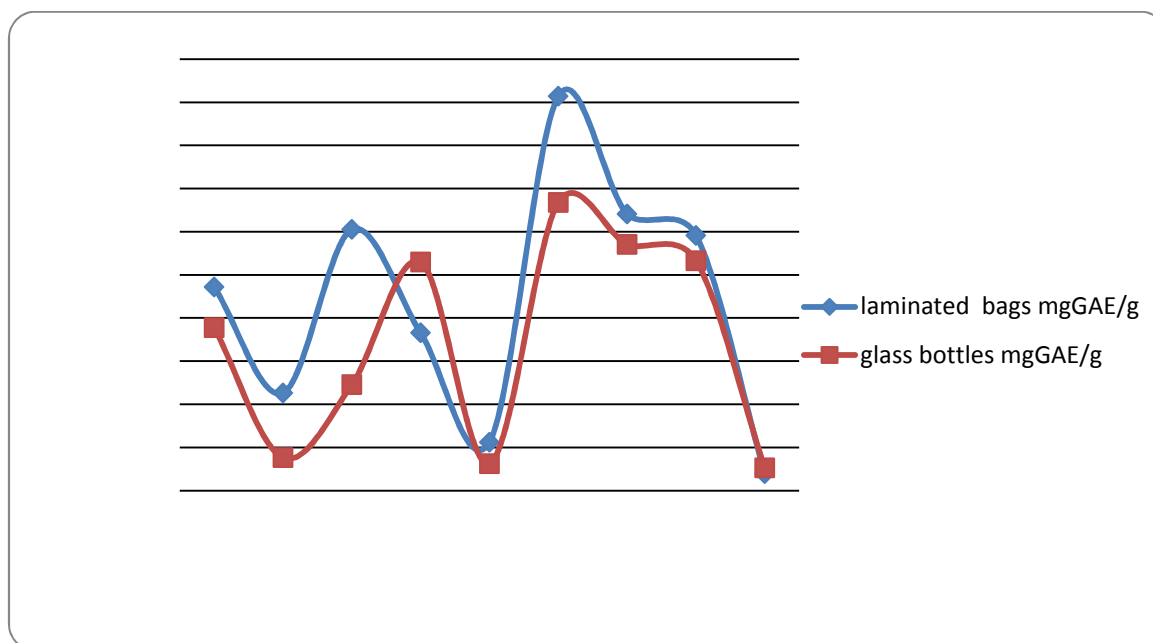

Figure 3: Comparison the total phenols content in both of packing of spices

Conclusions

In this study two different packing of nine spices were analysed and compared. The analysis of mentioned spices showed that greatest content of total phenols in both of packing were obtained for oregano and smallest for garlic. It can be concluded, that laminated bags packing of spices had higher values of TP (for oregano, rosemary, dill, clove and pepper) than these spices in glass bottles.

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PESTICIDES AS POLLUTANTS OF ENVIRONMENT AND USE OF BOTANICALS AS AN ALTERNATE MANAGEMENT STRATEGY

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Abstract

Pesticides are intended for preventing, destroying or controlling any pest. They are unable to discriminate between the harmful and non-harmful or useful species and therefore pose severe adverse effects. Pesticide residues in food, water, soil and fodder have been resulting in poisoning of wild-life and livestock, environmental pollution and therefore ecological imbalance. It is high time we think for some alternates for the management of insects. The present paper throws light on the impact of pesticides/insecticides on human and animal life and suggests some alternate management strategies major being the use of botanicals especially against an insect pest of stored pulses, *Callosobruchus chinensis* Linn. (Coleoptera: Bruchidae). Plants belonging to several families were screened by employing different formulations of various plant parts of varied concentrations and documenting the mortality of the test insect. It could be concluded from the study that most of the plants screened during the present study have a potential to be used against the pest *C. chinensis* and can prove to be an alternative, cheap, eco-friendly, and non-hazardous substitute as against chemical insecticides in household and storehouses to minimize the infestation and damage caused by the bruchid.

Key words: *Pesticides, Callosobruchus chinensis, botanicals, extracts, concentrations, mortality*

Introduction

Pesticides are intended for preventing, destroying or controlling any pest but their residues in food, water, soil and fodder have been resulting in poisoning of wild-life and livestock, environmental pollution and therefore ecological imbalance. Globally, hundreds of insects face the threat of eventual extinction, two major reasons for the many threatened and endangered species of animals especially insects internationally include shrinking habitats and increased use of pesticides and other chemicals. It is high time we think for some alternates for the management of insects. Application of different cultivation practices, use of resistant varieties, use of natural enemies, predators and pathogens, **use of bio-pesticides**, application of sterility methods, use of insect sex attractants, pheromones and use of chemical alternatives to pesticide and above all educating farmers can help reduce the risks. Our laboratory, therefore, undertook work on screening of certain plants for their insecticidal efficacy against the stored grain pulse *Callosobruchus chinensis*. Plants possess secondary metabolites, which can be an effective source of insecticides and can be considered to be safe to no-target populations, biodegradable and eco-friendly, safe in handling, cost effective and easily available. Plants belonging to families Zygophyllaceae (*Peganum harmala*, *Fagonia cretica*, *Tribulus terrestris*); Leguminoseae/ Fabacae (*Tephrosia purpurea*, *Trigonella foenum graecum*, *Crotolaria burhia*, *Prosopis cineraria*, *P. juliflora*); Solanaceae (*Solanum surratense*, *S. nigrum*, *Withania somnifera*); Lamiaceae (*Mentha spicata*, *Ocimum sanctum, O. Basilicum*); Euphorbiaceae (*Euphorbia hirta, Jatropha gossiipifolia*,

Phyllanthus amarus) have been screened and of Rutaceae (*Aegle marmelos, Limonia acidissima, Murraya koenigii*) are being screened in our Laboratory of Entomology for their efficacy.

Methodology

The test insect selected for the study was *Callosobruchus chinensis* Linn. A pure line culture was raised on seeds of green gram *Vigna radiata* Linn. at 28 ± 2^0C temperature and 70% relative humidity. The plant material used in the study was collected from Bikaner city and its vicinity (situated between 27^011' & 20^003' North latitude and 71^054' & 74^012' East longitude). Different parts viz., root/ stem/ bark/ leaves/ fruits were separated to prepare formulations. These were employed in the form of crude extract/ aqueous suspension/ aq. extract/ ether extract/ methanol extract/ ethanol extract at dose concentration ranging from 1.0/ 2.5/ 5 /10 / 25/ 50 % along with normal (no treatment) and control sets(treated with solvent), for comparisons. The aspect studied was adult mortality (per cent).

Results and discussion

Some salient findings based on significance level ($p<0.05$), 70% adult mortality was noted in sets treated by 10 % aqueous and ether extract of leaves of *P. juliflora*; more than 70% adult mortality by formulations of *T. purpurea* and 10% aqueous extract of pods of *C. burhia*; 80% adult mortality in sets treated with 10% ether extract and aqueous suspension of fruits of *S. surattense*; 85% by formulations of 10% ether extract of fruit of *P. harmala*; 100% adult mortality by 25% and 50% ethanol extract of leaf of *M. spicata* and also by 25 % crude extract of leaves of *P. amarus* was documented.

Earlier various plants belonging to different plant families have been suggested to possess insecticidal properties by various workers from time to time. Ofuya & Osadahun (2005) observed 100% mortality of *C. maculatus* when treated with powder from dry flower buds of *E. aromatica*. Roots of *T. minuta* were found to be more effective against *Z. subfasciatus* than flowers and leaves as observed by Weaver et al. (1994). Complete adult mortality of *C. maculatus* was also documented by Okonkwo & Okoye (1992) when treated with dried ground leaves *R. communis*. The present findings are also in conformation with the reports of Juneja & Patel (1994) who observed 100% adult mortality of *C. analis* after three days of treatments with various plant/products including leaves of mint. Other plants belonging to various families have also been screened by various workers and have been reported to be effective against different insects. These include the works of Worseley (1934), who suggested *Tephrosia vogellii* to possess insecticidal properties, Brindley et al. (1940), who found *Derris* to be effective against insects, rotenone has been reported to be effective by Huckett (1941), Rainwater & Bondey (1941), Richardson & Sciefeale (1941), Takai & Myajama (1941), Watkins (1941) and many others and these support the present observations.

Grainge et al. (1984) reported leaves of *Euphorbia splendens* and *E. poinsettiana* to possess antifeedant activity against several insect pests. The leaves and stem of four species of *Euphorbia* viz., *E. nivulia*, *E. pulcherrima*, *E. antiquoroum* and *E. tirucalli* were employed in the form of alcoholic extracts at different dose concentration against *Plutella xylostella* by Uma et al. (2009). All these reports give support to the investigations carried out during the present study. Aiyelaagbe & Gloer (2008) isolated many compounds including flavanoids, steroids, alkaloids and diterpenoids from *Jatropha podagrica*. The chemical class of diterpenes has been reported to have insecticidal activity as suggested by Medina et al. (2003), Breuer et al. (2003) and Akhtar & Isman (2004). Herota et al. (1988) reported the most important toxic compound in extracts of *J. curcas* likely to be the phorbol esters which are enriched as hydrobiomolecules by methanol extractions. According to Castagna et al.

(1982) phorbol esters are known to directly activate protein kinase-C (PKC). This key enzyme of signaling cascades plays a critical role in mainting the integretity of insect surface. Activation of PKC by phorbol esters may lead to phosphorylation of differents proteins and consequent organisation of the cell cytoskeleton as suggested by Bershadsky et al. (1990). PKC also regulates the activity of ion channels, which may lead to vesicle formation on pest surface (Xiao et al., 1984) or with a pore-forming toxin in extracts of *J. curcas* induces osmolaric instability, surface vasiculation and subsequent death of the pest. The solvent extracts could have hydrophilic components such as saponins, curcin, phytates and protease inhibitors as suggested by (Morgue et al., 1961; Stirpe, 1976). Arvinda (2009) suggested reason for the death of the insect to be due to the effect of toxic proteins in the extracts, which are ribosome-inactivating proteins. Earlier Hostettmann et al. (1982) have reported saponins to possess pesticidal properties. This could be true for the present investigations also.

Asmanizar et al. (2012) conducted a laboratory study to test the bioactivity of *J. curcas* and *Anona murieata* seed crude extract against *Sitophilus zeamais* and reported them to have contact and stomach poison activity. They further found the weevil mortality to range from 70-100% and suggested the potential of these extracts against the said pest. The present findings are in conformation with those of Stein & Klingauf (1990) who also suggested that ethanol extracts of *O. sanctum* were 60–100% effective as botanical insecticide against *M. persicae*, while, Pascual–Villalobos (1998) found polar extract of *M. longifolia* to produce 70–100% mortality when applied topically. Al Lawati et al. (2002) recorded 100% mortality of *C. chinensis* when treated with methanol and ethanol extracts within 20 and 4h of their exposure suggesting quick knockdown by ethanol. Mukherjee & Ramgovind (1954) suggested that ether extract, as contact poison was 0.8 times more toxic than petroleum ether extract and 0.9 times more toxic than alcoholic extract. Bhaduri et al. (1985) found *Tridax procumbens* extracted in petroleum ether to be most effective against pulse beetle and Teotia & Tiwari (1977), Pandey et al. (1980), Jilani & Su (1983), also reported petroleum ether extract to be more toxic, while Abdallah et al. (1988) observed ethanol extract and hexane extract to exhibit higher toxicity. Ahmed et al. (1991) using ethanol, acetone and ether solvents observed 66.66, 76.66 and 76.66% mortality respectively of insect *Ateva fabriciella* suggesting that solvents play a major role in the extraction of principal insecticidal constituents from the plant material which seems to be true for the present work also.

Earlier Pareek & Bhatta (1998) also observed highest mortality of *C. partellus* when treated with extract of various plant products at 10% concentrations. Similarly, Singh et al. (1998) also reported plant extracts of 10% concentration to be superior over others, a low dose concentration 0.2–0.5% was observed to cause mortality of *H. vigintioctopunctata*.

Conclusion

It could be concluded from the study that the plants screened have a potential to be used against the pest *C. chinensis* and can prove to be an alternative, cheap, eco-friendly, and non-hazardous substitute as against chemical insecticides in household and storehouses to minimize the infestation and damage caused by the bruchid.

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ALEUROCANTHUS SPINIFERUS (QUAINTANCE) (HEMIPTERA ALEYRODIDAE) IS SPREADING THROUGHOUT THE ITALIAN REGION APULIA

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Abstract

The recent introduction of orange spiny whitefly (OSW), *Aleurocanthus spiniferus* (Quaintance) (Hemiptera Aleyrodidae), in Italy is a new challenge for whoever is involved in citrus producing chain activity. *A.spiniferus* is a polyphagous insect, reported to infest 90 plant species of 38 plant families and it is considered as one of the most destructive Citrus whiteflies worldwide. It causes a general weakening of the infested trees due to sap loss and sooty mould blackening. In Italy, *A. spiniferus* diffusion from its primary detection sites has been monitored, with a special focus on population density and eventual new host plant species. Up to the end of 2012, the pest was found in Lecce district only; but more recently (till April 2014) it has been collected in both Taranto and Bari districts. These findings are isolated from the original infested areas in Italy and far northern from them. Moreover, these recent collections demonstrate the OSW ability to overwinter in the new northern territories. It is suggested that the whitefly was passively dispersed on traded plants and/or leaves–decorated marketed fruits. These findings alert about a possible further northern spread of *A. spiniferus*.

Key words: *Orange spiny whitefly, Quarantine pest outbreak, Citrus.*

Introduction

Given the damage that *Aleurocanthus spiniferus* (Quaintance) 1903 may cause to citrus and other agricultural crops, the Apulia Region - Plant Protection Centre, in collaboration with Consortia of Defence of the provinces of Lecce and Brindisi, published, in the official regional journal 146 of 7[th]November 2013, the measure 348/2013 of the Agriculture services containing phytosanitary requirements to control the spread of *A. spiniferus* in the regional, national and EU territory. *A. spiniferus*, originated in tropical Asia but has been spread to different geographic regions (Africa, Japan, India, Central America, South America and Australia) (Kanmiya et al., 2011; Cioffi et al., 2013). *A. spiniferus* is listed as a quarantine threat to Europe and is included in the EU Annex II/A1 and in the EPPO A2 list. In Europe, it was reported for the first time in Italy, in 2008 (Porcelli, 2008, Nutricato, 2009). In May 2012, *A. spiniferus* was first found in Croatia, on ornamental potted orange seedlings (*Citrus aurantium* L.) in a nursery garden in Split (Mladen&Tatjana, 2013).OSW is a polyphagous insect, here reported to infest 90 plant species of 38 plant families (Cioffi et al., 2013). It is considered as one of the most destructive citrus whitefly in tropical Asia and the seventh most important citrus pest in Japan. *A. spiniferus* is a common and sometimes serious pest of *Citrus* and other plants in the Indo-Malayan region (Clausen *et al.*, 1978). It is also

considered a pest of tea in the Guangdong province of China (Xie, 1993) and recorded as a serious pest of roses in India (David and Subramaniam, 1976). It causes a general weakening of the infested trees due to sap loss and development of sooty mold. The leaves, fruit and branches of infested trees are usually covered with sooty mold. Orange spiny whitefly is spread from one place to another through movement of nursery stocks and infested fruits.

As other whitefly species, OSW has six developmental stages: egg, crawler (1[st]instar), two sessile nymphal instars (2[nd]and 3[rd]instars), puparium (4[th]instar) and adult (APHIS, 1975). All stages are found on the leaves (USDA, 1974; EPPO/CABI, 1997). Depending on conditions, the life cycle of *A. spiniferus* generally takes 2-4 months, but there can be three to six overlapping generations per year. The development is most favoured by temperatures of 20-34°C (optimum 25.6°C) and relative humidity of 70-80%. The species does not survive at temperatures below freezing and is not found in areas with temperatures of 43°C or over (EPPO/CABI, 1997). In general, chemical control has not proved to be effective against OSW (Gyeltshen et al., 2010).The pest appears to be well controlled by natural enemies in its native countries. Biological control, using hymenopteran parasitoids, has proved to be effective in several regions of the world (Smith, 1945; Quezada, 1974; Clausen et al., 1978). This work aims to assess the *A. spiniferus* status in Apulia.

Materials and Methods

During the period 2009-2012, from April to September, monitoring was regularly carried out in all municipalities of the Lecce district on potential host plants to assess the presence and the spread of the whitefly *A. spiniferus*. Suitable host plants were checked in orchards, private and urban gardens, ornamentals, tree-lined streets, park areas and natural reserves. Moreover, in 2012-2014 similar inspections have been realised on the boundaries among Lecce and others Apulian municipalities, through the main transport routes. Inspections started in the city centre; they were then extended to boundaries and orchards, along the main routes, looking for infested host plant species. Yellow sticky traps have been also used, to check the presence of adults in the early stages of infestation. Leaves samples with preimaginal stages of the whitefly were collected, dry stored, and brought to lab in aerated and hermetically sealed boxes, until insect preparation. Once in the laboratory, puparia were slide-mounted for taxonomic identification, either by quick-mounts method (Martin et al., 2000) or in Canada Balsam, following the suggestions by Pizza and Porcelli (1993) and Martin (1999). All mounted specimens were identified to the species level according to relevant morphological keys (Silvestri, 1928; Bink-Moenen, 1983; Martin, 1987, 1999; Kanmiya et al., 2011). All laboratory observations were taken by stereomicroscope, light compound microscope equipped for bright field and phase contrast, and Hitachi TM3000 low pressure Scanning Electron Microscope (SEM).

Results and Discussion

The first detection of *A. spiniferus* was in Lecce District in April 2008 (Porcelli, 2008) in a Citrus orchard (figure1),by the end of 2008 *A. spiniferus* spread around, monitoring area showed that 13 municipalities in Lecce District were invaded by *A. spiniferus* (Nutricato et al., 2009): Alezio, Casarano, Collepasso, Gallipoli, Matino, Melissano, Parabita, Racale, Ruffano, Sannicola, Scorrano, Supersano and Taviano. At the end of 2009, the pest was found to infest 68 of the 97 municipalities of the Lecce district, with various degree in infestation intensity. One year later, *A. spiniferus* infested 88 municipalities but was still absent in Diso, Guagnano, Melendugno, Novoli, SaliceSalentino, Squinzano, Trepuzzi, Uggiano la Chiesa and Veglie. These nine non-infested municipalities are located along the Brindisi-Taranto districts border, on the Adriatic coast, at the north edge of the infested area. During 2011, the pest spread into the villages alongside the Adriatic coast; only Diso and

Melendugno remained apparently pest-free. Inspections in April 2011 revealed the presence of the whitefly on a lemon tree in a private garden in San Pancrazio Salentino (Brindisi district): that was the first OSW outbreak outside the Lecce district. In 2013-2014 new foci in

Figure 1 : The first detection of *A. spiniferus* was in Lecce District

Bari (both city centre and province) and Taranto have been detected. In 2014 previous results
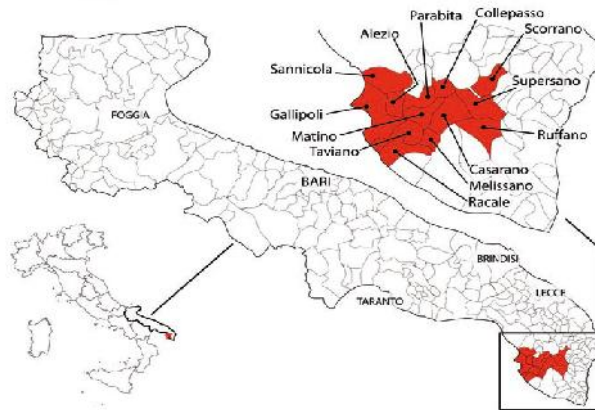
on new foci were confirmed; we noticed also that OSW populations were completely acclimatized and in continuous expansion.

Two maps report the spreading of the pest in Puglia Region (figure 2) and different infestation intensity (figure 3) by municipalities, both based on inspection results carried out to the end of 2011. The colour is re-lated to the first pest presence in the area. In general, the older the infestation the higher the population; thus, the infestation level increases over time. Consequently, the most dense pest populations were found in the early infestation sites and at sea level. So, uninfested areas are green, low and moderately infested areas are yellow and orange, severely infested are red.
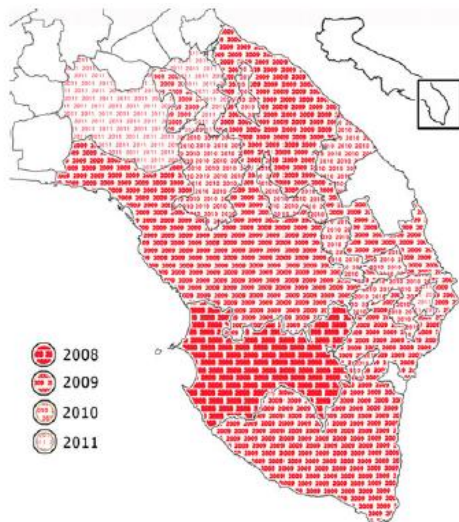

Figure 2 : Spreading and distribution map of *A.Spiniferus* up to 2011.
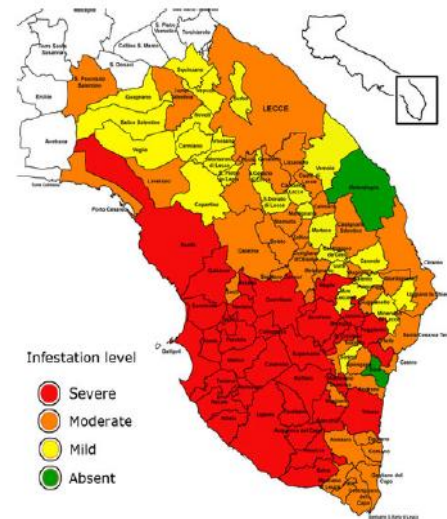
Figure 3: Infestation level of *A.spiniferus* in 2011.

Conclusion

Our study show that OSW is now acclimatized not only in the Lecce district but apparently in the whole monitored Apulia, except for northern districts, and its eradication is almost impossible. This is an additional validation of the high spreading capacity and harmfulness of the pest. In spite of the described critical situation and even more critical expectations, official control strategies are still absent in Italy.

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LABORATORY EFFICACY OF NATURAL SUBSTANCES ON *PLANOCOCCUS FICUS* (SIGN.) AND THEIR IMPACT ON ITS TWO NATURAL ENEMIES

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Abstract

Management of *Planococcus ficus* infestations in viticulture is a challenge for organic producers. Lack of information regarding the efficacy of natural insecticides used against vine mealybugs make its control more difficult. Principal aim of this study was to validate the efficacy of some natural substances used in organic vineyards, on *P. ficus.* The impact on parasitoid *Anagyrus* sp. near *pseudococci* (Girault) and predator *Cryptolaemus montrouzieri* (Mulsant) was also evaluated in laboratory bioassays. Natural insecticides that contain potassium salts of fatty acids (a.i. 49%), paraffinic oil (a.i. 98,8%), powder sulphur (a.i. 95%), spinosad (a.i. 11,6 % and 44,2 %) and pyrethrin (a.i. 1,4%) were tested by using maximum dose on label. Moreover, two commercial formulations containing seaweed and plant extracts were also tested. Mortality of *P. ficus*, at 24 hours, caused by potassium salts of fatty acids (69%) and paraffinic oil (42%) was significantly higher($p < 0.05$) than other substances. Other tested substances were not significantly different than each other. Potassium salts of fatty acids and paraffinic oil showed similar impacts on *A. pseudococci* and both were categorized as harmless. Substances categorized as harmful for parasitoids were Spinosad followed by sulphur and pyrethrin. Predator *C. montrouzieri* resulted sensible to potassium salts of fatty acids and pyrethrin. This two products were categorized as harmful for predators.

Keywords: *Organic Agriculture, Pest Management, Natural Insecticide, Bioassay, Mealybug.*

Introduction

Vine mealybug*, Planococcus ficus* Signoret (Hemiptera:Pseudococcidae) is among the list of common pests of vineyards and increased vine mealybug infestations are considered to be related to increased economic losses in vineyards during the last decade (Daane *et al.*, 2012). Most of the problems related to vine mealybugs are originated from large amount of excreted honeydew as a result of its intensive feeding behavior. Honeydew is considered as a substrate for many fungi, especially for black sooty mold which grows easily on it (Godfrey *et al.*, 2005). *Cryptolaemus montrouzieri* (Coleoptera: Coccinellidae), is a generalist predator and important biological control agent used for regulation of mealybugs and soft scale insects in warm climates and greenhouses (Kairo *et al.*, 2013). *Anagyrus* sp. near *pseudococci* (Hymenoptera: Encrytidae) on the other hand is a commonly used parasitoid for management of *P. ficus* (Triapitsyn *et al.*, 2007). Despite the fact that parasioid was reported to be the destroyer of 75% of host populations, insecticides are still utilized by intention of taking mealybug populations to lower densities (Flaherty and Wilson, 1999). Furthermore, treatment on immature stages of *P. ficus* are usually recommended while information related to efficacy on pest and side effects on natural enemies are insufficient (Landers *et al.*, 2012). Aim of this study was to contribute the sustainability improvement of *P. ficus* management, by providing

information concerning efficacy of several natural substances on pest and their impact on its natural enemies.

Materials and Methods

Insects

All insects used on this study was reared prior to bioassays in insectary of Mediterranean Agronomic Institute of Bari (MAIB). Continuous supply of pest population was obtained by rearing *P. ficus* on squashes *(Cucurbita moschata* cv.Butternut). Infested squashes were also used for the rearing of natural enemies. Parasitoid and predator were collected from experimental vineyard of MAIB and introduced to plexiglass cages (40x40x50 cm) where squashes infested with *P. ficus* were placed. A circular hole was opened on shorter side panel for cage access while top of the cage covered with fine gauze was left for air circulation. A cotton soaked into honey: water (2:1) solution was left for parasitoids as a food and water source and a cotton soaked into water was left for predators as a water source. Emerged natural enemies were transferred into new cages regularly and same procedure was repeated for continuum of rearing.

Bioassays

Lethal activity bioassays were conducted on *P.ficus, A.pseudococci* and *C. montrouzieri* using products listed on Table 1. Products were chosen by mentioned/recommended uses from literatures reviewed (Baldacchino *et al.*, 2010; Landers *et al.*, 2012; Kahramanoglu and Usanmaz, 2013; Guario *et al.*, 2014). Seaweed extract was tested only on *P. ficus.*

Lethal Activity Bioassays on *P. ficus*

Bioassays were conducted using methodology of Karamaouna *et al.* (2013) with slight modifications. Bioassays were carried out only on immature stages of vine mealybugs. Squashes were cut into pieces and placed on a 5% agar solution inside 5cm petri dish. Number of vine mealybug crawlerson each squash piece were counted under stereoscope prior to sprayment and petri dishes were placed into plastic cups. Insecticides were applied with an hand sprayer on rate of approximately $28\mu l/cm^2$. Treatments were replicated 5 times and control was treated with distilled water only. After each treatment, top of the plastic cups were closed by using fine gauze and rubber bands. Cups were kept in controlled laboratory conditions at25°C, 50-60% RH and 16:8 L:D. Mortality was controlled by nudging vine mealybugs using a fine paint brush, at 24 hours after treatment. Vine mealybugs without any responses to nudging were recorded as dead.

Table 1. Detailed list of substances used in laboratory bioassays.

Active Ingredient / Use	Commercial Name	Producer Company	Dose Used
Potassium Salts of Fatty Acids (49%) *Insecticide/Acaricide*	Ciopper	EuroAgro	2 l / hl
Paraffinic Oil (98,8%) *Insecticide*	UFO	Biogard	2 l / hl
Powder Sulphur (95%) Fungicide/Acaricide	Fiori di zolfo	Zolfindustria	35 kg / ha
Spinosad Based (44,2%) *Insecticide*	Success	Bayer	80 ml /hl
Spinosad Based (16%) *Insecticide*	Laser	Dow AgrSciences	20 ml / hl
Pyrethrin (1,4%) Insecticide	PyGanic	Biogard	250 ml / hl
Seaweed Extract *Growth Promoter*	Boundary SW	ICAS	400 ml / hl
Foliar fertilizer	DuoLif	Triumph	200g powder + 1 l oil / hl

Lethal Activity Bioassays on *A.pseudococci*

Bioassays were conducted using methodology of Mead-Briggs *et al.* (2000) with some modifications. Prior to bioassays ten female parasitoids were taken from rearing cages using test tubes. Test cells, details of which are given below in Figure 1 were cleaned before each use and dried completely. Insecticides were applied on inner surface of glass panels located above and below the frame of cell, at rate of approximately $39\mu l/cm^2$. Treatments were replicated 5 times and control was sprayed with distilled water only. Treated panels were left minimum two and a half hours until dried before assembly of the cell. Ten females were then introduced to cells assembled with dried glass panels and secured with rubber bands. Self made fan for aeration was connected to system immediately to provide air current and to prevent accumulation of volatiles inside the cells. Piece of cotton soaked into honey: water (2:1) solution was put to entrance hole as a food and water source for test insects. Cells were kept in controlled laboratory conditions at 25˚C, 50-60% RH and 16:8 L:D. Acute toxicity caused by residues were checked by counting dead insects inside the cells at 24 hours after treatment.
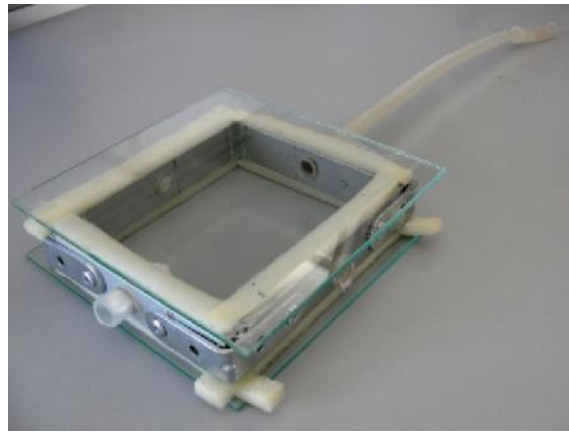

Figure 4. A cell used for *Anagyrus* sp.near. *pseudococci*

Lethal Activity Bioassays on *C. montrouzieri*

Bioassays were conducted using methodology of Babu and Azam (1987). Prior to experiments ten newly emerged predators (5 Males/5 Females) were taken from rearing cages by using test tubes and introduced into plastic cups (20cl). Insecticides were applied inside the plastic cups at rate of approximately $24\mu l/cm^2$. Treatments were replicated 5 times and control was sprayed with distilled water only. After insecticide applications cotton soaked into water and 30 *P.ficus* individuals were left inside the test tube. Following the treatments top of the plastic cups were closed using fine gauze and rubber bands. Cups were kept in controlled laboratory conditions at 25˚C, 50-60% RH and 16:8 L:D. Acute toxicity caused by direct contact and indirect contamination by food and water source was controlled by counting dead insects inside the cups at 24 hours after treatments.

Statistical Analysis

Data obtained from bioassays were subjected to one way analysis of variance (ANOVA) and Tukey's HSD (p 0.05). Prior to statistical analyses mortality rates were corrected using several formulas (Table 2). Impact of substances on natural enemies were also categorized according to the IOBC's toxicity ranking of pesticides on beneficial arthropods as harmless (<30%), slightly harmful (30-79%), moderately harmful (80-99%) and harmful (>99%) (Hassan *et al.*, 1994).

Table 2. Efficacy correction formulas used for lethal effect bioassays.

Species	Reference and Equation
P. ficus	Schneider-Orelli (1947) $$\text{Corrected \%} = \left(\frac{\text{Mortality \% in Treatment} - \text{Mortality \% in Control}}{100 - \text{Mortality \% in Control}} \right) * 100$$
A. pseudococci *C. montrouzieri*	Abbott (1925) $$\text{Corrected \%} = \left(1 - \frac{n\,in\,Treatment\,after\,treatment}{n\,in\,Control\,after\,treatment} \right) * 100$$

Results and Discussion

Lethal Activity Bioassays on P. ficus

Results of laboratory bioassays conducted on *P. ficus* are presented in Figure 2. Highest mean mortality (69%) was caused by active ingredient potassium salts of fatty acids (PSFA) . It was significantly higher than paraffinic oil which caused 42 % mean mortality. Foliar fertilizer, pyrethrin, two formulations of spinosad, sulphur and seaweed extract caused mean mortalities less than 20%. Among tested substances only results of potassium salts of fatty acids and paraffinic oils were considered sufficient for the control of *P. ficus.*
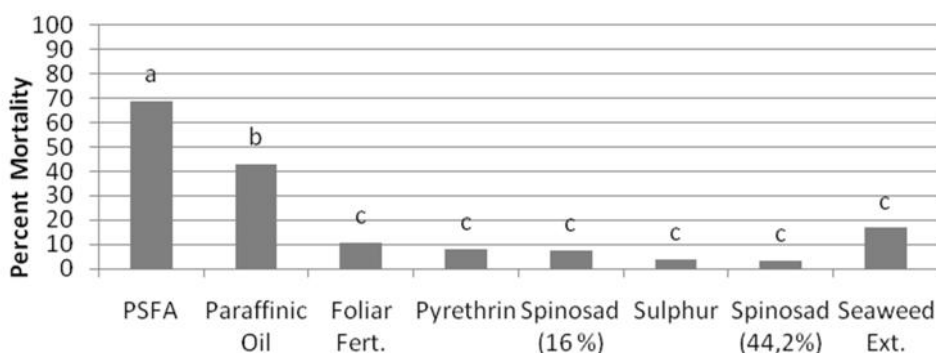
Figure 5. Mortality of *P. ficus* at 24h after treatments.

Lethal Activity Bioassays on A. pseudococci

Results of laboratory bioassays conducted on *A. pseudococci* are presented in Figure 3. Spinosad (a.i. 44,2%) caused 100% mean mortality of test insects and spinosad (16%) caused 97,5%. Sulphur and pyrethrin caused 77,5 % and 75,5 % mean mortalities, respectively. Paraffinic oil, PSFA and foliar fertilizer caused mean mortalities equal or less than 20%. According to results Spinosad (44,2%) was categorized as harmful while Spinosad (16%) was categorized as moderately harmful. Pyrethrin and sulphur were both categorized as slightly harmful and paraffinic oil, PSFA and foliar fertilizer were categorized as harmless.
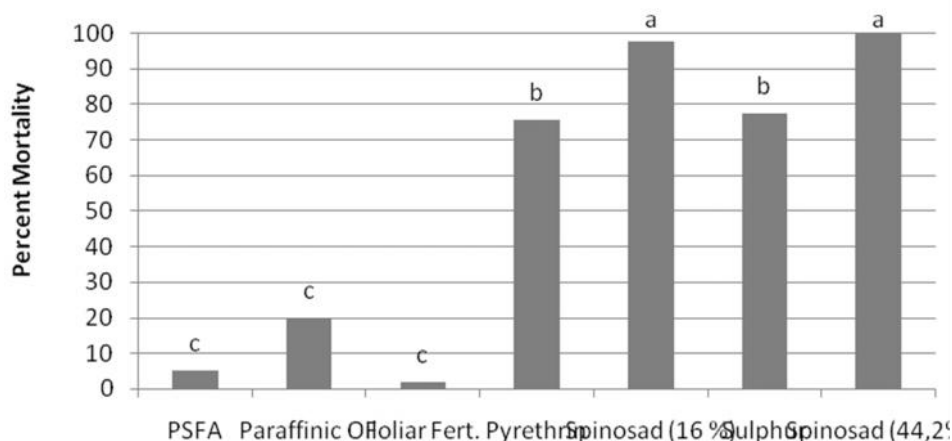
Figure 6. Mortality of *A. pseudococci* at 24h after treatments.

Lethal Activity Bioassays on C. montrouzieri

Results of laboratory bioassays on *C. montrouzieri* are presented on Figure 4. PSFA caused 90% mortality of test insects and phyrethrin caused 75% mean mortality. Paraffinic oil, foliar fertilizer and two formulation of spinosad caused mean mortality equal or less than 10%. According to results PSFA was categorized as harmful and pyrethrin was categorized as moderately harmful. Paraffinic oil, foliar fertilizer and two formulation of spinosad were all categorized as harmless.
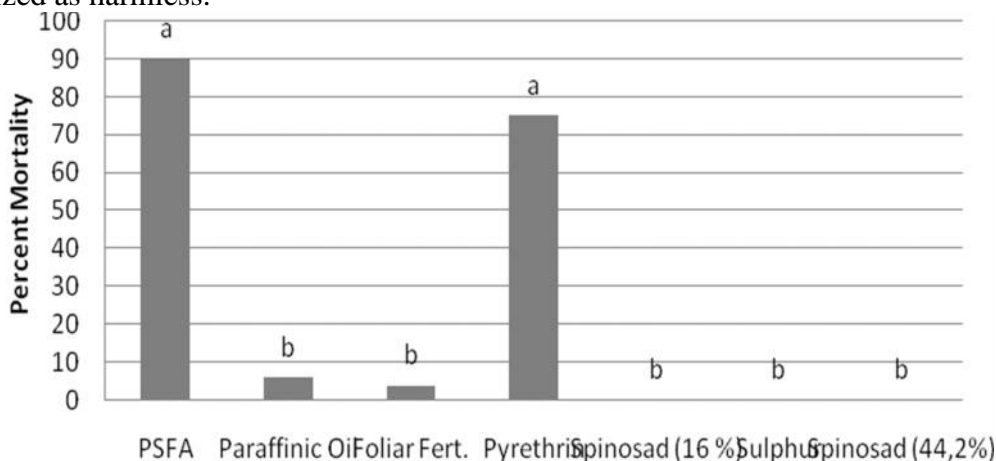
Figure 7. Mean mortality of *C. montrouzieri* at 24h after treatments.

Lethal Activity Bioassays on P. ficus

It was found that when used same doses and percentages of active ingredients potassium salts of fatty acids and paraffinic oil caused 22% and 12% mortalities, respectively (Hollingsworth, 2005). However, mentioned study was conducted under greenhouse conditions on later larval stages (3rd and 4th) while our study was conducted under laboratory conditions on crawlers. In field conditions, potassium salts of fatty acids and paraffinic oil caused 55% and 32% mortalities, respectively (Baldacchino *et al.*, 2010). In field conditions lower mortality than laboratory bioassays are generally expected as *P. ficus* individuals are generally located in hidden parts of plants and not easily reachable by the treatments.

Lethal Activity Bioassays on A. sp.near. pseudococci

Similar impact of spinosad on hymenopteran parasitoids was also confirmed by several other studies (Williams *et al.*, 2003; Newman *et al.*, 2004; Biondi *et al.*, 2012). Studies as early as 1975 reported that pyrethrin caused less mortality when applied in lower doses, recently in studies conducted with pyrethrin at similar doses also reported harmful impact on other

hymenopteran parasitoids (Wilkinson *et al.*, 1975; Tunca *et al.*, 2012; Tunca *et al.*, 2014). Sulphur was also mostly categorized as harmful (De Courcy Williams and Gill, 1996; Martinson *et al.*, 2001; Thomson *et al.*, 2001; Jepsen *et al.*, 2007a). Sulphur residues was found to be toxic up to 21 days and was reported harmful even in lower percentages (Martinson *et al.*, 2001; Jepsen *et al.*, 2007a). Despite the fact that it is mostly reported as harmful, (Jepsen *et al.* (2007b)) also argued that no effect was found on reproductive success of sulphur treated hymenopteran parasitoids from *Anagrus* spp.

Lethal Activity Bioassays on C. montrouzieri

Pyrethrin and potassium salts of fatty acids were reported as harmless for adults of *Harmonia axyridis,* another member of Coccinellidae family, when same doses were applied under laboratory conditions (Kraiss and Cullen, 2008). In contrast, another study suggested potassium salts of fatty acids as an alternative to pyrethrin which was reported harmful also on larval stages of *Adalia bipunctata* (L.), another predator of Coccinellidae family (Jansen *et al.*, 2010). Our results were confirmed by the side of pyrethrins impact by both studies. Hovewer, potassium salts of fatty acids were reported as harmless in both studies in contrast to our results. Conflicting results can be related to our methodology that facilitated complete sprayment of the test arena and residual contamination of food and water source of predators.

Conclusion

Laboratory bioassays on vine mealybugs and its two natural enemies resulted that only two substances (potassium salts of fatty acids and paraffinic oil) were efficient against pest and harmless for parasitoids while one of them (potassium salts of fatty acids) having harmful impact on predators. Efficacy on pest and potential impact on beneficial arthropods must be known for sustainability improvement of management by using natural substances. Results showed that even allowed natural substances in organic farming may have undesirable impacts on beneficial arthropods and they need to be carefully evaluated prior to use in pest management programs. Similar studies would be beneficial also for other natural enemies of vine mealybugs and our results should be confirmed by extended-laboratory and field trials in future.

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SURVEY RESULTS OF CITRUS TRISTEZA VIRUS (CTV) IN CRETE AND DETECTION BY DIRECT IMMUNOPRINTING-ELISA METHOD

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Abstract

Citrus tristeza virus (CTV), an aphid-borne closterovirus, is the causal agent of one of the most devastating citrus diseases, causing serious economic losses for the citrus industry all over the world. Currently, CTV is considered a quarantine virus in Greece and systemic surveys are conducted annually in the major citrus fruit growing districts of Crete to assess the incidence of CTV. Over a period of two years, more than 5,000 citrus trees in Crete were screened for CTV infection by immunoprinting-ELISA method. A total of 38 citrus samples (ca 1.9% of the total tested samples) were positive. This result represents almost a ten-fold increase in a number of detected CTV-positive samples compared to the previous study (2010). This observation calls for further in-depth studies in order to understand to a full extent CTV *loci* in Crete, and moreover design appropriate measures of CTV containment and control. Interestingly, CTV incidence at the newly identified locus (Koufos) in Western Crete accounted for 87% (33 out of 38) positive samples identified during the survey.

Key words: *CTV, Crete, survey, detection, immunoprinting-ELISA*

Introduction

Citrus tristeza virus (Closterovirus, Closteroviridae) is the most destructive and economically important virus of citrus worldwide. Losses from *Citrus tristeza virus* attacks and its economic impact on the citrus industry in particular regions depend on four main factors: presence of sour orange as susceptible rootstock, severity of CTV strains, ability of local aphid species to disseminate the virus and presence of *Toxoptera citricida*, the most efficient virus vector (Bar-Joseph *et al*. 1989; Cambra *et al*. 2000; Moreno *et al*., 2008). Generally speaking, CTV can cause three main syndromes: tristeza or decline, stem pitting (SP) and seedling yellows (SY) (Moreno *et al*., 2008). Some isolates are mild and essentially symptomless, and it is not infrequent to find infected trees that do not manifest any noticeable symptoms (Papayiannis *et al.,* 2007). Tristeza is a disease manifested by the progressive decline and death of most citrus species grafted on the susceptible sour orange rootstock (Citrus aurantium) or lemon (Citrus limon (L.) Burn. F.) (Moreno et al., 2008; Papayiannis et al., 2007). The general decay is a result of malfunction of the phloematic tissue induced by CTV infections (Schneider, 1959) which leads to continuous reduction of the root system with a deficient supply of water and minerals, which results in wilting, chlorosis and dieback symptoms (Fig.1, a). Stem pitting syndrome usually does not have a lethal effect on the host, but induces economic losses due to the prolonged reduction in yield quality and quantity. SP results in reduced vigor that causes stunting, thin foliage with small yellow leaves, low yields and small, poor quality fruits that are unmarketable (Fig. 1, b & c).

Figure 1. Progressive dieback of citrus tree in Chania (a); Leaf chlorosis of the citrus plant affected with CTV (b); Small-sized fruits from an orange tree severely affected by stem pitting (c)(Chania, November, 2010)

Although tristeza poses a tremendous threat to the Mediterranean citrus industry and it is widely distributed, CTV infections appear mostly as isolated foci and/or without showing clear-cut tristeza symptoms (Bové, 1995). However, tristeza has caused significant damages to the citrus industry in this region, in particular in Spain in 1957 (Moreno *et al*., 2008) and Israel in 1970 (Bar-Joseph *et al*., 1983) due to the adaptation of local CTV strains to *A. gossypii*. Tristeza outbreaks have also been reported from Cyprus (Kyriakou *et al*., 1996) and Italy (Davino *et al*., 2003). Moreover, CTV is currently considered a quarantine virus in Greece and was recently detected in relatively high rates in Crete (Afifi, 2010) illustrating the need for implementation of certification programs in Mediterranean countries, along with eradication efforts in order to prevent its spread. Bearing in mind that the citrus industry is very important for the Greek agriculture and economy in general, surveys for *Citrus tristeza virus* (CTV) in Greece were started in 1995 and large-scale testing was carried out by DAS-ELISA and direct tissue blot immunoassay (DTBIA). In June 2000, due to the accidental introduction of CTV-infected budwood from Spain, CTV was detected for the first time in Argolis (North East Peloponnese) and in Chania (Crete) (Dimou *et al*., 2002). The scope of this research was to conduct a survey in 2009 and 2010 to estimate the incidence of CTV infections in Crete.

Materials and methods

Plant material. Newly pushed stems and leaves from four branches of 2,565 and 2,665 citrus trees were obtained in two periods (May-June and September-October) in 2009 and 2010 from four Cretan prefectures (Chania, Rethymno, Heraklion and Lasithi).

Immunological detection. For the detection of CTV in citrus plant tissues, the Direct immunoprinting-ELISA method kit (PlantPrint, Spain) was used, which is comprised of the following: nitrocellulose membranes, pre-spotted positive and negative control tissue prints, alkaline phosphatase conjugated CTV-specific monoclonal antibodies, mineral salts and substrate tablets [5-Bromo-4-Chloro-3'-Indolyphosphate p-Toluidine Salt (BCIP), Nitro-Blue Tetrazolium Chloride (NBT)]. The tender shoots, leaves pedicels or fruit peduncles of the citrus plants were recommended to be used for the detection procedure. The printing was made by pressing the fresh crosswise cuts on the nitrocellulose membrane surface. A pack of ten membranes were firstly blocked by using 1% of blocking solution for one hour incubation at room temperature. Subsequently, for the antibody conjugation step, the antibody solution was added over the membranes for three hours incubation. Later, three washes were made to remove the excess of the antibody. Each wash was done for 10 min at room temperature. As a final step, the membranes were shacked in the substrate buffer which was poured on the membranes until the appearance of purple-violet in the positive control. After the reaction was stopped by adding the tap water, the membranes were air-dried and the results were observed by using a power magnification (X5-X10). All the solution and buffers were prepared with the recommended dilutions according to the manufacture's instructions.

Mapping of CTV presence in Crete. Geographic position system (GPS) data for each sampled plot were registered and then compiled in an ArcObject-based database and topographic maps geo-referenced in a Greek Grid (GCS-GGRS-1987) coordinate system.

Results and Discussion

CTV survey in Crete. An extensive survey was conducted in 2009 and 2010, in order to determine the incidence and distribution of *Citrus tristeza virus* (CTV) in Crete. Sampling was carried out by the personnel of different Cretan prefectures, and samples (stems and leaves) were delivered for lab analysis. Citrus trees and each sample were visually inspected for the presence/absence of visible virus-like symptoms ranging from mild leaf vein clearing to general plant stunting (Fig. 2.) Overall, samples from over 5,000 citrus trees were collected and analyzed for the presence of CTV. Young leaves/shoots collected from different points of the canopy were subjected to a standard diagnostic immunoprinting-ELISA test using a commercial kit (PlantPrint, Valencia-Spain). The nitrocellulose membrane of the kit included positive and negative control tissue prints and accommodated two sets (duplicates) of section prints from each of the four sides of the sampled trees. After completion of these tests, prints from 38 in total citrus samples exhibited purple-violet reactions in the vascular area of the printed sections indicating CTV infections (Fig. 3, and not shown), representing 1.9% of the total number of samples tested. Interestingly, the intensity of the color reactions was not uniform as expected in all four prints from the same tree-sample (Fig. 3) indicating a non-homogenous distribution of the virus among different branches of the same tree.
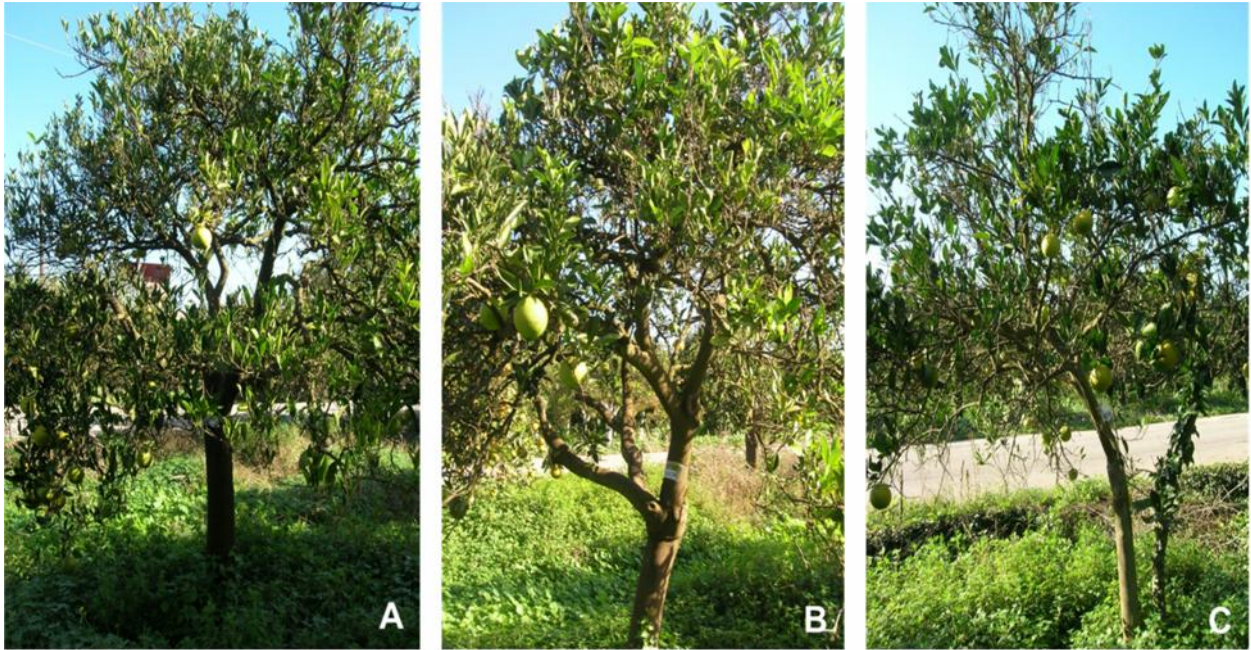
Figure 2. CTV-infected trees visited during the survey carried out during November 2010. Panels A-C show CTV-infected trees #1823, 1829 and 1851, respectively.
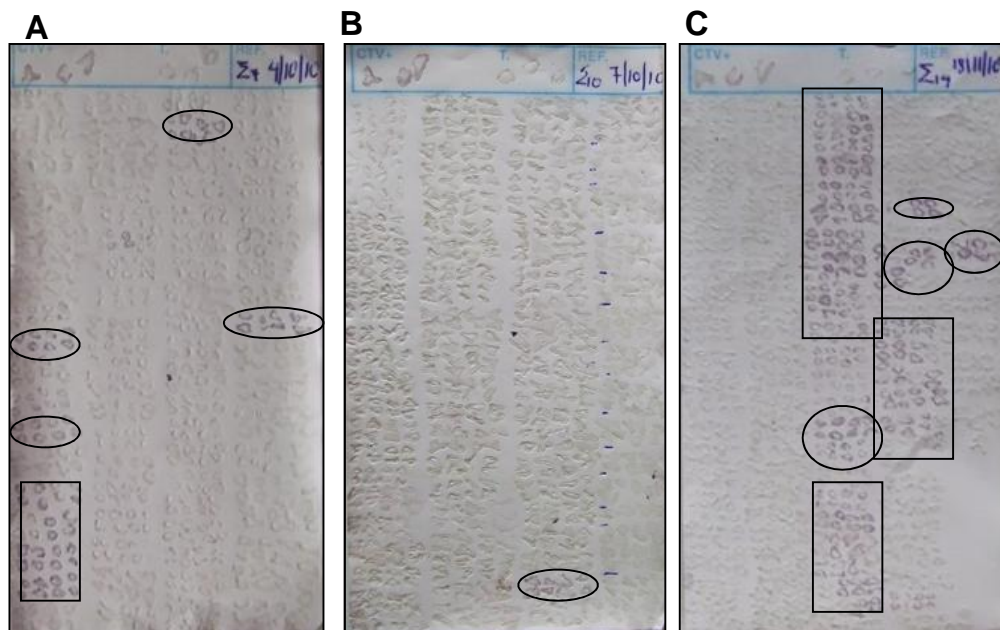
Figure 3. Immunoprinting-ELISA test. General view of three membranes (A, B and C) containing stem prints from surveyed plants. Boxed and/or encircled are CTV-infected samples.

CTV-infected trees were all identified at different locations of Chania prefecture (Fig. 4) with the highest incidence at the Koufos location.
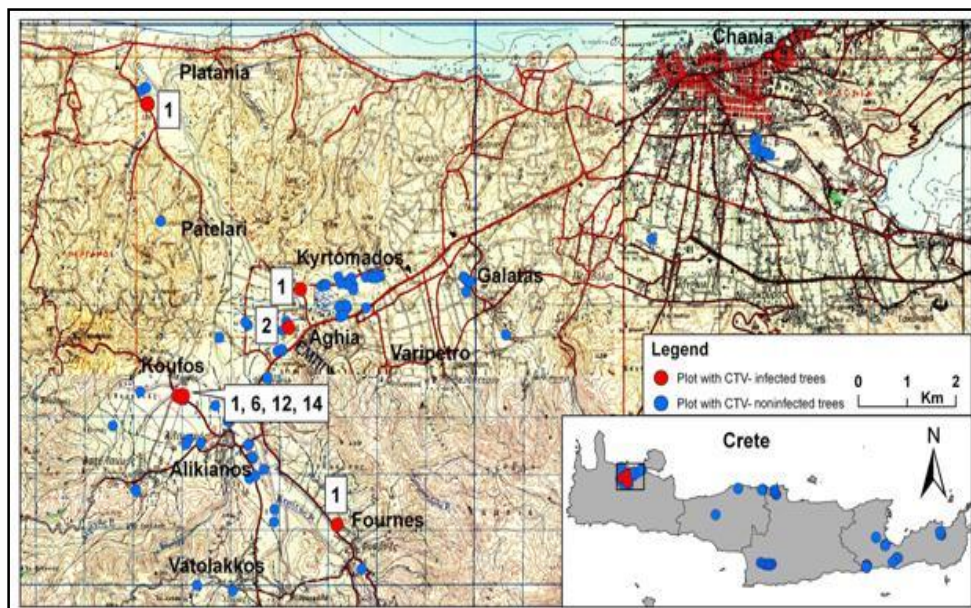
Figure 4. Map showing citrus orchards scouted during the survey in 2009-2010. Surveyed areas are indicated by dots; blue dots represent CTV-free orchards; red dots indicate CTV *loci*. The number of infected trees per orchard is indicated in the white boxes.

Conclusion

Bearing in mind a quarantine status of CTV in Greece, surveys should be executed routinely on a yearly basis on Crete and throughout Greece and combined with systematic monitoring for the aphid vector *T. Citricida* and epidemiological studies. Over a period of two years, more than 5,000 citrus trees in Crete were screened for CTV infection by immunoprinting-ELISA method, resulting in 38 infected trees, what represents almost a ten-fold increase in a number of detected CTV-positive samples compared to the previous study (Affifi, 2010). Our observations may be of use to extension and phytosanitary services and assist epidemiological studies to promote sustainable strategic solutions for the local and national citrus industry.

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DYNAMICS OF SOLUBLE PROTEIN CONTENT AND GRAIN YIELD IN MAIZE INBRED LINES INFLUENCED BY FORAMSULFURON

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Abstract

Soluble proteins are small-length proteins that have significant role in plant metabolism. Under the influence of various herbicides their content can be changed. Sulfonylurea herbicides have very specific mode of action, inhibiting biosynthesis of some amino acids, which lead to blocking of cell division. Alternations in soluble protein content can be an indicator to plant susceptibility/tolerance towards herbicides. The aim of this study was to examine effects of foramsulforon, as sulfonylurea herbicide, applied in 45 g a.i. ha^{-1} and 90 g a.i. ha^{-1} on maize inbreds. The influence of foramsulfuron was observed in alternation in soluble protein content 48h (1st phase) and 21 days (2nd phase) after herbicide application. Grain yield was determined at the end of vegetation. In sensitive lines foramsulfuron increased soluble protein content in 1st phase, especially in dose of 90 g a.i. ha^{-1}, while in second phase smaller variations in soluble proteins were observed. Foramsulfuron decreased grain yield in most lines, in both applied doses.

Key words: *maize inbred lines, foramsulfuron, soluble proteins*

Introduction

Maize hybrid production is a process that is accompanied by many challenges, so the production technology involves the use of a large number of measures and care (Pavlov et al., 2008). As one of the most important measures is a weed control. Seed maize characteristics may significantly differ from the hybrid. This is primarily to unequal growth and lower growth habit, which has an important role in maize-weed competition (Stefanovi et al., 2007). The higher sensitivity to different herbicides is also present between seed and hybrid maize. According to previously mentioned, it can see why weeds and herbicides are the main problem in seed maize production. It is known that weeds can completely suppress crop and cause yield loss. Herbicide application includes its selectivity to the crop. In the case of non-selectivity, various phytotoxic symptoms could be manifested. Those negative impacts reduce plants fitness, what results in yield reduction, which is certainly not desirable in maize production (Stefanovi et al., 2010). Herbicide application can cause temporary or permanent stress in plants, depending on the genotype, applied herbicide and agro-meteorological conditions (de Carvalho et al., 2009). In case of temporary stress, plants can recover and resume normal growth and development, while in the case of permanent stress, the yield is reduced and in the worst case the plant dies. Herbicide susceptibility testing is possible by measuring alternations in different morphological and physiological parameters compared to control plants. Each herbicide targets the precise location of the plant, inhibiting some essential reaction. Thus, it is possible to measure alternations in the content of different compounds, which are affected by herbicide, directly or indirectly. In case of foramsulfuron, it inhibits protein synthesis, through the inhibition of the synthesis of amino acids such as valine, leucine and isoleucine.

The aim of this study was to test the effect of foramsulfuron herbicide on soluble proteins content of five maize inbred lines 48h and 21 days after application, as well as to inbreeds grain yield.

Material and methods

Experiment was set up on slightly calcareous chernozem in the experimental field of the Maize Research Institute, "Zemun Polje", during 2010. 2011. and 2012. The four-replicate trail was set up according to the split-plot arrangement. The elementary plot size was 16.8 m^2, with the plant density of 60,000 plants ha^{-1}. Winter wheat was a preceding crop in all years. Influence of foramsulfuron on five maize inbred lines: PL 38, PL 39, L 335/99, L 375/25-6 and L155/18-4/1 RfVg, was observed. Five maize inbred lines were sown in experiment: PL 38, PL 39, L 335/99, L 375/25-6 and L155/18-4/1 RfVg. Foramsulfuron was applied in recommended (45 g a. i. ha^{-1}) and double dose (90 g a. i. ha^{-1}) for hybrid maize.Foramsulfuron was applied in doses recommended and doubled for application in maize hybrid production: 45 g a. i. ha^{-1} and 90 g a. i. ha^{-1}. Herbicide was applied when inbred lines developed 5-6 leaves (BBCH 15-16). Herbicide was applied when maize developed 5-6 leaves (BBCH 15-16).Samples for measuring soluble protein content were collected 48h and 21 days after herbicide application. Samples were dried at 40 °C in a ventilation dryer, and then milled. Soluble protein content was determined by Lowry et al. (1951). Maize grain yield was measured after harvesting and calculated at 14% moisture. Obtained data were statistically processed by ANOVA and differences between means were tested by the least significant difference test (LSD test). Meteorological data for experiment are presented in Table 1. First year (2010) has the most favourable weather conditions for maize growing. In 2011 the drought period occurred at the begginig of vegetation, while 2012 was an extremely dry with low rainfall and high temperature, particulary during grain filling period (June-August).

Table 1.Precipitation and average air temperatures for the period April-September

Months	Precipitation (mm)			Temperature (°C)		
	2010	2011	2012	2010	2011	2012
April	44.0	14.9	64.2	13.2	13.4	14.45
May	64.1	89.6	66.4	17.5	16.8	17.9
June	167.3	26.2	17.5	21.0	21.5	24.56
July	35.6	44.0	30.7	23.2	23.3	27.08
August	68.2	66.0	5.8	23.1	23.9	26.21
September	68.0	32.6	26.0	17.6	21.6	22.14
Average	447.2	273.3	210.6	19.3	20.1	22.05

Results and discussion

In general, the highest effect of foramsulfuron on soluble protein content was observed in double dose treatments with (90g a. i. ha^{-1}). Increased values of soluble proteins were also recorded in line PL 38 and PL 39, at both level of foramsulfuron. In period of 48h after foramsulfuron application soluble protein content was the most increased in line PL 38 (up to 25%) by double dose, compared to untreated control. Double dose of foramsulfuron also increased soluble protein content in line L 335/99, while recommended dose increase observed parameter in line L155/18-4/1 RfVg. In second phase (21 days after foramsulfuron application), an equalization of the contents of the soluble protein in most lines was observable. In comparison to the first, in the second phase a decrease in the content of soluble protein was observed in all maize lines, regardless of foramsulfuron dose (figure 1).

Soluble protein content is significantly influenced by sulfonilurea herbicides. Due to their mode of action, it comes to the inhibition of biosynthesis of amino acids such valine, leucine

and isoleucine (Ray, 1985). This leads to inhibition of protein synthesis. Soluble proteins presented small-length proteins chains. Dragi evi et al. (2010) indicates that increased content of soluble proteins could represent result of phytotoxicity in susceptibility maize lines, immediately after herbicide application (48h). Brankov et al., (2010) also stated that application of sulfonylureas in susceptible maize genotypes increase soluble protein content in period of 48h after application.
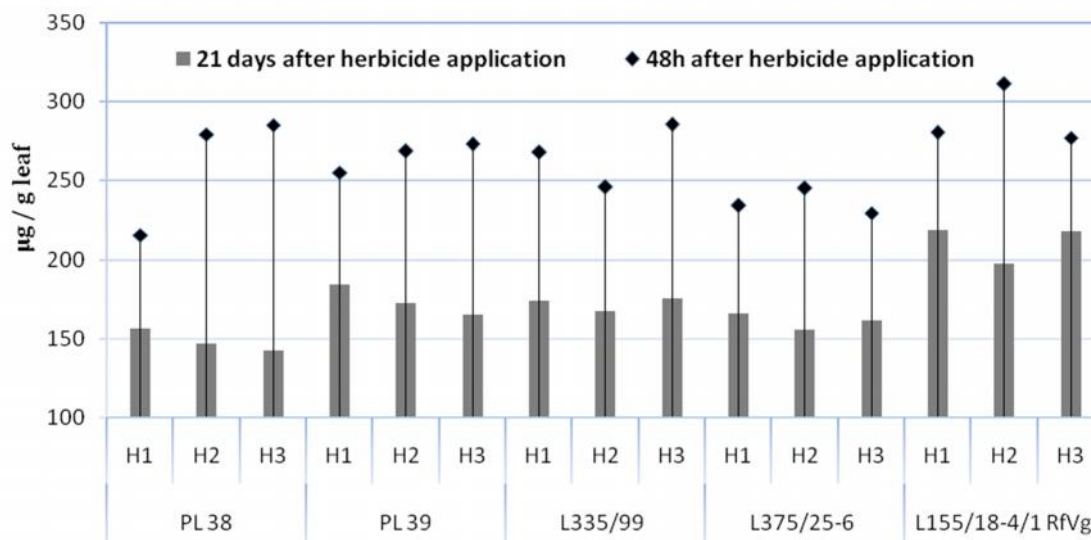
Figure 1. Soluble protein content in maize leaves influenced by foramsulfuron (H1 - control, H2 - reccomended dose of foramsulfuron, H3 - double dose of foramsulfuron), (LSD$_{0.05}$ 48h after herb. application - LSD$_{0.05}$: PL 38 - 3.85; PL 39 - 4.59; L335/99 - 3.15; L375/25-6 - 4.17; L155/18-4/1 RfVg - 3.44), (LSD$_{0.05}$ 21 days after herb. application - LSD$_{0.05}$: PL 38 - 2.93.8; PL 39 - 2,9; L335/99 - 3.42; L375/25-6 - 4.94; L155/18-4/1 RfVg - 3.35)

Application of foramsulfuron significantly decrease grain yield in the most genotypes, except in line L375/25-6, where at double dose of foramsulfuron, the higher yield was recorded. The highest decrease of grain yield was recorded in line PL 38, where a double dose of foramsulfuron reduced yield by 64% compared to control. Dragi evi et al., (2012) in trial with 19 maize genotypes, stated that foramsulfuron applied in recommended dose decreased grain yield in most genotypes (figure 2).
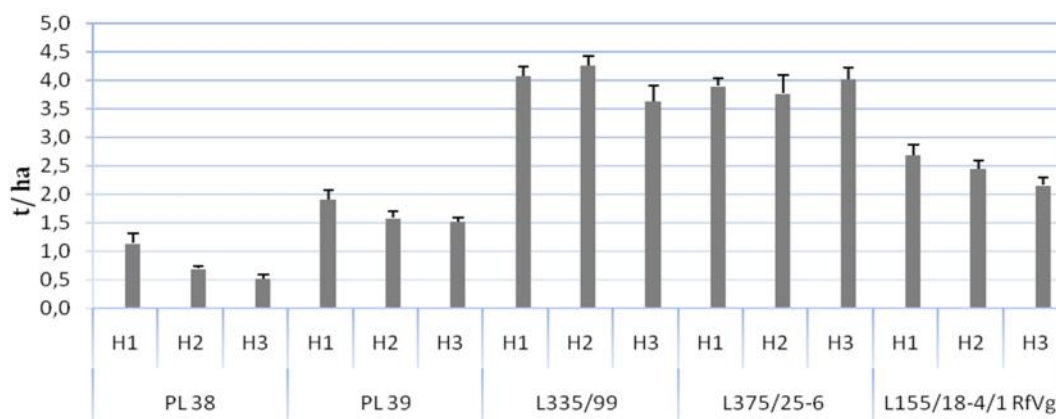
Figure 2. Maize grain yield (average 2010-2012). (H1 - control, H2 - reccomended dose of foramsulfuron, H3 - double dose of foramsulfuron), (LSD$_{0.05}$: PL 38 - 0.07; PL 39 - 0.11; L335/99 - 0.19; L375/25-6 - 0.20; L155/18-4/1 RfVg - 0.15)

Conclusion

Based on the obtained results it can be concluded that the application of foramsulfuron in the recommended and double dose influenced significantly on the content of soluble proteins in maize lines. Much stronger effect on soluble protein alteration was observed by measuring immediately after herbicide application (48 h). Grain yield of the most lines was also decreased with foramsulfuron application.

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WEEDS SEED BANK RICHNESS IN MAIZE FIELD: EFFECTS OF CROP ROTATION AND HERBICIDES

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Abstract

Crop rotation is important measure within Integrated Weed Management System. Sequences with row and grain crops, legumes and cereals influence weed community composition and seed bank richness. Cropping system diversification through extended rotation sequences contribute to reductions in weed sandbanks which determination in arable fields can facilitate to prediction of the future weed problems. This study assessed the effects of cropping system – continuous cropping, two and three crop rotations, and different weed management practices (application of full recommended herbicide dose and half that dose, weed removal by hoeing and weedy check) on weed seed bank richness in maize field.
Soil sampling for seed bank counting was carried out on the sowing and harvest time in 2012 and 2013. Soil samples were collected from the upper soil layer, with shovel 10x10 cm in a base and 4 cm deep. The average 200 g soil sample was washed inside special designed cylinders made from sieves mesh (0.2 mm), in order to separate weed seeds which were counted and identified by species under a magnifying glass (×10).
The most abundant were broadleaf annual weed species *Chenopodium* sp., *Amaranthus* sp. and *Datura stramonium*. The highest number of total weed seeds was identified in maize continuous cropping and the lowest number in three crop rotation maize-wheat-soybean in both years. Application of different amounts of herbicides did not affect weed seed bank richness in the first 3-4 years of crop rotation. Processes which affects the weed seed bank in the fields are complex and vary according to production practices.

Key words: *weed seed bank, crop rotation, herbicides, maize*

Introduction

Weed seeds placed in and on the soil, are the primary cause of weed infestation in maize fields. Seed bank richness is changeable and many processes influence seed additions and losses in the soil through time and system of production (Mohler, 2001). Herbicide application is a usual practice in maize weed control, but occurrence of resistant biotypes and invasive weeds, prevalence of troublesome weed species and increasing of weed seed bank richness, are the most important consequences of limitation in cropping systems, a lack of rotation of herbicide chemistry or sites of action and a limitation in weed control techniques (Menne and Köcher, 2012). Weed seed bank determination in arable fields can contribute to prediction of the future weed problems. Crop rotation is important measure within Integrated Weed Management System (IWMS), (Swanton and Weise, 1991). Requirements in maize growing are nowadays still high and there are many reasons for very intensive and profitable maize production. That forces maize continuous growing with positive effects on economy and many negative effects on environment and agro-phytocenoses, especially weed community. Cropping system diversification through the use of longer rotations of dissimilar crops can increase the mortality factors that regulate weed population dynamics and can facilitate effective weed control with reduced rates of applied herbicides (Liebman et al.,

2014). Sequences with row and grain crops, legumes and cereals influence weed community composition, abundance of individuals and soil seed bank richness (Teasdale et al., 2004; Bohan et al., 2011). Rotations facilitate the rotation of herbicides with the ability to control different weed species. Previous studies have documented reductions in weed seed banks due to cropping system diversification through extended rotation sequences (Schreiber, 1992; Teasdale et al., 2004).The alternation of crops breaks the life cycle and prevents a high distribution of any single weed species (Bastiaans, 2010). This study assessed the effects of cropping system – continuous cropping, two and three crop rotation, and different weed management methods including herbicide application, on weed seed bank richness in maize field.

Material and methods

A long-lasting field experiment have started in 2009, as a split-plot trial in the Maize Research Institute Zemun Polje, at the vicinity of Belgrade (44°52'N 20°20'E), Serbia. The main plots encompassed the following plant production systems: maize continuous cropping (MC), maize–wheat rotation (MW), maize-wheat-soybean (MWS) and maize–soybean–wheat rotation (MSW). The hybrid ZP606, wheat variety Takov anka and soybean variety Lana were conventionally sown within optimal periods in all the production systems. Conventional tillage was applied in the trial. A total of 30 t ha^{-1} of manure was incorporated in the autumn of 2008 in MW, MWS and MSW systems and then every third year. In the autumn of 2008 and 2010, 20 t ha^{-1} of manure was incorporated in the two-crop rotation and every second year thereafter. Immediately, prior to ploughing, 150 kg ha^{-1} of MAP fertilizer (N:P = 11:52) was added. Crop side dressing was performed according to the results obtained by the analysis of the available nitrogen in soil in the 5–6 leaf stage of maize.

The sub-plot treatments were represented by different weed management methods applied in maize: (RD) herbicide application of isoxaflutole + acetochlorat recommended dose (105 g a.i. + 1536 g a.i.) and half that dose (1/2 RD)(52.5 g a.i. + 768 g a.i.), hand hoeing treatment (weed free) and weedy check (weeds stayed throughout vegetation). Each sub-treatment had four replications. In wheat and soybean, the usual combination of herbicides for broadleaf and grass weed control was applied. At the beginning of the experiment, samples were taken only from different cropping systems, excluding herbicide treatments.

The elementary plot size was 28 m^2 and soil sampling (three soil sample cores from each elementary plot) for seed bank counting was carried out on the sowing (middle of May) and harvest time (middle of September) in 2012 and 2013. Soil samples were collected from the upper soil layer, with shovel 10x10 cm in a base and 4 cm deep. The average 200 g soil sample was washed inside special designed cylinders made from sieves mesh (0.2 mm), in order to separate weed seeds which were identified and counted by species under a magnifying glass (×10).

Results and discussion

Total number of weed seeds was different between cropping systems in 2009, and, in average, lower in autumn (2958.5 seeds/m^2) than in spring (3850.0 seeds/m^2), Table 1. Maize crop was grown in all four fields and differences in weed seed richness between cropping systems, at the beginning of the experiment, are probably occurred as a results of previous agricultural practice. Number of seeds in 2009 was higher for all cropping systems than in 2012 and 2013.

Table 1. Number of weed seeds (No of seeds/m^2) in different cropping systems in 2009

Weed species	Cropping system				
	MC	MW	MWS	MSW	Average
Spring					
Chenopodium sp.	2880	1530	1130	1500	1760.0
Amaranthus sp.	2780	1180	950	2450	1840.0
Daturastramonium		75	200	125	92.5
Abuthilontheophrasti	25	50			18.8
Ambrosia artemisiifolia	50				12.5
Atriplexpatula	150	180	75	50	113.8
Bilderdykia convolvulus			25	25	12.5
Total	5885	3015	2380	4150	3850.0
Autumn					
Chenopodium sp.	1250	530	630	850	820.0
Amaranthus sp.	2725	1630	600	1775	1682.5
Daturastramonium	75		100	300	118.8
Convolvulus arvensis				100	25.0
Atriplexpatula	800	100	250		287.5
Bilderdykia convolvulus		25	50	25	25.0
Total	4850	2285	1630	3050	2958.5

In spring 2012, the significantly highest average number of weed seeds was identified in maize continuous cropping (6425.0 seeds/m^2), Table 2. Application of herbicides affected weed seed bank richness and the highest number of seeds was identified in untreated control, in almost all production systems. Very effective in decreasing of weed seed bank richness was weed free treatment in which the lowest number of weed seeds was identified. But, differences in amounts of herbicides did not significantly affect weed seed bank richness in the first 3-4 years of crop rotation. The most distributed were broadleaf annual weed species *Chenopodium* sp., *Amaranthus* sp. and *Datura stramonium*. *Amaranthus* sp. accounted for 57.1% in total weed seeds number in MW rotation and 59.0% in MWS rotation.

Table 2. Number of weed seeds (No of seeds/m^2) in different cropping systems in spring 2012

Weed species	Herbicide treatments				
	Weedy check	RD	½ RD	Hoeing	Average
Maize continuous cropping					
Chenopodium sp.	3150	2950	2275	2550	2731.3
Amaranthus sp.	5775	3675	2125	2075	3412.5
Daturastramonium	300	175	125	200	200.0
Abuthilontheophrasti	25		25		12.5
Setariaviridis	25				6.3
Hibiscus trionum	50				12.5
Polygonumconvolvulus	25	125	25		43.8
Sinapisarvense		25			6.3
Total	9350	6950	4575	4825	6425.0 a
Maize-wheat rotation					
Chenopodium sp.	1650	1100	1400	875	1256.3
Amaranthus sp.	3775	1675	2025	1175	2162.5
Daturastramonium	225	250	275	300	262.5
Polygonum convolvulus	50	50		175	68.8

Convolvulus arvensis	25	25	50	25	31.3
Abutilon theophrasti			25		6.3
Total	5725	3100	3775	2550	3787.5 b
	Maize- Wheat-Soybean				
Chenopodium sp.	1350	1350	1025	875	1150.0
Amaranthus sp.	1350	2000	1350	775	1368.8
Daturastramonium	175	325	75	100	168.8
Polygonum convolvulus	125	125	100	75	106.3
Total	3000	3800	2550	1825	2793.9 b
	Maize-Soybean-Wheat				
Chenopodium sp.	1100	1150	1175	1350	1193.8
Amaranthus sp.	2750	2700	1650	1650	2187.5
Daturastramonium	300	200	275	175	237.5
Polygonum convolvulus	75	50	75	75	68.8
Convolvulus arvensis	25			25	12.5
Sorghum halepense	25				6.3
Total	4275	4100	3175	3275	3706.4 b
Average	5587.5 a	4487.5 a	3518.8 a	3118.8 b	4178.2

LSD 0.05 plant production system = 2236.0; LSD 0.05 weed management method = 2447.0
LSD 0.05 interaction = 2070.0

After one cycle of rotation, number of weed seeds was lower in autumn 2012, than in spring, over all cropping systems, Table 3. This could be connected with life cycles of prevalent weed species. Most of them are late spring weeds and they emerge when first analyse was conducted in May, and then in September their seeds was not completely matured and disseminated yet. Average number of seeds was higher in maize continuous cropping 2.0 times than in MW rotation, 2.5 times than in MWS and 1.4 times than in MSW rotation. The most abundant were broadleaf annual weed species *Chenopodium* sp., *Amaranthus* sp. and *Daturastramonium*. *Amaranthus* sp. accounted for 40.7% in total weed seeds number in maize continuous cropping, 52.3% in MW rotation, 45.3% in MWS and 56.8% in MSW rotation.

Table 3. Number of weed seeds (No of seeds/m^2) in different cropping systems in autumn 2012

Weed species	Herbicide treatments				
	Weedy check	RD	½ RD	Hoeing	Average
	Maize continuous cropping				
Chenopodium sp.	3525	2525	2400	2725	2793.8
Amaranthus sp.	3025	2150	2275	2300	2437.5
Daturastramonium	550	100	175	275	275.0
Polygonum convolvulus	25	975	650		412.5
Hibiscus trionum	50			25	18.8
Convolulusarvensis	25				6.3
Solanumnigrum	150				37.5
Sorghum halepense			25		6.3
Total	7350	5750	5525	5325	5987.5 a
	Maize-wheat rotation				
Chenopodium sp.	900	1525	1250	700	1093.8
Amaranthus sp.	2525	1300	1200	1175	1550.0

Daturastramonium	275	150	375	250	262.5
Polygonum convolvulus	25	75	25	50	43.8
Sorghum halepense		25			6.3
Abuthilontheophrasti				25	6.3
Total	3725	3075	2850	2200	2962.5 b
Maize- Wheat-Soybean					
Chenopodium sp.	1000	1050	1025	800	968.8
Amaranthus sp.	800	1375	1200	925	1075.0
Daturastramonium	125	175	125	75	125.0
Polygonum convolvulus	225	300	100	150	193.8
Sorghum halepense			50		12.5
Total	2150	2900	2500	1950	2375.0 b
Maize-Soybean-Wheat					
Chenopodium sp.	1500	1525	1425	1225	1418.8
Amaranthus sp.	1450	2850	1775	3425	2375.0
Daturastramonium	200	225	150	600	293.8
Polygonum convolvulus	75	150	50	75	87.5
Convolvulus arvensis	25				6.3
Total	3250	4750	3400	5325	4181.3a
Average	4118.8ns	4118.8ns	3568.8ns	3700.0ns	3876.6
LSD 0.05 plant production system =1663.0; LSD 0.05 weed management method = 2153.0 LSD 0.05 interaction = 1427.0					

Number of weed seeds decreased in crop rotations together with herbicide application or weed removal by hoeing in spring evaluation 2013, Table 4. Total number of weed seeds was 1.7 times lower in MW, 2.1 times in MWS and 1.4 times in MSW rotation than in continuous cropping. Especially effective were MW and MWS in which, after four years, crop rotation and herbicide application decreased the number of weed seeds even in comparison to 2012. In those two production systems, even in the untreated control, number of weed seeds in the soil upper layer was significantly lower (2700 and 1425 seeds/m^2) than in continuous cropping (4850 seeds/m^2). The most abundant were again broadleaf weed species *Chenopodium* sp., *Amaranthus* sp. and *Daturastramonium*, esspecialy *Amaranthus* sp, which participated about 50% in total weed seeds number.

Table 4. Number of weed seeds in different cropping systems in spring 2013

Weed species	Herbicide treatments				
	Weedy check	RD	½ RD	Hoeing	Average
Maize continuous cropping					
Chenopodium sp.	1800	2150	1350	1425	1681.3
Amaranthus sp.	2800	3000	1350	1250	2100.0
Daturastramonium	250	150	125	175	175.0
Hibiscus trionum				25	6.3
Convolulusarvensis				25	6.3
Polygonum convolvulus			25		6.3
Total	4850	5300	2850	2900	3975.0 a
Maize-wheat rotation					
Chenopodium sp.	875	1075	1125	825	975.0
Amaranthus sp.	1575	1350	950	975	1212.5
Daturastramonium	200	175	100	125	150.0

Polygonum convolvulus	25	75	25		31.3
Sorghum halepense	25			25	12.5
Convolvulus arvensis		25			6.3
Total	2700	2700	2200	1950	2387.5 b
		Maize- Wheat-Soybean			
Chenopodium sp.	600	400	400	550	487.5
Amaranthus sp.	650	2050	1050	775	1131.3
Daturastramonium	125	125	100	150	125.0
Polygonum convolvulus	50	100	175	75	100.0
Sorghum halepense		75	25		25.0
Total	1425	2750	1750	1550	1868.8 b
		Maize-Soybean-Wheat			
Chenopodium sp.	1725	950	1250	775	1175.0
Amaranthus sp.	2200	1150	1575	1325	1562.5
Daturastramonium	100	125	200	200	156.3
Polygonum convolvulus	25		50	25	25.0
Sorghum halepense			25	25	12.5
Abuthilontheophrasti		25			6.3
Total	4050	2250	3100	2350	2937.5 a
Average	3256.3ns	3250.0ns	2475.0ns	2187.5ns	2792.2
LSD 0.05 plant production system = 1391.0; LSD 0.05 weed management method = 1532.0 LSD 0.05 interaction = 1131.0					

Weed community is radically reduced under intensive application of high cropping technology (crop rotation, fertilization, herbicide application, etc.), which was obviously adequate (Barberi et al., 1998). Total number of weed species which were detected in maize field during two years (2012-2013) is between 4 and 8 species. Number of weed species was not affected by crop rotation, and even herbicide application, but number of their seeds was. Significant differences between maize continuous cropping and other cropping systems were found for number of weed seeds in the soil. The highest total number of weed seeds in average was identified in MC and the lowest in MWS rotation, in both years. Weed sandbank richness was the highest in spring 2012 (4187.2 seeds/m^2), lower in autumn 2012 (3876.6 seeds/m^2) and the lowest in spring 2013 (2792.2 seeds/m^2). Total number of weed seeds in spring 2013 was 1.7 times higher in MC than in MW, 2.2 times than in MWS and 1.4 times than in MSW cropping system. It is also noticeable that average number of weed seeds was even lower in spring 2013 than in spring 2012, which contribute to the integrated application of crop rotation with chemical weed control (Simic et al., 2014). Broadleaf species prevailed in comparison to grasses (Table 1, 2, 3 and 4), in all production systems and homogeneity of weed seed bank community analysed from upper layer of the soil, was noticeable as it was showed in previous investigations (Barberi et al., 1998). Similar results with *Amaranthus* sp. seeds prevalence was noticed in previous investigation of management system influence on seed bank composition in maize crop (Barberi et al., 1998).

Crop rotation significantly reduced weed seedbank richness and the most effective was MSW rotation in both years. Application of weed control methods also affected number of weed seeds in the upper soil layer and the most effective was weed removal by hoeing. Differences in efficiency of herbicides in weed seedbank size between recommended and half dose, were not significant. The lowest values of weed seeds were obtained in MSW cropping system, in spring 2013 (in average 1868.8 seeds/m^2), after four years of rotation. Wheat as a cereal crop, together with herbicides used for its production is suited better for effective weed control and

maize production than soybean. According to previous results, reduced herbicide rate together with rotations that include cereals or forage crops can facilitate suppression of some troublesome weeds (Heggenstaller and Liebman, 2005).

Conclusion

Crop rotation in combination with herbicides can reduce level of maize weed infestation in comparison to continuous cropping. The highest total number of weed seeds in average was identified in maize continuous cropping and the lowest in MWS rotation, in both years. The most abundant were broadleaf annual weed species *Chenopodium* sp., *Amaranthus* sp. and *Datura stramonium*. Results indicated that the processes affecting the weed seed bank in the fields are complex and will vary greatly based on the production practices used and the timing of their application. Because crop rotation expressed its effects after some years, the study will be continued in order to achieve more precise results.

Acknowledgments

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RAPESEED FLOWERS WILT CAUSED BY PATHOGENIC FUNGI LEPTOSPHAERIA MACULANS IN SERBIA

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Abstract

Stem canker (blackleg) is economically the most important disease of oilseed rape worldwide. In addition to the cotyledons, stem, leaf and pods in favorable climates conditions (humid and rainy weather) parasite can cause wilt flowers of rapeseed. In 2010, with the flowers of rapeseed more isolated strains of fungi. In these studies investigated the morphology and pathogenic properties that is associated with the molecular identification. On PDA medium at 25 ± 1^0C were studied morphological characteristics of the isolates: growth, appearance, color and appearance of the edge of the colony, the forms of pigments as well as structure and appearance of mycelium, the size, shape and color pycnidiospores and pycnidia 9 isolates (isolated in Serbia C -1, C-2, C-3, C-4, C-5, C-6, C-7, C-8, C-9). All study strains on nutrient medium formed irregular colonies, they have slow growth and a strong sporulation. Pycnidiospore are unicellular, hyaline, mostly straight, with or without a drop of oil. All tested isolates causing disease symptoms on cotyledons cultivar Bana anka Molecular identification was performed application the PCR technique using primers PN3/PN10. In addition to these isolates were used and two reference strains obtained from the Centre for agricultural studies, Rothamsted, UK, and which are marked with L.m (*Leptosphaeria maculans*) and L.b (*Leptosphaeria biglobosa*). These studies showed that all the strains isolated with wilt flowers of rapeseed belonging to the species *Leptosphaeria maculans*.

Key words: *Brassica napus*, *Leptosphaeria maculans*, *morphological and pathogenic properties, molecular identification.*

Introduction

Blackleg and stem canker is economically the most important disease of oilseed rape in Europe, Australia and North America (Fitt et al., 2006). This disease is caused by two species of plant pathogenic fungi of the genus *Leptosphaeria*: *Leptosphaeria maculans* (Desm.) Ces. de Not anamorphic stadium: Phoma lingam (Tode ex Fr.) Desm and *Leptosphaeria biglobosa* Shoemate and Brun. Both types are present on all the continents (Anon 2004 loc cit. Fitt et al., 2006). The intensity of the disease depends on climatic factors, agro-technical measures and resistance varieties (Howlett, 2004; Aubertot et al., 2006; Sosnowski et al., 2004). The parasite causes symptoms in the emergence and maturation of rapeseed. On cotyledons, leaves, and pods symptoms manifest themselves in the form of leaf spot, while the stem and root fungus causes cancer, or dry rot (Gabrielson, 1983; Paul & Rowlinson, 1992). During the autumn, the fungus causes leaf infection by ascospores that are released from mature pseudothecia (Huang et al., 2003a; Marcroft et al., 1999; Hammond et al., 1985). In addition to ascospores in Australia pycnidiospores pathogens cause the symptoms of the cotyledon and hypocotyl (Barbetti & Khangura, 2000 loc cit. West et al., 2001; Gosende et al., 2003). During the spring the mycelium from the leaf continue to grow and over the petiole infects a stem, causing the symptoms of cancer (Hammond et al., 1985; Thürwächter et al., 1999; Paul

and Rawlinson, 1992). On nutrient medium isolates of group A (*L. maculans*) are slow and irregular increase compared to group B (McGee and Petrie, 1978; Humpherson-Jones, 1983; 1986; Koch et al., 1989). However, there are also reports that some isolates of group A have a faster growth of group B, it is clearly not possible to distinguish reliable on the basis of colony growth rate in vitro (Delwiche, 1980 cited by Williams in 1992; Kharbanda and Stevens, 1993; Salisbury et al., 1995). In addition to the symptoms of the disease seems to plants,cultural characteristics or analyses of secondary metabolite(sirodesmin PL),the value of recent advances in nucleic acid technology in particular the polymerase chain reaction (PCR) in the detection and characterization of plant pathogen (Janse, 1995). Molecular characterization of *L. maculans* has received considerable attention and results from several methods: RFLP profiling, DNA sequence analysis and several PCR-based methods, provide compelling evidence that *L. maculans* consists of more than one species (Johnson and Lewis, 1990; Koch et al., 1991; Taylor et al., 1991; Jedryczka et al., 1997).

Material and Methods

Isolation of fungi and obtaining single-spores isolates
Fungal strains were isolated from diseased canola flowers that were collected from three sites (Crvenka, Rimski šan evi, Srbobran) from Serbia during 2010 year. Fragments of the diseased plant flowers were dipped into a solution of 3% sodium hypochlorite for 3 to 5 minutes, and then were washed with distilled water, and naturally dried in controlled conditions. After drying, the parts of the diseased tissue were placed on the PDA (potato dextrose agar) medium (Difco Detroit USA. The nutrient medium was added to 50 mg of streptomycin sulphate (Galenika Belgrade, Serbia) per liter. Petri dishes were kept at a temperature of $25^{o}C \pm 1^{o}C$. Obtaining single-spore isolates was performed on the follows: Pycnidiospores, which are released from the pycnidia in form droplets, the tip of the needle were transferred to plastic tubes containing previously added 2 ml of sterile water. The suspension pycnidiospores was poured on water agar. After 48^{h}, germinated pycnidiospore, together with a part of the substrate was transferred on the PDA medium, and placed in controlled conditions at $25^{o}C \pm 1^{o}C$ in order to develop single-spores isolates. In this study, was investigated 9 isolates (C -1, C-2, C-3, C-4, C-5, C-6, C-7, C-8, C-9). In addition to these isolates were used and two reference strains obtained from the Centre for agricultural studies, Rothamsted, UK, and which are marked with L.m (*Leptosphaeria maculans*) and L.b (*Leptosphaeria biglobosa*) and two isolates originating from Serbia, which are marked with K-117, K-118.

Morphological characteristics
On PDA medium at a temperature $25^{o}C \pm 1^{0}C$ were studied morphological characteristics of the isolates: growth, appearance, color and appearance of the edge of the colony, formation of pigment as well as the structure and appearance of mycelium,then the size, shape and color pycnidiospora and pycnidia (Muntanjola-Cvetkovic 1987). Mycelium growth of the tested isolates were expressed in cm after 5, 10 and 15 days.

Pathogenicity tests
In addition to the morphological characteristics were investigated and pathogenic properties of isolates.In jiffy pots, which are were previously filled with compost,seedlings were planted at 5 germinated rapeseed cultivar Bana anka. After germination (6-7 days) cotyledons were punctured with a sterile needle. On each wound a drop 5 µl of pycnidiospore suspension 10^{6}/ml was placed (Koch et al. 1991). The plants inoculated were transferred in controlled conditions at a temperature of $20^{0}C$ and 95% RH for 12^{h} photoperiod. After 48^{h} the plants were placed in the greenhouse. The first review of the plants was performed after 5 days and

the onset of symptoms and changes in plants have been observed in the next 20 days. Pathogenicity of isolates was assessed with + (causing the symptoms of the cotyledons) and - (no symptoms). Pycnidiospores suspension was prepared as follows: each isolate was placed on PDA medium in three replications. After 10-15 days based on binocular reviews in Petri dishes were added to 10 ml of sterile distilled water (Bonman et al. 1981. Sterile glass rod was gently withdrawn over the surface of pycnidia and mycelium to obtain his release pycnidiospores. Pycnidiospore released from Petri dishes were filtered through 10 MESHA sieve into a sterile plastic tube.The suspension pycnidiospores was kept 56h under controlled conditions at a temperature of 20° C $\pm$ 1° C and 12^h photoperiod.

Fungal DNA extraction
Total DNA isolates was extracted using the method described by O˙Gorman et al. (1994) with the following modification by Kuusk et al. (2002). Mycelium and pycnidia were harvested from two-to-three week old PDA plates and frozen in liquid nitrogen. By Day and Shattock (1997) material was subsequently ground to powder and suspended in 800 µl extraction buffer (2% (w/v) CTAB 100 µl Tris-HCl pH 8,0, 20 mMEDTA pH 8,0, 1,4 MNaCl i 1% (w/v) polyvinyl pyrrolidone). After incubation at 65^0C for 1h, the mixture was added 600 µl of chloroform and vortexed for 10 seconds in the incubator at 25°C. The tubes were then centrifuged at 1300 g for 10 min. The liquid phase (approximately 500 ul) was transferred into a new tube and added to 300 µl isopropanol. Re-incubated for 10 min at room temperature and then centrifuged for 10 min at 1300 g. Following centrifugation the liquid was decanted from the tube and then added 600 µl of 70% ethanol. The tubes were vortexed for 10 seconds in an incubator and then centrifuged for 10 min at 1300 g. Open tube placed in a dryer at 50°C for 10 min. The resulting precipitate was dissolved in 100 µl TE buffer pH 8.0 and kept for several minutes at room temperature and then frozen at-20°C.

PCR analysis
Primers used for ITS amplification were deduced from flanking sequences of *Saccharomyces cerivisiae,* the 18S rDNA for primer PN3 (forward) (5´CCGTTGGTGAACCAGCGGAGGGATC) and the 28S rDNA PN10 (reverse) (TCCGCTTATTGATATGCTTAAG). Amplifications were performed in a total volumeof 25 µl containing: 1 µl fungal DNA, 11 µl H_2O, 12.5 µl master mix REDTaq (Sigma aldrich) with $MgCl_2$ (Taq polymerase 0.06 U/µl 3 mM $MgCl_2$ 0.002% gelatin 0.4 mM dNTP), 1.25µl each primer.(Balesdent et al.1998). The mixture is centrifuged briefly and then the tubes were placed in PCR (Eppendorf master cycler gradient).The reaction was performed for 37 cycles.Each cycle consisted of 30 s at 94ºC, 30 s at 58ºC and 1 min at 72ºC. PCR amplified fragments were visually observed on the 1.5% agarose gels stained with ethidium bromide .Marker (M)=DNA Length Standard 3000 bp, Eurofines, Gene Scan.

Results and disscusion

Symptoms
Leptosphaeria maculans is causing symptoms to the rapeseed plants from the stages cotyledon until maturity of crops. In addition to (hypocotyls, cotyledon, stem, upper stem, pod) parasite causes wilt and decay of flowers. In the early stages of the parasitic fungus causing wilt flowers (fig.1). Later, the flowers become rudimentary brown colour and remain on floral branches. At this stage, the parts of the flower and floral sprigs can be observed pycnidial fungi.

Fig.1. Rapeseed flowers wilt caused by the fungus *L. maculans* (initial and final symptom)

Morphological characteristics

On PDA medium after 5 days (at a temperature of $25^0C \pm 1^0C$) isolates form a roundish irregular colonies off-white color with an irregular edge. After 10 days, the center of the colony is black color because of the presence of pycnidia. Sustratna colony is also the form of irregular, off-white, with early accumulation of black pigment. After 15 days colonies due to strong sporulation have a brown color, and only certain parts of the edge of the colony are dirty white. With the age of the colony of the edge becomes more irregular. All the tested isolates and reference with LM have slow growth on PDA medium. Pycnidia are roundish, dark brown, singular or in stromatic, diameter 220 x 510 um. Pycnidiospores released from the pycnidia in the form of drops of gelatin, yellow to pink color. Pycnidiospores are unicellular, hyaline, shortly cylindrical, mostly straight, a slightly curved, with or without a drop of oil, the diameter of 1.30 x 2.20 x 2.80 to 5.40 um. Mycelial growth and sporulation of tested isolates is shown in Tab. 1.

Table 1. Diameter (cm) and sporulation of tested isolates of L. maculans on PDA medium and temperature of $25^0C \pm 1^0C$.

Isolate	After 5 days	Sporulation	After 10 days	Sporulation	After 15 days	Sporulation
L.m	1.51	-	3.30	++	4.70	+++
L.b	1.55	-	4.30	-	9	+

C-1	1.39	-	2.40	+	3.35	+++
C-2	1.45	-	2.95	++	4.60	+++
C-3	1.40	-	2.70	++	4.35	+++
C-4	1.53	-	3.00	+	4.10	+++
C-5	1.57	-	2.50	++	4.05	+++
C-6	1.80	-	3.40	++	4.80	+++
C-7	1.6O	-	2.90	++	4.50	+ + +
C-8	1,48	-	2,95	+ +	3,90	+ + +
C-9	1,50	-	2,40	+	3,05	+ + +
K-117	1,60	-	4,40	+	9	++
K-118	1,57	-	4,45	-	9	+

- No sporulation; + low sporulation; + + middle sporulation; + + + strong sporulation

Pathogenicity isolates

The first appearance of symptoms (after 5 days) could be observed on the inoculated part of the cotyledon in the form of chlorosis tissue. After 7 days, chlorosis covered the entire cotyledon. On the infected part of the tissue appeared grayish spots edged with dark margin (fig.2). After 15 days the center of the spot it had a pronounced greyish white color. During this period was observed the beginning of the formation of pycnidia in the center of the spots. In this study, all tested isolates showed high aggressiveness.

Fig. 3. Control (on the left) and symptoms of the disease (on the right)

Molecular characteristics

Size polymorphism of the ITS region was evident following amplification of fungal DNA using the PN3 and PN10 primers.The tested isolates (C-1, C-2, C-3, C-4, C-5, C-6, C-7, C-8, C-9), as well as reference strains L.m (*L. maculans*), PN3 and PN10 primers givig a 560 bp band (fig.3). Based on obtained fragments size tested isolates (C-1, C-2, C-3, C-4, C-5, C-6, C-7, C-8, C-9) belonging to the species L. maculans. With reference strains Lb (*L. biglobosa*) and K-117, K-118 size of the amplified fragment were 580bp
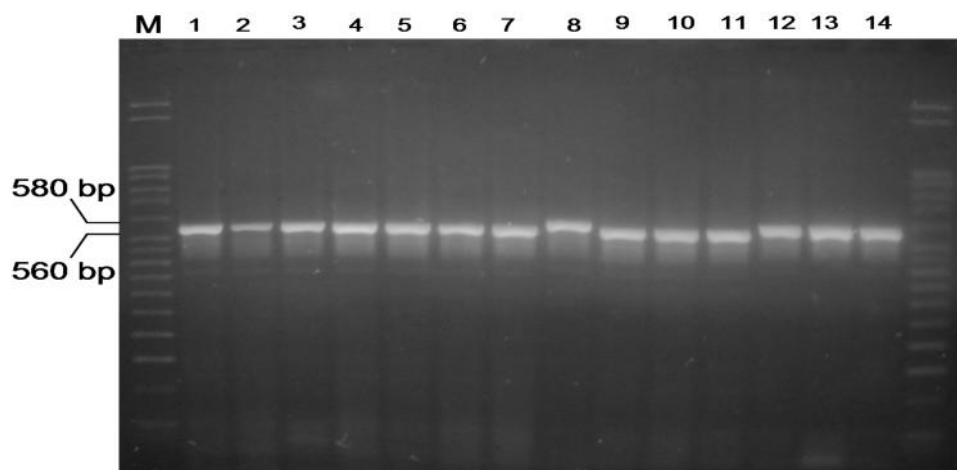
Fig.3. PCR amplified fragments with PN3 and PN10 primers. M 3000 bp marker, 1 C-1; 2 C-2; 3 C-3;4 C-4; 5 C-5; 6 C-6; 7 L.m; 8 L.b; 9 C-7; 10 C-8; 11 C-9; 12 L.b; 13 K-117; 14 K-118.

Among the many diseases, stem cancer is an economically important disease of oilseed rape in the world (Fitt et al., 2006). The parasite causes the symptoms of disease of the stages cotyledons until maturity rapeseed (Petrie, 1979; Paul and Rawlinson, 1992). Fungi in nature are maintained by pycnidia, mycelia and pseudothecia (Williams, 1992). The favorable climatic conditions for fungi (wet and rainy weather) pathogen can cause collapse flowers. In the initial stages of the disease occurs in the form of wilting flowers. Later, the flowers become rudimentary brown color and remain glued to twigs. At this stage floral sprigs and flowers become grayish white color on which were observed pycnidial fungi (Mitrovic and Trkulja, 2010).

On PDA medium, in the initial stages of development, and later, all of the isolates tested (C -1, C-2, C-3, C-4, C-5, C-6, C-7, C-8, C-9) forming mycelium gray-white color which is in accordance with Williams & Fitt (1999) and Fitt et al. (2006) Aging colony forming black pigment in the medium (Pound, 1947; Humpherson-Jones, 1986; Williams and Fitt 1999; Mitrovi and Marinkovi , 2007). Mycelia of all tested strains have slow and erratic increase in the PDA medium with a rim, which is often with irregular edges, which is in accordance with Pound (1947), Koch et al. (1989), Mitrovi and Marinkovi (2007), Williams and Fitt (1999). However, there are report that some isolates (*L. maculans*) have a rapid increase in the nutrient medium (Delwiche 1980 cit. Loc. Williams 1992; Kharbanda and Stevens 1993, Salisbury et al. 1995), which is not the case with tested isolates. All the tested isolates on PDA medium, forming roundish pycnidia dark brown, singular or in stromatic Pycnidia diameter of 220 to 510 μm which is in accordance with Punithalingam and Holliday (1972). Pycnidiospores released from the pycnidia in the form of drops of gelatin, yellow to pink color. Pycnidiospores are unicellular, hyaline, shortly cylindrical, mostly straight, a slightly curved, with or without a drop of oil, the diameter of 1.30 x 2.20 x 2.80 to 5.40 um. Similar results were presented by other authors (Punithalingam and Holliday, 1972; Williams, 1992; Mitrovi and Marinkovi , 2007; Mitrovi , 2013). The appearance of spots on the infected cotyledons is very similar to the other authors (Hall, 1992; West et al. 1999; Brun et al. 1997; Mitrovi , 2013). PN3 and PN10 primers in the tested isolates amplified DNA fragments of about 560 bp for species Leptosphaeria maculans and 580 bp for *Leptosphaeria biglobosa* type which is consistent with the results (Balesdent et al. 1998) while Mendes–Pereira et al. (2003) reported size of the amplified fragment were 468 bp for *Leptosphaeria maculans* (Tox[+] isolates representative) and 496 bp of *Leptosphaeria biglobosa*.

Conclusion

The tested isolates, from infected plants, are causing symptoms in the form of light gray to gray spots bordered by a dark rim within which are pycnidia. On PDA medium, colonies grow slowly and irregularly. Pycnidia are roundish black with a diameter of 220 to 510 um. Pycnidiospores are unicellular, hyaline, shortly cylindrical, mostly straight and slightly curved, with or without a drop of oil, the diameter of 1:30 x 2:20 x 2.80 to 5:40 m. PN3 and PN10 primers in the tested isolates amplified DNA fragments of about 560 bp. Based on the conducted research it can be concluded that all isolates belong to the species Leptosphaeria maculans.

Acknowledgement

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RESISTENCE OF SOME WINTER WHEAT GENOTYPES TO PUCCINIA LEAF RUST

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Abstract

Winter wheat (*Triticum aestivum* L.) is one of the oldest and most important crops ever. Rust diseases are well-known more than a thousand years ago, and are the most frequent causal agents of wheat diseases in the world. Wheat leaf rust, caused by the biotrophic fungus *Puccinia triticina*, is a disease which accompanies wheat production regularly. The study was carried out during 2011 and 2012, in the condition of natural infection, at the location Kraljevo (Serbia). Resistance of 20 winter wheat cultivars was studied. Seeding was done a cultivar per row, with row length of 1 m and inter-row distance of 30 cm. During maximal pathogen development, reaction mode of the investigated cultivars was graded by determining infection type from 0-4 and infection intensity from 0-100%. A high level of resistance in 2011 and 2012 was shown by the cultivar Gordana, with infection coefficient of 0%. Moderately susceptible infection type 3 and trace infection intensity in 2011 was observed in the cultivar Zvezdana. Low infection intensity (10%) in 2012 was observed in the cultivar Renesansa, which reacted by infection type 3. Infection intensity of the most susceptible cultivar Rapsodija was 40% in 2011, and 30% in 2012.

Key words: *leaf rust*, *winter wheat*, *resistance*, *susceptibility*, *cultivars*.

Introduction

Wheat (*Triticum aestivum* L.) is the most important field crop which today is grown on large areas throughout the world. Wheat grain yield is affected by numerous factors, and among them are parasites, causal agents of various plant diseases. Den i (2006) suggested that good utilizability of genetic potential for grain yield of grown wheat cultivars demands optimal weather conditions, adequate agro-technique, as well as resistance to diseases.

Leaf rust of wheat, caused by biotrophic fungus *Puccinia triticina*, is a disease which regularly follows wheat production. Boškovi and Boškovi (1994) stated that leaf rust is the most common wheat disease, which attacks this crop so in cold regions, as in subtropical ones. Damage caused by this parasite depends on resistance of grown cultivars, virulence of its pathotypes, as well as on ecological factors. Kolmer (2001) pointed out that grain yield decrease also depended on phenological stage of wheat during which primary infection happened. If plants were infected in initial developmental stages, they showed decreased resistance to low temperature, so that tillering was not strong enough, and spike size was also decreased. The all mentioned caused presence of empty grains in spikes, root and stalk lodging, and often death of whole plant (Roelfs and Bushnell, 1985). Samborski (1985) reported estimation that grain yield loss caused by leaf rust was from 5-15%, but also could be higher.

Causal agent of leaf rusts is present in Serbia every year and intensity of its attack rises rapidly from the second decade of May. In addition to grain yield decrease, this pathogenous fungus has a significant deteriorating effect on technological quality of wheat grain (Jerkovi

and uri , 1998). Among integrated protection measures, the most important one is breeding and growing resistant cultivars, and that way most efficient, most economical and environmentally friendliest protection is achieved. For that reason, in Serbia, a special attention is paid to studying resistance of various wheat cultivars, with the aim to identify good donors of resistance genes and to use them in wheat breeding programs. Jerkovi et al. (2007) pointed out that reaching high and stable grain yield in semiarid regions is possible only growing cultivars with genetic resistance. Introduction of new cultivars put a pressure on parasite population and force it to make adaptations. It does that by changing racial composition, and very quickly resistant cultivars become susceptible ones.

This study has been aimed to establish resistance of some wheat cultivars in order to recommend the most resistant ones to farmers and help them in achieving high and stable production.

Material and metods

The study was carried out during 2011 and 2012, in the condition of natural infection, at the location Kraljevo. The trials were set at 192 m of altitude, $43^{o}43'N$ of latitude and $20^{o}40'$ E of longitude. Resistance of the following 20 winter wheat cultivars was studied: Rusija, Zvezda, Zelengora, Jasenica, NS-Rana 5, Etida, Jugoslavija, Panoramka, Lasta, Evropa, Renesansa, Pobeda, Rapsodija, Kruna, Žitnica, Francuska, Zvezdana, Natalija, Gordana and Simonida.

Seeding was done a cultivar per row, with row length of 1 m and inter-row distance of 30 cm. During maximal pathogen development, reaction mode of the investigated cultivars was graded by determining infection type from 0-4 (Stakman et al., 1962) and severity of infection from 0-100%(Peterson et al., 1948). Meaning of infection types is the following: 0 – very resistant (VR); 1 – resistant (R); 2 – moderately resistant (MR); 3 – moderately susceptible (MS); 4 – very susceptible (VS). Plants that react by infection type 0-2 are regarded as resistant, and those reacting by infection type 3-4 as susceptible ones. On the basis of determined infection type and severity of infection we calculated coefficient of infection multiplying severity of infection by numerical values for infection types (0-0; 1-0.2; 2-0.4; 3-0.8 and 4-1). Cultivars with observed coefficient of infection 0-5 were regarded as very resistant, 6-10 as resistant, 11-25 as moderately resistant, 26-40 as moderately susceptible, 41-65 as susceptible and 66-100 as very susceptible ones (Stojanovi , 2004).

Results and discussion

Results of the study showed that severity of infection of the most susceptible cultivar Rapsodija in 2011 was 40%, while in 2012 it was 30% (tab. 1). The most resistant cultivar in both 2011 and 2012 was Gordana with coefficient of infection 0%. It pointed to this cultivar as having factors of complex resistance. High level of resistance was also shown by the cultivar Lasta which had coefficient of infection 2% in 2012. Resistance of cultivar Lasta was previously reported by Stojanovi et al. (2006) and Stojanovi et al. (1997), which was in accordance with the results of our investigation. Trace intensity of infection was established in cultivar Zvezdana during 2011 and in cultivars Zelengora, Jasenica and Francuska during 2012. Zvezdana and Jasenica reacted by moderately susceptible infection type 3, while Zelengora and Francuska by moderately resistant infection type 2. Low severity of infection (10%) during 2011 showed cultivars Zvezda, Zelengora, Panoramka and Simonida, as well as Renesansa in 2012, and all of them reacted by the infection type 3. Moderate resistance in 2011 was observed in cultivars Rusija, NS-Rana 5, Etida, Jugoslavija, Renesansa, Kruna, Žitnica and Natalija with coefficient of infection from 11% to 25%. According to Jerkovi and Jevti (2002) the cultivar Renesansa reacts by partial resistance to this parasite. The results from 2012 showed a higher number of cultivars with severity of infection up to 20% (Rusija, Zvezda, NS-Rana 5, Etida, Jugoslavija, Panoramka, Evropa, Pobeda, Kruna, Žitnica,

Zvezdana, Natalija and Simonida). Furthermore, during the second year of investigation in most of cultivars the observed reaction types were moderately resistant or resistant. Having in mind that infection type is a result of interaction between host's resistance genes and pathogen's virulence genes, regardless severity of infection observed, it does not mean those values have to be the same in other environmental conditions. For that reason, before final decision on cultivars of choice, one ought to investigate resistance of available cultivars in given environmental conditions.

Table 1. Resistance of some winter wheat genotypes to *Puccinia triticina*

No	Cultivar	2011			2012		
		Type of infection	Severity of infection	Coeff. of infection	Type of infection	Severity of infection	Coeff. of infection
1	Rusija	4	20	20	3	20	16
2	Zvezda	3	10	8	2	20	8
3	Zelengora	3	10	8	2	t	-
4	Jasenica	3	20	16	3	t	-
5	NS-Rana 5	2	30	12	2	20	8
6	Etida	3	20	16	2	20	12
7	Jugoslavija	2	30	12	2	20	8
8	Panoramka	3	10	8	1	20	4
9	Lasta	0	0	0	1	10	2
10	Evropa	4	30	30	2	20	8
11	Renesansa	3	20	16	3	10	8
12	Pobeda	3	40	32	3	20	16
13	Rapsodija	4	40	40	4	30	30
14	Kruna	4	20	20	2	20	8
15	Žitnica	4	20	20	2	20	8
16	Francuska	2	20	8	2	t	-
17	Zvezdana	3	t	-	2	20	8
18	Natalija	3	20	16	2	20	8
19	Gordana	0	0	0	0	0	0
20	Simonida	3	10	8	1	20	4
	Average		21.7			19.3	

Conclusion

Leaf rust is one of diseases regularly met in Serbia every year. The average coefficient of infection was higher in 2011 (21.7%) than in 2012 (19.3%). The most resistant cultivar to *Puccinia triticina* in both years of investigation was Gordana. Furthermore, a high resistance was also shown by the cultivar Lasta. Observing both years of the study, the greatest susceptibility was observed in the cultivar Rapsodija. Success in wheat protection from the causal agent of leaf rust could be achieved by combining various protection measures. In addition to growing resistant genotypes, an adequate attention should be paid to agrotechnical and chemical protection measures.

Acknowledgment

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IN VITRO COMPREHENSIVE ASSESSMENT OF ANTAGONISTIC ACTIVITY OF *TRICHODERMA* GENUS FUNGI AGAINST *FUSARIUM* SPP.

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Abstract

As a result of researches from different substrates (peat, soil ground and mineral rock) new isolates of *Trichoderma* genus fungi were isolated with a wide variability of cultural and morphological features. Studying of new isolates and also collection *Trichoderma* genus fungus strains antagonistic activity has shown the presence of differently directed mechanism of antagonistic interaction in relation to phytopathogenic micromycetes *F. semitectum, F. verticilliodes* and *F. solani*. Inhibiting the linear pathogens growth on the 5-th day of co-culture cultivation varied in relation to *F. semitectum* from 39% to 100%, *F. verticilliodes* – from 48% t 100%, *F. solani* – fr m 45% t 85%. The growth coefficient of *Fusarium* spp. phytopathogens in a co-culture with the studied antagonists is fallen significantly and depending on the antagonist isolate or strain can be decreased for more than 5 times. For a majority of studied *Trichoderma* fungi a presence of a mixed type of antagonistic activity fungistatic alimental (II type) and antibiotic (IV type) antagonism is determined. The comprehensive assessment of antagonistic activity has shown that the most active antagonist is a fungus *Trichoderma* sp. D-11, effectively inhibiting the linear growth of studied phytopathogens and rendering a high antagonism level by II and IV type what allows to substantiate the perspectiveness of its use as a basis of a preparation to control *Fusarium* genus phytopathogenic micromycetes for biological control of fusarium etiology diseases.

Keywords: *Trichoderma, Fusarium, antagonistic activity, comprehensive assessment*

Introduction

To develop the biological plant protection against pathogens it is necessary to do search of active antagonists and hyperparasites with a high competition ability and a wide range of adaptation to different biological and abiotic factors (Muromtsev, 1980; Prokofiev, 1983). The microorganisms with the antagonistic peculiarities among which the representatives of the genuses *Bacillus, Pseudomonas, Trichoderma* answer these demands (Pavlyushin, 2002; Holmes, 2004; Bazhanov, 1998; Borodko, 1999). The effective biocontrol agents are the antagonist fungi of the genus *Trichoderma*, based on which a set of biological preparations for plant protection against phytopathogens and stimulation of growth and development of a wide crop assortment is developed. It is caused by high antagonistic potential of the indicated fungi, growth speed, sporulation ability at submerged cultivation (blastic type of conidiogenesis presence), technologicity of cultivation in the production (Grinko, 2000; Windham et al., 1968; Papavizas, 1985; Berestetsky and Sokornova, 2009). One should do the concrete search of antagonists to the specific pathogen species in their co-inhabitance medium, as it is more expedient to use local fungi of the genus *Trichoderma,* the most adopted to specified conditions (Golovanova, 2002; uromtsev, 1980; Papavizas, 1985).To develop a strategy of antagonists use in the biological control practically it is necessary to know their interrelations with the phytopathogens. By antagonist population introduction into ecosystem with already formed biotic connections for getting maximum protective effect the

population should successfully colonize substrate and being interrelated with the phytopathogenic microorganisms, decrease or suppress their development with the help of biologically active substances (antibiotics, lytic enzymes and other metabolic products). So, the antagonist should differ by high competition ability necessary to establish topic and trophic connections and occupy a correspondent ecological niche (Bazhanov, 1998; Sukhovitskaya, 1998; Philipchuk, 1998). So, the main selection criteria by active strains screening are their high growth speed, sporulation and the effective pathogen suppression *in vitro* (Monte, 2001; Vey et al., 2001). Based on it, the objective of our researches was to study the antagonistic activity of fungi genus *Trichoderma* in relation to phytopathogenic micromycetes genus *Fusarium*.

Materials and methods

The antagonists genus *Trichoderma* isolation was done from greens (dill, salad and parsley) rhizosphere and rhizoplane. The fungi genus *Fusarium* isolation was accomplished from the phytopathological material of plant samples. By micromycetes isolation from soil, 0,5-1 g plates were put in flasks with sterile water. The micromycetes desorption from soil particles was done on laboratory rocker (180 rotations/min.) in the course of 10-15 minutes (Zvyagintsev, 1991). While carrying out the researches the monospore isolates of *Fusarium* sp., were used which were obtained from fungus sporodochium formed at prolonged crop storage. To stimulate the typical sporulation formation carnation-leaf agar (CLA) was used. The species identification was done using Gerlach and Nirenberg atlas (Gerlach, Nirenberg, 1982). The antagonistic action study of isolated isolates and collection strains (*Trichoderma viride* IZR 2A and *Trichoderma harzianum* IZR S-4 – strains-bases of biopreparations Trichodermin-BL and Lignorin) of fungi genus *Trichoderma* in relation to phytopathogenic micromycetes genus *Fusarium* was done *in vitro* conditions by dual culture method (Egorov, 1976). The incubation temperature – 25° , repetitions – 4. As a control a pure phytopathogen culture was used. In the experiments a character of the fungus growth was periodically recorded (substrate or aerial mycelium), colony diameter, on the 3-rd day of co-culture cultivation the presence of sterile zones was analyzed, on the 5-th day – the antagonist zones increase on the phytopathogen colony were marked. To evaluate the antagonistic activity of the fungi genus *Trichoderma* the growth c efficient (RC) and the percentage of phytopathogen inhibition was recorded (Tarunina and Maslova, 1979).

The growth coefficient (RC) was calculated by formula:

$$RC = \frac{d \times h \times g}{t}$$

where, RC – growth coefficient; *d* – colony diameter, mm; *h* – colony height, mm; *g* – colony density, point; *t* – colony age, days.

The phytopathogen growth inhibition on the record day was determined by formula:

$$D = \frac{Dk - Do}{Dk} \times 100\%$$

where *D* – phytopathogen growth inhibition, %; D_k – fungus colonies diameter in control, mm; D_o – fungus colonies diameter in the experiment, mm.

The experiment was carried out on nutritive Chapek, wart-agar, Saburo, PDA.

The type of interrelations between fungi genus *Trichoderma* was characterized by the methods mentioned Poluksenova et al. (2004):

I – indifferent interrelations (the fungus genus *Trichoderma* colonies increase on the surface of the phytopathogen colony keeping the growth speed of both fungi);

II – fungistatic alimentary (one-side) antagonism (the fungus genus *Trichoderma* colonies increase on the phytopathogen colony surface which stops the active growth in this case);

III – territorial antagonism (the accumulation of the fungus genus *Trichoderma* by the pathogen colonies, usually the pathogen drops in growth behind);

IV – ntibiotic antagonism (slowing down the pathogen colonies growth in a distance from the fungus genus *Trichoderma*, zone formation in which the pathogen growth is not observed as a result of antibiotic substance secretion by the fungus genus *Trichoderma*);

V – mutual antagonism (fungus genus *Trichoderma* increase on the surface of the phytopathogen colony with the mutual inhibition of growth speed).

Results and discussion

Considering the fact that the effective antagonists screening to specific pathogens should be done in their cohabitation medium as the use of local strains of fungi genus *Trichoderma,* the most adapted to the specific conditions is the most appropriate, we have isolated from greens rhizosphere and rhizoplane the isolates of micromycetes genus *Trichoderma*:   -2,   -3,   -1,   -4-1,   -3,   -4, PMT-1, D-11.

Cultural and macromorphological characters of the fungi *Trichoderma* spp.

The analysis of cultural and macromorphological traits has allowed to determine that all isolates when cultured on nutritive agars PDA, wart-agar, Saburo, Chapek have formed correctly rounded form colonies. The edge of the most isolates colonies was clearly limited. Nevertheless, the isolates *Trichoderma* sp. TK-2 on wart agar and Chapek ,   -3 – PDA and Chapek agar,   -1,   -3,   -4, PM -1 – on PD , D-11 – on Chapek agar have formed irregular, refined edge of the colony.

On all the studied nutritive agars a profile of *Trichoderma* sp. isolate D-11 colony was salient, the isolate *Trichoderma* sp. T-3 on PDA and Saburo agar has formed a protuberant profile, on wart agar and Chapek – even. All other isolates have formed an even colony profile regardless of the medium.

The colonies structure analysis has shown the formation of three consistency types – tomentose, velvet and woolly. Each isolate on different nutritive agars has formed 2-3 different types of colonies: on PDA – tomentose and velvet, wart-agar – velvet and woolly, on Chapek agar – tomentose and velvet, on Saburo the structure of all colonies has got a woolly texture.

The colonies color varied depending on both the isolate and culture medium – yellow, yellow-green, dark-green. The color of the colonies reverse side also varied – white, beige, pale yellow, yellow, brown.

Most of the studied isolates have formed a colony without a marked centre, except the isolates of *Trichoderma* sp.   -2 on PDA, *Trichoderma* sp. D-11 – on PDA, Saburo and Chapek agars the colony's centre has got a crater-like appearance.

All isolates cultured on studied nutritive agars have got a typical fungal smell.

Starting of all isolates sporulation on wart-agar was noticed on the 3-rd day, apart the isolate *Trichoderma* sp.   -4 (4-th day). On PDA the isolates *Trichoderma* spp.   -3,   -3,   -4 started the sporulation on the 3-rd day, of *Trichoderma* spp.   -2,   4-1, P   -1 –on the 4-th day, *Trichoderma* spp.   -1 and D-11 – on the 5-th day of cultivation. On Saburo agar *Trichoderma* spp.   -2,   -3,   -1, P   -1 the isolates spores formation was marked on the 4-th day, *Trichoderma* spp.   4-1,   -3 and D-11 isolates – on the 5-th day. When cultured on Chapek agar *Trichoderma* spp.   -1, P   -1, D-11 isolates have formed spores on the 4-th day, *Trichoderma* spp.   -2, T-3,   4-1,   -3,   -4 – on the 5-th day.

The analysis of *Trichoderma* spp. isolates intensity of sporulation has shown that higher productivity was characteristic for *Trichoderma* sp. D-11 strain on wart agar (titer $9,0 \times 10^7$ spores/ m^2) and Chapek (titer $8,4 \times 10^7$ spores/ m^2).

Thus, it is shown that depending on the selected culture medium a variability of cultural-morphological peculiarities of *Trichoderma* spp. fungi strains is observed.

Screening of antagonistic activity of *Trichoderma* genus fungal strains activity in relation to phytopathogenic micromycetes *Fusarium* spp.

The results of our researches have shown that all the studied isolates and strains of *Trichoderma* spp. fungi possess the antagonistic activity in relation to phytopathogenic micromycetes of *Fusarium* spp. The analysis of character of *Trichoderma* spp. strains and isolates interaction with phytopathogens testify to different mechanisms of antagonistic interaction.

In relation to the studied fungi of *Fusarium* spp. all *Trichoderma* spp. isolates and strains have shown rather high effect in inhibiting a linear growth of pathogens. On the 5-th day of co-culture *F. semitectum* growth inhibition varied from 39 (*T. viride* 2A) to 100% (isolate D-11), *F. verticilliodes* – from 48 (isolate -2) to 100% (isolate D-11), *F. solani* – from 45 (isolate -3) to 85% (isolate D-11) (Fig. 1).
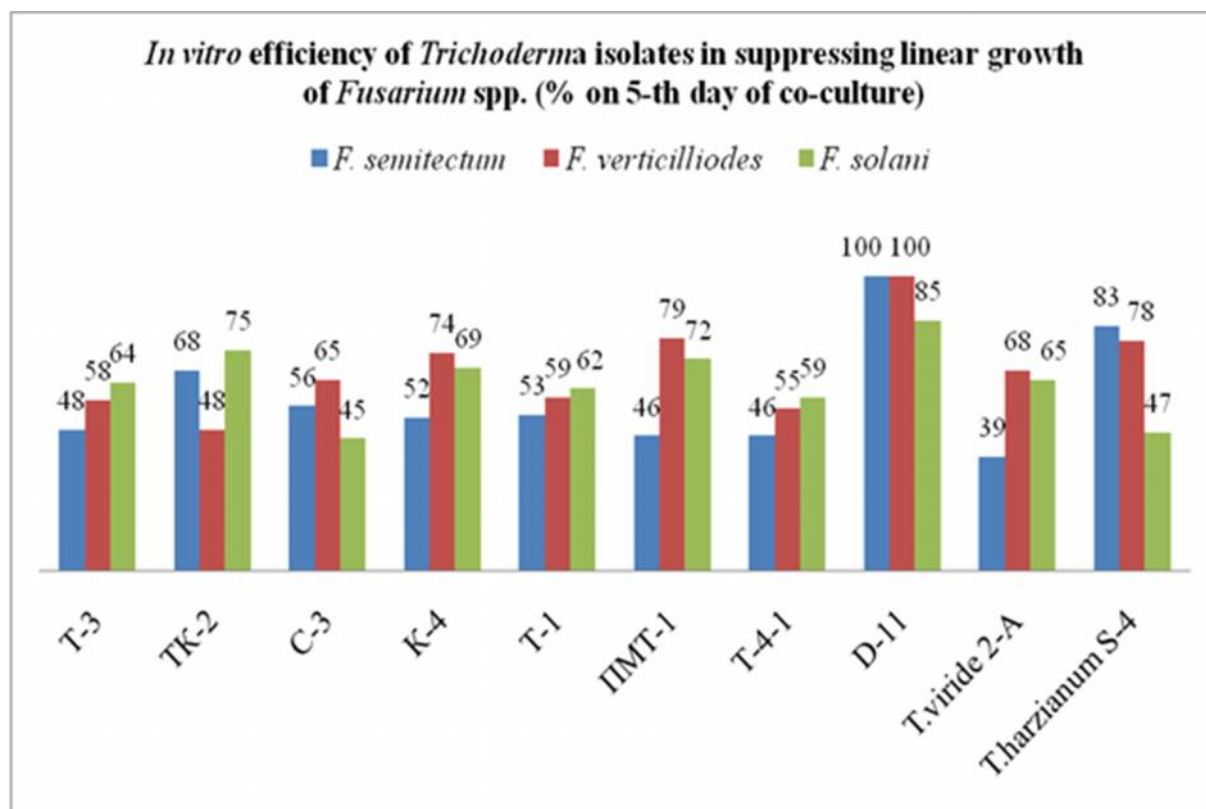
By subsequent observations it is determined that in relation to *F. semitectum* fungus all isolates and strains of *Trichoderma* spp. have shown the antagonism by II and IV type. For all isolates and strains of *Trichoderma* spp. a sterile zone formation was observed, the size of which varied from 8,0 to 15,8 mm, nd also rather significant for some antagonist isolates and strains increase on phytopathogens colony is observed (Table 1).

Table 1. The antagonistic activity of *Trichoderma* spp. isolates and strains in relation to fungi genus *Fusarium*

Trichoderma isolates (strains)	*F. semitectum*		*F. verticilliodes*		*F. solani*	
	F^1	F^2	F^1	F^2	F^1	F^2
-3	9,0±1,29	17,5±4,6	9,5±0,9	–	–	27,5±4,5
-2	8,8±1,52	30,0±2,4	5,0±1,3	–	–	22,5±3,3
-3	9,5±2,05	12,5±3,9	–	21,5±3,1	–	9,3±1,5
-4	13,3±2,38	21,3±4,6	5,8±1,5	25,3±2,0	–	26,8±3,7
-1	9,5±2,05	22,5±4,6	–	7,5±4,6	–	16,3±3,9
-1	8,5±2,05	20,0±2,4	18,3±2,4	33,8±3,9	2,2±0,7	32,0±3,8
-4-1	8,0±1,29	15,0±1,6	3,5±2,1	9,3±1,5	–	27,5±4,5
D-11	15,8±3,52	45,0±3,3	5,8±1,5	39,0±2,3	4,7±0,7	31,2±3,9
T. viride 2-	8,5±2,05	6,3±3,9	6,0±1,3	17,5±4,6	–	27,5±4,5
T. harzianum S-4	10,8±1,52	40,0±4,6	23,5±2,1	24,8±3,3	–	9,2±1,5

Note: F^1 – sterile zone on the 3-rd day of co-cultivation, mm; F^2 – the antagonist increase zone on phytopathogen on the 5-th day of co-cultivation, mm

In relation to *Fusarium verticilliodes* the isolates -3 and -1 were characterized by IV type antagonist action, the isolates T-3 and K-2 – by II, the other isolates and strains were characterized by a mixed type of antagonistic action. In relation to *F. solani* all isolates and strains of *Trichoderma* spp. were formed on the pathogen colony, what testifies to the II type antagonism, moreover, the isolates PMT-1 and D-11 have provoked sterile zones formation (IV type of antagonistic activity).

The data of *Fusarium* spp. micromycetes growth coefficient have shown that the given parameter by co-cultivation with antagonists fall significantly and varies depending on antagonist isolate or strain. The most intensive growth coefficient increase is marked in the variant *F. solani* + *Trichoderma* sp. D-11 – 5,1 times decrease (Table 2).

Table 2. *In vitro Trichoderma* spp. influence on growth coefficient of *Fusarium* spp.

Trichoderma isolates (strains)	Growth coefficient on the 3-rd day of co-culture		
	F. semitectum	*F. verticilliodes*	*F. solani*
Control	80	98	154
-3	65	31	107
-2	32	36	78
-3	53	75	104
-4	65	51	96
-1	59	24	92
P -1	46	33	91
-4-1	64	53	106
D-11	53	47	30
T. viride 2-	71	53	93
T. harzianum S-4	61	29	100
SED_{05}	12,3	15,6	7,1

Conclusions

The analysis of components of the antagonistic activity of new isolates and strains of *Trichoderma* fungi indicates a complex mechanism of antagonistic interaction with phytopathogenic micromycetes *F. semitectum, F. verticilliodes* and *F. solani*. The vast majority of the studied antagonists were characterized by a mixed type of antagonistic action with the pronounced presence as fungistatically alimentary (II type) and antibiotic activity (IV type). According to the results of a comprehensive assessment of the antagonistic activity a fungus *Trichoderma* sp. D-11 was more active. The results obtained allow to justify a perspectiveness of its use as a basis for biological preparation to control phytopathogenic micromycetes genus *Fusarium*.

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TRAPPIST CHEESE HISTORY

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Abstract

The original Trappist cheese, the product of the monastery of "Marija Zvijezda" in Banja Luka, Bosnia and Herzegovina, is produced for more than 130 years. The specialty of this cheese is in its secret recipe which is transferred orally from a monk to a monk. Another particularity of this cheese is that only monks who passed vows and are inside the order community can produce Trappist cheese. As the production started in 1882, the cheese became a synonym for semi-hard cheeses in the area of South-Eastern Europe. After the Second World War, the monks produced it only for their own needs inside the monastery of "Marija Zvijezda", and in this period there was neither opportunity nor interest by the legal representatives of that time to accurately describe its organoleptic characteristics and traits. Since the production of Trappist cheese has been revived in 2008, we can try to correct this injustice. The characteristic of the Trappist cheese is the wheel weight 1.6-2.0 kg and it has a natural rind which is yellowish, thin and smooth. Its consistency is soft, elastic, mild and can be easily cut. The cut is smooth with or without very little holes, and the color is pale yellowish. Its aroma is clean, milk-specific, and it is moderately saline and easily soluble. According to Gerber, the fat content is about 32 %, the water content is about 41 % while the dry matter is 56 %.Instead of a conclusion, we can only wish that the Trappist monks continue the production of the Trappist cheese and that political circumstances will not influence it as it was the case up to now.

Key words: *Milk, Monastery of "Marija Zvijezda", Trappist cheese.*

Introduction

In 2014, the monastery of "Marija Zvijezda" will celebrate 132 years since the production of Trappist cheese has begun in Banja Luka. The cheese has been produced in all these years with more or less problems that followed the monks and their destiny in these areas. The production was interrupted only from 1996 to 2008 due to sudden death of Father Mohor who knew the secret recipe and which he did not manage to transfer to his brothers. The cheese production was revived again in 2008 when Father Tomislav went to France in the monastery of Mont-des-Cats and learned the technique of cheese making and brought back the recipe for cheese production. After the Second World War, the property of the monastery was confiscated, monks had to leave and the name "Trappist" was taken away but not the secret of cheese making. On the territory of the former Yugoslavia, each dairy owned by the state began the production of cheese called Trappist because this name was a synonym for a quality and for semi-hard cheese, but this production had never the approval of the monks. A particular problem then was the dairy of Banja Luka to which some cooperation was negotiated but which failed because the former government had its own experts who produced "better" and "original" cheese. Even now and as before, the Trappist monks had problems in regards to the protection of their intellectual property and many other producers used this name illegally for some of their products. Today in the monastery we can also find notices to consumers where Trappist monks warned about the look of the original cheese and

how it differs from forgeries. Trappist cheese is standardized and we hope that Bosnia and Herzegovina will finally protect this product under the designation of origin and thus prevent further illegal use of the Trappist name labeled on other semi-hard cheese.

The History of Trappist Order
Trappists belong to the monastic family that follows Christ by living according to the Rule of St. Benedict of Nurisa, the father of Western monasticism, the founder of the monastery Subiaco and Monte Cassino. The name "Trappists" was received by the reform movement that began in 17th century in French Cistercian monastery of Notre Dame de La Trappe in Normandy, under the guidance of Abbot Armand Jean le Bouthillier de Rance. This reform movement was inspired by the reform movement that began 500 years ago in the monastery of Cîteaux near Dijonin France. With this movement the aim was to influence changes in a loose lifestyle of the monks in many French monasteries. Therefore, the official name of the Trappists is *Ordo Cisterciensis Strictioris Observantiae* (O.C.S.O.) which means the stricter observance of the Cistercian Order. Trappists are actually reformed Cistercians who have started their activities as insignificant local reform movement, and today in the world they serve in more than 100 monasteries. It is less known that Trappists have a female branch which has 72 monasteries, mainly in Europe. The Trappists are a contemplative order in the Catholic Church that serves to God and to people in silence, prayer and physical work. Their motto is „Ora et labora" – Pray and work. These silent monks and nuns devote their entire lives to God and their life path is governed by the cross (Ostoji , 1965).
The monastery of "Marija Zvijezda" is the only Trappist monastery which produces cheese on the right side of the Rhine River that is in the former countries of the communist bloc.
Often, the religious community of Trappist monastery is misplaced with Cistercist monks who were also engaged in different productions, including the production of different cheese types. Some documents mention that Trappist cheese was made in the monasteries in Hungary, Czech Republic, Slovakia, etc. (Sanders, 1954) which is not true because in these countries there were no Trappist monasteries.

History of Trappist Cheese
The beginning of cheese production in "Marija Zvijezda" monastery is found in 1872, in a small dairy built by Father Franz and who called that cheese as a „Swiss". However, this cheese plant production did not last long due to animal diseases that caused the lack of milk.
The production of the original cheese began in 1882 when in the monastery in Banja Luka arrived Father Ignatius from the French monastery „Port-du-Salut". He trained his brother Luka in making cheese. At the beginning, the cheese was made only for the purposes of the monastery, and later it was made for the markets in Austria and Hungary as well as for the whole Europe. It was very well known and it was awarded numerous prizes at fairs in Europe. At first, the monks processed the milk from their own farm and later they started to buy it from the local farmers.
There was an auxiliary dairy at "Marija Zvijezda" monastery, and the main dairy was established in Josipovac (today called Bosanski Aleksandrovac) where in 1887 a branch of "Marija Zvijezda" was opened. However, the monks again encountered some problems, especially in the first year. First, because of the lack of expertise of cheese makers, they had initially problems with the quality of cheese. Therefore, in 1888 abbot Bonaventure the First sent brother Dositej to France to the local monasteries, especially in Port-du-Salut, to train in cheese making for one year. When he came back he taught his brothers about cheese production and they were obliged to keep the secret of production. The secret was transmitted orally from brothers to brothers or they would carry it with them into the grave. Kirin wrote about this: Even though in cheese making industry the Trappist cheese was dominantly

present for the entire century, in our literature there are very little data about the technological process of making this cheese. Due to the secrecy of making cheese, there is no description of the original Trappist cheese from Banja Luka, so it can only be speculated.

This secrecy draws the following conclusion: "The quality of the cheese and the art of its production are predicated largely on the method of its preparation. Specifically, a dozen specialists participated in the production of the cheese. Particular intervention was done by only one cheese maker. Each cheese maker knew his part of the job to perfection while the job of the others was a secret to him." The success of the branch Josipovac prompted the Abbot Bonaventure to establish the second branch. The colonists were well developing economically in the colony Windthrst (today called Nova Topola). The Trappists bought land from one colonist in 1893 and in that place they established the branch Marienburg – Marijin Dvor (Nova Topola). The cornerstone was set on March 18, 1893. In this branch, besides other buildings, a cheese making plant was opened. The local people brought the milk and the monks processed it into cheese and butter. Cheese production in both branches was developing successfully. Every day, 2.000-3.000 liters of milk were brought in. As the cheese plant was developing successfully, the purchase of milk rose up as much as 8.000 liters. The cheese production has reached 100 – 120 tons per year. The excess of milk was pasteurized and transported to Banja Luka where it was offered for sale. The milk was much appreciated for its quality but also because of the price. Specifically, it was cheaper than from other sellers. The cheese was packed in packages of 4.8 kg and sent by post or railway to the clients throughout the monarchy as well as beyond its borders. The Trappist monks were also the official suppliers for the royal palace in Belgrade. H. Renner travel writer wrote: „Now the monastery.... deals with manufacture of the „Trappist cheese" which has a good reputation abroad as well. Since the monastery does not have enough cows, the milk for cheese making plant is taken from the close German settlements. " Up to now, there were no reliable data on the organoleptic properties of the original Trappist cheese, and his secrecy of production does not allow us to obtain an insight into the production technology. The assumptions by different authors were the same as today's Saint-Paulin cheese that is a successor of Port-du-Salut and Port-Salut (Kirin, 2003). Mainly, the research was done to study the chemical composition, the quality and organoleptic characteristics of semi-hard cheese, which were produced in the former communist dairies. The cheese production was revived again in 2008 when Father Tomislav went to France in the monastery of Mont-des-Cats and learned the technique of cheese making and brought back the recipe for cheese production (Budimir, 2012).

Material and methods

Research is done on the Agricultural Cooperative "Liva " which is located in Aleksandrovac in Laktaši municipality, Bosnia and Herzegovina. The cooperative is engaged in the production of raw milk. Since 2008, in a newly built space for cheese production, the Trappist cheese is produced in collaboration with the monk Tomislav Topi . The cooperative provides production material and auxiliary work force and the recipe is owned by the monastery of "Marija Zvijezda". Currently is produced about 2.5 tons of Trappist cheese per month. The cheese plant is HACCP certified and has ISO 2008:2009 certificate and is under the constant supervision of a veterinary inspection. Microbiological and chemical analysis of cheese is done at the Veterinary Institute of the Republic of Srpska „Dr. Vaso Butozan" in Banja Luka.

Organoleptic Properties of Trappist Cheese

The Trappist cheese belongs to the group of semi-hard cheese types and is easily cut. It has somewhat stiffer consistency but is still soft enough; compared to the bad copies which are either too soft or too hard to cut. Unfortunately, because up to now it was not possible to

forbid the use of the name „Trappist", on the market there are different cheese plants that make cheese types based on different recipes and then they label it as „Trappist".

The softness and ease of cutting comes from a special way of preparing and of course due to special conditions of its ripening. It is important to note that the original Trappist cheese ripens in special conditions, where it is handled with care and it is rotated and cleaned daily. The copies of Trappist cheese which can be found on the market are produced in a way that it is „dried" for fifteen days and then it is delivered to the stores. The ripening time of the original Trappist cheese is between 75 and 90 days as a minimum and this allows it to have a special consistency and taste.

The cheese is produced exclusively in the form of a wheel, 19 cm in diameter and 7-9 cm size (Table 1).

Table 1. Organoleptic Properties of Trappist Cheese

Group	External appearance	Texture	Cutting	Smell and taste
semi-hard	wheel d=19 cm hight= 7-9 cm weight 1.6-1.8 kg smooth rind, dry yellowish, thin	soft, elastic, mild easily cut plastic	smooth without or with very little holes pale yellow color	clean milk–specific scent taste sweet, moderately saline easily soluble

The characteristic of the Trappist cheese is the wheel weight 1.6-2.0 kg and it has a natural rind which is yellowish, thin and smooth. Its consistency is soft, elastic, mild and can be easily cut. The cut is smooth with or without very little holes, and the color is pale yellowish. Its aroma is clean, milk-specific, and it is moderately saline and easily soluble.

According to Gerber, the fat content is about 32 %, the water content is about 41 % while the dry matter is 56 % (Table 2).

Table 2. Chemical Composition of Trappist Cheese

Water	Dry matter	Milk fat	Milk fat according to Gerber	NaCL %
41,26	56,01	53,56	33	2

Some authors mention that the Trappist cheese is produced in the form of a block (Kirin, 2002) which is not true. All types of cheese which are made by Trappist monks are done in the form of a wheel. The authors note that this is cheese with bark which is usually protected by a coating, or as cheese without bark, if it ripens and ships as a cheese packaged in foil or vacuum packed plastic bag, thereby reducing the manufacturing abatement (Doruši et al., 1976; Kirin, 2002). This was typical for forgeries, or for semi-hard cheeses that were made in dairies of former system, or to those that today illegally use this name. The Trappist cheese has a natural rind, and a special coating is used which is acceptable in terms of hygiene and health and which gives a yellowish color of the bark.

In the earlier papers, the authors state that the cheese has small holes once it is cut. The scent and taste of the cheese are described almost as in the original Saint-Paulina, as well as in the illustrated versions (Mileti , 1969; Sabadoš and Rajši , 1980; Sabadoš, 1981). The original Trappist cheese once it is cut it does not have holes because of the production technology and the quality of milk which is used for its production.

Technological Process of Trappist Cheese

For obvious reasons, it is difficult to describe the technological process of Trappist cheese production. It is of utmost importance the quality of the raw materials out of which the cheese is produced, meaning the hygienic and microbiological safety of milk. Furthermore, the production conditions must be of a high standard. Upon receipt of the milk, a low pasteurization is done after which the milk is cooled and cultures and rennet have been added. Unfortunately for all, and fortunately for the cheese, the secret of the quantity and order of culture is known only to monks but not to all of them. Lay people do not know the quantities and types of cultures so they cannot describe this process. The written recipe is only in the Port-du-Salut monastery in France and is available only to the chosen monks.

After adding cultures the cheese is left resting to create a cheese curd after which the cutting starts. The cheese is moved to the cheese making table and it undergoes pre-pressing to separate the whey. Often, semi-hard cheese types undergo the rinse of the curd with water which is not the case with the Trappist cheese. After pre-pressing, the cheese is cut into an appropriate form; it is placed into a cheese mould and goes under pressing again. The cheese is pressed under certain pressure and after some time it is rotated and goes back under the pressure.

After completion of this process, the cheese is left to rest for some time and afterwards goes into brine which consists of water and salt concentration.

Once this phase is finished, the cheese is left on a shelf to drip and afterwards it is put into a pre-chamber. The first phase of cheese ripening has been done in this pre-chamber under adequate moisture and temperature conditions. After 40 to 50 days, the cheese is moved into another chamber with altered ripening conditions: lower temperature and slightly higher humidity. The ripening process ends with the optimal 75 to 90 days.

During the ripening process, the cheese is covered by the coating and it is rotated and cleaned in the chambers daily. The cheese is cleaned and coated regularly, as well as the wooden holders and shelves on which the cheese ripens. Hygiene has a great influence on the ripening and the quality of Trappist cheese.

Conclusion

Considering everything mentioned above, it remains to hope that the community of the monks of "Marija Zvijezda" monastery will continue to produce their cheese and that finally in Bosnia and Herzegovina the conditions will be set to protect the originality of the product according to the European standards.

This is also very important for other indigenous types of cheese that are made in BiH because they represent a significant potential for the development of tourist and gastronomic offer. The protection of cheese will enable the milk production to increase and a greater value will be achieved. In addition to this, it will lead to hiring additional population, either through direct or indirect arrangement in agricultural production, tourism and other related industries.

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THE ANTIOXIDANT ACTIVITY OF HONEY AND HONEY WITH ADDED MUSHROOM CORIOLUS VERSICOLOR

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Abstract

In this paper were analyzed samples of honey and honey with added mushroom *Coriolus versicolor*. *Coriolus versicolor* is one of the most important fungi used in traditional Chinese and Japanese medicine for centuries. It is also found in Serbia, where it is also known as the turkey tail fungus. Active components of the fungus *C. versicolor* include ß-glucan proteins which exhibit antiviral, antibacterial and antioxidant activity. Honey has been reported to contain about 200 substances and is considered to be an important part of traditional medicine. The aim was to determined antioxidant activity, tothal phenols content and reducing power in these two samples. The total phenols content was determined using modified Folin-Ciocalteu method and the antioxidant activity by the method of quenching stable free 2,2-diphenyl-1-picrylhydrazyl (DPPH) radicals. The reducing power of honey sample and honey with added mushroom *Coriolus versicolor* sample were determined by the method of Oyaizu. Higher total phenols content (26,04 mg/100 g) and higher reducing activity it was found in the sample of honey with *Coriolus versicolor*. That indicate that this mushroom has significant antioxidant activity.

Keywords: *honey, Coriolus versicolor, antioxidant activity, phenol compounds*

Introduction

Coriolus versicolor is one of the most important fungi used in traditional Chinese and Japanese medicine for centuries. It grows in clusters on fallen branches and logs in deciduous forests throughout the world. It is also found in Serbia, where it is also known as the turkey tail fungus. *Coriolus versicolor* is inedible because it has a tough tissue, but its aqueous extract has been used in traditional Chinese medicine since ancient times (Mau et al., 2005). The top surface of the cap is velvet-like and occurs in multiple colors, such as green, dark green, grey, black, reddish, rust, brown. The flesh is white. The underside of the cap shows minute pores numbering 3-8\mm². Active components of the fungus *C. versicolor* include ß-glucan proteins which exhibit antiviral, antibacterial, antioxidant, antitumor and immune-stimulating properties and ergosterol (provitamin D2) which has anti-inflammatory effects on the upper respiratory, digestive and urinary tracts (Smith et al., 2002). Honey, a nectar collected from many plants and processed by honey bees (*Apis mellifera*), is one of the oldest and widely used food product (Savatovic et al., 2011). Honey has been reported to contain about 200 substances (complex mixture of sugars, but also small amounts of other constituents such as minerals, proteins, vitamins, organic acids, flavonoids, phenolic acids, enzymes and other phytochemicals), and is considered to be an important part of traditional medicine (White,1979; Ferreira et al., 2009). Overall, honey serves as a source of natural antioxidants (Ferreira et al., 2009; Al-Mamary et al., 2002; Aljadi and Kamaruddin, 2004). Many studies indicated that the antioxidant activity of honey varies widely, depending on the floral source (Effem, 1988). Honey sample was multifloral from village near Kraljevo. The purpose of the present study was to determine the the total phenolic and flavonoid contents,

their antioxidant activity by different tests, including the reducing power and 2,2-diphenyl-1-picrylhydrazil (DPPH) free radical scavenging assay of honey samle and honey sample with added mushroom *Coriolus versicolor*.

Material and methods

In this study it was used mushroom *Coriolus versicolor* that is collected on mountain Vujan near Gornji Milanovac. The fungus was air dried in the dark under constant airflow conditions. The dried material was properly stored until was added in honey. Honey wich is usued for the experiment was multifloral honey that is processed by honey bees that collected nectar from plants in the village near Kraljevo.

Reducing power

The reducing power of honey sample and honey with added mushroom *Coriolus versicolor* sample were determined by the method of Oyaizu (Oyaizu, 1986). For this purpose, solution of honey and honey with added mushroom *Coriolus versicolor* (10/120 mg) in 1 ml of distilled water or 1 ml of distelled water (blank) was mixed with 1 ml of 1% potassium ferricyanide $K_3[Fe(CN)_6]$. The mixture was incubated at 50°C for 20 min and then rapidly cooled. Following this, 1 ml of trichloroacetc acid (10%) was added and the mixture was than centrifuged at 3000 rpm for 10 min. An aliquot (2 ml) ot the upper layer, mixed with 2 ml og distilled water and 0,4 ml of 0,1% $FeCl_3$ was left to stand for 10 min. The absorbance of the mixture was measured at 700 nm against the blank.

The effective concentration (EC_{50}), assigned at 0,5 value of absorption, was used to define specific reduction capability. Ascorbic acid (10-120 µg/ml) was used as positive control.

Radical scavenging activity and antioxidant content

The scavenging activity (SA) of honey sample and honey with added mushroom *Coriolus versicolor* sample for the DPPH radical was measured spectrophotometrically using the modified DPPH method (Meda et al.,, 2005). Honey sample and honey with added mushroom *Coriolus versicolor* sample were dissolved in methanol, and 1,5 ml of each sample or 1,5 ml of methanol (blank) was mixed with 3 ml of DPPH in methanol (0,135 µg/ml). The range of the investigated honey concentrations was 0,33-166,67 mg/ml. The mixture were left for 15 min at room temperature and then the absorbances was measured at 517 nm against reference mixtures that had been prepared in a similar manner, by replacing the DPPH solution with methanol. The capability to scavenge the DPPH radicals, DPPH scavenging activity (SA) was calculated using the following equation:

$$SA (\%)=100 \cdot (A_0-A_1)/A_0$$

where A_0 is the absorbance of the blank and A_1 is the absorbance of the sample.

The effective concentration (EC_{50}), defined as the concentration of honey required for 50% scavenging of DPPH radicals under experimental condition employed, was used to measure the free radical scavenging activity. Ascorbic acid (0,33-166, 67 µg/ml) was used as positive control.

The antioxidant content was evaluated as described by (Meda et al. 2005). Honey samples were dissolved in methanol (50 mg/ml) and 1,5 ml of each solution was mixed with 3 ml of a 0,135 µg/ml solution of DPPH in methanol. The blank for each sample consisted of 3 ml of a methanolic honey solution (50 mg/ml) with 6 ml of methanol. The mixture was left for 15 min at room temperature and the absorbances were measured at 517 nm. The antioxidant content expressed as mg of ascorbic acid equivalent antioxidant content (AEAC) per 100 g of honey was determined using standard calibration curves for ascorbic acid (0-1,67 µg/ml).

Results and discussion

Reducing power

The reducing power of samples was measured by the method of Oyaizu (Oyaizu, 1986). In this assay, the yellow colour of the test solution changes to various shades of green and blue, depending on the reducing power of the antioxidant substances in samples. The reducing power may serve as a significant indicator of its potential antioxidant activity.

The EC50 values of reducing power of samples are shown in Table 1. The results for reducing power demonstrate the electron donor properties of honey and honey with added *Coriolus versicolor*, thereby neutralizing free radicals by forming stable products. The outcome of the reducing reaction is the termination of the radical chain reactions that may otherwise be very damaging.

Table 1. EC50 (mg/mL) values of honey and honey with added *Coriolus versicolor* and controls (quercetin and ascorbic acid) in the antioxidant activity evaluation asssay: reducing power

Sample	Reducing power
Honey with added *Coriolus versicolor*	2,0030± 0,6920
Honey	1,5620± 0,9950
Ascorbic acid	0,0154± 0,0007
Quercetin	0,0317± 0,00 14

The scavenging activity

The scavenging activity (SA) of honey sample and honey with added mushroom *Coriolus versicolor* sample for the DPPH radical was measured spectrophotometrically using the modified DPPH method. The DPPH free radical scavening activity of the samples increased with increase in concentration. The higher SA values were found in honey with added *Coriolus versicolor*. The results are shown in Table 2.

Table 2. SA values of the samples

Samples	SA values %
Honey	37,40
Honey with added *Coriolus versicolor*	53,82

The total phenolics contents

The total phenolic contents in samples were determined from the regression equation of gallic acid calibration curve, and expressed as mg of gallic acid equivalents per 100 g of honey and honey with added *Coriolus versicolor*. The total phenolics are shown in Table 3. The higher content of total phenolics was in honey with added *Coriolus versicolor*.

Table 3. Total phenolics

Samples	Phenolocs (mg gallic acid/100 g)
Honey with added *Coriolus versicolor*	26,04±1,71
Honey	22,94±4,81

Conclusion

In this study, total phenolic, antioxidant content and antioxidant activity of honey and honey with added mushroom *Coriolus versicolor* were determined.

The content of total phenolics (26,04±1,71) was higher in honey with added *Coriolus versicolor*.

Also, higher reducing power and DPPH free radical scavening activity showed the same sample.

Based on this results the conclusion is that the honey with added mushroom *Coriolus versicolor* has significant antioxidant activity. Also, based on this the conclusion is that the mushroom Coriolus versicolor has significant antioxidant activity, but honey with added *Coriolus versicolor* has bitter taste.

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SUPPRESSION OF OAK POWDERY MILDEW THROUGH USE OF BIOFUNGICIDES

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Abstract

Serbia is involved in the International Co-operative Programme forest programme through its National Focal Centre. The condition of forests in Serbia has been monitored since 2003 during the vegetation period, at 131 sample plots. The occurrence of mass dieback in oak forests is another consequence of the presence of powdery mildew, which is caused by the pathogenic fungi *Microsphaera alphitoides* Griff. et Maubl. and which affects in particular new, young foliage susceptible to infections. Oak powdery mildew is a serious problem on seedlings in nurseries as well as on naturally and artificially introduced progeny. To date, the Republic of Serbia has registered no fungicides for suppression of pathogens in the forest ecosystems. In order to introduce proper use of new disease-fighting agents into a country, certain relevant principles, requirements and criteria prescribed by the Forest Stewardship Council . The experiments were set on penduculate oak seedlings in nurseries, where control of oak powdery mildew had been conducted through alternative protection measures by means of various dosages of AQ-10 biofungicide, with and without added polymer. The results of the research have demonstrated that AQ-10 biofungicide can be used as a part of integrated disease management programmes as an alternative, through application of several treatments during vegetation and combination with other active matters registered for these purposes, so as to curtail the use of standard fungicides for control of powdery mildews on oak seedlings in nurseries. The best results in suppression of oak powdery mildew were attained through use of AQ10 biofungicide with added polymer Nu Film-17.

Key words: *powdery mildew, sample plots, biofungicides*

Introduction

Consequence of the strong development of science and technology changes and disruption of the natural balance, which ultimately leads to the survival of some plant communities. However, with increasing risk increases the awareness of people that are at risk, and in this context qualitatively changing value systems of society as a whole, leading to the formation of ecological culture. Sustainable management of forest resources, policies and environment must be focused scientific approaches that enable long-term intensive monitoring of forest conditions on a large scale, which is one of the main goals of ICP (Cumming *et al*. 2001, Metzger & Oren, 2001, Nevenic e*t al*., 2009). To be in a country introduced the proper use of new products for diseases control, it is necessary to comply with any relevant principles, requirements and criteria, which are primarily related to measures of assessment and mitigation of risks, the list of hazardous and extremely hazardous pesticide, with the ability to application of alternative care, which are prescribed by the (FSC). To the management of forest resources were defined as viable, it must be primarily environmentally oriented, or adverse effects of management on the environment must be properly assessed and as small as possible (Sekulic, 2006). It is therefore against harmful organisms necessary to take measures for fighting that alternative chemicals within antipesticidne legislation. These measures

include the use of biodegradable, non-chemical means, without the negative side-effects on non-target organisms without harmful effects on the environment.

Material and methods

The Republic of Serbia are included in the ICP program for forest owners, through its National Centre (NFC - National Focal Centre) for forest monitoring. The methods are described in the first Handbook as Visual Assessment of Crown Condition and in Submanual on Visual Assessment of Crown Condition on Intensive Monitoring Plots. Background and policy work are defined by the working group of the European Commission for Forestry (EFC) and the International Organization for Food and Agriculture (FAO). The Manual was redesigned in 2012 and provides harmonized data and a more flexible approach to monitoring the state of the crown, with better quality and more transparent. All parameters are described in the latest version of the Manual. They have been tested in several Europe countries or countries in North America, and the values of the parameters are continuously monitored under the control of the international Expert Panel. In Serbia, monitoring of the crown state is carried out during the growing season on the 131 sample plots. Oaks were on the 68 points. On this point were done a visual assessment of oak powdery mildew caused by fungi *Microsphaera alphitoides* Griff. et Maubl. (Syn. *Erysiphe alphitoides*). In Serbia it is presented almost everywhere where there are oak grown. A young, soft leaves are more susceptible to infection than mature. So that seedlings in nurseries and in the woods were more vulnerable than adult trees in the stands. Therefore, it was testing the efficacy of biofungicide AQ10 on young oak seedlings in two different nursery in Serbia (I - „Rogot" – near Kragujevac and II - „Barosevac" near Lazarevac).

In this study it was investigated the efficacy of biofungicide AQ-10 (the active component is *Ampelomyces quisqualis*, which attacks and destroys the fungi which causing powdery mildew). During the experimental tests biofungicide were used with the polymer Nu Film. This polimer were used in two different formulation Nu Film-17 and Nu Film-P. Polimer prepared a protective coating (film) and have a two-fold to prevent washout of the active ingredient of biofungicide and mitigate the realization of new infections of powdery mildew. For standard product it was used fungicide Sulphur SC (Table1).

Table1. Examined products and the dose/concentration of application

No	Product	Composition	Manufacturer	Mode of action	Dose/concentration
1.	AQ–10	*Ampelomyces quisqualis* 5X10^9 sporae/g	Bio Intrachem Italia	Biotrophic	30-50-70 g/ha
2	Nu Film-17	di-1-p-Menthene 96%	Miller- Chemical&Fertilizer Corporation, Hanover, Pensylvania	Encapsulated pesticide and protects it from various weather conditions	1-1.5 l/ha
3.	Nu Film-P	di-1-p-Menthene 50%	Miller- Chemical&Fertilizer Corporation, Hanover, Pensylvania	Encapsulated pesticide and protects it from various weather conditions	0.3-1 l/ha
4.	Sulphur SC	Elementary sulphur 810.50 g/l	Galenika - Belgrade, Zemun	Preventive	0.5%

Experiments were carried out on the instructions of methods PP 1/152 (2) (EPPO, 1997) in a randomized block design. The emergence and development of powdery mildew, followed by the first appearance of the disease and the development of the control treatment (when there

is a clear difference between the control variants and variants treated with fungicide and biofungicide combined with a polymer). Estimation of secondary infection on the leaves was carried out on 100 leaves in four replicates per variant.

Results and discussion

Health status of oaks and monitoring of powdery mildew in Serbia

If we consider all oak species present throughout the study period, *Quercus pubescens* Willd. showed best results in terms of drying and chlorosis. Almost all the trees (from 92.3 to 100% of the trees) had index chlorosis 0 best state of health immediately after pubescent oak showed *Quercus cerris* L., who in category 0 chlorosis for the entire time of the study, with 71.8% and 97.0% of the trees.The third in the investigated area in Serbia is *Quercus farnetto* Ten. The highest percentage of *Q. farnetto* had chlorosis with index 0. Sessile oak - *Quercus petraea* (Matt). Liebl. The state of health comes at fourth place in the investigated area of the Republic of Serbia.The highest percentage of oak trees had chlorosis indexes 0 and 1 indicating the relatively healthy trees, but these percentages are lower than the previously mentioned species of oaks.

At the last place on health, when the parameters of observed chlorosis and drying, there is *Quercus robur* L. This species of oak had the highest percentage of trees found in chlorosis 0 (from 33.9% in 2004 to 83.3% , 2003), but the relatively large procent trees and in categories 1 and 2 and as high as 35.6% in the index 2, 2004, and there are plenty of trees in the index 3. At the investigated oak trees infestation throughout the study period is generally very strong and is an average of 49.16% and a maximum of 79.3%. Intensity of infection has changed, so that the beginning of the study did not show the presence of powdery mildew, but the following year saw the emergence of a weak attack of 8.6%. Next, in 2005, recorded the culmination of infection or heaviest infestation, but during the study period infection gradually decreased, and in 2009 amounted to 51.8%.

Control of the oak powdery mildew with biofungicide

In Tables 2 and 3 were showed the data of the intensity of infection of oak on the research areas, the percentage of efficacy of the preparation in relation to the standard (Sulphur) and control variant. Based on the results shown in Table 2, the highest efficiency was obtained in the variant 3 which is used in the AQ-10 at a dose of application of 50 g/ha, with the addition of NuFilm-17 at a dose of 1.5 l/ha (2.35% of the intensity of the infection).

A good efficacy is achieved in the variants 2 and 6 (4.65% and 4.60%) in which the AQ-10 was used with polymer Nu Film-17 in a dose of 1.0 l/ha and 0.5% sulphur. Similar efficacy was achieved in 5 variants using AQ-10 with polymer Nu Film-P high application rates of 1.0 l / ha.

Table 2.The intensity of the attacks *M. alphitoides* and efficiency of the fungicide (I)

Number of variants	Fungicide	Conc./Dose (%), g, l/ha	Infection (%)	Efficiency (%)	Standard (%)
1.	AQ-10	50 g	7,15 a	64,07	83,33
2.	AQ-10+Nu Film-17	50 g+1 l/ha	4,65 a	76,63	99,67
3.	AQ-10+Nu Film-17	50 g+1,5 l/ha	2,35 a	88,19	114,71
4.	AQ-10+Nu Film-P	50 g+0,3 l/ha	6,35 a	68,09	88,56
5.	AQ-10+Nu Film-P	50 g+1 l/ha	5,70 a	71,36	92,81

6.	Sulphur SC	0,5%	4,60 a	76,88	100,00
7.	Control	-	19,90 b	0,00	0,00
	lsd 005		5,36		
	lsd 001		7,35		

The worst efficiency is shown in variant 1 where was used AQ-10 without the addition of the polymer (7.15% the intensity of the infection). In the control treatment in which protection was not carried out, the intensity of infection is 19.90%.

Statistical analysis of the obtained test results showed that there were no significant differences in all tested variants in comparison with the control variant. Based on the analysis of variance the difference between the variants were no statistically significant at the 95% , because of the $F_0 > F_{0,05}$. Also, comparative analysis (Duncan test, 1955) showed that there were no significant differences identified one homogeneous group. Based on the results shown in Table 3, the highest efficiency was obtained in the variants 6 and 10, or a variant in which is used a sulphur + NuFilm-17 and a variant in which the AQ-10 was used at a dose of application of 70 g/ha, with the addition of NuFilm-17 at a dose of 1.0 l/ha.

Table 3.The intensity of the attacks *M. alphitoides* and efficiencyof the fungicide (II)

Number of variants	Fungicide	Conc./Dose (%), g, l/ha	Infection (%)	Efficiency (%)	Standard (%)
1.	AQ-10	30 g	10,60 a	61,21	65,03
2.	AQ-10	50 g	12,42 a	54,53	57,93
3.	AQ-10	70 g	4,45 a	83,71	88,94
4.	AQ-10 +Nu Film-17	30 g + 1,0 l/h	9,13 a	66,61	70,76
5.	AQ-10 +Nu Film-17	50 g + 1,0 l/ha	10,55 a	61,39	65,22
6.	AQ-10 +Nu Film-17	70 g + 1,0 l/ha	3,28 a	88,01	93,51
7.	AQ-10 +Nu Film-P	30 g +1,5 l/ha	12,40 a	54,62	58,03
8.	AQ-10 +Nu Film-P	50 g +1,5 l/ha	6,75 a	75,30	80,00
9.	AQ-10 +Nu Film-P	70 g +1,5 l/ha	4,25 a	84,45	89,72
10.	Sulphur SC+Nu Film-17	0,5%+1,0 l/ha	0,98 a	96,43	102,45
11.	Sulphur	0,5%	1,61 a	94,13	100,00
12.	Control	-	27,33 b	0,00	0,00
	lsd 005		10,34		
	lsd 001		14,61		

Slightly higher values of infection, but also a high degree of efficiency showed a variant of 11 which was used only sulphur (intensity of infection 1.61%).A good efficiency is achieved in variants 8 and 9 (6.75% and 4.25%) were AQ -10 (50 g and 70g) were used with the addition of NuFilm-P at a dose of 1.5 l/ha. Similar efficacy was achieved in 3 variants using

high concentration AQ-10 (70 g) without surfactant additives (intensity of infection of 4.45%).

Statistical analysis of the test results showed that there are no the significant differences in all studied variants compared with the control. There were no differences between variants 10 and 11, in which the fungicide were used with or without the addition of polymer.

Between the mean values of control and AQ-10 application doses as well as for all other combinations, there is a statistically significant difference at the probability of 99%.

In the first investigated the site, we applied a comparative analysis (Duncan test, 1955), in order to determine significant differences were identified 3 homogeneous groups, with statistically significant differences at 99%, which is consistent with the groups already explained variance analysis.

Low and high air temperatures (11 and 30°C) directly influenced the reduction of infection, which at that time was 10 and 32% of the total number of tested plants. Very high infection rate of seedlings was observed at temperatures of 17 to 21°C and at a relative air humidity of 85 to 100% (infection in this period was 51 to 63% of the tested plants.

In the literature to the many authors in different climatic regions confirmed and proved that the intensity of powdery mildew infection in various plant species directly dependent on environmental conditions, especially temperature and air humidity.

Comparative analysis of effects of temperature and air humidity on the occurrence of secondary infections and the spread of powdery mildew infection and the results of other authors (Kothari & Verma, 1972; Whipps & Budge, 2000; Guzman-Plazola et al., 2003) shows that high relative humidity reduces the intensity of the infection, which may aid in the control of this pathogen in the future.Temperature of 30°C and are more detrimental to the development of pathogens. The growth of the fungus is significantly higher at 20°C than at 25°C. High levels of relative humidity (80-90%) are favorable for the development of the pathogen in the short term, but prolonged exposure to these conditions leads to the limitations of the infection.

This means that the number of treatments is not crucial for achieving high efficiency and bioproducts. If the treatment is performed at an appropriate time, with fewer treatments and a lower dose of bioproducts achieve the same efficiency as well as the large number of treatments, and the higher doses of bioproducts, which is of course very important from the economic point of view, and this experience can be applied to control powdery mildew bioproducts in nurseries.

Conclusions

Results of testing of bioproducts AQ-10 showed good efficacy in controlling powdery mildew of oak in nurseries in Serbia, using several treatments during the growing season and the combination with other active ingredients registered for this purpose. The best results in the suppression of powdery mildew were achieved with oak embodiments in which the biofungicide AQ-10 was used in higher doses (50 and 70 g/ha) with the addition of the polymer film Nu Film-17 at doses from 1.0 to 1.5 l/ha.

The number of treatments is not crucial for achieving high efficiency and bioproducts. That is, if the treatment is performed at an appropriate time, with fewer treatments and a lower dose of bioproducts achieve the same efficiency as well as the large number of treatments, and the higher doses of bioproducts, which is very significant from an economic viewpoint. Properly administered, timely and professional use by selecting the appropriate preparation, provide the rationalization of the use of pesticides, as well as the reduction of the treated area. In accordance with the actual capabilities (in the case of limited possibilities of mechanical measures and the lack of labor force), use alternative solutions to protect forests or perform the combined use of pesticides and alternative methods.Within repressive measures, the

development and introduction of alternative methods of forest protection against harmful organisms is done in order to find suitable alternative products and methods of protection, in order to overcome the problem of exclusion of unwanted pesticides. Therefore, it is necessary to support academic institutions in research aimed at finding alternative methods and pesticides less harmful impact on the environment and biodiversity in forest ecosystems.

Acknowledgment

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MYCOPOPULATIONS OF CORIANDER SEEDS

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Abstract

Coriander (*Coriandrum sativum* L.) is a valuable multipurpose medicinal plant. All parts of the plant are edible, but the dried seeds (*Coriandri fructus*), fresh leaves (*Coriandri folium*) and aerial parts of the plant (*Coriandri herba*) are the most commonly used. In folk medicine, the seeds of coriander are used as an aromatic, carminative, antispasmodic remedy used to treat gastrointestinal complains such as dyspepsia and gastralgia. It is often recommended for insomnia and anxiety. Seed is also used as an analgetic and antirheumatic agent. This paper aims to present the results of research of mycopopulation on coriander seeds in Serbia.

The pathogenic mycobiota of coriander seeds was studied on the commercial plantation of the three localities in Serbia: Pan evo municipality, Ostoi evo and Mošorin villages during 2012-2013. Mycopopulations of coriander were studied by seed incubation on filter paper and on potato dextrose agar (PDA), according to the International Seed Testing Association (ISTA) rules. The active growing mycelia from the seeds were transferred on PDA: Monosporial isolates were used for this investigation. Identification of obtained isolates was based on the morphological and cultivation characteristics of isolated fungi.

The seeds of coriander were affected by different pathogenic and saprophytic fungi. Incidence of *Alternaria* species was 44 and 66%, *Rhizoctonia* spp. 3 and 7 % and *Fusarium* spp. 2 and 6% in 2012 and 2013, respectively. The other fungi (*Aspergillus niger*, *Aspergillus flavus*, *Penicillium* spp., *Epiocccum purpuescens*, *Cladosporium cladosporioides*) were present in sporadically (1-2%), while incidence of *Trichothecium roseum*, *Trichoderma viride*, *Myrothecium leucotrichum*, *Nigrospora macrospora*, *Mucor* spp., *Rhisopus* spp. was up to 5%.

Key words: *coriander, seed, mycopopulation*

Introduction

Coriander, *Coriandrum sativum* L., is an annual herb in the family *Apiaceae*. This plant, native to southern Europe, northern Africa, and southeastern Asia, is used in cooking as well as for medicinal uses.

In many countries and cultures, throughout history, coriander has been used as medicinal for treatment of digestion organs, diabetes and urinary tract diseases, as well as for excretion of heavy metals from organism, for treatment of insomnia, as aphrodisiac and as anthelmintic. Contemporary methods of research have confirmed the effect of this plant on all mentioned diseases and in addition they have confirmed its antibacterial, antioxidant, antiinflammatory and anticancer effect. Due to its complex chemical structure, coriander has a wide range of application. All parts of plant are used for medicinal and nutrition purposes of humans and animals, but they also have a non-food use in perfume, pharmaceutical and tobacco industry. Coriander is used for production of biodiesel, as insecticide and fungicide in organic

agriculture and it is often used as protection crop, because large quantities of its nectar and pollen attract various useful insects.

Interest in growing coriander is growing, especially in developing countries, where people are increasingly turning to alternative treatments, primarily traditional medicine, which has almost disappeared during the industrialization. Nowadays, modern scientific methods, confirmed by numerous medicinal properties of this plant, and it quickly found its place in people's lives, as a spice, medicine or functional food.

It is estimated that the Holy coriander grown on about 550,000 ha per year and that its production of 600,000 t (Diederichsen, 1996).

Many fungal diseases to date in the world spread by infected seeds of coriander. Stakvilevi ien (2003) isolated on Lithuanian coriander seeds: *Botrytis cinerea, Fusarium sambucinum* (*Gibberella pulicaris*), *Mortierella isabellina* (*Umbelopsis isabellina*), *Sclerotinia sclerotiorum* and *Thielaviopsis basicola*. Seed germination was markedly suppressed by fungi, i.e. *Aspergillus flavus, A. niger, A. fumigatus, Alternaria alternata, Cochliobolus lunatus, Fusarium solani, F. chlamydosporum* and *Rhizopus stolonifer* (Samota and Singh, 2006).

The experimental research of coriander seeds' mycopoulation has been conducted during 2012-2013 on the cultivating plantations of the Institute for Medicinal Plants Research 'Dr Josif Pan i ' and on the cooperative fields in Serbia. The aim of the investigation is to represent the results of the presence a number of different fungi species for the first time on the coriander seeds' in Serbia.

Material and methods

The pathogenic mycobiota of coriander seeds was studied on the commercial plantation of the three localities: Pan evo municipality, Ostoi evo and Mošorin villages during 2012-2013. Mycopopoulation of coriander were checked by seed incubation on filter paper and on potato dextrose agar (PDA), according to the ISTA rules (ISTA, 2003).

Exactly 400 seeds (4 trials each with 100 seeds) from each locality were sterilized with NaOCl for 3 minutes and then rinsed with sterile water and transferred to the filter paper on Petri dishes. Also 10 seeds were taken from each lot after surface sterilization where transferred to Petri dishes with potato dextrose agar medium (PDA). Seeds were incubated for 7 days at 25 C. The pathogenicity test was confirmed by method of Molt and Simone (1967). The active growing mycelia from the seeds were transferred on PDA. Monosporial isolates were used for investigation. Identification of obtained isolates was based on the morphological and cultivation characteristics using the taxonomic keys for identification (Neergard, 1979; Sutton, 1980; Nelson et al., 1983; Lesli and Summerrll, 2006; Simmons, 2007).

Results and discussion

Analysing results of the collected coriander seeds mycopopulation enabled 23 different species from 18 genus to be identified (Table 1).

Alternaria alternata was a predominant fungal species on seeds, accounting 55 and 66% in localities Pan evo and Mošorin while a slightly lower in Ostoi evo 44 and 57% in 2012 and 2013, respectively. This fungus is also dominant on other medicinal plants such as valerian (Pavlovi , 2003), camomile, St. John's worth (Pavlovi and Draži , 2000; Pavlovi et al., 2000), marshmallow and ehinacea (Pavlovi et al., 2006; 2007). Kohmoto and Otani (1991) shoved that isolates belonging to the species *A. alternata* have the possibility to cause infection and disease on many plant hosts.

Table.1. Incidence of fungi (%) on coriander seeds in Serbia during 2012 and 2013

Fungal species	Locality					
	Pan evo		Ostoi evo		Mošorin	
	2012	2013	2012	2013	2012	2013
Alternaria alternata	55	66	44	57	56	66
Alternaria spp.	0	0	4	16	3	6
Aspergillus niger	2	2	3	2	3	1
Cladosporium cladosporioides	2	2	2	0	2	0
Epicoccum purputescens	2	2	1	3	0	3
Botrytis cinerea	0	0	2	1	0	0
Fusarium oxysporum	3	3	3	4	2	6
Fusarium verticillioides	3	2	0	0	0	3
Fusarium equiseti	1	1	0	2	3	4
Fusarium sporotrichioides	2	2	2	0	2	0
Fusarium semitectum	1	0	0	0	0	0
Penicillium spp.	2	2	0	0	1	3
Nigrospora macrospora	2	1	1	3	1	0
Mucor spp.	3	5	1	3	3	0
Rhisopus spp.	2	1	2	2	2	1
Rhizoctonia spp.	3	3	4	7	6	2
Sclerotinia sclerotiorum	1	2	3	0	1	3
Myrothecium leucotrichum	2	1	2	1	1	2
Phoma spp.	0	0	0	0	2	2
Acremonium sp.	1	2	0	1	2	0
Physarum sp.	2	2	0	0	0	0
Trichothecium roseum	2	1	2	2	1	0
Trichoderma viride	2	1	1	3	0	0

The most destructive fungus in coriander seeds are species from genus *Fusarium.* Five *Fusarium* spp. were identified from the coriander seeds*: Fusarium oxysporum*, *F. verticillioides*, *F.equiseti*, *F. sporotrichioides* and *F. semitectum* (Fig.1: e,f,g,h:ž; Fig 2: a,b,c,d). The diseased seed is small and wrinkled, with changed colour, wilting and seedling decay, commonly known as firing and melting of seedlings (Jasni and Maširevi , 2006). This isolated species are known as pathogens different seeds, like: maize, millet, sugar beet, sunflower, alfalfa, etc. (Nirenberg and O'Donnell, 1998; Levi et al 2003; Stojšin, 2003; Krnjaja, 2004). In addition to these fungi, *Rhizoctonia* spp. was significantly present (3- 7%) in the coriander seed (Fig.1: e,f).
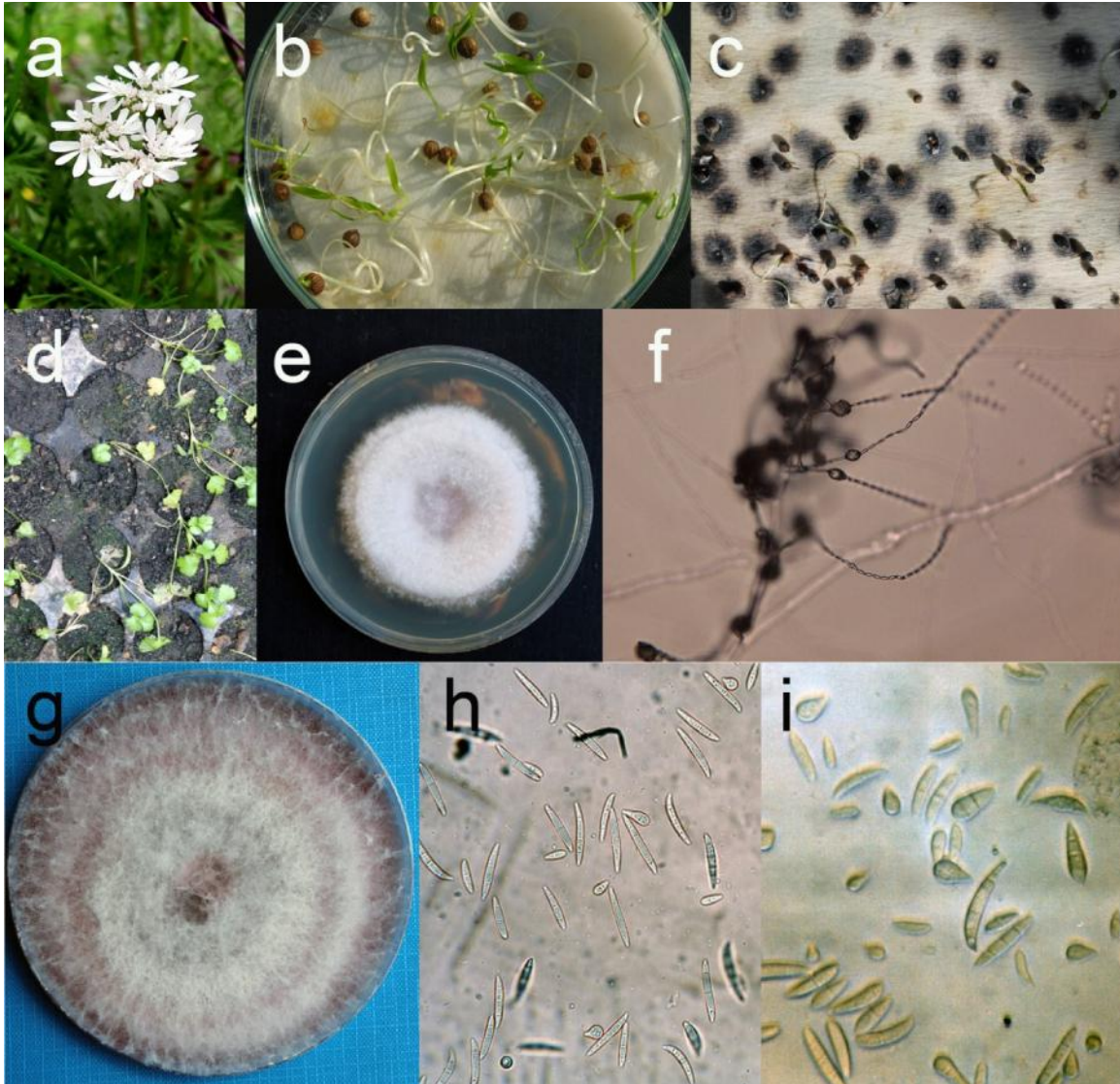
Fig. 1. *Coriandrum sativum*: healthy plant in the field (a) and healthy seedlings on filter paper (b); *Alternaria alternata*: non germinated and weakly seeds (c); *Fusarium oysporum*: pathogenicity test (d) and colony on PDA (e); *F. verticillioides*: appearance of microconidia *in sity* (f) *F. sporotrichioides*: colony on PDA (g), macroconidia formed in sporodochia (h) and microconidia (i).

The other fungi: *Aspergillus niger*, *Aspergillus flavus, Penicillium* spp., *Epiocccum purpuescens*, *Cladosporium cladosporioides,* were present in low percentage (1-2%), while incidence of *Trichothecium roseum*, *Trichoderma viride*, *Myrothecium leucotrichum, Nigrospora macrospora, Mucor* spp., *Rhisopus* spp. was up to 5%, even though does not make the problem on seed.
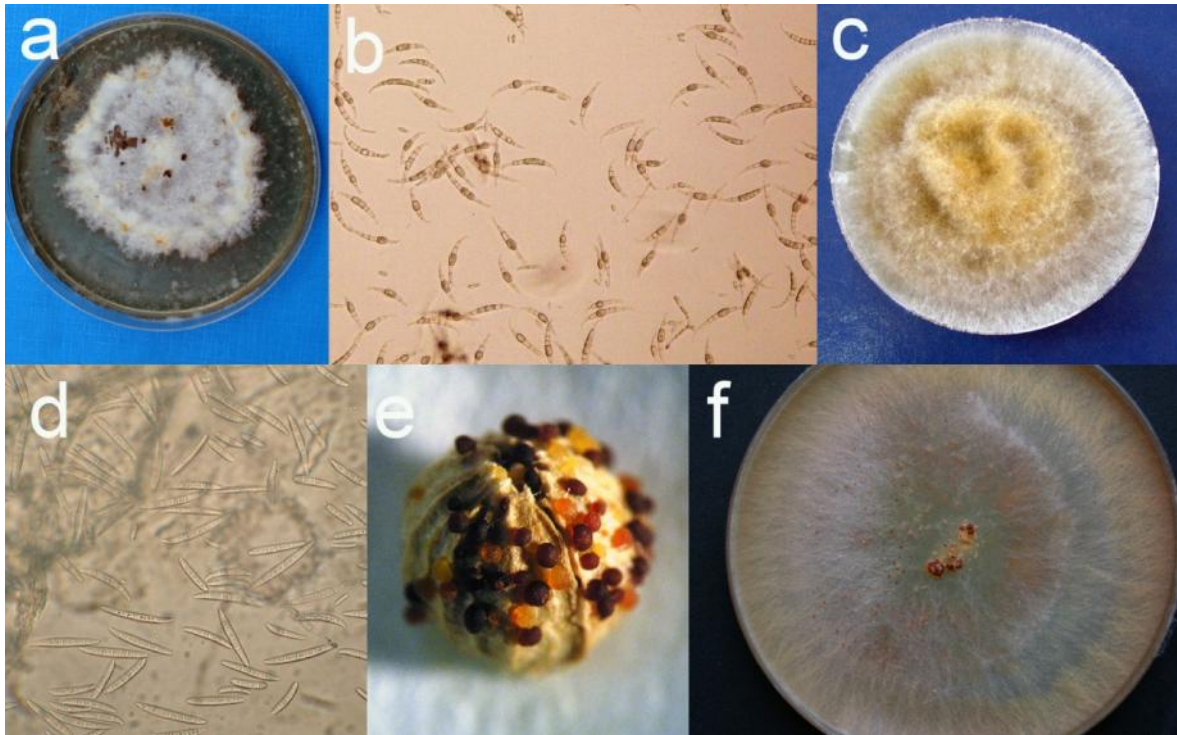
Fig. 2. *Fusarium equiseti*: colony on PDA (a) and conidia (b); *F. semitectum*: colony on PDA (c) and conidia (d); *Rhizoctonia* sp.: sclerotia on seed of coriander (e) and colony on PDA.

Sclerotinia sclerotiorum as very destructive pathogen causal plant wilts and collapse and *Botrytis cinerea* (Fig 3: a,b) were present in low percentage (1-2%). The cottony mycelium usually produces numerous sclerotia, black seed-like reproductive structures, a reliable diagnostic sign of *Sclerotinia* (Fig 3: a).
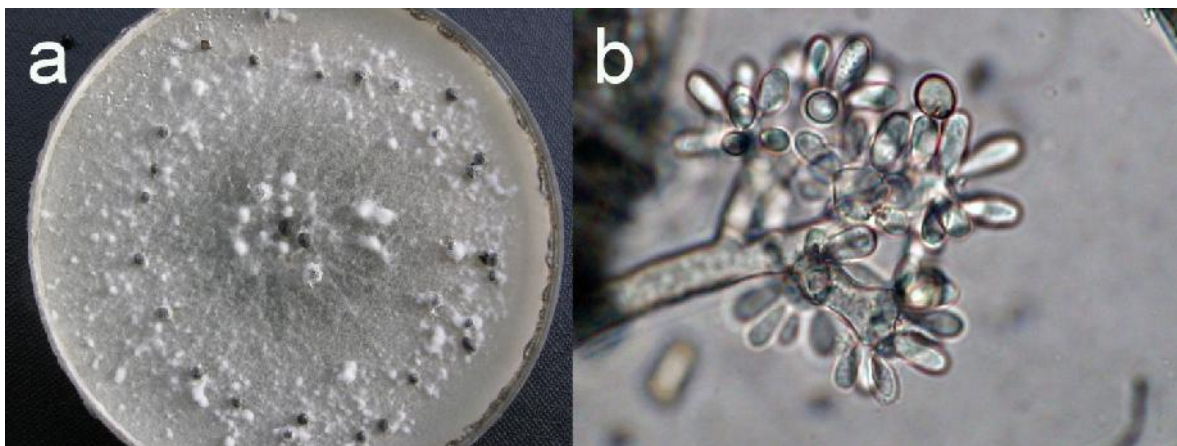
Fig. 3. *Sclerotinia sclerotiorum*: colony with sclerotia formed on PDA (a); *Botrytis cinerea*: conidiophore with conidia on PDA (b).

Conclusion

Twenty-three different species of fungi were identified in the mycopopulation of coriander seeds in 2012/2013 seasons. *Alternaria alternate* and *Fusarium* spp. were a predominant pathogen species on the coriander seeds. The infection of *Alternaria* and *Fusarium* spp. were frequent mixed infection of seeds. *Rhizoctonia* spp. was significantly present (3-7%), while *Sclerotinia sclerotiorum* and *Botrytis cinerea* were sporadically present (1-2%) in the coriander seeds.

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APHID SPECIES (HEMIPTERA: APHIDIDAE) OF SOUTH EASTERN ANATOLIA REGION (TURKEY) AND THEIR HOST PLANTS

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Abstract

This study was carried out during 2006-2008. The research focused on the taxa in Aphididae family which is distributed on different plants in cultivated and uncultivated fields in the Southeastern Anatolia Region (Adiyaman, Batman, Diyarbakır, Mardin and Sanlıurfa). Aphids were collected by checking shoots, branches and leaves of the different plants (cultivated and uncultivated. Species were identified by checking distinguishing characters and comparing with previous literatures. As a result, total of 45 aphid species belonging to 23 genus of the family Aphididae were determined.

Results of the presented study are also going to be important for the future studies in this area due to economical importance of aphid species.

Key Words: *South Eastern Anatolia Region, Aphididae, Hemiptera, Survey.*

Introductıon

Aphid also called plant louse, greenfly, or ant cow, any of a group of sap-sucking, soft-bodied insects (order Hemiptera) that are about the size of a pinhead, most species of which have a pair of tubelike projections (cornicles) on the abdomen. Aphids may damage plants by sucking plant juices, which directly weakens the plant, by injecting toxins from their saliva that cause curled leaves and malformations, or by transmitting viral diseases that cause secondary plant injury (Kennedy et al., 1962; Blackman and Eastop, 1985; Conti, 1985).

Aphid species have very close relationship with their host plants and climatic conditions have a strong effect on the distribution of aphids worldwide. Turkey has diverse types of climatic conditions, very large agricultural land and rich flora consisting of 12000 plant species. Therefore, it can be expected that territory of Turkey is characterised by the presence of many aphid species. Studies related to the Turkish aphid fauna dated back to the begining of the 1900s. (enol, et. al, 2014). The first records of Turkey's aphids were given by Trotter (1903) and Fahringer (1922), followed by Bodenheimer and Swirski (1957), Börner and Heinze (1957), Tuatay and Remaudiere (1964), Çanakçıo lu (1975) and Düzgüne et al. (1982).

In this study, Aphididae species were determined in the cultivated and noncultivated areas in South Eastern Anatolia province of Turkey. Results of the presented study are also going to be important for the future studies in this area due to economical importance of aphid species.

Materıals and methods

Aphid samples on various hosts were collected from different locations in cultivated and noncultivated areas of South Eastern Anatolia province of Turkey during the period of 2006-2008.

Plant parts with aphids on them were cut off and placed into separate polyethylene bags. The aphids sample were transferred into Eppendorf tubes containing 70 % ethyl alcohol with a fine brush. Mounting was performed as described by Hille Ris Lambers (1950). The determined species were classified according to Remaudiere and Remaudiere (1997). The

aphids were systematically classified from the catalog of Remaudière and Remaudière (1997).

Results

A list of the species is given below together with their host plant in Adıyaman, Batman, Diyarbakır, Mardin and anlıurfa provinces (Table 1). As a result, it has been revealed that the variety of aphid fauna in this region depends on the rich different plants flora.

Table 1. Aphid species and their hosts

Species	Host plants
Alt Familya: Aphidinae **Tribe: Aphidini-Aphidina** **Cins: *Aphis* Linnaeus, 1758** **Species: *Aphis affinis* del Guercio, 1911**	*Mentha* sp.
Species: *Aphis chloris* Koch, 1854	*Hypericum* sp.
Species: *Aphis craccivora* Koch, 1854	*Robinia pseudoacacia, Glychiriyza* sp., *Vicia* sp., *Capsella bursapastoris, Phaseolus vulgaris, Urtica urens, Gossypium* sp.
Species: *Aphis fabae* Scopoli, 1763	*Phaseolus vulgaris, Galium* sp., *Salvia sp., Chenopodium* sp., *Rumex* sp., *Malva* sp., *Circium arvense*
Sub-Species: *Aphis fabae* subsp. *solanella* Theobald, 1914	*Solanum nigrum*
Species: *Aphis gossypii* Glover, 1877	*Citrullus vulgaris, Lactuca sativa, Lycopersicon esculentum, Cucurbito pepo, Gossypium* sp., *Cucumis melo, Solanum melongena, Capsicum annuum, Tribulus terrestris, Pyracantha* sp
Species: *Aphis euphorbiae* Kaltenbach, 1843	*Euphorbia* sp.
Species: *Aphis polygonata* (Nevsky, 1929)	*Polygonum* sp.
Table Contıuned	
Species: *Aphis pomi* de Geer, 1773	*Malus communis*
Species: *Aphis punicae* Passerini, 1863	*Punica granatum*
Species: *Aphis rumicis* Linnaeus, 1758	*Rumex* sp.
Species: *Aphis salviae* Walker, 1852	*Salvia* sp.
Species: *Aphis tirucallis* Hille Ris Lambers, 1954	*Euphorbia* sp.
Species: *Aphis umbrella* (Börner, 1950)	*Bifora* sp.
Species: *Aphis urticata* Gmelin, 1790	*Urtica* sp.
Tribe: Aphidini-Rhopalosiphina **Genus: *Hyalopterus* Koch, 1854** **Species: *Hyalopterus amygdali* (Blanchard, 1840)**	*Amygdalus communis*
Species: *Hyalopterus pruni* (Geoffroy, 1762)	*Prunus armeniaca, Phragmites* sp.
Species: *Rhopalosiphum maidis* (Fitch, 1856)	*Zea mays*
Species: *Rhopalosiphum padi* (Linnaeus, 1758)	*Triticum aestium, Typha latifolia*
Tribe: Macrosiphini	*Medicago sativa, Pisum sativum*

Genus: *Acyrthosiphon* Mordvilko, 1914 **Species: *Acyrthosiphon pisum*** (Harris, 1776)	
Species: *Brachycaudus helichrysi* (Kaltenbach, 1843)	*Prunus* sp., *Prunus domestica*
Subgenus: *Acaudus* van der Goot, 1913 **Species: *Brachycaudus cardui*** (Linnaeus, 1758)	*Cirsium arvense*
Subgenus: *Appelia* Börner, 1930 **Species: *Brachycaudus* (*Appelia*) *tragopogonis*** (Kaltenbach, 1843)	*Tragopogon* sp.
Genus: *Brevicoryne* van der Goot, 1915 **Species: *Brevicoryne brassicae*** (Linnaeus, 1758)	*Sinapis arvensis, Diplotaxis* sp., *Brassica oleracae* var. *capitata, Rhaphanus sativus, Sinapis* sp., *Brassica napus* var. *oleifera*
Genus: *Dysaphis* Börner, 1931 **Species: *Dysaphis devecta*** Walker, 1849	*Malus communis*
Subgenus: *Pomaphis* Börner, 1939 **Species: *Dysaphis* (*Pomaphis*) *plantaginae*** (Passerini, 1860)	*Malus communis, Pyrus malus*
Species: *Dysaphis* (*Pomaphis*) *pyri* (Boyer de Fonscolombe, 1841)	*Pyrus communis*
Genus: *Hyperomyzus* Börner, 1933 **Species: *Hyperomyzus lactucae*** (Linnaeus, 1758)	*Sonchus oleraceus, Lactuca serriola*
Genus: *Lipaphis* Mordvilko, 1928 **Species: *Lipaphis erysimi*** (Kaltenbach, 1843)	*Raphanus sativus, Sinapis arvensis*
Genus: *Macrosiphum* Passerini, 1860 **Species: *Macrosiphum euphorbiae*** (Thomas, 1878)	*Euphorbia* sp.
Species: *Macrosiphum rosae* (Linnaeus, 1758)	*Rosa* sp.
Genus: *Myzus* **Species: *Myzus cerasi*** Fabricius, 1775	*Gallium* sp., *Prunus cerasus*
Species: *Myzus* (*Nectarosiphon*) *persicae* (Sulzer, 1776)	*Prunus persicae, Capsicum annuum, Solanum melongena*
Genus: *Sitobion* Mordvilko, 1914 **Species: *Sitobion avene*** (Fabricius, 1775)	*Triticum* sp., *Hordeum* sp.
Genus: *Uroleucon* Mordvilko, 1914 **Species: *Uroleucon* (*Uroleucon*) *sonchi*** Linaeus, 1767	*Sonchus oleraceus, Sonchus* sp.
Subfamily: Chaitophorinae **Tribe: Chaitophorini** **Genus: *Chaitophorus* Koch, 1854** **Species: *Chaitophorus leucomelas*** Koch, 1854	*Populus* sp., *Salix* sp.
Subfamily: Lachninae **Tribe:** Cinarini **Genus:** *Eulachnus* del Guercio, 1909 **Species: *Eulachnus tuberculostemmatus*** (Theobald, 1915)	*Pinus sp.*
Tribe: Lachnini **Genus:** *Pterochloroides* Mordvilko, 1914	*Prunus persicae*

Species: *Pterochloroides persicae* (Cholodkovsky, 1899)	
Genus: *Tuberolachnus* Mordvilko, 1909 **Species: *Tuberolachnus salignus*** (Gmelin, 1790)	*Salix* sp.
Subfamily: Myzocallidinae **Tribe:** Myzocallidini **Genus:** *Chromaphis* Walker, 1870 **Species: *Chromaphis juglandicola*** Kaletnbach, 1843	*Juglans regia*
Genus: *Panaphis* Kirkaldy, 1904 **Species: *Panaphis juglandis*** (Goeze, 1778) (=*Callaphis juglandis* Walker, 1870)	*Juglans regia*
Subfamily: Pemphiginae **Tribe:** Eriosomatini **Genus:** *Eriosoma* Leach, 1818 **Species: *Eriosoma lanigerum*** (Hausmann, 1802)	*Malus communis*
Tribe: Fordini **Genus:** *Forda* von Heyden, 1837 **Species: *Forda formicaria*** von Heyden, 1837	*Pistacia* sp.
Tribe: Pemphigini **Genus:** *Pemphigus* Hartig, 1839 **Species: *Pemphigus immunis*** Buckton, 1896	*Populus* sp.

Conclusıon

In this study, the 45 aphid species and subspecies identified were found to be from 23 genera and the subfamilies Aphidinae, Chaitophorinae, Lachninae, Myzocallidinae, Pemphiginae and *Aphis craccivora* Koch, *Aphis fabae* Scopoli, *Aphis gossypii* Glover, *Hyalopterus pruni* (Geoffroy), *Myzus cerasi* (Fabricius) and *Myzus persicae* (Sulzer) were the most common species. *Aphis craccivora* Koch, *Aphis fabae* Scopoli and *Aphis gossypii* Glover were found to have the highest number of hosts in descending order.

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NEED FOR INTEGRATED WEED MANAGEMENT IN FINE GRAINED DRY DIRECT SEEDED RICE

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Abstract

The culture for growing fine grain aromatic basmati rice includes flooding and puddling of the field. These puddled and flooded fields are then transplanted with nearly 30 days old rice nursery. The weeds present in the field sown with rice by this traditional method are suppressed by two means. These are eradicated and buried under the heavy soil layer through tillage done in the form of puddling as well as suppressed by the standing layer of water. The standing layer of water not only suppresses the growth of germinated weeds but also prevents the germination of more weeds. The traditional basmati rice cultivation culture is desired to be replaced with water saving rice cultivation culture (dry direct seeded rice; DDSR) due to water shortage resulting from the climatic changes. However, DDSR is severely constrained by weeds which strongly interfere the rice growth and yield. Further, a variable weed flora was recorded under both the rice cultures. The results of experiments indicated that some herbicides can effectively control the weeds in DDSR. However, relying on a single or combination of two herbicides (one pre- + one post-emergence) may not be a good idea in the wake of environmental pollution and herbicide resistance development. Relying on integrated weed management (IWM) would be the most suitable and sustainable option to effectively control the weeds for the successful production of rice by DDS method. Careful field sanitation, crop rotation, stale seed bed, chemical control, brown mulching and spotted hand weeding can be implemented integrated for an effective weed control in DDSR. The strategies if integrated suitably would result in sustainable weeds control, increased yield and improved quality of basmati rice grown by DDS method.

Keywords: *fine grain rice, weeds, yield losses, integrated weed management*

Introduction

Rice grains are eaten by a huge portion of population on the earth. Moreover, countless byproducts of rice can be listed. Rice bran, paper, oil are important among these byproducts which are utilized from rice. Fine grain rice cultivars are important within the other types of rice due to pleasant fragrance, grain length and greater cooking quality (Bhattacharjee *et al.*, 2002). Hence, these cultivars are preferred over the other rice. The traditional way of growing fine grain rice cultivars is the flooded puddled method which requires a lot of water and labor (Tabbal *et al.*, 2002; Tuong *et al.*, 2005). However, the reduced water availability and labor shortage throughout the rice growing areas of the world leads to a failure in maintaining the fine grain rice production by routine method. In response to labor and water shortage, sowing of fine grain rice under dry soil environment has been suggested as an alternative. The method is named as dry direct seeded (DDS) rice, and possesses the advantage of having lower labor and water requirements than the conventional methods (Farooq *et al.*, 2011). Nevertheless, a number of limitations challenge the sustainability of DDS rice method. Weeds are salient among such challenges (Chauhan, 2012). Weeds even result in 100% crop

loss of DDS rice under certain instances (Chauhan and Johnson, 2011). Usually, applying a single technique was not sufficient for reasonable weed control in DDS rice. Hence, the use of integrated weed management would probably successfully tackle the problem of high weed proliferation in DDS rice (Chauhan and Johnson, 2011; Bhurer *et al.*, 2013). In this article, we have highlighted the importance of fine grain basmati rice cultivars, the traditional way of growing rice, dry direct seeded rice and issues in growing basmati rice by dry seeding method. Further, the weed control methods which can be used for integrated weed management in DDS fine rice have been explained.

Importance of fine grain basmati rice cultivars

The fine grain basmati rice cultivars are grown mainly in Pakistan and India. A number of distinguishing features make the fine grain rice cultivars prominent among the other types of rice in the world (Bhattacharjee *et al.*, 2002). The first character which distinguishes the basmati from other rice types is the strong sweet smell of grain called aroma. The chemical compound supposed responsible for aroma in basmati grains is 2-acetyl-1-pyrroline. The other salient character of basmati rice, which makes it outstanding among the other rice types, is the extra-long size of grain. This makes it attractive for the consumers. Moreover, the grain size is further increased after the cooking (almost doubled upon cooking). Outstanding cooking quality is the other distinguishing character of the basmati rice. The basmati rice grains do not stick with each other during cooking owing to specific concentration of amylose contents. Based on these characters, the basmati rice is sold in the world market at the highest price compared with all other types of rice. A price comparison of different important rice types from around the world are presented in the Fig. 1.

Therefore, the basmati rice types are unique among the several of rice types found all over the world. Hence, this type of rice is liked more than the other types and fetches higher economy benefits.

The traditional way of growing rice

The traditional way of growing rice is one which needs high amounts of water and labor. For sowing rice under this system, the first step is to grow nursery seedlings. Meanwhile, the agricultural fields are flooded and then puddled with tractor mounted cultivator and planker. The flooded and puddled fields are transplanted with nursery seedling, either through a machine or manually (San-Oh *et al.*, 2004; Mishra and Salokhe, 2008). The major drawbacks of this system are the higher water requirement and labor needs. Hence, the dry-seeded rice is suggested as an alternate to the traditional way growing rice in order to save significant amount of water and labor (Bouman *et al.*, 2007).

Dry direct seeded rice

Dry direct seeding (DDS) is the way of growing rice where the nonflooded fields are sown with the rice seeds. The seed drilling is done using seeding machines. The crop is irrigated before the complete soil drying (Farooq *et al.*, 2011). The purpose of growing rice by this method is to save the huge energy and water, as needed in case of traditionally grown rice (Bhushan *et al.*, 2007).
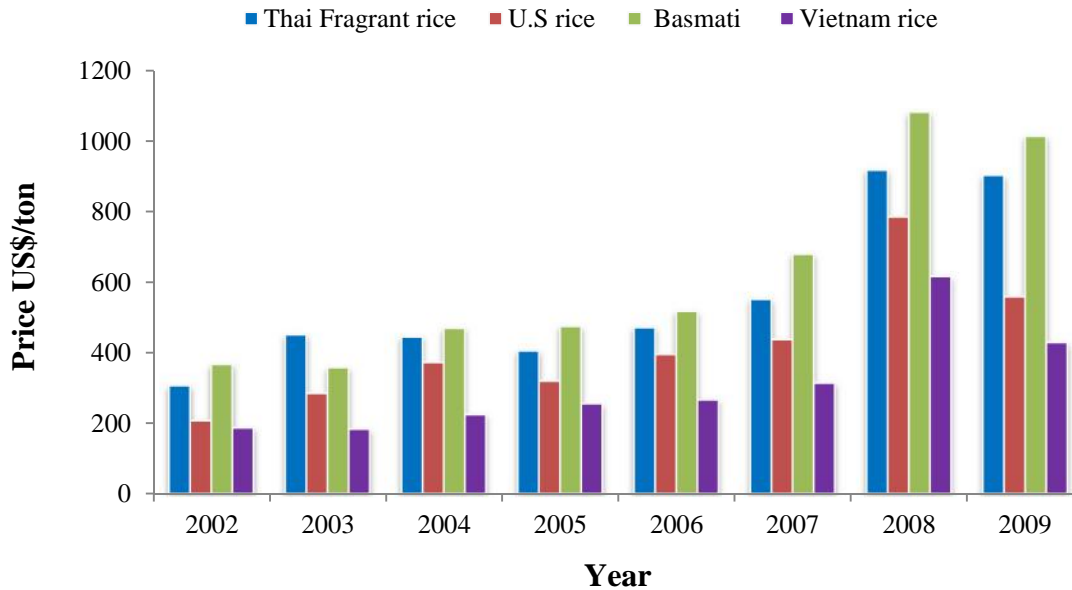
Fig. 1: A comparison of price for rice grains in the world market; Source:
http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1229

Issues

Several of the issues restrict the successful rice production by DDS method. Many of the crop management issues still require solution to successfully exploit potential of DDS method. For example, a poor crop stand may be witnessed if the rice seed is of poor quality and has not been treated with some suitable treatment to improve germination. Similarly, limited information is available regarding the nutrient in DDS method of rice growing. Moreover, severe spikelet sterility, high weeds and diseases intensity are among the serious issues being faced by DDS method of rice cultivation. However, high weed proliferation carries extreme gravity which results many times in failure of rice crop when grown by DDS method. *Dactyloctenium aegyptium* (L.) Willd., *Echinochloa crus-galli* (L.) Beauv., *Echinochloa colona* (L.) Link, *Cyperus rotundus* L., *Cyperus iria* L., and *Trianthema portulacastarus* L. are among the most important weeds which are infesting the DDS rice (Tindall *et al.*, 2005; Sanusan *et al.*, 2010; Chauhan and Opeña, 2013). On the other hand, huge quantity of rice grains in DDS method is lost due to weed-crop competition. For example, a study from Pakistan reported that the weeds such as *C. rotundus*, *T. portulacastrum*, *Eclipta prostrata* L., *E. crus-galli* and *D. aegyptium* caused a nearly 75% decline in the productivity of rice grown by DDS method (Jabran *et al.*, 2012a). Hence, weeds are the most serious issue faced while growing rice as DDS.

Integrated weed management (IWM)

IWM is the scientific and smart way of controlling weeds where more than one methods are practiced in integration. Use of multiple methods to control the weeds makes the control techniques to work in harmony. Hence, the antagonistic effects of few practiced weed suppression methods improve the reliability of weed control. IWM is particularly desired for the DDS rice owing to hardy weeds, shifts in weed flora and the appearance of repeated flushes of weed flora. For IWM in DDS rice, the different techniques can be integrated to have improved weed control and higher paddy yields. Several techniques such as field sanitation, crop rotation, brown mulching, chemical control, mechanical control and spotted hand weeding are elaborated here.

Field sanitation

Field sanitation comprise of a complex of sanitary practice which are aimed to prevent the weed propagation in the agricultural fields (Norris *et al.*, 2003). Field sanitation is important for maintaining weed free fields as the hygienic conditions are important for avoiding illnesses in humans, and enjoying a healthy life. Although, a number of field sanitation practices can be listed we will briefly discuss those which are important in relevance with the weed management in DDS rice. Irrigation canals, rice farm areas, rice farm roads and field bunds can be listed as the places which should be free from weeds to avoid the weed propagation in DDS rice (Rao *et al.*, 2007). More importantly, the entire crop inputs like seed, fertilizer, water, compost and mulches should no contain weed seeds. Similarly, the equipment like tractor, cultivator, sowing drills, sprayers and others, which are used for different farm operations must be hygiene from weed seeds to avoid weeds proliferation in DDS rice. Adopting such cares to practices field sanitation will help to reduce weed intensity, in order to improve the weed suppression through IWM.

Crop rotation

Crop rotation is the phenomenon where a definite crop sequence is disturbed by introducing an out-of-routine crop. It is the weed control techniques which reduces the weed intensity without any extra expenses. Crop rotation can be used to reduce weed intensity in DDS rice (Rao *et al.*, 2007). Hence, the rice fields with DDS having abundant uncontrolled weeds can be vacated from rice for one season, and sown with another crop, such as a legume crop like *Vigna mungo* (L.) Hepper, or *Vigna radiata* (L.) R.Wilczek. This crop rotation will help to break the weeds' life cycle by depriving them from their specific ecology. Further, rotating rice with a legume crop will also improve the soil health in addition to reducing the weed intensity. Therefore, crop rotation can be helpful in managing the weeds in DDS rice. More precisely, the crop rotation can help to improve weed control under the auspices of IWM

Brown mulching

Recently, the technique of brown mulching has been found effective for managing weeds in dry-seeded rice. In this technique, the plants from *Sesbania* spp. are sown (as intercrop) along with the dry-seeded rice. Both the rice and *Sesbania* spp. plants are allowed to grow together four to six weeks after crop sowing. Thirty to forty days later, herbicide (usually 2, 4-D) is sprayed to kill the *Sesbania* spp. The applied herbicide kills not only the *Sesbani* spp. plants, but also the susceptible weeds. The *Sesbania* spp. turning brown, hence, the technique is named brown mulching. The weeds in the dry-seeded rice crop are first suppressed by the shading of the intercropped *Sesbania* spp., while the weeds are suppressed by the brown mulch through physical effect and shading. Therefore, the technique of brown mulching can play an important role for weed control in DDS rice.

Chemical control

Herbicides have done a remarkable job for agriculture by suppressing weeds efficiently. Weed control through herbicides gains more significance if the existing weed flora is tough. Although, some literature indicate that applying an herbicide can suppress weeds in DDS, contradictory reports indicate the failure only of herbicides to control the hardy weed flora in DDS rice (Mahajan *et al.*, 2009). Application of a single herbicide may be suitable for keeping down the weeds if the weed flora is not complex (Jabran *et al.*, 2012a). However, if the weeds are hardy and complex, a combination of herbicides would probably be desired to quash the weeds (Bhurer *et al.*, 2013). A study was conducted for evaluating the effect of three herbicides for controlling weeds in DDS basmati rice (Akbar *et al.*, 2011). The herbicides such as pretilachlor (1250 g a.i. ha^{-1}), pendimethalin (1650 g a.i. ha^{-1}) and

butachlor (1800 g a.i. ha^{-1}) decreased the weed dry weight by 74-87% and the weed density by 81-87%, and improved paddy yield by 6-19% over the control treatment (Akbar *et al.*, 2011). Bispyribac sodium (30 g a.i. ha^{-1}), 2,4-D (500 g a.i. ha^{-1}), ethoxysulfuron (38 g a.i. ha^{-1}) and penoxsulam (15 g a.i. ha^{-1}) are among the most important herbicides which can be applied for chemical weed control in DDS rice (Singh *et al.*, 2006; Hussain *et al.*, 2008; Jabran *et al.*, 2012b).

Mechanical control

Mechanical weed control has particular importance for DDS rice owing to repeated appearance of flushes of weed. Hence, controlling weeds gets impossible while using a single method of control. Hand tools are important for mechanical weed control at small farms. Tractor drawn mechanical weeders can be used in integration with other techniques for IWM in DDS rice. Modern weeders can improve the precision of mechanical weed control in DDS rice.

Spotted hand-weeding

Hand-weeding is among the oldest methods of managing weeds in crops, vegetables, fruit crops and other places. However, only hand-weeding is insufficient to control all the weeds in DDS rice. Hand-weeding can be performed in the DDS rice setting some special objectives. Hence, performing targeted hand-weeding would strengthen the integrated weed control in DDS rice. For instance, the hand-weeding can be combined with a pre-emergence or early post-emergence herbicide to improve the weed control (Singh *et al.*, 2008). In this case, the hand-weeding is done 3-5 weeks after the herbicide application. Similarly, the other way is to perform hand-weeding a few days after the herbicide application (Mahajan *et al.*, 2009). In this way, the spotted hand-weeding is done to pull the weeds which are left uncontrolled after the herbicide application. In another way, the weeds which attain the reproductive growth stage after completing the vegetative stage (i.e. these weeds were not controlled by any of the applied methods) can be cut by a sickle. The cut weeds can be put in the soil to add organic matter to soil. Therefore, the spotted hand-weeding can be employed for achieving specific target in order to improve integrated weed control.

Conclusions

Basmati rice grains outstanding quality conventionally grown by the puddled flooded method requiring high labor and water inputs. DDS is the method which can reduce water input and labor use for cultivating the basmati rice. Weeds are most important among the constraints which reduce productivity of basmati rice under DDS method. High weed infestation in DDS rice stresses to adopt IWM for

Acknowledgements

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INFLUENCE OF DIFFERENT IRRIGATION LEVELS ON THE GROWTH OF REDROOT PIGWEED (*Amaranthus Retroflexus* L.) AND JIMSONWEED (*Datura Stramonium* L.) UNDER DIFFERENT COMPETITION CONDITIONS

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Abstract

Growth of redroot pigweed and jimsonweed grown either alone or in competition with cotton and maize was evaluated under two irrigation levels. Plots were seeded with crops based on the regional growing practices and crops were grown until first irrigation date without weeds. Weed seeds were then sown on plots with or without crops 7-10 days prior to first irrigation date. Weed growth was then monitored weekly during whole irrigation period. At the end of the experiment, weeds were harvested and their mean fresh and dry weights were determined. Water use efficiency (WUE) and irrigation water use efficiency (IWUE) of weeds were determined.
Results showed that irrigation rates did not affect weed fresh and dry biomasses significantly both under non-competitive or competitive conditions. In both water conditions, weeds were significantly suppressed by the competition with crops. Results from both years showed, that water use efficiency and irrigation water use efficiencies of weeds were improved significantly under 50% irrigation water level. Results of these studies suggest that reduced irrigation would not cause important changes in terms of crop-weed competition in the case of cotton and maize crops, because at the beginning of irrigation crop species have great growth advantage over new emerged weed seedlings. However, changes in competition severities between crops and weeds can be expected at the earlier growth stages depending on soil water availability or in crops which are started to be irrigated earlier.

Key words: *water levels, weed-crop competition, cotton, maize*.

Introduction

Cotton and Maize are important summer crops grown in western part of Turkey and weeds are important yield limiting factors for both crops in the same region. Weed control in both crops should be carried out at early stages of growth to reduce the yield losses due to competition for resources such as water, nutrients as well as light. Therefore a weed free period starting from shortly after emergence until row closure is generally required to avoid weed based yield losses (Bükün 2004, Do an et al., 2004).Irrigation is an important growing practice for the growth of both crops that is done mainly atthe end of critical period for weed control in both crops. However, it can still cause new weed emergences in late season which can be problem during harvest and/or reduce the quality of both crops. So late season weed control is also necessary in most cases to avoid such indirect effects of weeds.
Redroot pigweed (*Amaranthus retroflexus* L.) and jimsonweed (*Datura stramonium* L.) are important weeds found frequently in cotton and maize fields which are in most cases target weeds for these crops together with some other species. These species can be found in fields

in early stages and damage crops by means of competition, but also they emerge after irrigation and need to be controlled in most cases mechanically, especially by hand pulling. So they increase water demand on the field and cause extra cost for production.

Because water resources are being more critical during the last decades, special attempts have been put on the reduction of water use in agriculture currently. Deficit irrigation is one of these attempts aiming to reach potential crop yield with minimum water input. Since water is an important competition factor for both crops and weeds, it can be estimated that the growth of weeds can be affected by water supply as well. Therefore it was aimed in this study to evaluate the growth and water use efficiencies of above mentioned weed species at two water levels.

Material and Methods

Experiments were conducted at the Research Station of Adnan Menderes University, Faculty of Agriculture in Aydin province of Turkey in 2012 and 2013 growing seasons. In the study, a split plot design was used with three replications. A drip irrigation system was designated for the experiment. Irrigation water was supplied by a pump to the experimental site. Distribution lines consisted of PVC pipe manifolds for each plot. The diameters of the laterals were 16 mm PE and each lateral irrigated one plant row. The inline emitters were used with a discharge rate of 2 L/h above 10 m operating pressure. In the system, emitter and the lateral spacing were chosen as 0.25 and 0.70 m, respectively. Irrigation water was applied based on cumulative Class A-Pan evaporation within 4 day irrigation interval. There were 3 m between main blocks and each main block was receiving 100% and 50 % of the cumulative evaporation from Class A-Pan. Main blocks were then split into five sub plots. The total area of one main block was 630 m^2 and each sub plot was 33.6 m^2 at sowing. Treatments in each sub plots were:

Crop alone: maize or cotton crops were grown regularly without weeds. Weeds were

removed from plots mechanically when required

Crop with redroot pigweed

Crop with jimsonweed

Maize or cotton crops were grown regularly without weeds until the first irrigation timing. About 1-2 weeks before first irrigation weed seeds were sown on two parallel 2 meters long rows on plots. After emergence weed seedlings were thinned one seedling between two crop plants (20-30 cm apart from each other) on each 2 meters row. In cases where no weed emergence occurred, weeds were also transplanted.

Redroot pigweed alone

Jimsonweed alone

These plots were kept crop and weed free until weed seeding time mentioned above for 2-3. Only weeds were grown on the plots without crops. Weed seeds were sown on two parallel 2 meters long lines on each plot. After emergence weeds were thinned to obtain one weed per 20-30 cm to simulate the distance between weeds as in the case of treatments 2 and 3.

Details to experiments were given in Table 1.

Table 1. Sowing, weed seeding, irrigation dates and amounts during experiments

Crop	Maize		Cotton	
Year	2012	2013	2012	2013
Sowing date	10.07*	08.05	08.05	22.05
Weed seeding date	24.07	22.05	20.06	14.06
Irrigation starting date	13.08	28.06	05.07	28.06
Irrigation end date	25.09	13.08	03.09	29.08
Total full irrigation amount (mm)	395	406	662	596

*second crop maize

Weed growth was followed weekly during whole irrigation period. At the end of the experiment weeds were harvested and their mean fresh and dry weights were determined. Since only weeds grown without competition produced considerable fresh and dry weights, water use efficiency (WUE) and irrigation water use efficiency (IWUE) of these weeds was calculated as below (Howell and Hiler, 1975)

Irrigation water use efficiency (IWUE) = Weed biomass (kg)/ irrigation water applied (mm)

Water use efficiency (WUE) = Weed biomass (kg)/Evapotranspration (mm)

All experimental data was subjected to ANOVA and differences between means were separated by using Standart Errors (SE) of estimation.

Results and Discussion

Fresh and dry biomasses of both weeds grown under two irrigation regimes alone or in competition with crops are shown in Table 2. Since year related interactions were not significant so data from both years was combined and jointly analyzed. Results showed that crops suppressed weeds significantly under both irrigation regimes, so that weed biomasses under competition were significantly lower as compared to weeds grown alone. Crop species (cotton and maize) were not differed in their suppressive abilities over weeds under both competition condition in both years so weed data from each crop was also combined and analyzed jointly.

Table 2. Fresh and dry biomass of jimsonweed and redroot pigweed as affected by irrigation rate and competition

Condition	Jimsonweed				Redroot Pigweed			
	Alone		In competition		Alone		In competition	
Irrigation rate	Full	Half	Full	Half	Full	Half	Full	Half
Fresh weight (kg/per individual)	1,92	2,88	0,10	0,08	1,48	1,52	0,12	0,22
SE	0,33		0,01		0,13		0,07	
Dry weight (kg/per individual)	1,32	1,43	0,02	0,02	0,32	0,33	0,01	0,01
SE	0,46		0,001		0,05		0,001	

Irrigation rate did not affect weed biomass in most cases under both competition conditions. Only fresh weight of jimsonweed grown without competition was significantly higher under half irrigation regime, while this difference was not obtained with dry weight parameter. In the case of redroot pigweed irrigation rates did not affect fresh or dry biomass of this weed significantly.

Irrigation water use efficiency (IWUE) and water use efficiencies (WUE) of both weeds grown alone are shown in Table 3. ANOVA results showed that water factor was significant, while year factor and year-water interaction were not. So data from both years were combined and analyzed jointly. Results showed that both WUE and IWUE values for weeds were significantly higher under half irrigation rate. So it can be concluded that both weeds use soil water more efficiently under limited water conditions.

Table 3. Irrigation water use efficiency (IWUE) and water use efficiencies (WUE) of Jimsonweed and Redroot pigweed as affected by irrigation rate and competition

	Water use efficiency (WUE)				Irrigation water use efficiency (IWUE)			
Condition	Jimsonweed		Redroot pigweed		Jimsonweed		Redroot pigweed	
Irrigation rate	Full	Half	Full	Half	Full	Half	Full	Half
	0,94	1,93	0,68	1,48	0,76	1,29	0,57	1,00
SE	0,17		0,15		0,12		0,11	

Results from these studies showed that both weeds were suppressed by either crop significantly regardless of irrigation rate. So, significant changes in competition cannot be expected based on these results. This can be attributed to the well development of above and underground parts of crops at the time of irrigation, which can make considerable advantage for crop growth and reverse for weeds. So, new emerged weeds can fail in most cases to catch the light, as well as to take water and some nutrients up from the soil. Results showed furthermore that amount of irrigation water did not affect weed biomass significantly when grown without competition. However, water use efficiencies of weeds were nearly doubled under 50% irrigation deficit conditions.

Although some studies have been conducted to investigate the effect of irrigation regimes on the growth and yield of some crops, studies concerning the effect of irrigation rate on weed growth are limited. In a similar study Pearcy et al. (1981) investigated the competition between two weed species redroot pigweed (C4 weed) and common lambsquartes (*Chenopodium album* L., C3 weed) under full and deficit irrigation systems and found that irrigation amount did not alter the competition between two weed species. So, these results are similar to the findings derived from this study. However, Ward et al. (1999) investigated the competition between redroot pigweed (C4 weed) and velvetleaf (*Abuthilon theoprastii* L. Medic., C3 weed) under drought and no water stress conditions and found that drought conditions favored by redroot pigweed in terms of competition.

Conclusion

Results of our studies suggest that weed growth cannot be significantly influenced by water conditions, but water use efficiencies of weeds can strongly be improved under deficit irrigation conditions. Since first irrigation is done at a date where crop species widely completed their vegetative growth, later emerging weeds cannot compete with crops effectively, so that irrigation water amount is insignificant at that crop growth stage. However, in case of some crops irrigated at earlier periods, such as vegetables, significant effects of irrigation water amount on crop-weed interactions are expected. This issue should be the aim of further studies.

Acknowledgement

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INVESTIGATIONS ON PREVENTING WHEAT PHYTOTOXICITY DUE TO MISAPPLIED GLYPHOSATE

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Abstract

Recently, some phytotoxicity problems are faced in wheat, cotton and maize crops, and vineyards which are caused by factors like misapplication of herbicides, drift or herbicide residues in treatment equipment. To reduce or limit the phytotoxicity, some cultural practices or activators are offered by some dealers, however, whether these methods are really suitable to recover the phytotoxicity or not, still remain unclear. In order to investigate this issue, some pot experiments were conducted. Wheat plants were at first treated with 5 doses of glyphosate (Roundup Star) corresponding 12.5, 25, 50, 100 and 200% of the recommended dose (3.0 l/ha). Eight hours after treatments, some activators were used in different combinations. To assess the injury of wheat plants, phytotoxicity symptoms were observed weekly for four weeks long visually and percent injuries were recorded. In addition to that plant vegetation index, stomatal functions and chlorophyll contents of plants were measured. As the results it was observed that the activators did not cause any positive recovery of affected wheat plants, so that their use is not recommended in case of glyphosate injury to wheat plants. Special attention should be paid to avoid misapplications.

Keywords: *Glyphosate, phytotoxicity, activator, wheat, recovery.*

Introduction

During the last a few years, some phytotoxicity problems from herbicides have been noted in crops like vineyard, maize, cotton and wheat. These phytotoxicity problems probably resulted from drift, herbicide residues in the sprayer and use of non-recommended herbicide dose. Such wrong applications of herbicides result in the crop yield losses. Several studies report the negative effects of drift and the use of non-recommended herbicides on the crops (Moffett et al., 1980; Street and Snipes, 1992; Sciumbato et al., 2004; Thomas et al., 2005). Although, the reports regarding the damages of misuse of herbicides are available in the literature, however, no studies report the solutions to tackle such problems. Glyphosate is one among the herbicides which are misapplied in the crop fields. Glyphosate is an enolpyruvyl-shikimate-phosphate (EPSP) inhibitor which inhibits the amino acids (Vencill, 2001). Some enzyme activators and organic fertilizers, if applied to plants receiving a misapplication of herbicides are supposed to get recover. The effectiveness of activator to reduce the phytotoxic effects results from the activity of harpin protein. Harpin protein are produced naturally in the crop plants, fruits, vegetables in response to stress, like pest attack. The harpin proteins strengthen the plant resistance against stresses and help the plants to draw more water and nutrients, improve the photosynthetic activity, enhance the plant growth and hence improve the crop yields (Anonymous, 2012a). Another activator groups is made of a special combination of Cu, Mn and Zn obtained after fermentation from microorganism and addition of organic matter. One of them has been found to be an effective material which reduces the

herbicide phytotoxicity in plants (Anonymous, 2012b). Some research work has been conducted regarding the effects of some activators to control the plants viruses (Çalı kan, 2007), fungus (Dereboylu and Tort, 2010) and bacteria (Soykan, 2010). The growers have no information regarding the strategies in response to phytotoxicity caused by herbicide drift, misapplication of herbicides and the residual effects of herbicides in the equipment. As no research has been done to tackle such kind of phytotoxicity, the growers facing such problems cannot be advised a solution. This results in harmful effects on produce as well as wastage of money.

In this research, we have determined the phytotoxic effects of misapplication different doses of glyphosate. Moreover, the effectiveness of some chemical activators to negate these phytotoxic effects has been evaluated.

Materials and methods

The research work was done two times during 2014 at the Faculty of Agriculture, Adnan Menderes University Aydin (Turkey). The wheat plants of variety Sagittario were grown in pots while a single plant was allowed to grow in each pot. Different doses of glyphosate herbicide (12.5 %, 25 %, 50 %, 100 % and 200 % of the recommended dose) were sprayed on wheat plants at the tillering stage (BBCH=22-23) in the morning time. The recommended dose of glyphosate was 3 Lt/ha. Each dose of glyphosate was applied on 20 wheat pots. Later, 5 out of 20 posts received no further treatment. The other pots (in a set of 5, making a total of three sets) were applied with Activator I (Agrozym[TM], 1 kg/ha), Activator I+Activator II (Flora X [TM], 1 Lt/ha) and Activator I+Activator III (Messenger Gold [TM], 60 g/ha) separately. Moreover, 5 pots received no treatment to act as control. These treatments were made 8 hours after the glyphosate application to combat the phytotoxicity caused by herbicide application. The phytotoxicity showed its symptoms one week after herbicide application, hence the effect was recorded 4 weeks after application. Water was used 200 L/ha for herbicide application while 110-03 fan type nozzle was used with spraying chamber.

Observation of phytotoxicity: The data on phytotoxicity was recorded comparing the respective treatments with the untreated control. The experiment was visited at one, two, three and four weeks after the treatments application. The phytotoxicity was recorded visually and expressed in percentage effect.

Determination of chlorophyll concentration index, vegetation index and stomatal conductance and dry weight: The data on the agro-physiological parameters of wheat was recorded six times during experiment; first, one day before the herbicide application; second, one day after herbicide application; and then every week for four times. The data recorded included parameters such as chlorophyll concentration index, vegetation index and stomatal conductance. The chlorophyll concentration index (CCI) was determined using Chlorophyll Meter (Apogee Company), vegetation index was determined by NDVI meter (QUBIT Z951 NDVI-Pen), and the stomatal conductance (mmol $m^{-2}s^{-1}$) was measured using leaf porometer (Model; SC-1, Decagon Devices, Inc.). All the wheat plants in pots were harvested 28 days after herbicide and activator application and dried in oven for 70 ^{o}C in two days to record the dry weight.

Results and discussion

Phytotoxicity: The applied doses of glyphosate differed in phytotoxicity (Table 1). The lowest phytotoxicity noted for the 12.5 % dose i.e. 12-14 % on 3 weeks after application and 25-30 % on 4 weeks after sowing (Table 1). The phytotoxicity caused by 50 % glyphosate dose was 38-42 % at 3 weeks after application and 44-74 % at 4 weeks after application. Further, no big difference was there for the phytotoxicity among the doses including 50 %, 100 % and 200 %. All of these doses (50, 100 and 200 %) gave nearly 80-90 % phytotoxicity at 3 weeks

after application and 100 % phytotoxicity at 4 weeks after application (Table 1). Further, the results indicated the visual phytotoxicity on the wheat plants applied with either of the activators was similar as it was for the only herbicide applied wheat plants (Table 1).

Table 1.Phytotoxicity after application of different glyphosate doses

Exp.	Glyphosate		Glyphosate+Activator I		Glyphosate +Activator I+II		Glyphosate +Activator I+III	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Dose=12.5% (375ml/ha)								
1st week	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2nd week	6,0	1,8	2,8	0,0	2,2	5,0	3,2	4,0
3rd week	14	12	13	4,0	6,0	22	6,8	28
4th week	25	30	32	1,0	9,0	6,0	24	26
Dose=25% (750ml/ha)								
1st week	2,0	2,2	2,0	3,2	0,4	2,6	0,4	1,8
2nd week	4,8	24	7,8	22	2,2	58	9,4	22
3rd week	38	42	52	44	32	87	46	62
4th week	74	44	59	46	86	89	79	54
Dose=50% (1500ml/ha)								
1st week	5,0	0,4	2,6	1,2	3,8	7,4	2,2	4,4
2nd week	78	50	66	56,0	95	64	86	81
3rd week	88	88	66	98	82	100	94	100
4th week	100	100	97	100	98	100	100	100
Dose=100% (3000ml/ha)								
1st week	6,0	6,0	7,0	3,0	3,2	7,0	6,4	5,4
2nd week	89	90	95	90	89	90	91	90
3rd week	91	100	98	100	95	100	96	100
4th week	100	100	100	100	100	100	100	100
Dose=200% (6000ml/ha)								
1st week	4,2	9,0	4,8	9,0	5,8	8,0	5,8	8,0
2nd week	86	96	91	96	92	94	94	93
3rd week	93	100	96	100	95	100	96	100
4th week	100	100	100	100	100	100	100	100

Chlorophyll concentration index (CCI), vegetation index (NDVI) and stomatal conductance and dry weight: CCI for 12.5 % glyphosate dose was decreased at 7 and 14 days, and it was increased after 21 days. However, CCI was highly decreased after the application of 50 %, 100 % and 200 % doses at 7 days. As a result, the 12.5 % dose and control had same CCI, 25 % dose was similar with only herbicide, Activator I and Activator I+III. The results on NDVI indicated that in the two experiments, the 50 % and higher doses extremely decreased the NDVI after 7 days. The results for CCI were not consistent while the results for NDI were consistent and uniform. Similar to CCI and NDVI, in untreated control and 12.5 % dose stomatal conductivity was decreased between 7 and 14 days, afterwards, it was increased. All the applications of 25 % had a moderate effect. However, at 50 % and higher doses, stomatal conductivity was highly decreased after 7 days.

Regarding the dry weight, the data for the first and second experiments was different. But, the dry weight was decreased for 12.5 % and 25 % doses including for the plants applied with activators. For all the plants applied with 50 % or higher doses (with or without activator), no dry weight was recorded as the plant were died.
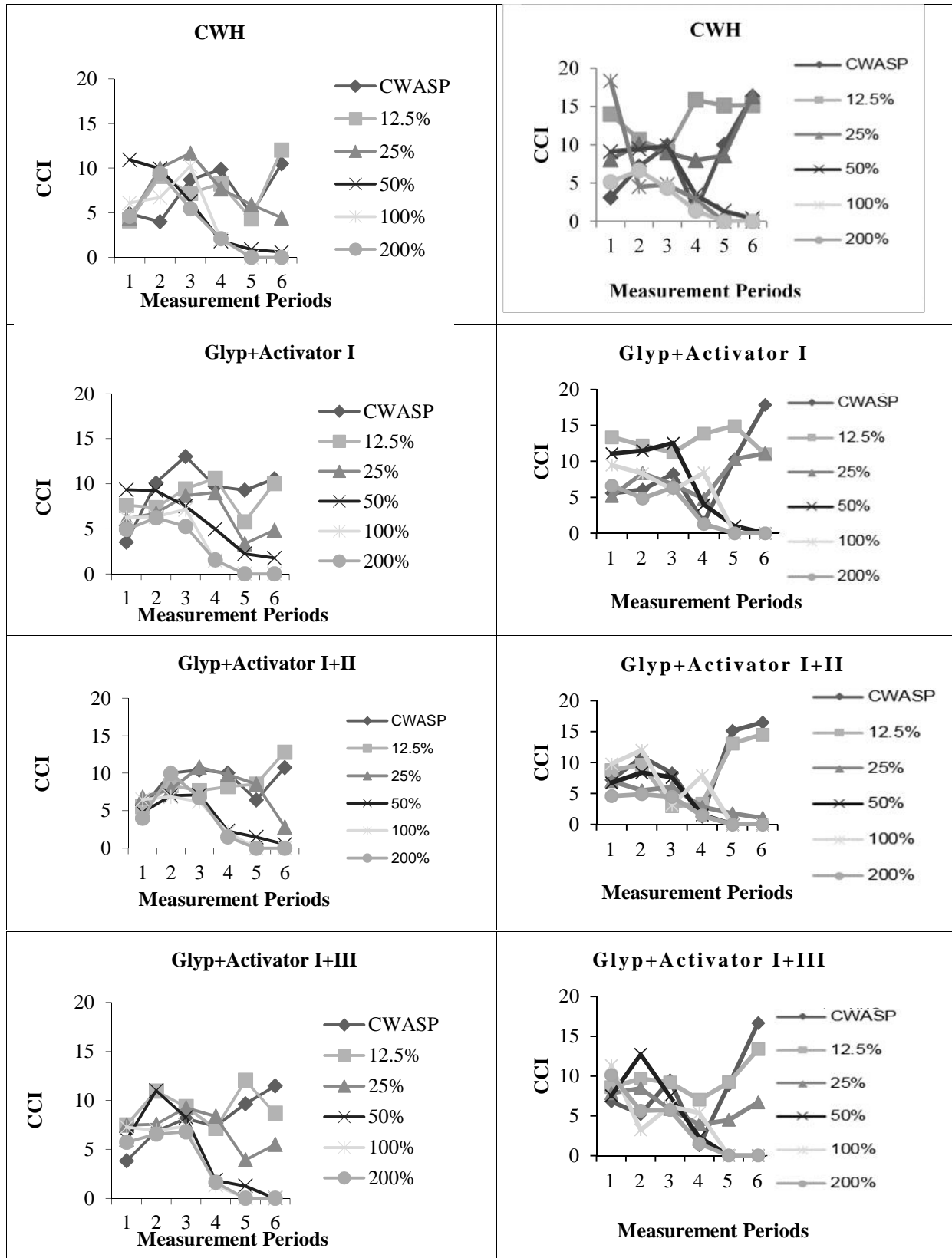
1st Experiment   2nd Experiment

Figure 1. CCI before and after application of glyphosate and activators

Measurement periods were: 1=one day before application; 2=one day after application; 3 = 7 days after application; 4= 14 days after application; 5=21 days after application; 6=28 days after application
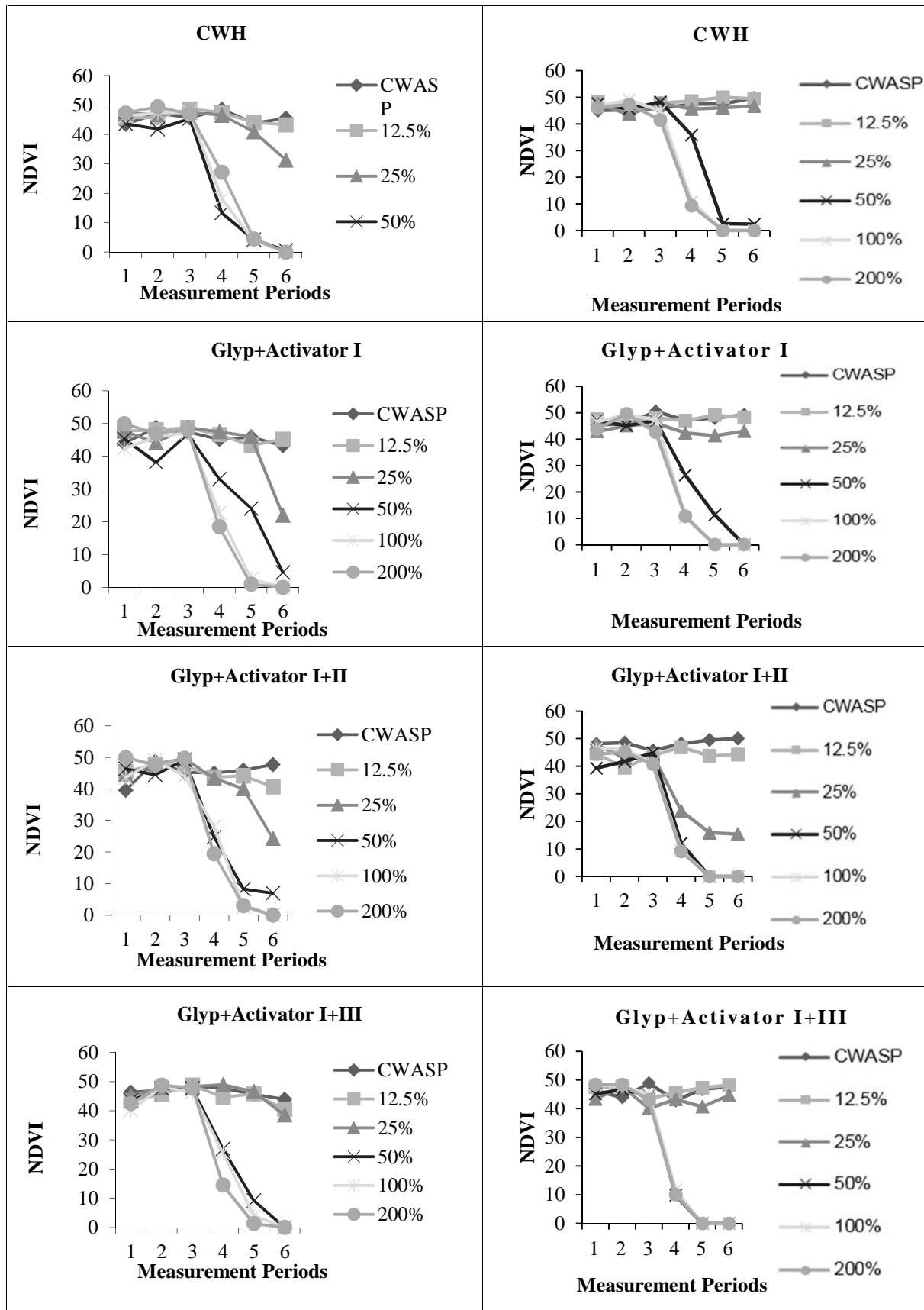
1st Experiment   2nd Experiment

Figure 2. NDVI before and after application of glyphosate and activators
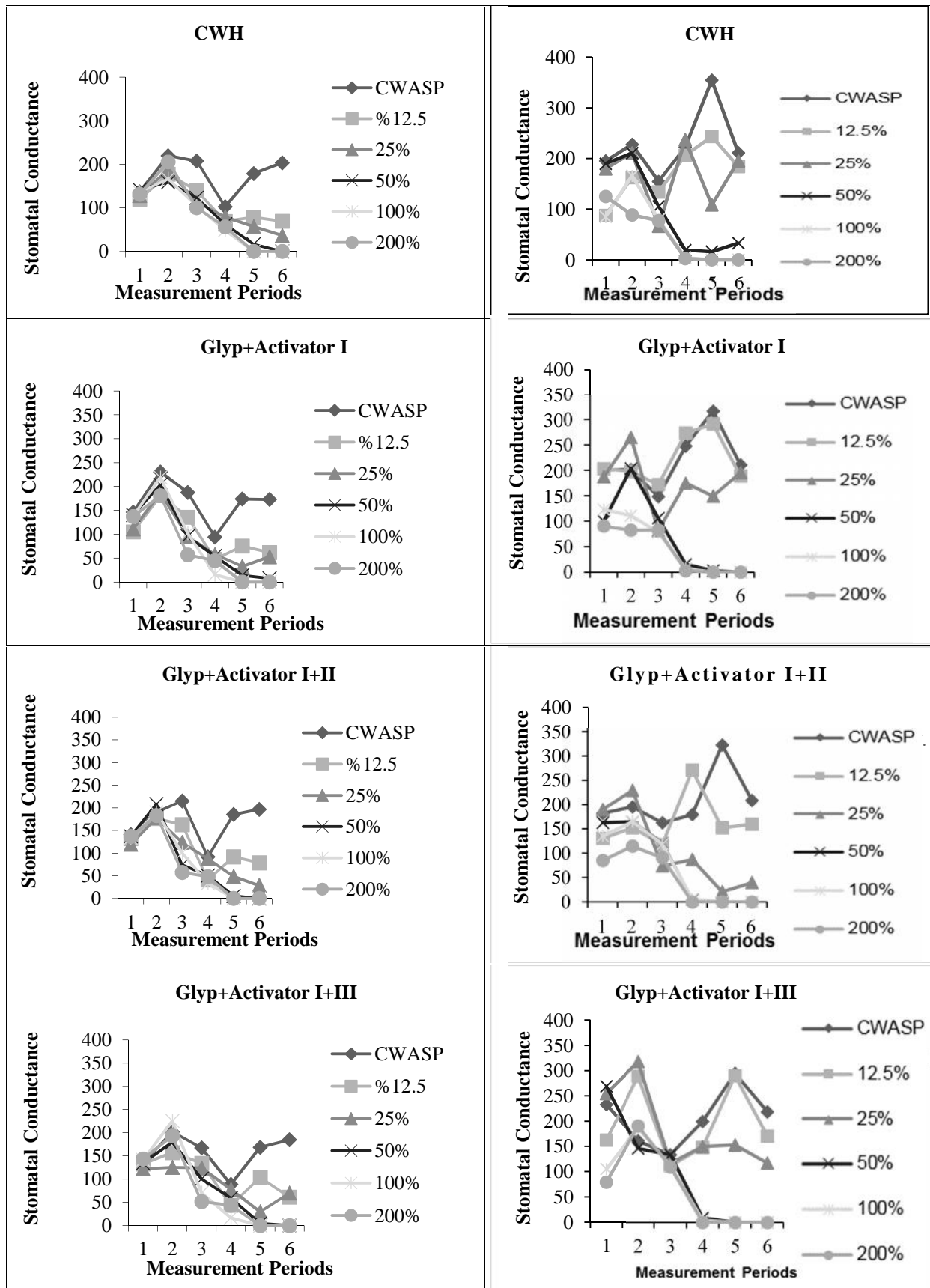
1st Experiment   2nd Experiment

Figure 3. Stomatal conductance before and after application of glyphosate and activators
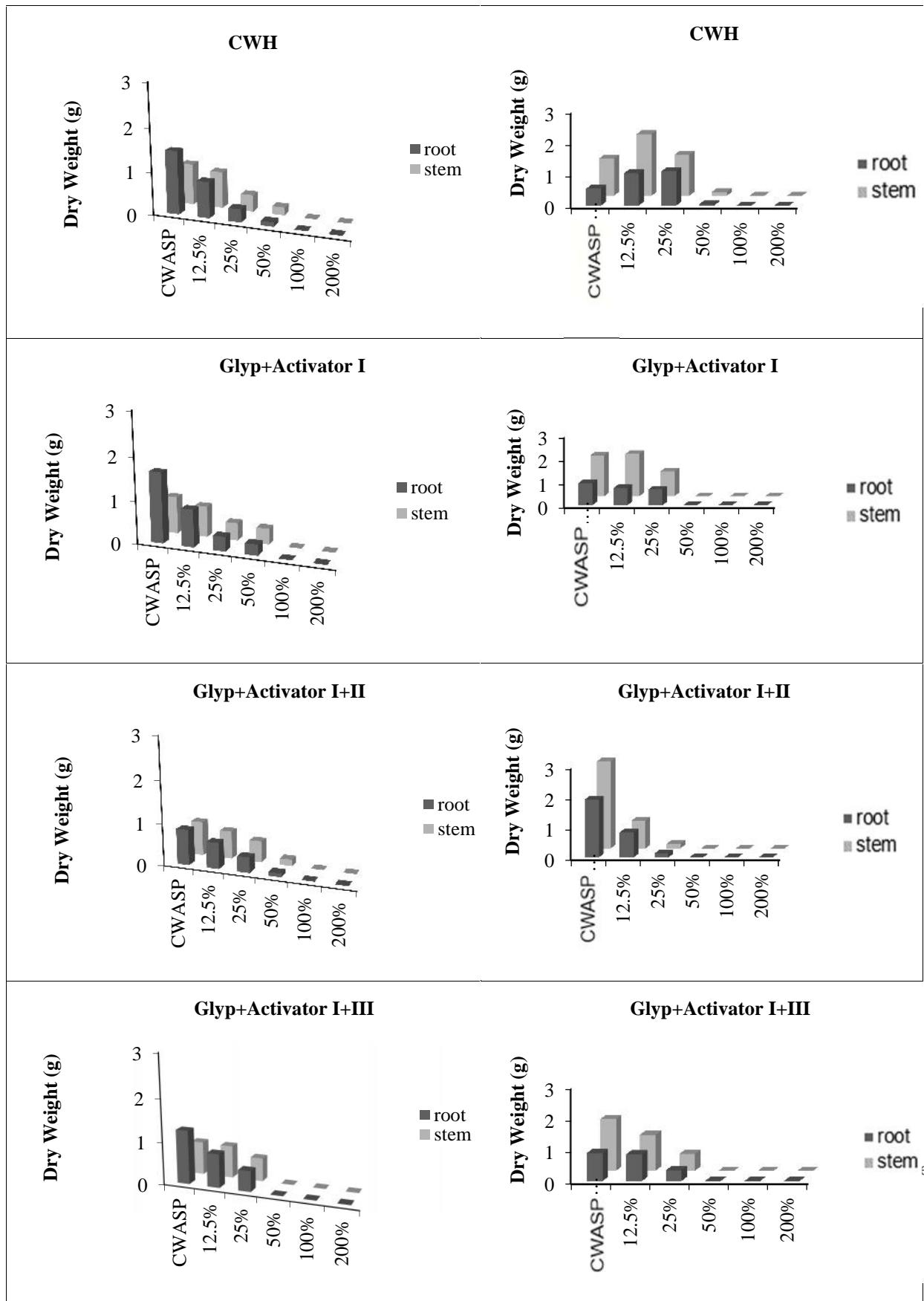
1st Experiment   2nd Experiment

Figure 4. Dry weight of wheat after application of glyphosate and activators

Conclusions

The results indicated that the activators did not cause any positive effect for the recovery of glyphosate affected wheat plants. Hence, the use of such chemical is not recommended in case of glyphosate injury (phytotoxicity) to wheat plants. Special attention should be paid to avoid misapplications.

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VIRUS DISEASES OF EDIBLE SEED SQUASH (*CUCURBITA PEPO* L.) IN KONYA PROVINCE

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Abstract

Squash seeds have been used as a snack in Turkey like in some Mediterranean countries and Germany, Hungary, Austria and China. Viral diseases are very destructive especially on squash (*Cucurbita pepo* L.) which is grown for seeds in Konya province. This paper aims at determining the virus infections in major squash growing areas in Konya province (Turkey). Totally 334 plant samples with common virus symptoms like mosaic, curling, blistering, mottling, distortion, shoestring, stunting and vine decline were collected from squash plants during 2013. The viruses were identified by DAS-ELISA. The results showed that 80.53 % of plant samples were infected with *Zucchini yellow mosaic Potyvirus* (ZYMV), *Watermelon mosaic Potyvirus-2* (WMV-2), *Cucumber mosaic Cucumovirus* (CMV), *Papaya ringspot Potyvirus*-watermelon strain (PRSV-W) and *Squash mosaic Comovirus* (SqMV). ZYMV was predominant in the research area with the ratio of 60.18 %. WMV-2 was detected in squash at the ratio of 52.99 % and it was second important virus disease in the survey area. Also mixed infections of those virus infections were detected commonly in squash. *Cucumber green mottle mosaic Tobamovirus* (CGMMV) was not present in the research area.

Keywords: *DAS-ELISA, edible squash seed, Konya, WMV-2, ZYMV.*

Introduction

Cucurbits (the Cucurbitaceae family) include 119 genera and 825 species distributed primarily in tropical and subtropical regions of the world (Andres, 2004; Jeffrey, 1990) The major cultivated cucurbit species such as melon (*Cucumis melo* L.), cucumber (*Cucumis sativus* L.), squash (*Cucurbita pepo* L.), and watermelon (*Citrullus lanatus* (Thunb) Matsum.&Nakai) are important vegetable crops worldwide. According to the different estimates, 3-5% of overall vegetable production is lost due to virus infections, but losses can be occasionally very high, where pest control is insufficient, especially in developing countries (Caciagli, 2010). Virus diseases are a worldwide problem for cucurbit production and cause serious economic losses. Indeed, more than 35 different viruses have been isolated from cucurbits (Provvidenti, 1996). These viruses constitute complex and dynamically changing problems as described by Nameth et al. (1986). Edible seed squash is among the major vegetables grown in Konya province of Turkey. It planted on 1839 ha in the province during 2013, with an estimated production of 2093 tons (Anonymous, 2012). From different parts of Turkey, several virus diseases inducing mosaic symptoms were previously reported including *Cucumber mosaic Cucumovirus* (CMV) (Kurcman, 1977), *Watermelon mosaic Potyvirus-2* (WMV-2) (Nogay & Yorgancı, 1984), *Zucchini yellow mosaic Potyvirus* (ZYMV) (Davis & Yılmaz, 1984), *Papaya ringspot Potyvirus*-watermelon strain (PRSV-W) (Erdiller & Ertunç, 1988), *Cucumber vein yellowing Ipomovirus* (CVYV) (Yılmaz et al., 1991), *Cucurbit aphidborne yellows Polerovirus* (Yılmaz et al., 1992), *Melon mosaic virus* (MMV) (Yılmaz et al., 1995), *Tomato ringspot Nepovirus* (TRSV) and *Tomato black ring*

Nepovirus (TBRV) only in cucumber (Fidan, 1995), *Squash mosaic Comovirus* (SqMV) (Ça lar et al., 2004 Gümü et al., 2001; Gümü et al., 2004).

In the present research, one year of surveys were undertaken in order to evaluate the incidence and distribution of viruses (WMV-2, ZYMV, CMV, SqMV, PRSV-W, and CGMMV) infecting squash crops grown in the Konya province.

Material and methods

Collection of infected plant material

Symptomatic leaf samples were collected during the period July-October 2013 in the main edible seed squash-growing areas of Konya province. Each sample consisted of the youngest fully developed leaf from plants exhibiting symptoms such as mosaic, mottling, vein clearing, blistering distortion, shoestring, stunting or yellowing and fruit discoloration and deformation. All samples were tested for the presence of ZYMV, WMV-2, CMV, PRSV-W, CGMMV and SqMV. All collected samples were placed in plastic bags, and stored in a freezer (-20°C) until use.

DAS-ELISA

All collected samples were subjected to DAS-ELISA and were tested for the presence of ZYMV, WMV-2, PRSV-W, CMV, SqMV and CGMMV using the double-antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) tests as described by Clark & Adams (1977). The antisera and conjugates were purchased from BIOREBA AG (Reinach, Switzerland) (ZYMV, WMV-2, SqMV, CMV, and PRSV-W), and ADGEN Phytodiagnostics (Neogen Europe Ltd., Scotland, UK) (CGMMV) and used according to the instructions of the companies. The leaf samples were homogenized using a mortar and pestle with the addition of the sample extraction phosphate buffer solution (8.0 g NaCl, 0.2 g KH_2PO_4, 2.9 g $Na_2HPO_4.12H_2O$, 0.2 g KCl, 0.2 g NaN_3, 20 g polyvinylpyrrolidone-25 per L, pH 7.4) at a ratio of 1:8. Plates (Nunc Microwell, Roskilde, Denmark) were precoated with virus IgG that were diluted in carbonate buffer (1.59 g Na_2CO_3, 2.93 g $NaHCO_3$, 0.2 g NaN_3 per L, pH 9.6), and incubated for 4 h at 37°C. After washing the plates with PBST buffer (8.0 g NaCl, 0.2 g KH_2PO_4, 2.9 g $Na_2HPO_4.12H_2O$, 0.2 g KCl, 0.2 g NaN_3, 0.5 mL Tween-20 per L) three times, samples were added to wells and incubated overnight at 4°C. Alkaline phospahatase conjugated antibody diluted in conjugate buffer (PBST+2% polyvniylpyrrolidone-40 + 0.2% egg albumin (Sigma A-5503) pH 7.4) was added after washing the plates, and incubated for 4 h at 37°C. *P*-nitrophenylphosphate in substrate buffer (97 mL diethanolamine, 0.2 g NaN_3 L^{-1}, pH 9.8) was added to each well and incubated for 30 to 90 min. at dark and room temperature. Absorbance values were measured at 405 nm using an Anthos 2010 Microplate Reader (Biochrom Ltd., Cambridge, UK) at the laboratory. Tests were considered positive when the mean absorbance value of tested samples were greater than twice the healthy control (Abou-Jawdah et al., 2000; Cradock et al., 2001; Ertunç, 1992; Paylan & Erkan, 2011; evik & Arlı-Sökmen, 2003).

Results and discussion

In this study, 334 plant samples were tested by DAS-ELISA. The relative frequencies of the different viruses infecting squash are reported in Tables 1 and 2. The data clearly showed that ZYMV and WMV-2 are the most widespread cucurbit viruses in the research area. Their incidence reached 60.18 and 52.99% in squash, respectively. They are followed by CMV, SqMV, and PRSV-W 13.77, 1.8, and 1.2% in all tested samples, respectively. CGMMV were not detected in any of the tested squash samples. Double virus infection was detected in 153 of the samples. Among double infected plants, 69.28 % were infected with ZYMV+WMV-2, the most frequently detected viruses in the samples. Double infections with CMV+ZYMV (13.07%), CMV+WMV-2 (11.76%), PRSV-W+ZYMV (2.61%),

SqMV+ZYMV (1.96%), and SqMV+WMV-2 (1.31%) were detected. Triple infections were not detected in tested samples. Among the surveyed districts, the highest incidences of the viruses were detected in Altınekin and Yunak with the ratio of 86.66%. ZYMV was the most commonly detected in samples from Yunak (75%), Altınekin (61.66%) and Ak ehir (56.25%). As for, WMV2-2, CMV, and SqMV were frequently detected in samples from Konya-Merkez (60%), Yunak (20%), and Altınekin (6.66%), respectively.

Table 1. Number of plants infected by the following viruses: ZYMV, WMV-2, CMV, PRSV-W, SqMV or CGMMV as determined by DAS-ELISA

Location	No. Tested	Healthy	CMV	SqMV	WMV-2	ZYMV	CGMMV	PRSV-W
Akşehir	32	9	1	0	2	2	0	0
Altınekin	60	8	3	1	9	16	0	0
Çeltik	50	12	0	0	6	13	0	0
Çumra	72	13	3	0	14	10	0	0
Güneysınır	40	10	1	0	7	9	0	0
Konya Merkez	20	5	0	0	4	3	0	0
Yunak	60	8	0	0	3	9	0	0
Total	**334**	**65**	**8**	**1**	**45**	**62**	**0**	**0**

Table 2. Number of samples double infected by the following viruses: ZYMV, WMV-2, CMV, PRSV-W, or SqMV as determined by DAS-ELISA

Location	Double virus infection					
	WMV-2+ ZYMV	CMV+ WMV-2	CMV+ ZYMV	PRSV-W+ ZYMV	SqMV+ WMV-2	SqMV+ ZYMV
Ak ehir	13	2	2	1	0	0
Altınekin	14	1	3	2	1	2
Çeltik	13	2	3	0	0	1
Çumra	21	5	4	1	1	0
Güneysınır	11	2	0	0	0	0
Konya Merkez	6	2	0	0	0	0
Yunak	28	4	8	0	0	0
Total	**106**	**18**	**20**	**4**	**2**	**3**

In Konya province, edible seed squash is economically important but has a high incidence of virus-like symptoms. Viruses causing mosaic, leaf deformation, fruit deformation and reduced growth were observed in squash plants in the province. Reduced growth and yellowing symptoms caused by mineral deficiency were also observed in a few fields. Diseases symptoms were similar to the symptoms previously reported from virus-infected cucurbits fields worldwide (Abou-Jawdah et al., 2000; Alonso-Prados et al., 1997; Davis et al., 2002; Dodds et al., 1984; Lecoq et al., 1981; Luis-Arteaga et al. 1998; Makkouk & Lesemann 1980; Massumi et al., 2007; Provvidenti, 1996; Sammons et al. 1989; Yuki et al., 2000). The occurrence and incidence of viruses on cucurbit plants have been studied in different parts of Turkey. The presence of ZYMV, WMV-2, CMV, PRSV-W and SqMV has been reported by different researchers (Ça lar et al., 2004; Davis & Yılmaz, 1984; Erdiller & Ertunç, 1988; Fidan, 1995; Köklü & Yılmaz, 2006; Kurcman, 1977; Nogay & Yorgancı, 1984; Özaslan et al., 2006; Yılmaz & Davis, 1985; Yılmaz et al., 1991; Yılmaz et al., 1995). ZYMV and WMV-2 were the most widespread viruses in our study. Similarly, Yılmaz et al., (1992) found that they were the most common viruses among five viruses (CMV, WMV-2,

ZYMV, PRSV-W and CABYV) in different provinces of Turkey. Also, a survey was performed by evik & Arlı-Sökmen (2003) on 165 cucurbits in Samsun province, 53.9% WMV-2, 38.8% ZYMV and 20.6 CMV of 165 samples were determined. In the survey conducted in 33 fields in the Gaziantep province of Turkey for viruses infecting cucurbits, ZYMV was found in higher incidence than two other viruses, CMV and *Potato Potyvirus Y* (PVY) (Özaslan et al., 2006).

Conclusion

With this study, the presences of ZYMV, WMV-2, CMV, PRSV-W and SqMV on squash were determined in the province. The results revealed that edible seed squash grown in commercial fields commonly were infected with viruses in Konya. According to the results obtained, the following recommendations should be considered for Konya Province

1. Certified and virus-free seed must be used.
2. Except for SqMV, all viruses detected were spread efficiently by aphids and mechanical inoculation (Hollings et al., 1981; Kaper and Waterworth, 1981). Unfortunately, growers in the province are not aware of spreading the viruses from plant to plant and don't know about control measures for virus dissemination.
3. Weeds play an important role on virus epidemiology and are a common problem in vegetable-growing areas in the province. In order to control the virus infection, weeds should be controlled.
4. Cultural practices are very important in cucurbits. For this purpose, cultural practices such as sowing, fertilizing and irrigation should be performed properly.
5. Virus infected plants should be destroyed promptly to prevent them from serving as sources of further infections.

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INDIGENOUS PSEUDOMONAS CHLORORAPHIS AFFECTS GROWTH OF ALTERNARIA SP., PHOMA SP. AND DRECHSLERA TETRAMERA FROM ANISE

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Abstract

Pseudomonas chlororaphis is a bacterium used as a soil inoculant in agriculture and horticulture. It can act as a biocontrol agent against certain phytopathogenic fungi via production of phenazine type antibiotics. Phytopathogenic fungi are responsible for several plant diseases in different medicinal plants and cause very important economic losses in Serbian plantation. Among them, *Alternaria* sp., *Phoma* sp. and *Drechslera tetramera* are known as major plant pathogens, whereby at least 20% of agricultural spoilage is caused by *Alternaria* species. In this study, we examined the antifungal activity of indigenous *Pseudomonas chlororaphis* isolates against the phytopathogenic fungi *Alternaria* sp., *Phoma* sp. and *Drechslera tetramera*, which had infected anise (*Pimpinella anisum* L., fam. Apiaceae), using *in vitro* inhibition tests. The obtained results showed that studied antibiotic-producing *Ps. chlororaphis* isolates inhibited the tested fungi as follows: *D. tetramera* in the range from 3.85-69.23%, *Alternaria* sp. in the range from 5-50%, and *Phoma* sp. in the range from 0-50%. In general, it has been concluded that studied *P. chlororaphis* isolates have potential in controlling plant diseases caused by phytopathogenic fungi *Alternaria* sp., *Phoma* sp. and *D. tetramera*, whereby the bacterial isolates with the highest inhibitory potential will be selected for further experiments.

Key words: *Pseudomonas chlororaphis isolates, phytopathogenic fungi, Pimpinella anisum, antifungal activity.*

Introduction

Pathogenic microorganisms affecting plant health are a major and chronic threat to food production and ecosystem stability worldwide. As agricultural production intensified over the past few decades, producers became more and more dependent on agrochemicals as a relatively reliable method of crop protection helping with economic stability of their operations. However, increasing use of chemical inputs causes several negative effects, i.e., development of pathogen resistance to the applied agents and their non-target environmental impacts (Compant et al., 2005). An answer to this problem is replacing chemicals with biological approaches, which are considered more environment friendly in the long term. One of the emerging research areas for the control of different phytopathogenic agents is the use of biocontrol activities of microorganisms, which are capable of suppressing or preventing the damages caused by phytopathogens (Nihorembere et al., 2011).

Phytopathogenic fungi, as the most common plant pathogens, are capable of infecting different types of plant tissues. Among the main aims in agriculture is finding adequate strategies for their suppression. One of these strategies is biological control (biocontrol) of plant diseases that relies on the use of natural antagonists of phytopathogenic fungi (Heydari and Pessarakli, 2010). A special place among the natural antagonists of phytopathogenic

fungi belongs to rhizobacteria that show beneficial effects on plant growth (PGPR) (Zehnder et al., 2001). These bacteria use various mechanisms for their action: production of plant hormones, asymbiotic fixation of N2, antagonism towards phytopathogenic microorganisms and the ability to solubilize mineral phosphates and other nutrients (Cattelan et al., 1999). Different isolates of fluorescent *Pseudomonas* species take prominent place in this respect. Fluorescent *Pseudomonas* species are present in temperate and tropical soils, often dominant among rhizobacteria (Ayyadurai et al., 2007). They belong to PGPR because of the ability to colonize the roots of plants and stimulate growth by decreasing the frequency of diseases. Suppression of diseases includes the inhibition of pathogens by competition and/or by antagonism (Couillerot et al., 2009). The prominent feature of fluorescent *Pseudomonas* species is the production of antibiotics as inhibitory compounds that play a role in the suppression of diseases caused by phytopathogenic fungi (Haas and Défago, 2005). One of the best-studied antibiotics of fluorescent *Pseudomonas* species are phenazines, nitrogencontaining heterocyclic compounds (Fernando et al., 2005). The only known natural producers of phenazines are bacteria (Pierson III and Pierson, 2010). Among fluorescent *Pseudomonas* species a bacterium *Pseudomonas chlororaphis* is used as a soil inoculant in agriculture and horticulture. It can act as a biocontrol agent against certain phytopathogenic fungi via production of phenazine type antibiotics (Maddula et al., 2008; Shen et al., 2012). Phytopathogenic fungi are responsible for several plant diseases in different medicinal plants and cause very important economic losses in Serbian plantation. Among them, *Alternaria* sp., *Phoma* sp. and *Drechslera tetramera* are known as major plant pathogens, whereby at least 20% of agricultural spoilage is caused by *Alternaria* species. The genus *Alternaria* is widely distributed in nature and its species are among the most common fungi on the phyllosphere (Lopes and Martins, 2008). It includes both plant-pathogenic and plant-saprophytic species that may damage crops in the field or cause post-harvest decay (Griffin and Chu, 1983), causing considerable economic losses for farmers and food industries. In addition, the genus produces mycotoxins and phytotoxins. The toxins alternariol, alternariol methyl ether, altenuene, and tenuazonic acid are known as possible food contaminants with potential toxicological risk (Pose et al., 2004). Most *Phoma* species are saprobes, but have plant pathogenic potential causing numerous diseases of vegetables and other annual plants (Schwartz and Mohan, 1999; Boerema et al., 2004). *Phoma* sp. infects subterranean organs directly and aerial parts of the plants indirectly (Boerema et al., 2004). The species *Drechslera tetramera* was first described causing foot rot in winter wheat (McKinney, 1925). It was reported to cause crown and root rot disease, leaf spot (Singh and Lal, 1965; Naphade, 1968) and storage disease in many plants (Rao, 1967). The species was also observed on seeds of many crops (Chidambaram et al., 1973). One of the hosts of *Alternaria* sp., *Phoma* sp. and *Drechslera tetramera* is anise (*Pimpinella anisum* L., fam. Apiaceae). Anise is an aromatic plant which is used in traditional medicine (especially its fruits) as carminative, aromatic, disinfectant and galactagogue (Shojaii and Abdollahi Fard, 2012). Regarding the widely distribution and phytopathogenicity of *Alternaria* sp., *Phoma* sp. and *Drechslera tetramera*, as well as the capability of *Pseudomonas chlororaphis* isolates to inhibit the phytopathogenic fungi, the aim of this study was to examine the antifungal activity of thirteen indigenous *P. chlororaphis* isolates against the phytopathogenic fungi *Alternaria* sp., *Phoma* sp. and *Drechslera tetramera*, which had infected anise (*Pimpinella anisum* L., fam. Apiaceae).

Material and methods

The antifungal activity of the following indigenous *Pseudomonas chlororaphis* isolates: PB4, PB5, K38, Q34, M28, B25, PBA12, PD5, C7, C8, Q16P, K24, K29 and K35, was examined

against the phytopathogenic fungi *Alternaria* sp., *Phoma* sp. and *Drechslera tetramera*, which had infected anise (*Pimpinella anisum* L., fam. Apiaceae).

The study was carried out in the Genetics Section of the Institute of Soil Science, Belgrade, from February to April in 2014. The examination was conducted on Waksman agar nutrient media, using *in vitro* inhibition tests. Overnight cultures of the tested *P. chlororaphis* isolates, optimized to $1 \cdot 10^7$ cfu/ml were used to examine the influence of extracellular metabolites of cells (1 ml of cultures was centrifuged at 13000 rpm for 10 min and resuspended in the same volume of sterile saline solution).

The sowing of Waksman nutrient media with the tested cultures of *P. chlororaphis* isolates was done near the edges of Petri dishes and mycelia of the studied phytopathogenic fungi were placed in the center. Control variants contained only mycelia of phytopathogenic fungi on Waksman agar plates.

Observation and the measuring of zones of mycelia growth inhibition around bacterial colonies were performed after seven days of incubation at 25°C (Nair and Anith, 2009). The percentage of growth inhibition of mycelia of *Alternaria* sp., *Phoma* sp. and *D. tetramera* was calculated by the formula: % Inhibition = [(Control - Treatment)/Control] x 100 (Ogbebor and Adekunle, 2005).

Results and discussion

Due to the soil-borne nature of the diseases caused by *Alternaria* sp., *Phoma* sp. and *D. tetramera* the use of chemical methods for the control of disease is rarely successful. Inconsistencies in biocontrol under varying environmental conditions have been a common limitation of soil-borne pathogens. The present research was conducted to evaluate the efficacy of indigenous *P. chlororaphis* isolates against these pathogens.

Table 1 displays the data on *in vitro* antifungal activity of selected *P. chlororaphis* isolates toward *Alternaria* sp., *Phoma* sp. and *D. tetramera*, which had infected anise.

The obtained results imposed that all studied antibiotic-producing *P. chlororaphis* isolates showed more or less pronounced antifungal activity and inhibited the tested fungi as follows: *D. tetramera* in the range from 3.85-69.23%, *Alternaria* sp. in the range from 5-50%, and *Phoma* sp. in the range from 0-50%.

The highest percentage of growth inhibition was caused by the following *P. chlororaphis* isolates: K24 (from 50.00% toward *Phoma* sp. and *Alternaria* sp. to 69.23% toward *D. tetramera*), K35 (from 40.00% toward *Alternaria* sp. to 69.23% toward *D. tetramera*), K29 (from 40.00% toward *Alternaria* sp. to 65.38% toward *D. tetramera*), Q16P (from 40.00% toward *Alternaria* sp. to 69.23% toward *D. tetramera*) and M28 (from 35.00% toward *Alternaria* sp. to 61.54% toward *D. tetramera*).

The lowest percentage of inhibition was caused by *P. chlororaphis* isolates PD5 (from 0.00% toward *Phoma* sp. to 15.00% toward *Alternaria* sp.) and PBA12 (from 0.00% toward *Phoma* sp. to 30.00% toward *Alternaria* sp.).

In general, *D. tetramera* showed the highest sensitivity to antibiotic-producing *P. chlororaphis* isolates.

Figures 1 and 2 display the zones of inhibition, caused by the most active *P. chlororaphis* isolates toward *Phoma* sp. and *D. tetramera*.

More or less pronounced antifungal activity of indigenous *Pseudomonas* isolates toward phytopathogenic fungi *Alternaria* sp. and *D. tetramera* was also confirmed in other investigations (Joši et al., 2012; 2012a; 2012b). In addition, *in vitro* assays in previous studies (Lovic et al., 1993; Avinash and Ravishankar Rai, 2014) revealed that PGPR strains showed good antifungal activity against *Phoma* sp. As pronounced by other authors (Haas and Défago, 2005; Couillerot et al., 2009; Karimi et al., 2012), PGPR can be used in the biocontrol of phytopathogens.

Table 1. Antifungal activity of selected *Pseudomonas chlororaphis* isolates toward phytopathogenic fungi *Alternaria* sp., *Phoma* sp. and *Drechslera tetramera*

Pseudomonas chlororaphis isolates	*Alternaria* sp.	*Phoma* sp.	*Drechslera tetramera*
PB4	10.00[*]	10.00	26.92
PB5	10.00	15.00	30.77
K38	20.00	10.00	23.08
Q34	30.00	15.00	26.92
M28	35.00	45.00	61.54
B25	15.00	10.00	26.92
PBA12	30.00	0.00	11.54
PD5	15.00	0.00	3.85
C7	15.00	20.00	61.54
C8	5.00	20.00	61.54
Q16P	40.00	45.00	69.23
K24	40.00	50.00	69.23
K29	40.00	50.00	65.38
K35	50.00	50.00	69.23

[*]Inhibition (in %).
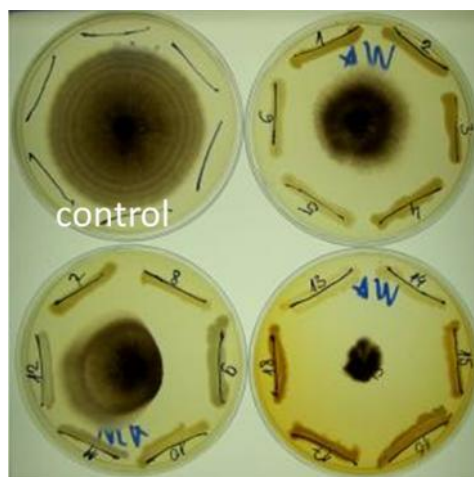
Figure 1. Zones of inhibition caused by *P. chlororaphis* isolates toward *Drechslera tetramera*
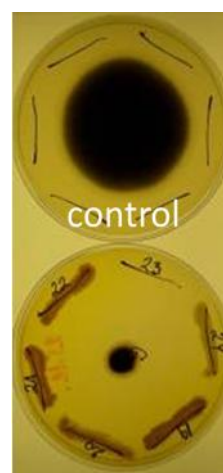
Figure 2. Zones of inhibition caused by *P. chlororaphis* isolates toward *Phoma* sp.

Conclusion

Biological control of phytopathogenic fungi *Alternaria* sp., *Phoma* sp. and *D. tetramera*, causing considerable economic losses in cultivation of medicinal plants in Serbia, is an ecological method of plant protection. In this regard, different isolates of fluorescent *P. chlororaphis* species have been intensively studied.

Our investigation confirmed more or less pronounced antifungal activity of all tested *P. chlororaphis* isolates, whereby the most pronounced activity was observed for K24, K35, K29, Q16P and M28 strains. Regarding the studied phytopathogenic fungi, the highest sensitivity to antibiotic-producing *P. chlororaphis* isolates was observed for *D. tetramera*.

Our findings impose that the studied *P. chlororaphis* isolates have potential in controlling plant diseases caused by phytopathogenic fungi *Alternaria* sp., *Phoma* sp. and *D. tetramera*, whereby the bacterial isolates with the highest inhibitory potential will be selected for further experiments.

Acknowledgements

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3. ORGANIC AGRICULTURE

ISOLATED AND IDENTIFIED A CHEMICAL COMPOSITION OF THE LEAVES EXTRACT OF *WARIONIA SAHARAE* FROM ALGERIAN WESTERN SOUTH

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Abstract

The essential oil of *Warionia saharae* Benth & Coss., was obtained by hydrodistillation. This has been extracted and the six main components have been chromatographically purified by TLC and GLC and identified GC-FID and IR analysis, resulting in the isolation and identification of five several new compounds such -Eudesmol, 1-Tricosane, 3-Methyltricosane, Heneicosanoic acid and Hexacosane, witch include the major compounds of essential oil of *Warionia saharae*. This has been ex- tracted and the three main components have been chromatographically purified by TLC and GLC and identified as Eudesmol, Linalool and Nerolidol.

Key words: *Warionia saharae, essential oil, Silica gel column chromatography, GC-IK, IR*.

Introduction

Warionia Benth & Coss. Is a monotypicc genus of asteraceae[1, 2], endemic to the northwestern edge of the African Sahara desert [1, 3]. The species *Warionia saharae* Benth & Coss., known by the vernacular name of '' Afessas''[1, 4], or '' Kabar lem'aiz''[4], "Abessas"[5] and " afezded" in some Moroccan region. The Berber name is "Tazart n-îfiss"[6].

This is a thistle-like aromatic plant, of 1 to 3 m of height, with white latex and fleshy, pinnately-partite leaves [1, 3]

Pervious, chemical composition of *Warionia saharae* essential oils from the leaves was reported for the first time by Ramaut et al[07], the researcher have isolated and identified only three (3) major constituents; Eudesmol (42,25%), Nerolidol (17,26%) and Linalool (8,63%).

Recently, several studies have been carried out on the phytochemical studies and floristic treatment [15, 16].Our work consists with the fractionate method of the essential oil extracted from *Warionia saharae*, for objectif to isolate the major constituents by the classic chromathography methods.

Materials and methods

Plant material
The leaves of *Warionia saharae* were collected from Bechar (south west Algeria) in 2011. The plant material was identified according to the A.N.N (National Agency Nature protection- Bechar, Algéria)[08, 09]. Voucher specimen is kept in the herbarium of POSL (Phytochemical and Organic Synthesis laboratory) laboratory, faculty of sciences university of Bechar, Algeria under N$_=$° 02/07[08].
Extraction and isolation

The leaves samples were air-dried and hydrodistilled. The obtaines extract essential oil extracted was analyzed by TLC and fractionated on the silica gel column, The Column chromatography was performed over silica gel 10cm (size L=40cm, R=2cm), eluted with a gradien of Benzene : ethyl acetate (9 :1), obtained by combining the eluates on the basis of TLC analysis. The recovered fraction are analysed by gas chromatography GC-FID, identified by comparison of their retention indices with those published in the literature and confimed by IR spectroscopy.

Oil analysis

The analysis of the essential oil fraction was carried out by GC-FID on SHIMADZU gaz chromatograph using the retention indices obtained by injection of the homologous hydrocarbons series C_6-C_{44} in the same conditions, and infrared spectrum IR was carried out using a AVATAR 320 FFIR, thermo Nicolet apparatus.

A SHIMADZU GC-2014 gaz chromatograph equipped with a FID, and a DB-5 cappillary column (30 m× 0,32mm i.d., film thicknes 0, 25µm) was used. Carrier gaz, N_2, oven temperature programmed at 50°C for 3min, rising at 3°C/min to 140 and 240°C at 100°/min. Injection and detector temperatures, 220°C and 240°C, respectively.

The injected volume was 1µl, using split injection ratio of 1.0.

Results and discussion

The essential oil of *Warionia saharae*, was extracted by hydrodistillation appearing as light yellow color, viscous liquid with a percentage yield of 0.5% (w/w), charactized by a strong odeur.

TLC: The analysis by TLC shows that there are **10** products separated of the essential oil extract of this plant (Figure 1). Spots on TLC were visualized under UV light and after the revelation by the iodine.

CLC: Next, in second step, the oil was fractioned by Column Liquid Chromatography. This analysis reveals the separation of **6** products of the essential oil extracted from *Warionia saharae* including the major product of this plant (-Eudesmol).
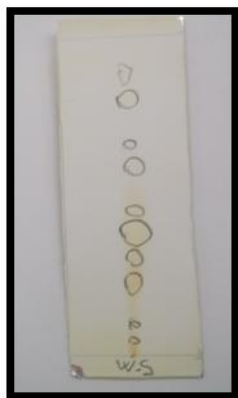
Figure1. Result of TLC analysis of essential oil from *Warionia saharae*

Compounds **1-6** (Figure2) were isolated from the essential oil of *Warionia saharae*, to give -Eudesmol (**1**) as a major component, its constituted approximately (32.87%) of our oil sample, 1-Tricosene (**2**), 3-Methyltricosane (**3**), Tetracosane (**4**), Heneicosanoicacid (**5**) and Hexacosane (**6**). All these compounds were isolated for the first times from *Warionia saharae* expect the -Eudesmol[07].
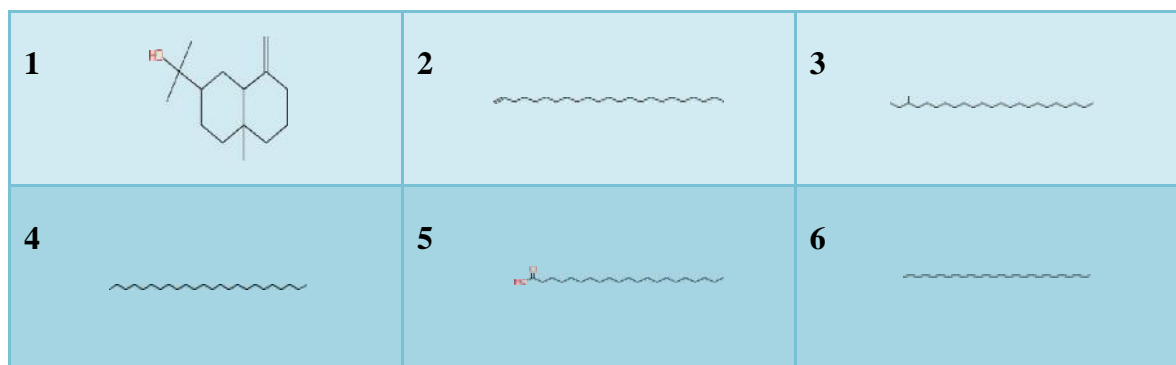
Figure2. Chemical structures of compounds **1-6**

Table 1: Isolated compounds from *Warionia saharae* essential oils

N°	IK DB-5	Formula	Name
1	1654	$C_{15}H_{26}O$	Bêta-Eudesmol
2	2296	$C_{23}H_{46}$	1-Tricosene
3	2375	$C_{24}H_{50}$	3-Methyltricosane
4	2400	$C_{24}H_{50}$	Tetracosane
5	2424	$C_{21}H_{42}O_2$	Heneicosanoicacid
6	2600	$C_{26}H_{54}$	Hexacosane

The structures of the compounds were elucidated by GC-IK, IR spectroscopy as well as by comparing their spectroscopic data with those reported in the literature.

Conclusion

Thus, the major products have been successfully isolated from essential oil of *Warionia saharae*. This compound is a sesquitepene alcohol presente in essential oil of several plants.

The -Eudesmol has multiple pharmacological effects. Its anti-inflammatory effect was shown and was proved recently[10], and The optically pure (+)- -Eudesmol is a possible starting material for the synthesis of several termite defense compound[11].

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YIELD AND QUALITY OF BLACKBERRIES (*Rubus Fruticosus Agg.*) IN ORGANIC PRODUCTION

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Abstract

Organic fruit growing is mostly related to the berry fruit production (strawberries, blackberries, raspberries).

The aim of this research was to examine the effect of water extracts of nettle, alfalfa and dandelion, with different numbers of days of fermentation, on yield and quality of blackberry. Field test was conducted during 2010 and 2011 on a plantation in municipality of Kozarska Dubica. Laboratory tests were conducted at the Agricultural Institute of the Republic of Srpska - Banja Luka. Water extracts of nettle, dandelion and alfalfa, with fermentation period of 14 days or 21 days were used. The content of macro-elements in water extracts was determined by chemical analysis.

According to the research the average yields of blueberries were from 9.02 t ha^{-1} to 10.94 t ha^{-1}. The highest yield was recorded in the treatment of blackberry bushes with extract of alfalfa with 21 days fermentation period.

Average values of soluble dry matter in ripe blackberry fruits were from 9.06° to 9.36° Brix. The highest content of soluble dry matter in the fruit were found in the treatment with the extract of dandelion where the fermentation lasted for 21 days (9.50° Brix) and lowest in the treatment with extract of alfalfa with the same fermentation period (8.80° Brix).

All tested treatments had higher yields compared to the control. The highest average yield was obtained by treating the blackberry bushes with water extract of alfalfa. The fermentation time did not have significant effect on the quality of fruits in any of treatments.

Key words: *blackberry, yield, fruit quality, water extracts*.

Introduction

The main goal of organic agriculture is the production of healthy food without use of pesticides, while preserving biodiversity and biological activity of soil. This kind of food production eliminates use of mineral fertilizers in the production cycle. Blackberry is a major consumer of nutrients because it forms a large vegetative mass and it is very fruitful. It requires a large quantity of potassium, a little less of nitrogen, and much lower phosphorus quantity for the growth and fruiting (Misic and Nikolic, 2003). In these circumstances, in order to avoid yield reduction, there is a need to increase usage of organic fertilizers instead of mineral. Foliar fertilizers are particularly important among the organic fertilizers, due to the possibility to use during the whole growing season. When using organic fertilizers one should be careful, because their untimely and excessive use may cause intense mineralization, with some negative consequences such as a significant increase in mineral forms of nitrogen in the soil. Because of the negative consequences that may occur during the application of organic fertilizers, use of foliar organic fertilizer is more popular among healthy food producer, thus they can have healthy products and preserve the environment at the same time. The application of water extracts made of different plants provides an opportunity for producers to achieve a good yield and quality for unrestricted placement on the market.

Organic products are the result of organic production with the use of cultural practices that exclude the use of chemical agents. Products that are produced in this way have a higher biological value and higher dry matter content (Milenkovic and Tasic, 2013). Use of organic foliar fertilizer does not have negative impacts on the natural environment. Studies have shown that foliar fertilization in some cases can be 8-10 times more effective than nutrient uptake from the soil, and that about 90% of the nutritional solution can be found in the smallest parts of the roots of plants 60 minutes after application (Akanbi *et al*., 2007). The essential feature of foliar fertilizers is that they absorbed by the plant directly and in limited quantities, unlike fertilizers that are given in soil (Fernandez and Eichert, 2009). Use of organic foliar fertilizer essentially supports the concept of sustainable agriculture. Bearing in mind that the water extracts are environmentally friendly and do not pollute environment (water, soil), undertaken research should make a significant contribution to the advancement of organic fruit growing in our country, and beyond. Plant extracts are products which can be a significant source of various oligo elements, which may depend on the type and quality of soil in which the plants for the preparation of the extract are grown (Popescu *et al.,* 2010).

The aim of this research was to examine the effect of water extract of plants with different numbers of days of fermentation, on yield and quality of blackberry.

Material and methods

Testing of effects of nettle water extracts, dandelion and alfalfa on yield and quality of blackberries was conduct during 2010 and 2011 at the plantation in the Kozarska Dubica municipality. Laboratory tests were conducted at the Agricultural Institute of the Republic of Srpska - Banja Luka. Two-factorial field trial (factor A–extract of plant, factor B-number of days of fermentation), with four repetitions and randomized blocks, was set up at the organic plantation in Brekinja village in Kozarska Dubica in 2010 (Fig. 1). Each repetition consisted of five blackberry bushes.

Figure 1. Trial of blackberry variety Cacanska bestrna

Water extracts of nettle, dandelion and alfalfa, with fermentation periods of 14 and 21 days were used for these experiments. Research consists of the following water extracts treatments:
1. Water extract of nettle with 14 days of fermentation (K14);
2. Water extract of nettle with 21 days of fermentation (K21);

3. Water extract of dandelion with 14 days of fermentation (M14);
4. Water extract of dandelion with 21 days of fermentation (M21);
5. Water extract of alfalfa with 14 days of fermentation (L14);
6. Water extract of alfalfa with 21 days of fermentation (L21);
7. The control (untreated plants).

Water extracts obtained from the alfalfa, nettle and dandelion, after fermentation cycle, and before the foliar were strained and then diluted with rainwater to a ratio of 1:10. Spraying with extracts was performed with motor sprayers WILAGER DM 25 which has volume of 15 l. The first treatment was carried out on May 18, 2010, and the following treatments were performed every 10 to 15 days. The treatments were repeated until the first ripe blackberry fruit.

The first harvest of ripe blackberry fruit was carried out on July 14, at the stage of their physiological ripeness. Blackberries were harvested six times by the end of August. During harvest, the yield measurement was performed with the precise "TEHNIKA" scale, for each blueberry bush. We calculated yields of each variety, including the control by measuring the weight of harvested fruits.

Research results have been statistically analyzed using analysis of variance (ANOVA) and significant differences in mean values was determined by LSD test.

Results and discussion

In order to have clearer picture of the impact of different type of plant extract on the yield and quality of fruits, before the application, extracts were chemical analysed for the contents of macro elements and pH. The results of the analysis are given in table 1.

Table 1. The chemical composition of water extracts of 14 days fermentation time

	Extract	pH	N (mg l^{-1})	P (mg l^{-1})	K (mg l^{-1})
1.	Nettle	6,4	56,8	56,3	700,2
2.	Dandelion	5,2	41,0	42,5	1205,3
3.	Alfalfa	5,4	105,6	40,2	670,4

The results of chemical analysis of plant extracts showed that the pH of the dandelion and alfalfa extracts were acidic and nettle was weakly acidic. The nitrogen content is particularly high in alfalfa extract (105.6 mg l^{-1}). Phosphorus content is fairly uniform, and dandelion extract has the highest potassium content (1205,30 mg mg l^{-1}). Water extract of nettle contains high levels of nitrogen, mainly in ammonium form (Peterson and Jensen, 1985). Dandelion has a high content of potassium (Ertas *et al*, 2005) as shown in the results of our research.

Blackberries yield depends on many factors, of which the most important are: varieties, growing systems and agro ecological conditions. Yields from these tests are shown in Tab 2.

Table 2. Yield of blackberries (t ha^{-1}) with different water extract treatment

Fermentation time	E x t r a c t			
	Control	Nettle	Dandelion	Alfalfa
14 days	9,02	10,55	10,21	10,91
21 days	9,01	10,26	10,37	10,97
$\bar{X}$	9,02	10,41	10,29	10,94
Level	A*	B**		AB***

LSD	0,05	1,52	1,07	2,13
	0,01	2,04	1,45	2,88

* Factor A - Extract; ** Factor B - Fermentation time, *** Interaction AB - Interaction

Yields of blackberries, according Stancevic (1990) are from 22-25 t ha^{-1} depending on the variety (Thornfree, Thornes logan and Gionta dell Giardino) up to 30 t ha^{-1} in a variety Smoothstem. The same author states that blackberries on poor soils produce yields below 15 t ha^{-1}. Osmancevic and Brzica (1991) point out that in our conditions blackberry can achieve average yields of about 20t ha^{-1}. In testing of characteristics of new varieties of blackberries in the agro-ecological conditions of eastern Serbia (Miletic et al., 2006) average yields of 14 t ha^{-1} were achieved in the conventional production.

Yields of blueberries in our tests were from 9.02 t ha^{-1} (control) to 10.94 t ha^{-1} (alfalfa extract) Higher yield of blackberries with all of the applied treatments compared to the control was recorded. The highest yield was achieved with water extracts of alfalfa (10.94 t ha^{-1}). There were no significant differences recorded in blackberry yield between the treatments of water extracts with different fermentation periods. The blackberry fruit has various organic and inorganic compounds, which give nutritional and medicinal value. Chemical composition of fruits (Vracar, 2001) is given in Table 3.

Table 3. Average chemical composition of blackberry fruit

Water	84,50
Total sugar content	7,30
pH	3,2
Total acid content	1,5
Pectin	0,4
Proteins	1,2
Fat	0,9
Cellulose	4,1
Vitamin C	24 mg/100g
K	180 mg/100g
Ca	40 mg/100g

The quality of the fruit, from a technological point of view, depends on the content of soluble dry matter (SDM). Content of SDM depends on the maturity of the fruit, bushes vigour and total leaf surfaces. In our study, it was measured SDM content in the fruit of blackberries treated with different plant extracts and the results are shown in Table 4.

Table 4. Content of soluble dry matter (° Brix) in ripe blackberry fruit treated with different water plant extracts

Fermentation time		Extract			
		Control	Nettle	Dandelion	Alfalfa
14 days		9,24	9,43	9,20	9,32
21 days		9,20	9,07	9,51	8,80
$\overline{X}$		9,22	9,25	9,36	9,06
Level		A*	B**		AB***
LSD	0,05	0,52	0,37		0,72
	0,01	0,70	0,50		0,98

* Factor A - Extract; ** Factor B - Fermentation time, *** Interaction AB - Interaction

Blackberry fruit is rich with a various components, and the chemical composition of fruits varied (Nikolic, 2004). Chemical composition of fruits depends on the variety, environmental growing conditions, abundance of fruit, ripening stage of the fruit at the time of harvest, as well as cultivation practices applied during the growing season. Wild blackberry fruit contains an average of 6.0 to 13.1 ° Brix SDM. Soskic (1984) and Nikolic (2004) reported that ripe blackberries contain from 9-14% SDM. In the results of our research the average values of SDM was from 9.06 to 9.36 ° Brix.

The results of our study are similar to the research results of Miletic et al. (2006). In our experiment the highest content of SDM in blackberry fruits were found in the treatment with the extract of dandelion where the fermentation lasted 21 days (9.50° Brix), and the lowest values were observed in the application of an extract of alfalfa with the same number of days of fermentation (8.80° Brix). Statistically significant differences in the content of SDM in blackberry treated with alfalfa extracts with different number of days of fermentation. In wild blackberries SDM content of 6.0 to 13.1%. The content of total dry matter and sugar may depend a great deal on the variety and environmental growing conditions and can vary by up to 40% every year.

Conclusion

On the basis of these results, the following conclusions can be derived:

Chemical analysis of macronutrient content determined that an extract of alfalfa contained mostly nitrogen, nettle extract phosphorus, and dandelion extract had highest content of potassium.

All tested treatments had higher yields compared to the control. The highest yield was obtained by treatment of blackberry bushes with extract of alfalfa.

Duration of fermentation period of plant extract showed no effect on the yield of berries in any treatment.

The application of plant extracts did not significantly affect the quality of fruits which is reflected in the content of SDM.

Taking into consideration the increasing interest in natural control of plant pathogens, increasing demand for healthy food, and the fact that we have not done much on this issue in our country, we consider it necessary to continue research in order to obtain as much information on the use of water extracts in agriculture.

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THE IMPORTANCE OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) IN HEALTH AND PRODUCTIVITY OF AGRO-ECOSYSTEMS

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Abstract

Excessive application of chemical fertilizers lead to several environmental hazards, causing damages to human, animal and ecosystem health. Their chemical remnants in both aqueous and non-aqueous (soil ecosystems) environments could potentially interrupt natural ecosystem balance which consequently results in several critical health issues and numerous side-effects to agricultural productivity in agro-ecosystems. Such environmental, agricultural and health crises call us for serious attention toward the production and application of environmentally friendly bio-fertilizers. Plant growth promoting rhizobacteria lodging around or in the plant roots have several functional activities such as increasing the nutrient availability to plants (biofertilizers), promoting plant growth via phytohormones as plant growth regulators (phytostimulators), degrading organic pollutants like xenobiotic compounds (rhizoremediators), controlling plant diseases and protecting them from phytopathogens (biopesticides), improving soil structure and fertility(bioremidiators). In close future, they are expected to substitute by chemical fertilizers, artificial growth – dependent regulators and pesticides.

Keywords: *Plant Growth Promoting Rhizobacteria, bio-fertilizer, stable agriculture, yield*

Introduction

Believing in a reality known as "Population Growth" requires mankind to produce more agricultural products and to inevitably move towards increased production per unit area. This won't be achieved but through the production of more fertilizers. Since fertilizer management is considered as one of the main factors of sustainable agriculture, gradual replacement of chemical fertilizers, especially phosphorus and nitrogenous ones with biological fertilizers is quite inevitable due to their advantages and cost-effectiveness. The history of plant inoculation with useful bacteria goes back to many centuries ago. For instance, by experience, farmers knew that if the soil in which legumes were planted was mixed with the soil for non-legume crops, it resulted in an increased crop yield. In late 19th century, the first license for producing a biological fertilizer known as Nitragin was issued for the production of rhizobium inoculants and after that, inoculation of legumes started to be practiced in many countries using rhizobium fertilizers (Bagnasco et al., 1998). Rhizobiums are among the most useful rhizobacteria, whose global usage as a nitrogenous bio-fertilizer (Bio-N fertilizer) in planting legumes and forage legume crops has always been a common practice (Kirchner et al., 1993). Though it's been a century that rhizobiums' useful role in stabilizing molecular nitrogen has been known, unfortunately, this significant group of rhizobacteria has not been practically used except in legumes. Of the beneficial activities of these bacteria which have led to putting them in the plant growth promoting rhizobacteria group (PGPR), production of plant growth promoting hormones, specifically Auxins, the ability to solve organic and mineral phosphates, producing Ionophores, especially Siderophores, their positive effects on root growth and morphology, improving symbiotic relationship with host legume crops and

the induction of mycorrhizal symbiosis can be mentioned (Rodriguez and Fraga, 1999). As a whole, rhizobacteria are blessings that up until now, except for their useful and productive relationships with plants, no reports on any disease or microbial contamination caused by them either in human beings or other creatures have been submitted.

Plant Growth-Promoting Rhizobacteria

Rhizosphere is a narrow zone where the interaction between soil, plants and microorganisms occurs. Different bacterial genera that are widely involved in many biological activities such as sustainability of soil ecosystems and nutrient turn over are called Rhizobacteria (Ahemad and Kibret, 2014). Those types of them which positively affect crop growth and yield are called plant growth-promoting rhizobacteria (PGPR). The term was first introduced by Klopper and Schroth in 1978 and for the years that followed, it was only used to refer to some specific rhizosphere bacterial genera that indirectly provided conditions required for plant growth through controlling phytopathogenic factors and helping to maintain plant health (Ahemad and Kibret, 2014). In other words, PGPRs as bio-control agents improve the plant growth and development directly by either regulating plant hormones or acquisition of essential elements or indirectly via reducing the destructive effects of growth-inhibiting pathogens (Ahemad and Kibret, 2014). Today, direct effective mechanisms of PGPR such as phytohormones, ionophores, increased phosphorus availability for the plant through enzymatic and non-enzymatic dissolution of mineral and organic insoluble phosphates, expansion of plant root systems, enzymatic activities such as ACC-deaminase, production of rhizobiotoxine to reduce the adverse effects of stress-induced ethylene, enhancement of nodulation and ultimately, bio-fixation of molecular nitrogen have been proved (Klopper and Schroth, 1978). On the other hand, earlier PGPR studies were only conducted on root crops such as potato, radish and sugar beet. However, later studies included a wider range of crops such as cereals and leguminous plants as well (Ligero et al., 1986). Some of the well-known PGPR types include those belonging to *Azotobacter*, *Azospirillum*, *Bacillus*, *Pseudomonas*, *Arthrobacter* and *Enterobacter* genera. What is interesting about PGPR types is the new look at rhizobium bacteria (Ahemad and Kibret, 2014).

Beyond Rhizobium-legume Symbioses (Beyond N$_2$ Fixation)

Besides their cardinal role in the nitrogen balance of the biosphere, rhizobium bacteria can help increase plant growth and crop yield in some other ways as well.

The Ability to Dissolve Insoluble Mineral Phosphates

There are several reports that indicate the ability of different bacterial strains to bio-solubilize mineral insoluble phosphate compounds (Glick et al., 1998). The main mechanism of solubilizing mineral phosphate has been known to be the result of organic acids produced by soil bacteria. Producing these acids acidifies the area surrounding bacterial cells as a result of which, due to the replacement of H$^+$ with calcium ions in the soil, phosphor is released (Abd-Alla, 1993). Of organic acids, it seems that Gluconic acid is the most frequent factor in the dissolution of inorganic phosphates (Chabot et al., 1996). Abd-Alla (1993) showed that organic acids detached from the culture medium of *Rhizobium leguminosarum* biovar *phaseoli* cause the said phosphates to dissolve. Moreover, due to the effect of these acids on solutions lacking bacterial cells, the level of dissolved phosphates is almost similar to that of dissolved phosphates in media containing *Rhizobium leguminosarum* (Guerinot, 1991). Research results have indicated that the dissolution of mineral phosphates is not an enzymatic process.

The Ability to Dissolve Insoluble Organic Phosphates

Soil contains a broad spectrum of organic substances which can be used by the plant as a source of phosphorus. For the organic phosphorous to change into an absorbable form for a plant, it should be transformed into its mineral form through the hydrolysis of organic substances (Ligero et al., 1986). Mineralization of phosphorus organic compounds is often

done by phosphatase enzymes being also called phosphoric diester hydrolase (or phosphomonoesterase) (Illmer and Schinner, 1995). The ability of rhizobacteria of different genera such as *rhizobium*, *pseudomonas* and *bacillus* has been proved by the production of significant amounts of phosphatases. Chabot et al. (1996) proved that rhizobium bacteria's ability to dissolve phosphate is a major plant growth-promoting mechanism in soils with medium to high fertility levels.

The Ability to Produce Siderophores

Siderophores are organic compounds with low molecular weights, whose ligands have a high-affinity for iron III (Fe^{3+}) binding (Goldstein, 1986). The role of bacteria responsible for the production of microbial siderophores can be indirectly played through the bio-control of phytopathogenic agents or the direct stimulation of plant growth by increasing Fe absorption (Klopper and Schroth, 1978). In the past few years, the ability to synthesize siderophores by several strains of different rhizobium bacteria species has been proved (Goldstein, 1986). The specific importance of siderophores among types of microbial metabolites released in rhizosphere could be to some extent due to the key role that Fe plays in vital metabolic processes in plants, on one hand and to specific features of Fe in the soil, on the other. The role of capable strains in the synthesis of siderophores for controlling phytopathogens has also been proved.

Synthesis of Phytohormones

Some PGPR strains can interfere with the concentration of identified phytohormones and increase plant growth and development (Dalal, 1977). These phytohormones affect the root growth pattern and lead to developing larger roots with more branching and a larger effective area (Rodriguez and Fraga, 1999). In some cases, it has been observed that even with sufficient amounts of nitrogenous fertilizers, plant inoculation with PGPR has caused plant growth and development to increase, which in that case, the presence of other mechanisms such as the synthesis of plant regulating substances (such as IAA) by PGPR has been a growth enhancing factor (Antoun and Kloepper, 2001). Many of the rhizobium species show ability to synthesize IAA and some studies have indicated that auxin plays a key role in the nodulation of legume crops and as a whole, in rhizobium-legume symbiosis. Also, it has been proved that flavonoids (as inducers of nodulation genes) intensify IAA synthesis through rhizobiums. Moreover, it has been shown that compared with roots that don't have nodes, nodular roots contain higher levels of IAA hormone and it plays a role in the development of the root system and its maintenance. Different studies approve that production of higher IAA levels in root nodules must have a rhizobial origin (Arshad and Frankenberger, 1991). Recently, synthesis of Cytokinins (CK) and Gibberellins (GAs) by PGPR has been proved as well (Rodriguez and Fraga, 1999; Ahemad and Kibret, 2014).

Reduced Synthesis of Ethylene in Plants

It's been more than a decade that the inhibitory effect of ethylene on nodule formation in legume crops has been known. Ligero et al. (1986) stated that high levels of ethylene produced in alfalfa (*Medicago sativa L.*) right after being inoculated by *Sinorhizobium meliloti* (a gram negative nitrogen-fixing bacterium or rhizobium) should be a sign of the defensive response of the legume crop to bacterial attack to its root cells. It seems that rhizobial infection in legumes just like other environmental stressors stimulates the plant to synthesize and accumulate additional ethylene known as stress-induced ethylene (Ahemad and Kibret,2014). Studies show that rhizobial bacteria can prevent ethylene concentration from increasing in legume and non-legume crops and cause the negative effects of this hormone on the growth and development of plant organs to decrease (Glick, 1995). This function is performed through at least two known ways: production of ACC-deaminase and rhizobitoxine biosynthesis.

Synthesis of ACC-deaminase

The ACC (1-aminocyclopropane-1-carboxylic acid) deaminase enzyme catalyzes the hydrolysis of the ACC substance and transforms it into ammonium and -ketobutyric acid(Glick,1995). Since ACC is the precursor of ethylene synthesis in higher plants, its exclusion would reduce ethylene content in the plant (Yasuta et al., 1999). It is noteworthy that the enzyme has only been identified (so far) in soil-inhabiting microorganisms, and those rhizobial strains which contain it, have been able to successfully overcome ethylene's negative effects on nodulation and elongation of roots in legume and non-legume plant species. To sum up, plant growth promoting rhizobacteria containing the ACC-deaminase enzyme, facilitate the plant growth and development thereby decreasing ethylene level, increasing salt tolerance, and reducing drought stress (Zahir et al., 2008).

Biosynthesis of Rhizobiotoxine

Chemically, rhizobiotoxine [L-2-amino-4-(2-amino-3-hydroxypropoxy)-trans-but-3-enoic acid] is a phytotoxin synthesized by some strains of the legume symbiont genus *Bradyrhizobium elkanii* and the plant pathogen, *Pseudomonas andropogonis*, which are capable of its biosynthesis. Rhizobiotoxine affects ACC-synthase and limits ACC biosynthesis, which will ultimately inhibit extra ethylene production (Vessey, 2003).

Cyanide Biosynthesis

The indirect function of PGPR is the bio-control of phytopathogenic agents. Among the inhibitory mechanisms of these bacteria, secondary metabolites such as hydrogen cyanide (HCN) can be mentioned. Synthesized HCN interrupts the respiratory system of pathogenic fungi and thus, inhibits their growth and activities (Badenoch-Jones et al., 1983). Recently, Antoun and Kloepper (2001) introduced some rhizobium strains as cyanide-producing bacteria. Bagnasco et al. (1998) believed that HCN-producing bacteria can be used as a safe way for the bio-control of rhizopathogens because they have no adverse effects on soil microbial communities or on plant growth. Kremer and Souissi (2001) suggested that the ability to produce HCN in PGPR is a potential and suitable mechanism for the biological control of weeds, which should be taken into more consideration as a new aspect of promoting and stimulating plant growth and increasing crop yield.

Conclusion

Today, fertilizers are vastly used as a means of increasing yield quantity, especially in the developing countries. Therefore, the quality of agricultural crops should be also taken into account so that besides preventing environmental pollution and the destruction of valuable soil and water resources, excessive accumulation of nutrients and other pollutants in plant tissues could be prevented as well. It goes without saying that using biological fertilizers instead of chemical fertilizers can ensure a healthy environment and the sustainability of production resources and by improving the quality of food products, it can have a remarkable effect on improving health in the society. If we add reduced production costs of biological fertilizers and their high efficiency to the advantages mentioned above, preferring to use them instead of chemical fertilizers is a right decision. As a whole, it could be said applying bio-fertilizers of the PGPR type with a positive effect on different growth and development aspects can accelerate plant growth and development through a synergistic effect on growth and development-improving factors and an antagonistic effect on growth and development-decreasing factors and would ultimately increase the crop yield.

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FACTS AND VISIONS ON THE STATUS AND THE FUTURE OF ORGANIC FARMING IN THE REPUBLIC OF MACEDONIA AND THE MEDITERRANEAN COUNTRIES

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Abstract

The idea for conducting this research and comparative analysis elaborated in this paper, popped-out from several of our conclusions related to the Organic Farming (O.F.) in Macedonia and the Mediterranean countries. After close study of the SWOT analysis performed in Macedonia and by the Mediterranean countries it is clear that there are numerous common factors, resources, structures and gaps in the organic sector. The research goal in this paper is to present in a sublimated referent document in a form of listed strategic goals and instruments for development of O.F. in Macedonia and Mediterranean countries. The following methods were used: comparative-analytical, statistical and results from surveys are presented. The beginnings and developments stages of the O.F. are described, current status, sector analysis, on-going policies and development initiatives as well. The data related to the facts and visions are referred to the Republic of Macedonia, but relevant data on EU countries, candidate-countries and south Mediterranean countries are presented as well. The conclusions are formulated in a common SWOT analysis with special accent on the new possibilities for development of O.F. in the near future, especially through applicative scientific research activities.

Keywords: *organic farming, analysis, development, data, visions.*

Introduction

As compared to the conventional, organic farming is characterized by several different specifics. Holistic and environmental approach gives this kind of farming unique production dimension, given the influence of ambient conditions which tend to differ even on micro-regional level. In the first decades of the 20th century, scientifically formed concepts were brought into the traditional instinctive approach to nature. Change of lifestyle laid the foundations for changes in nutrition, hygiene and physical culture. It was based not only on an attempt to adapt life to nature but also on scientific knowledge (Sharapatka et al., 2010).
The period from 1960-1970 is the one that is considered most significant for the development of standardization and control in organic farming, due to increased demand for organic food. Firstly, these kinds of activities were applied at private farmers and farmers' associations' level, but of 1972 after the establishment of the International Federation of Organic Agriculture Movements (IFOAM) in 1972 the movement became international. In the last 5-6 decades the rise or the fall in the intensity of organic production depends of various socio-political and socio-economic legislations. Organic farming and processing standards are being subjected to continuous improvements and amendments in accordance with the progress of the sector, knowledge and needs. Since the mid-1980's organic farming has been promoted through political initiatives. The policies of the various governments have included financial support for the conversion of conventional farms, regulation and control, an advisory service, information campaigns, education and research in organic farming (Organic

research and development 1996-2010 – ICROFS, 2011). The 2010 Organic Industry Survey conducted by the Organic Trade Association (OTA), revealed that U.S. sales of organic products continued to grow during 2009, whereas organic food and non-food product sales in that year grew by 5.3 percent, despite the distressed state of the economy (Reine et al., 2010; OTA, 2010). The organic production methods attracted also the attention of local governments and economic operators and found space in discussion platforms and official strategies papers (Al-Bitar et al., 2010). The facts and figures about organic agriculture statistics in this area have almost doubled between 2001 and 2007 (Al-Bitar and Pugliese, 2008), and continue to increase in terms of organic agricultural land. In 2008, with more than 143 thousand operators, organic agriculture in the Mediterranean covered an area of about 5 million ha of which around 1.3 million ha of wild collection and forests, mainly concentrated in Eastern Adriatic and some South-Eastern countries (Al-Bitar et al., 2010). Many non-EU Mediterranean countries already have a national law (Tunisia, Turkey, Serbia, Croatia, Macedonia and Montenegro) and a well-developed export market (Morocco, Tunisia, Turkey and Serbia), while local markets are still emergent. After close study of the SWOT analysis performed in Macedonia and by the Mediterranean countries it is clear that there are numerous common factors, resources, structures and gaps in the organic sector. The research goal in this paper is to present in a sublimated referent document in a form of listed strategic goals and instruments for development of in Macedonia and Mediterranean countries. Much indicates that the highly applied research has had a very important part to play in the development of the sector. But rarely have research programs been analyzed and evaluated on their effect on a sector of society and this is generally thought to be quite difficult, among other things because it can be difficult to distinguish the contribution from research from those of other development forces.

Materials and methods

The data related to the conditions in the Republic of Macedonia are based upon own research activities, as well as of Ministry of Agriculture, Forestry and Water Economy of the Republic of Macedonia (MAFWE), statistical publications which are in majority of the cases published in the National plan of Organic Farming 2013-2020. The National Plan for Organic Production 2013-2020 was adopted by the Government of the Republic of Macedonia on the 178th session held on 30 December 2013. The part of the document which is related to the situation in Mediterranean countries is performed through processing data published by the Mediterranean Agronomic Institute of Bari – Italy. Relevant facts and data from scientific research activities and possibilities of their applicative purpose, which are presented in this paper were taken from the publication of the International Centre for Research in Organic Food Systems (ICROFS). Using comparative and analytical methods, own and other researchers' interview results, strategic goals for organic farming are emphasized for Macedonia and Mediterranean countries.

Results and discussions

In 2007 the Government of the Republic of Macedonia had adopted the National Strategy for Agriculture and Rural Development in which a strategic goal is defined for development of agriculture and the rural sector for the period 2007-2013, and which states: "to strengthen the agriculture in order to become competitive on integrated regional markets of EU and SE Europe through:
Improved efficiency of agricultural production, processing and marketing;
To establish relevant public and private institutions;
To improve farm efficiency;
To ensure consumers have access to safe and healthy food;

To optimize the use of limited resources such are: soil, water and forest;
To establish vital rural communities through sustainable rural development."
The National Plan for Organic Production 2013-2020 relates to the following parts of organic production: 1. Production: a. plant production; b. animal production; 2. Processing; 3. Trade; 4. Research, education and science; 5. Policy, legislation and control; 6. Input materials. Based on performed SWOT analysis on different subsectors in agriculture, analysis of the conditions in O.A. is performed and strategic goals are set, as well as specific policy goals and activities that are to be implemented during this time frame. In the Action plan for organic farming several activities are set, such are: area of intervention, activities, approach and time frame for task completion. The development of organic farming records steady growth. More and more subjects are joining thus contributing to the expansion of production facilities. In the past few years a growth trend is recorded since many operators are joining and processing facilities are expanding as presented in table no.1 and figure no.1, (source: www.mzsv.gov.mk).

Table no.1 - Certified area under organic in Republic of Macedonia 2006-2013

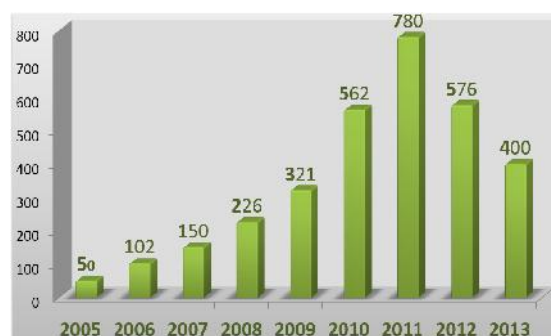| year	Total certified area under organic (ha)	% of the total arable agricultural land
2006	509,42	0,099
2007	714.47	0,139
2008	1029,00	0,200
2009	1373,83	0,268
2010	5228,00	1,019
2011	6580,92	1,283
2012	4663,08	0,908
2013	3168,00	0,617

Figure no.1 – Number of operators 2005 – 2013 in Republic of Macedonia.

Driven by the increased number of operator s and processing facilities in the past few years, the governmental support increased the level of subsidy in this sector as presented in figure no. 2, (source:www.mzsv.gov.mk)
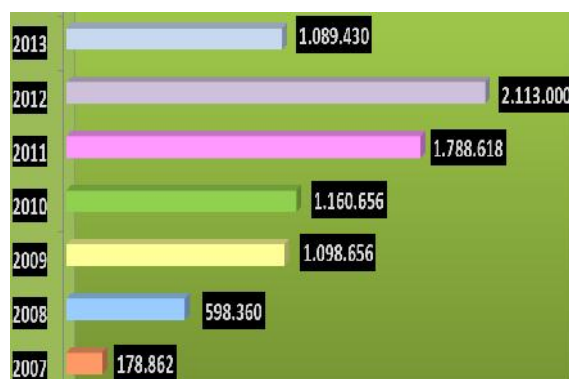
Figure no. 2. Level of financial support in organic farming, 2007-2013/euro

Although data point to intensive growth of organic farming in Macedonia, still there are number of bottleneck pints that present themselves as serious burden
for the development of organic farming.
One of the most significant is poor input presence on the market: quality seed and plant protection pesticides allowed for use in organic farming. The next week point is insufficient and irregular campaign on beneficial effect of organic food on human health. Poor education and low level of organic farmers' organization are another week point on the road for local and national development of organic farming. IPARD funds are unused as well, especially on the measures meant for processors and storage facilities, specialized and certified enterprises for processing and packaging.

Very little number of tourist facilities are offering organic menu. Furthermore, underdeveloped sector of rural tourism makes its contribution to the slow development of organic farming too. The status of education and science in Macedonia related to the organic sector are illustrated through the SWOT analysis presented below:

SWOT analysis on condition of education and science over the development of organic farming in the Republic of Macedonia:

Strenghts
- Existence of several high schools and higher education facilities which have organic farming as a topic in their curricula;
- Since 2004, existence of governmental programme for development of education according to the principles of life-long learning;
- The Faculty of Agriculture at Goce Delchev University in Shtip and the Faculty of Agricultural Sciences and Food in Skopje have Centers of applied research and continuous education in the sector of organic farming;
- The Department of Plant Production of the Faculty of Agriculture at Goce Delchev University in Shtip there is an accredited module of MSc course in organic farming;
- Agricultural high schools have available land, mechanization and trained personnel to conduct organic farming and applied field research activities;
- There are experts and facilities with proper infrastructure to conduct research in organic farming;
- MAFWE had published guides/brochures in organic farming on dozen most significant crops.
- Several projects in organic farming are implemented or are under implementation;

Opportunities
Incorporation of new modules in organic farming and rural development for gaining social and economic benefit;
Appliance of new know-how in bio-technology, IT and digital communication;
- Continuous education of experts in organic farming and environment protection for obtaining positive approach in organic farming and rural development;
Possibilities to apply for domestic and foreign calls for projects related to organic farming;
Improved level of use of universities capacities for farmer training;
Popularization of NGO's in organic sector;
Establishment of training and research centers i.e. transfer of know-how for promotion of organic producers;
Conducting new courses for farmers which would give them skill to apply on EU pre-accession funds;
- Preparation of programs for licensing advisors which would give support in organic sector.

Weaknesses
- Insufficient content of education with volume of organic farming in the teaching process on high school level;
Inappropriately set educational standards compatible with those of EU countries and inadequate design of study programs;
- Insufficient exchange of information with the education institutions from other countries;
- Poor implementation level of non-formal education by Workers' universities, employment agencies etc. in each of the neighboring countries;

- Low level of applicative projects and scientific research activities on certified farm level, processing facilities and accredited laboratories;
- Lack of data on eco condition, agro-eco issues (soil, water, biodiversity) on arable land on regional and national level;
- Lack of education materials in organic farming and insufficient exchange of information the region ;
- Insufficient use of scientific potential in the country due to irregular and insufficient funding of research projects;
- The majority of farmers have no or very small knowledge of practice in agro-ecology and organic farming principles.

<div align="center">Threats</div>

- Reduced interest for professions linked to agriculture;
- Falling behind in applying new methods and technologies in organic farming;
- Young professionals leaving the country;
- Lack of current and long-term analysis of the climate changes over agricultural production;
- Lack of research in contemporary technologies in organic farming for agro - ecological conditions in Macedonia;
- Ineffective and low-quality partnership and knowledge transfer of technologies between higher education institutions and the economy;
- Limited effect by advisor's service with limited service range, use of under developed methods and cover of limited target groups.

<div align="center">Organic farming research outside Macedonia</div>

This kind of surveys is mainly concentrated in Europe that is considered the cradle of organic research by Wilier (2009). However, in the last few years studies and experiments on organic farming and practices started emerging in other parts of the world involving several actors. Some of them are the Organic Centre of Canada (OACC), the Brazilian Agriculture Research Corporation (EMBRAPA) and the Rodale Institute in the US. Other research activities related to organic farming are mainly carried out by universities. All these initiatives have a common objective which is the collaboration for the promotion and enhancement of organic research worldwide (Reine et al. 2010).

To date the EU contribution to the development of research in organic agriculture has included the funding of around 70 research projects that refer directly (explicit reference in the title) or indirectly (mentioned as part of the topic) to organic agriculture (Zanoli, 2009), The first contribution of EU to organic agriculture research dates back to the 2nd Framework Programme - FP2 (1987-1993), where in organic agriculture was mentioned as part of the extensification and diversification of agricultural production. At present, only three research projects entirely concern organic agriculture in FP7 (2007-2013), probably due to the overall limited research funding (Zanoli, 2009). Across the Mediterranean the transfer and dissemination of organic agriculture research results is carried out by means of two main tools: publications and training courses. Internet websites appear to be an important tool for results sharing, diffusion in EU but not in CPC (Candidates and Potential candidates Countries) and SEM (South and East Mediterranean) countries, where more probably farmers and other actors of the agricultural sector still do not have easy access to the computer technology (Reine et al. 2010). According to the opinions of many researchers the main research priorities for organic research in the Mediterranean need to be:
- In Macedonia and other CPS country : Pest management/Plant protection, Soil fertility management, Agroecology and biodiversity, Market study and promotion.
- In SEM countries: Plant protection/Biological control, Soil fertility management, Postharvest and food processing, quality control and inspection system.

- In EU Mediterranean countries: Plant and animal genetic resources, Cropping systems, Market study and promotion, Improving knowledge and technologies.

Conclusion

According to the results of the current situations and researches in Macedonia and Mediterranean countries, the new opportunities in the near future for development of O.F. especially through applicative scientific research, are in key strengths that are identified by the following real facts and conditions:
- The high qualification of human resources involved in research in organic issues; The existing infrastructures (laboratories and experimental farms) available for research in organic agriculture in Macedonia and Mediterranean countries;
- An adequate transfer of the research results mainly through publications and workshops;
As most influential weaknesses we emphasize:
- The small number of centers fully specialized in organic research;
- Lack of long-term experiment on organic agriculture in Macedonia and Mediterranean countries. For further work to support organic research in the Mediterranean region it would be useful to:
- continue monitoring the evolutionary trends of organic research in the Mediterranean in order to base future support initiatives on a comprehensive and updated picture of the situation;
- identify the practical problems of the sector and try to find out how research may contribute to their solution;
- participate to regional Mediterranean and International projects trying to convey and consolidate common interests;
- establish relations and partnership and develop networking at Mediterranean and International level for a better exchange of information and sharing of experience.

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PLANT PROTECTION PRACTISE OF ORGANIC FARMERS IN MACEDONIA AND THE ROLE OF HIGHER EDUCATION INSTITUTION IN PROVIDING SUPPORT

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Abstract

Recent data from the Department of Organic Farming of the Ministry of Agriculture, Forestry and Water Economy are showing decrease of interest by farmers to continue the organic practice and new farmers are not sufficient in numbers to compensate the number of those one who made their decision to turn back to conventional principles. Searching for the reasons of such trend, the Department of Organic Farming at the Ministry of Agriculture, Forestry and Water Economy conducted own research and analysis present that major reason are low economic benefit.

But, is it so? Is this the only reason for losing interest? A Study for Development of Organic Farming in the East Planning region in 2010, performed by the Faculty of Agriculture at Goce Delchev University in Shtip could be revealing something else under the surface. An interview on 983 farmer households, from 80 rural settlements in the East Planning Region was performed in a search of what are practices of the farmers, what is their understanding of what organic farming is.

Finally, research in 2014 was conducted with an assistance from one of the certification bodies, aiming to find out if our farmers are familiar with permitted pesticides that can be obtained on the market and are they relying on their application.

Keywords: *plant protection, organic farming, higher education institutions*

Introduction

Agriculture (along with forestry and fishery) is the third largest economic sector in Macedonia, following services and industry (MAFWE, 2012). Macedonia has 1.120.213 ha of agricultural land, of which 511.316 ha arable land and 608.176 ha under pastures. Main production crops are wheat, barley and tobacco with 76.545 ha, 41.096 ha and 19.679 ha respectively (State Statistical Office, 2012).

Making its first steps in 1997, organic farming in Macedonia had always been considered as something 'easy to be achieved'. First certified organic products were several kinds of tea from indigenous herbs, prepared and produced by the largest pharmaceutical factory in Macedonia. The next year, 4-5 farmers from Ohrid, Strumica and Kumanovo initiated the first organic activities on farm level. By the end of 2000 with assistance of EU experts on organic practice National framework for development of organic agriculture was developed. In 2001, The Law on Organic agriculture was adopted and first national associations were established. One of the strongest beliefs on organic's future depended on Macedonian farmers' long traditional farming practice, the belief that it does not require drastic changes in understanding, behavior and belief, and finally that prices of organic commodities are higher on foreign market. Unfortunately, such expectations or desires were not substantiated by performed strategic analysis on farmers' habits, level of education, markets, absolute absence of modules on organic farming at the Faculties of Agriculture. While Table 1 indicates the

level of governmental support through the years, Table 2 indicates the number of farmers that considered change of practice. (Zlatkovski *et al.*, 2010, MAFWE, 2013).

Table no.1 – National budget for organic farming support

Year	MKD	€
2005	6.000.000	97.561
2006	0.00	0
2007	11.000.000	178.862
2008	36.500.000	598.360
2009	66.938.000	1.098.360
2010	70.800.000	1.160.656
2011	110.000.000	1.788.618
2012	130.000.000	2.113.000
2013	67.000.000	1.089.430

Table no.2 – Area under organic production

Year	ha	Certified operators
2005	266	50
2006	509	102
2007	714	150
2008	1.029	226
2009	1.374	321
2010	5.228	562
2011	6.581	780
2012	4.663	576
2013	3.167	400

Table 2, clearly points out that despite the volume of subsidy in 2012, highest since organic farming got under governmental support, there was a drop in number of hectares under organic and drop in number of operators. So, considering that there is insufficient volume of subsidies or 'unsatisfactory return rate' cannot be proven as prevailing factors for losing interest.

Materials and methods

As far as method is concerned, a direct approach (visit on-site) was used when institutions and individuals are considered. Questionnaires were developed and before proceeding to obtaining answers, interviewees were given explanation for the significance of their sincere answer.

Results and discussion

Mihajlov *et al.* (2013) consider several parameters that define Macedonia as favorable for organic farming, especially due to the following:

Low-polluted areas	Unpolluted resources (water, soil)	Fertile valleys
Diverse vegetation	Low input of pesticides	Low use of fertilizers
Vast area under pastures	Significant number of animals	Strong governmental support

On the other hand, there are number of 'issues' that pose serious obstacle to the development process:

Lack of strategic document on regional limiting factors (weather, soil etc.)	Poor volume of literature in Macedonian
No training camps/sites	Poor knowledge about organic farming among extension/advisory service
Too rigorous state inspectorate	Underdeveloped processing industry

Three climatic zones can be determined that have their influence over the living beings in Macedonia. The Mediterranean, which is present along the valleys of the rivers Vardar and Bregalnica (south and east) and in these areas the temperature in July – August often exceeds 40°C. On the other side there is mountain climate, which dominates the western part of the country. This climate is characterized by long winter, lots of snow and short summer period. Majority of the country enjoys moderate climate with warm and dry summers, relatively cold and wet winters.

Beside the weather, many other different factors determine the profitability level of agricultural production, of which the following are considered as most influential ones: inputs expenses (seed, pesticides and fertilizer), post-harvest technology, level of knowledge for farm management, advantages & disadvantages of farm location, proximity to markets etc.

The results from a poll on 983 farms in the East Planning region, are implicating to the following situation. Analysis of the age structure of examinees are that in the East planning region people that deal with agriculture are older than 50 years (44% of the examinees), the young population (20-30 years old) that deals with agriculture is only 4%.The largest number of the working age population is between 30 to 40 years old (16%) and 40 to 50 years old (36%). Regarding the sex structure of the examinees, 93% were male and only 7% were female, which indicates to the traditionally subordinated role of women in Macedonian agriculture, where the dominant role is left to the man, as a head of the family. An analysis of the education level of examinees show that only 3% of them have higher education, 46% are with secondary education and most of them are with elementary education. In one of the municipality 97 examinees answered that they deal exclusively with organic agricultural production. On the other hand, the analysis of the question's answer "What is organic farming?" as well as the answers of the question "What kind of manure do you use?" shows that a small part of the examinees know the real importance of this type of production, because all examinees use artificial fertilizers! This indicates to ignorance of the organic agriculture as a system of production and the examinees probably consider the organic production as something they cultivate for their own needs without application of pesticides. Regarding the professional assistance during work, the greatest part of the examinees responded that they don't get any professional assistance (86%). Part of them answered that they get professional assistance by the Agency for Development of the Agriculture (6%), agricultural pharmacies (pharmacists) and agronomists (3%) and by the state/Ministry of agriculture, forestry and water management (3%). As a source of professional assistance, with less than 2% are listed the following things: municipalities, agricultural programmes, seminars, parents, children and friends (Mitrev *et al.* 2010).

The weather conditions and those one which are determining the development of organic farming in the East Planning Region as described by Mitrev *et al.* (2010), are providing conditions to reveal that growing plants in Macedonia is not as easy as it might seem. Having frequent cases of rainy spring with high relative humidity and reasonably high temperatures, offer more than favorable conditions for disease outbreak, especially of the farm location is not on suitable terrain i.e. in valleys, near rivers etc. Such locations provide more than excellent conditions for development of economically most significant diseases such are those of *Phytophotra, Plasmopara, Ersiphicaceae, Sclerotiniaceae* etc.

Own research in 2014, conducted in collaboration with ProCert certification body, aiming to check farmers' pre-organic period experience and farms location 'suitability' gave very interesting in-depth information. The sample and results refer to the 176 (of 400 organic farms nationwide) and farm type:

Table 3 – Number and type of organic farms under analysis

Farm type	Number of operators
Fruit production	24
Wine and table grape	6
Vegetables	7
Small grains and forage	33
Animal husbandry and plant production (plant production for feed)	65
Animal husbandry	34

Bee-keepers and plant production (fruits and forage)	4
Plant production and processing (vegetables, spices and medicinal herbs)	3

In order to find-out how farmers are managing with prevention disease out-break or in case of disease severity what they do, a questionnaire was developed with 16 group of questions, divided in three groups of questions:

Prevention of out-break

Activity	Practice	Survey results
Disinfection	VF seed removing plant residues soil steam treatment	0% of the farms are using VF material;0% are destroyingplant residues; 0% practice soil steam treatment;
Time asynchrony	Earlier/later seeding/planting w/relation to the pathogen, vector of development phase/stage	0% of the farms are using these techniques;
Mandatory practice	Rotation Use of repellent-crops, Adding organic matter to the soil, Use of repellents in storing facilities	100% use of crop-rotation system; 100% use of repellent-crops; 80% add organic matter to the soil; 0% use repellents in storing facilities;
Spatial isolation	Sowing crops away of: pest-host plants, weed population, non-crop removal except growing one; growing barrier crops, physical separation from colonizing organisms	0% of farms practice sowing away of pest-host practice; 50% keep the interplant space without vegetation (100% in orchards/vineyards); 40% are having barrier-crops; 60% of the farms;
Natural conditions disruptors	Mating confusion, traps, release of sterile males, birds protection nets, reflecting tapes and sounds against birds	0% of farms use mating confusion techniques or release of sterile males; Only fruit and sunflower growers use protections nets;

Regulation of population

Activity	Practice	Survey results
Resistance of host-plant	Elimination of poorly developed plants Resistant varieties/cultivars Increased crop spacing Plant extracts	100% in vegetable farms 100% in vegetable farms 100% in vegetable, fruit & grape farms 10% of the farms
Intercropping	Mixed crops Strip cropping Green manures Incorporation of repellent plants	1% 0% 30% 10%
Competition	Use of herbivores and microbial activity for decreasing population	0%

	of weeds	
Predator host-plants or pest-attracting plants	Flowering plant presence by the edges, strips, pre-determined areas,	0%
	Keeping beneficial birds	40%
	Nests for predator birds	40%

Curative actions

Activity	Practice	Survey results
Organic pesticides	Soaps	5%
	Oils	20%
	Compost tea	0%
Non-organic pesticides	Sulfur (dust) and sulfur spray	100% (vine, fruits & vegetables)
	Diatomaceous earth	0%
	Micronutrients	0%
	Iron phosphate	0%
	Carbon dioxide	0%
	Nitrogen	0%
	Bordeaux mixture	100% (vine, fruits & vegetables)
Bio-control	Predators (predatory mites, lady bird)	0%
	Parasitoids	0%
	Bacteria (*Bacillus thuringiensis*)	5%
	Fungi	0%
	Virus	0%
Physical methods	Setting traps	10%
	Vacuuming	0%
	Hand removal	20% (most in vegetable growing)
	Hunting	2% (in orchards)
Other methods	Flambination – use of flame to disinfect the top earth layer in vegetables plantlet production (57% - 4 out of 7 producers)	

Here are some other results of the research conducted with the organic inspectors:

95% of the farms which decided to turn to organic in the period of 2007-2010, never considered checking farm location as a possible factor for disease & pest outbreak. They turned organic only by being attracted by higher subsidy level.

90% of the organic farms are turning for plant protection advice to the inspectors of the certification body and only 10% are searching for an answer with the extension/advisory service or more experienced farmer. Exclusion to this practice are bee-keepers, for which three-out-of-four (75%) are having regular exchange of know-how. Three farms, of different type have reached development stage and are implementing applicable technology to the extent to be considered as possible group leaders.

Until 2012 neither of the higher education institutions in Macedonia had developed as study program for organic farming. At present, only the Faculty of Agriculture at Goce Delchev University in Shtip has this course in all of its10 study programs. Furthermore, prior 2012 no higher institution in the country had possibilities to perform research in organic practice. Since 2012, 9 ha of Goce Delchev University's land were applied for conversion and this year (2014) that land will be certified as organic. Following faculty's policy for obtaining best possible conditions for students to gain practical knowledge, the area under organic is expanded to additional 7 ha and preparations are in progress for turning this area into Training site/Farmer Field School.

In 2013, a survey on availability of human resources in advisory sector and their capability/knowledge in organic, presented disturbing data. Out of 23 interviewed advisors from two Regional offices of the National Extension Agency none had a degree in organic, nor had received any training in it. Similar to this, no experience was in possession with regard to organic plant protection practice as well.

As illustrated in Table 2, the number of operators and area under organic farming had dropped almost to double. While most of the government authorities feel that this could be remedied by simply increasing the volume of subsidies, there is a strong belief that by simply increasing financial support and not dealing with the rest of the factors will not bring much of a difference. Namely, organic farming is based on awfully different principles than the conventional one. The organic's holistic approach, anticipating what is to be happening rather than acting aftermath, living in harmony with the surrounding organisms and heavily depending on their 'collaboration' in 'maintaining pest population balance' etc. are just one of the things farmers in Macedonia are not introduced to prior their decision to turn to organic. Furthermore, the processing industry is almost none existing, hence the disappointment feelings when organic product is to be sold by price as conventional and in raw format. On the other hand, the only organic specialized store in national's capital is full with processed products, but imported. Finally, farmers can hardly understand that in order to make their farm profitable, before they sign the papers for first inspection they need to do their homework much better than just simply being attracted by high subsidy volume. Careful market analysis, deep research in soil, weather, pollution possibilities, recent disease & pest outbreaks and crop-types presence is something they need to consult a specialist before jumping into big decision as turning into organic is.

On the other hand, as usual nothing is as negative as it seems. One of the positive things is the decision of the Faculty of Agriculture at Goce Delchev University in Shtip to certify a part of their production sites into organic. This could be much better utilized if the Ministry of Agriculture, Forestry and Water Economy would transfer part of their subsidy budget into this site and turn it into training site. Farmers, their children and other interested parties can receive training through specially tailored programs in:

Growing crops (which in some cases can reach up to two crops per season);

How to restructure their production by starting growing more profitable crops (such are medicinal herbs and spices rather than depending only on small grains);

Most significant plant pest & disease life cycle and required growing conditions;

Plant protection according to the organic principles (since the survey clearly points out the low level of knowledge farmers possess in using means to control disease & pest outbreak).

The Department of Plant and Environment Protection of the Faculty of Agriculture at Goce Delchev University in Shtip since 2010 had launched an internet-based application containing all pesticides registered for use in Macedonia and a special part for organic farming, with uploaded manuals, guidelines and other scientific materials, based on free-access use. No matter Macedonia had fully harmonized its legislation to the EU, thus making possible for organic pesticides to be imported/sold on the market, yet very few of them, or perhaps better to say close to zero can be purchased commercially.

Conclusion

If the period of 9 years since the organic farming begun officially recognized in Macedonia can be considered as innovative way of farming, then by applying the basic principles of diffusion of innovation can significantly contribute to stop, then maintain and finally attract more farmers. As described by Rogers (1983), diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. Communication is a process in which participants create and share information with one

another in order to reach a mutual understanding. The diffusion process typically involves both mass media and interpersonal communication channels.

Since plant protection in organic farming is very close to be considered as something new and in full respect to the four main elements of the diffusion of innovations and giving respect to the S-curve of diffusion as described by Rogers (1983), the following is to be considered:

Improve human capacity in understanding the principles of organic farming, especially in the area of plant protection (preventive and curative activities);

Determine target groups which will serve as 'early adopters', who will lately 'be used' as a model of plant protection practice;

The National Program for Agricultural and Rural Development should be upgraded by expanding a budget line for projects that will engage higher education institutions in establishing Training centers or Farmer Field Schools for activities in teaching organic principles through their or farms that have reached certain level of development;

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ECOLOGICAL AGRICULTURE IN POLAND

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Abstract

Ecological agriculture is system of rural production based on utilization natural processes, which gets on rural farm. Organic fertilizers for plants are fabricated in farm as well as pasture for animals. It is forbidden in ecological farm to use artificial fertilizers application, chemical pesticides and also all substance of chemical synthesis in pasture and organisms modified genetically. From rendered accessible data by Ministry of Agriculture and Rural Development result, that ecological agriculture spreads out in Poland permanently. Increment of ecological farms number is continuous. On day 31 December 2012, there was control of unit in year 2013 included certifying 26,5 thousand producers of ecological food. In that were 25,9 thousand of ecological producers farming on over 650 thousand hectare. There is growth about 10% of surface and numbers of farms relatively to 2011. In 2012, number of ecological farms amount to 25944. Majority of them was placed on north and northern east of Poland. When it comes to processing plants using ecological products, they were situated in middle and on east of Poland. Surfaces used for cultivation according to regulations about ecological agriculture in 2012 have totaled in amount over 661 687 ha. It is 10% more than in 2011. In period 2003-2011 surface of ecological application has grown 11-fold and it presents about 3.4% whole surface used agricultural in Poland. Average surface of ecological farms surpasses 26 ha presently, when it is much lower for conventional farms because one farm has about 10 ha middling.

Key words: *ecological agriculture, certification, ecological product, ecological farm.*

Introduction

Ecological agriculture is characterized varied vegetable production and animal, moderate application of chemicalization of agriculture, it resists on crop rotation, vegetable leavings, manure, crop cultivated between main crops, organic wastes. Ecological agriculture is source many benefit for environment and for people. Fabricating of food of high quality is purpose, at in nature biological balance maintaining it. In order to achieve this purpose it is reduced for minimum influence of person on environment and this system of farming is realized to natural manner and for environment friendly (Golinowska, 2013). Control and certification is trump of ecological food. It gives guarantee for consumer, that products are fabricated ecological way and have high quality, as they have been produced according to regulations process of ecological production strictly defining, they are free from artificial fertilizers and GMO. Consumers have certitude, that they are not duped, when they are buying ecological products. System of control includes all periods i.e. production, storage, processing and sale of ecological food. Each can approach for system of farming to ecological manner, who is interested this system. There is for people, which promise, that they will obey criteria of ecological production. When somebody will approach for this system, it expresses agreement on facilities for control organ carrying inspection all building, as well as for farm or processing plant account books.

Materials and methods

The main aim of this elaboration is presenting how to look ecological farming in Poland. The data concerned in years 2003 – 2012. This study is an example of desk research. During the research has been used documentary method (Stachak, 1997). The results have been presented in the form of descriptions and figures. The source data are secondary character and come from special bibliography and from the Internet web site of Polish Ministry of Agriculture and Rural Development (MinRol, 2014).

Results and discussion

In order to approach for ecological agriculture, intention of taking of such activity it has to be reported in chosen unit certifying. After application it is period of permutation from conventional agriculture on ecological system and it is under control. For one-year cultivation control lasts 24 months, and for several years old cultivation- 36 months.

In farms waiting for certificate and with certificate there is every year control of farm. If farm worker gets good results during 2-year conducting of farm under control, he receives certificate. Products can be sell as ecological after his getting. Certificate is document informing, that farm uses method of production with requirements of ecological agriculture consistent. Development of ecological agriculture is dynamic and consumers play important role in development, because of them has followed fast increasing of ecological food. And that motivated owners of big farms to lead it in ecological system. Ecological agriculture is tied with lowest production capacity and procedures related with standards compound and certificates. (Golinowska, 2013).

Union support was main cause of increasing of interest with certificate ecological agriculture and in period of permutation, as well as increasing of surface cultivatedwith ecological methods. Big growth of number of ecological farm has followed from year 2004, as in 2004 it was 3760 this type of farm, but in 2010 it was already 20582. Surface of rural application has accrued from 82730 in 2004 for 519068 in 2010 (Łuczka-Bakuła, 2013).

The newest data from Ministry of Agriculture and Rural Development has informed, that ecological agriculture spreads out in Poland permanently (number of ecological farm accrues). According to data on day 31 December 2012 , there was 26,5 thousand ecological producers in Poland under control of certifying units and 25,9 thousand farms of them has over 650 thousand hectare. This is 10% more than in 2011. In 2012 there were 25944 ecological farms (MinRol, 2014).
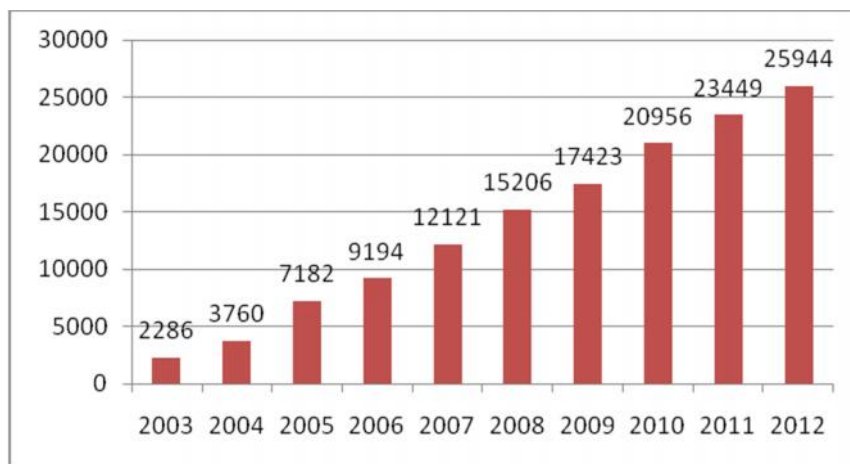

Chart 1. Change in the number of ecological farm in Poland (years 2003-2012).
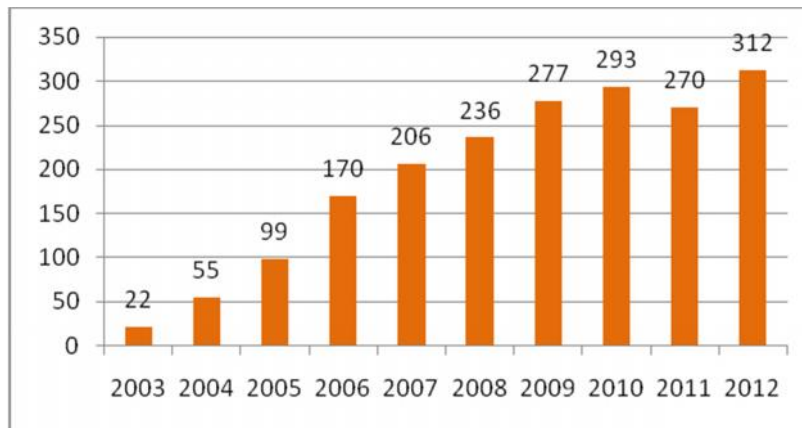
Chart 2. Number of farms that have caused increasing of number of processing plant.

Surface of cultivation according to regulations about ecological agriculture totals over 661687 hectare in 2012 and it is growth about 10% with reference to 2011. It presents 3,4% whole surface use agricultural in Poland. Average surface of ecological farm surpasses about 26 hectare when for conventional farms it is about 10 hectare (MinRol, 2014).
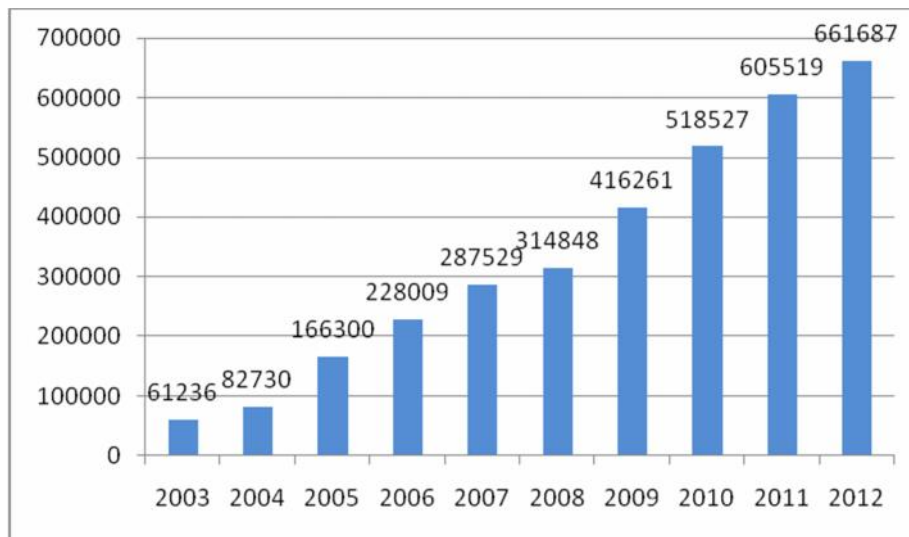

Chart 3. Surface of ecological farms in Poland.

Since 1999 ecological agriculture has been included in surcharges for surface of ecological cultivation, which was paid out from budget of state. When Poland entered for European Union, Poland received help from Union (Rural Development Plan 2004-2006, 2007-2013). Increase of variant and ecological surcharge have caused growth of activity of rural producer (Golinowska, 2013).

Rates of grants from Rural Development Plan 2004-2006 admitted for ecological agriculture on realization of package was differentiated in dependence if farm had certificate of correspondence or not. Rates totaled: the highest for fruit-growing was without certificate 1800 zloty[1]/ hectare and with certificate 1540 zloty/hectare, the lowest for permanent green applications 330 zloty /hectare and with certificate 260 zloty/hectare.

In 2004-2006, it was paid out within Rural Development Plan grants in height 830 million zloty. At that in 2004 it was paid about 35 million zloty and in 2010 it was 100 million zloty,

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[1] Polish currency

that means triple increasing. Average rate of grant has grown from 511 zloty in 2004 to 609 zloty in 2006 and 782 zloty in 2010.

According to estimates average value of production of one ecological farm amounts to 37,985 thousand zloty in 2010. Sale of products as ecological, that is after high prices than not ecological products, total in converting into one farm 16,985 thousand zloty, that presents about 45%. So, every other one zloty was gotten from sale of product after long prices merely. The rest part was sold beyond the farm in the price of products conventional (Nowogrodzka et al., 2013).

Along with the increase in the area of farm a share of the leased earth is rising. In the biggest farms it was from 42 to 40%, because the rent of leased field is low (average price: 135-110 zloty/hectare). The share of the leased fields in farm to 30 hectares didn't exceed the 15%.

Edition of work were very high in smallest farms, personal work presented at that 85-87%. Edition of work diminished along with increasing of surface on 100 hectares fields. In very big farm sit was about 11 cases small than in the smallest farms. Alike value of asset diminished on 1 hectare when surface of field accrued. In the smallest farm it is twice small than in the biggest farms. After year 2008 value of asset has grown significantly in all groups of farms, big and small, as manner of pricing of land value has been changed (Nachtman, 2013).

Quality is one of most important feature of stock of land in agriculture, because it effects production capacity of production and it is condition of selection of proper plants and it effects productive results and economic farms. Researched ecological farms owned weak qualities of soils (Komorowska, 2012a).

No doubt, low quality of soil caused limitations in organization of production. Cereals predominated, especially rye, oat, corn mixtures and pasture plants. Participation of other plant was low enough- 8-10% in farms to 50 hectares and 3-6,5% in very big farms, but in 2010 there was some growth of their participation in comparison for worst year: 2009. Small farms had high participation of orchard in rural applications (9-10%), then they presented in big farms from 0,4 for 1,6% (farms 30-50 hectares) only. In very big farms, over 120 hectares, there was groth from 4,5% in 2008 for 7,6% in 2010. Cultivation of vegetable had small meaning in researched farms; in small and middling small farms they presented merely near 4% area of rural application. Pasture plants were important in structure of rural application in all farms, as it boned with animals cultivated in farms (Nachtman, 2013).

Cost have accrued in all researched farms about 9% in 2008 in comparison for 2007 and it was caused increasing of material cost, reward of mercenary work and estimates of expenditures of permanent centers (means) (amortization costs). Cost have gone down in 2009 year in researched farms about 2% on result of material cutting of cost, with production mainly related directly, and cost of rewards of mercenary work (Komorowska, 2012b).

Conclusion

Ecological agriculture spreads out permanently. Big influence has on this interest of consumer, because farm workers will produce what consumers would like to buy. Unfortunately farm workers have problems with selling. Not everyone is interested in higher prices of ecological products. It has to be more expensive, as production has higher cost than conventional production. Although there are more and more consumers interested in that food every year.

Other problems are farm owners interested just in surcharges. They do not care about development of their farm and the market. That is the problem that authorities and European Union have to deal with.

Obtained results during presented research show strong incrementation of number of ecological farm in Poland during the period 2003-2012. Surface used has grown distinctly this

type distinctly farms also. It shows, that market of ecological food dynamically spreads out in Poland and farthest development depends on farm workers, as well as market conditions favorable and farthest supports of institutional national governments and European Union.

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SOME EXPERIENCES FROM THE WORLD IN THE USE OF COVER CROPS AND THE POSSIBILITY OF THEIR IMPLEMENTATION IN THE REGION

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Abstract

The paper aims to point out many benefits offered by the use of cover crops, selecting ecologically adequate plant species for this purpose, and the possibilities of their wider implementation within the intensive development of organic agriculture in the Region. Analyzed characteristics and experience with species that have been successfully grown as cover crops in the northern hemisphere indicate that many of them could be very successfully applied in the Region. Some of these species have been already used in the most countries of the Region, but not primarily as cover crops, but because of other beneficial properties. It is very important to pay attention to proper choice and management of cover crops. At the beginning, it is important to determine the desired primary benefits of cover cropping, then to analyze site conditions (climatic, type of soil, water availability, method of irrigation, cropping sequence, cultural practices). After all these analyses, can be accessed to the choice of a species or mix that will provide specific desired benefits and that will be compatible with the farming system.

Key words: *cover crops, benefits, experiences, implementation*

Introduction

The group of cover crops presents a group of plants with a long list of benefits. They are grown for many purposes: for soil erosion control, to add organic matter, stabilize and increase the content of nutrients, improve the number and diversity of microorganisms and on that way to improve physical, chemical and microbiological soil properties. They also suppress appearance and spreading of weeds, and even contribute to the control of diseases and pests. These plants are not primarily planted to be harvested for food. They are usually ploughed or tilled under before the next food crop is planted, in which cases it is used as a soil amendment ("green manure crop"), or its capacity to control weeds ("living mulch"). In addition to listed practical considerations, they also have aesthetic role from the landscape designer's perspective, since they are taking the place of garden plants in between growing seasons.

Cover crops were frequently used on farms in the first half of 20th century, but when pesticides and fertilizers came into widespread use (after 1950s), they were rarely grown.

In the last decades, researchers and farmers have taken a renewed interest in cover crops because of their potential role in reducing chemical inputs and numerous other benefits. Cover crops are also recognized in Serbia as an important component of "sustainable" agro production (Dolijanovic, Z. et al., 2012., Cupina B., 2014., upina, B. et al., 2011., upina B., et al., 2007., Ivaniševi , D. et al., 2012. and many other articles).

Matherials and methods

We analyzed the characteristic and experience with species that have been successfully grown as cover crops in the northern hemisphere, and could be successfully applied in the Region. Some of these species have been already successfully used in the most countries of the Region, but not primarily as cover crops, but because of other beneficial properties.

Generally speaking, the largest number of cover crop species belongs to the three groups of plants: Grasses, Legume and Non-Legume Broadleaves.

Grass species suitable for use as cover crops are fast growing and relatively easy to control, chemically, mechanically or by winter weather. Grasses do not fix any nitrogen out of the atmosphere, but they can accumulate large quantities from the soil. The group of Grasses which are characterized bya fine, fibrous root systems, includes: Rye (*Secale cereale* L.), Winter wheat (*Triticum aestivum*L.), Oats (*Avena sativa* L.), Barley (*Hordeum vulgare* L.), Sudangrass and Sorghum (both in the species *Sorghum bicolor* (L.) Moench), Ryegrass (*Lolium* sp.), and some other (corn, pearl millet, etc.).

Legume includes a group of cover crops that can fix nitrogen from the air, supplying nitrogen to the succeeding crop as well as protecting the soil from erosion and adding organic matter. The amount of nitrogen fixed varies between species. Some legume species have aggressive tap roots which can break up subsoil compaction. Commonly used legume cover crops include: *Red clover* (*Trifolium pratense* L.), Alfalfa (*Medicago sativa* L.), Sweet Clover (*Meliolotus* sp.), Hairy Vetch (*Vicia villosa* Roth.), Field Peas (*Pisum sativum* subsp. arvense (L.) Asch.) and some other (soybeans, white clover, crimson clover, berseem clover, etc.).

Non-legume broadleaf crops are specific. They may have a role as green manure crops and in providing a different plant species and root system for soil building. They cannot fix nitrogen out of the air, but they can absorb large quantities from the soil. Most of these crops are not winter-hardy. We have found that is mostlyin use the following species of non-legume broadleaves: Buckwheat (*Fagopyrum esculentum* Moench), Oilseed Radish (*Raphanus sativus* or *R. sativus* var. oleiferus, Fam. *Brasicaceae*), some other Brassicas (Fam. *Brassicae*) and Marigold (*Tagetes* spp., Fam. Compositae).

Results and discussion

Based on a detailed analysis of available data about successful use of numerous plant species as cover crops in northern hemisphere, we decided to point out a few specially interesting species that could be successfully grown as cover crops in the region. By groups of plant species, these are:

Grasses

Rye(*Secale cereale*), verry common in use from numerous reasons: it tolerates a wide range of soil conditions, but themost appropriate are well drained light soils – sands, loamy sands, sandy loams and gravelly soils. Well tolerate cold temperatures and can withstand temperatures of – 35° C. Rye is more drought tolerant than wheat or oats. It is also shade tolerant and can be seeded in corn fields before leaf drop. In addition to the other benefits, it is good for suppressing weeds and have allelopathic effect – prevents weed germination and growth. It is of significance that the large volume of plant biomass is returned to soil.

Winter wheat(*Triticum aestivum*) tolerates a moderately wide range of site conditions, but does not thrive well in saturated or droughty soils. Grown as a cover crop and food crop. Can be overseeded in growing crop (e.g. beans, tomatoes).

Oats (*Avena sativa*) is growing as an annual grass with fibrous root system that reaches 1-2 m. Preferred soil in pH range from 5.0 to 6.5, but can tolerate as low as 4.5 Require moist soils

for optimum growth and do not tolerate hot and dry conditions. Oats produce high quantity of biomass.

Barley (*Hordeum vulgare* L.), belongs to the fast growing annual grasses, with fibrous root system reaches 1.5 to 2 m in depth. Grows best in cool dry conditions, requires less soil moisture for optimum growth. Preferred soil pH is greater than 6.0. It is very significant that barley has a very high salt tolerance. The amount of biomass is sufficient to increase soil organic levels.

Sudangrass and *Sorghum* (both in the species *Sorghum bicolor* (L.) Moench), are warm season annual grass cover crops that can provide good weed suppression, grazing and forage supply, in addition to the soil structure improvements. It prefers neutral pH, but can tolerate 5.0 to 9.0 and it is characterized by extreme drought tolerance and tolerance to salinity. Besides Sorghum and Sudan grass can be used as forage, they also can produce massive amounts of dry matter (Björkman, T. and J.W. Shail., 2010). These crops provide abundant root biomass, which is useful for increasing soil organic matter. They suppress root knot nematodes and inhibit weed germination if densely sown.

Ryegrass (Lolium sp.) can be grown as annuals (60-120cm) or perennials (30-90cm annually for 3-4 years).Shade tolerant, often used in orchards and vineyards for ground cover. Grows best on medium to heavy soils and have high requirements for moisture and nutrients. Annual ryegrass tolerates more standing water than perennial ryegrass.

Corn (*Zea mays*). Annual grass which can make an inexpensive and effective cover crop if seeded early. Tolerant of most soil types, but very sensitive to frost. Corn is best used as a green manure crop and very often used in erosion control projects to stabilize banks.

Pearl millet [*Pennisetum glaucum* (L.) R.Br.] is a warm season annual grass crop that is best known in the U.S.A. as a forage crop. Pearl millet grown for grain has a growth habit similar to sorghum. Like any grain crop, pearl millet will yield best on fertile, well drained soils. However, it also performs relatively well on sandy soils, under acidic soil conditions, and when available soil moisture and soil fertility are low.

Legume

Red clover (*Trifolium pratense* L.). Short lived perennial, grow on a wide variety of soil conditions - including slightly acidic pH, but best growth with soil pH 6.0 to 7.0. Shade tolerant species, efficient nitrogen-fixer - 45 kg/ha, adds considerable biomass, improves conditions for soil microbial life, improves water holding capacity, infiltration and permeability rates.

Alfalfa (*Medicago sativa* L.). Excellent cover once established. Performs best on a deep permeable soil with adequate soil moisture, but no prolonged periods of standing water. Not tolerant of severely compacted soils, intolerant of acidic soils (pH < 6.2). Large biomass producer. *Alfalfa* can breaks-up some compacted layers, improves soil infiltration and permeability.

Sweet Clover (*Meliolotus* sp.). Grows in the areas with average annual temperature range between 5° and 22°, on a wide range of soil textures, pH tolerance 6.5 to 7.5C. Strong taproot system can penetrate up to 2 m compacted silty and clayey soils. White sweet clover tolerates calcareous conditions, perform well in moderately well drained conditions. Fixes nitrogen and believed to move P and K to the root zone through the root system.

Hairy Vetch (*Vicia villosa* Roth.).Winter annual legume with many cultivars. Does well on most soils if well drained, but the best on sandy soils, prefers soil pH of 6.0 to 7.0, drought tolerant. Fixes nitrogen and can make K more accessible to subsequent crops. Once established it provides enough cover to suppress weeds and protect soil.

Field Peas (*Pisum sativum* (subsp. arvense (L.) Asch.).Winter annual legume which grows best on well-drained loamy and clayey soils, but does not do well on poorly drained soils and

droughty, sandy and gravelly soils. Prefers fertile soils and pH range of 6.0 to 7.5.Fixes nitrogen and adds considerable amounts of biomass to soil. Can be used as feed - either as forage or as dried seed supplement.

There is also in use some other Legumes: soybeans, white clover, crimson clover and berseem clover:

Soybeans (Glycine max (L.) Merr.) well tolerate wide range of soil conditions, but is less tolerant of low pH, droughty and saturated soils. Release N and cause leaching in winter and spring. Residue readily breaks down.

White clover, Crimson clover, Berseem clover (*Trifolium* spp.) also tolerates a wide variety of soil conditions, except poor drainage and calcareous conditions. Does best on well drained, humified, loamy soils with a pH in range of 5.0 to 7.0.

Non-Legume Broadleaves

Buckwheat (*Fagopyrum esculentum* Moench) is fast ground cover which tolerates a wide range of soil types, even on infertile soils. Prefers well drained soils with a pH range of 5.0 to 7.0, but intolerant of droughty, saturated or compacted soils. Buckwheat is effective at extracting phosphorus from the soil. Residue is easily decomposable.

Oilseed Radish (*Raphanus sativus*, Fam. Brasicaceae) primarily used for oil production, now is widely used as a cover crop. Prefer swell drained loam to clay loam soils, cool, moist growing conditions. Intolerant of shade or traffic. May have an allelochemical effect following decomposition that can help control soil-borne pests, including insects, weeds and nematodes. Oil seed radish has a deep root system that can break up compacted soil layers. It is also very good forage and can be used for organic matter production. Because of fast growth it is quick ground cover which also protect against soil erosion.

Other Brassicas (Fam. *Brassicae)*includes canola (*Brassica rapa* subsp. *oleifera*, syn. *Brassica campestris* L.), rapeseed (*Brassica napus* L.) and mustard, black and white.

It should be mentioned one more interesting species for ground cover. It is Marigold (*Tagetes*spp., Fam.Compositae), annual decorative plant (Dover K. E. et al., 2003). Because its allelopathic effect, Marigold can be grown as a cover crop to suppress nematodes before planting a susceptible crop such as a vegetable crop and also in ornamental planting beds where nematodes are a problem (Krueger, R. et al., 2010). Marigold should be planted at least two months before the desired vegetable crop. The allelopathic effect is reflected in the ability to produce chemicals that are toxic to other organisms. Marigold roots release the chemical alpha-terthienyl, one of the most toxic naturally occurring compounds found to date (Gommers and Bakker, 1988). This compound is nematicidal, insecticidal, antiviral, and cytotoxic (Arnason et al., 1989; Marles et al., 1992).

Conclusion

Based on the experience from the similar climatic, soil and other environmental conditions, it can be concluded that there is a significant number of plant species used in the northern hemisphere suitable for use as cover crops in the Region.

Undoubtedly there are the numerous potential benefits of cover crops which are primarily reflected in protection of soil from water and wind erosion, addition of organic matter to soils, improvement of soil structure and water penetration, addition or conservation of nitrogen, suppression of weed growth, attraction and sustenance of beneficial insects and also many others. These benefits considerably exceed the eventual potential disadvantages of cover crops such as depletion of soil moisture, temporary decrease in availability of plant nutrients, increased weed problems, increased danger of frost damage, attraction of arthropod and rodent pests or increased associated costs.

It is very important to pay attention to proper choice and management of cover crops (Ingels, C.A. et al., 2007). At the beginning, it is important to determine the desired primary benefits of cover cropping, then to analyze site conditions (climatic, type of soil, water availability, method of irrigation, cropping sequence, cultural practices). After all these analyses, can be accessed to the choice of a species or mix that will provide specific desired benefits and that will be compatible with the farming system. All the mentioned phases of planning are necessary in order to maximize the benefits and reduce potential problems.

Research and practical experiences indicate that a successful cover crop stand and the greatest benefits can be obtained by using mixtures of species, such as grasses and legumes and that cover crops should be rotated periodically (Clark, A., 2007).

In this paper, we have tried to identify and listed some of the most important species of grasses, legumes and broadleaf non legumes which are for decades very successfully usedascovercropsin the northern hemisphere. Many of them could find the implementation in the countries of the Region, but to cover cropping should be approached very carefully and systematically.

Acknowledgement

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EFFECT OF FERTILIZATION ON *Pimpinella Anisum L.* IN DIFFERENT LOCATIONS IN SERBIA

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Abstract

Aniseed (*Pimpinella anisum* L.) is a plant from parsley family, widely cultivated for fruit and essential oil. Aniseed is an important raw natural material mostly used in medicine, pharmaceutics, perfumery and cosmetic industries. It is also used as functional food; it is added to confectionary products and alcoholic beverages. Recent research found that aniseed has an antimicrobial and antifungal properties, as well as antioxidant effect on human health. Also, it is found that aniseed has insecticidal activity against storage pests and mosquitoes. The study of this plant is focused on its morphological and productive traits in three locations in Serbia (Mošorin, Veliki Radinci and Ostoji evo), with different microclimatic and soil conditions. Field trials were conducted during two successive years (2011/12) by randomised block system. The experiment has included the application of different types of fertilisers approved for organic production system (Slavol, Bactofil B-10, Royal Ofert biohumus, vermicompost), as well as a chemical fertiliser (NPK) used in conventional agriculture. Plots where no fertiliser was applied were used for control purposes. The results showed that the location had a great influence on plant height, number of umbels per plant, number of seeds in an umbel, 1000 seed mass and whole plant mass in both investigated years. In 2011, the locations had an influence on the umbel diameter and, in 2012, on yield of essential oil per hectare. Different fertiliser types had an influence only in the first investigated year in case of whole plant mass.

Keywords: *aniseed, morphological features, productive traits, yield*

Introduction

Anise (*Pimpinella anisum* L.) is a plant from parsley family, widely cultivated for fruit and essential oil. Anise is an important raw natural material mostly used in medicine, pharmaceutics, perfumery and cosmetic industries. It is also used as functional food; it is added to confectionary products (honey cookies, candies) and alcoholic beverages (liqueurs and sweet flavored wines) (Acimovic et al. 2013). Medicinal applications include use as an appetizer, carminative and sedative agent, or for stimulating milk production in breastfeeding mothers (Ozel, 2009). Recent research found that anise essential oil poses antioxidant potential (Rajeshwari et al., 2011), antimicrobial activity (Kubo and Himejima, 1991; Kosalec et al., 2005; Ozcan and Chalchat, 2006; Yazdani et al., 2009) and insecticidal activity against storage pests (Tunc and Erler, 2000) and mosquitoes (Prajapati et al., 2005; Erler et al., 2006). It is known that organic fertilisers compared to the chemical ones have a lower content of nutrients and act more slowly, but they are more effective than chemical in continuous use, and have a complex chemical composition (Naguib, 2011). From available literature, there are a of couple papers on the application of chemical and organic fertilisers in growing practices of anise (Jev ovi and Maleti , 2006; Darzi et al., 2012; Nabizadeh et al., 2012; Jev ovi et al., 2012). For this reason, the aim of our study was to investigate the application of various types of fertilisers available in our country, whose application is permitted in organic

production system according to Law on Organic Production of Serbia. The scientific objective of this paper was to examine the influence of fertilisation with different types of organic and microbiological fertilisers on yield and morphological traits of anise in an organic farming system.

Materials and Methods

Field experiments were carried out during the growing season of 2011 and 2012, at the three research localities: L1 (Mošorin, 45°18' N, 20°09' E), L2 (Veliki Radinci, 45°02' N, 19°40' E), and L3 (Ostoji evo, 45° 54' N, 20° 09' E).

The four-replicate trial was set up according to the randomised block system and treatments included six different fertilisers: control (F1), Slavol (F2), Bactofil B-10 (F3), Royal Ofert granules (F4), vermicompost (F5) and chemical fertiliser (F6).

Slavol and Bactofil B-10 are microbiological fertilisers. Slavol contains *Azotobacter chroococcum, A. vinelandi, Derxia sp. Bacillus megaterium, B. lichenformis, B. subtilis*. Bactofil B-10 contain *Azotobacter vinelandı, Azospırıllum brasılense, A. lıpoferum, Bacıllus megaterıum, B. suptılıs, B. cırkulans, B. polymıxa, Pseudomonas fluorescens*. Apart from bacteria, these fertilisers contain natural vitamins and growth stimulator.

Royal Ofert biohumus is made from organic waste from poultry and pig farms inoculated with domestic fly larvae. Vermicompost is modified cattle manure with *Lumbricus terrestris*.

The requested quantities of fertilisers, except Slavol, were applied and incorporated in the 5 cm layer of soil before the sowing of anise seeds. The doses of application investigated fertilisers are: Slavol (7 l ha^{-1} by watering twice during vegetation), Bactofil B-10 (1.5 l ha^{-1}), Royal Ofert biohumus (3 t ha^{-1}), vermicompost (5 t ha^{-1}), and chemical fertiliser NPK (400 kg ha^{-1} in formulation 15:15:15).

Aniseed (local cultivar) was sown during April, in continuous rows 35 cm apart, and with 200 plants per square meter. The plots were kept weed-free by hand weeding and hoeing. One sample is presented by 10 randomly selected plants from the central row from each fertilised plot.

In time of full flowering (June), the plant height (PH) was measured. Harvest was performed when the seed turned colour to brownish-yellow (August), and after it had dried in the shadow for a couple of days to obtain constant weight, after which the whole plant mass was measured (WPM). Umbel diameter (UD), number of umbels per plant (No UP), number of seeds in the umbel (No SU) were also measured. The plants were manually harvested in order to determine seed weight per plant (SWP). Also, we calculated the harvest index (HI=SWP/WPM*100), seed yield per hectare (SYH=SWP*2000000) and essential oil yield per hectare (EOH=SYH*% of essential oil in seeds). Determination of essential oil in seeds was performed on Faculty of Chemistry (Belgrade) by distillation with Clevenger-type apparatus. The weight of 1000 seeds was measured (TSM) in Seed-testing laboratory (Sremska Mitrovica).

Soil samples were taken from 0-30 cm, and analysed in Soil-testing laboratory of Agricultural Extension Service, Sremska Mitrovica, and are shown in table 1.

Table 1. Agrochemical analysis of soil

	pH (KCl)	CaCO$_3$ (%)	Humus (%)	Total nitrogen (%)	AlP$_2$O$_5$ (mg 100 g^{-1})	AlK$_2$O (mg 100 g^{-1})
L1	7.3	8.4	2.7	0.18	81.6	75.1
L2	7.1	2.0	2.5	0.16	22.4	21.7
L3	7.3	8.8	2.2	0.14	17.6	30.3

For determination of soil pH potentiometric method was used, for CaCO₃ molar volume of carbon dioxide was used, humus content was determined by Turin method, total nitrogen by Kjeldahl method, available phosphorous and potassium with Al-method, Egner-Riehem.

The obtained experimental data was processed by a mathematical statistical procedure using the statistical package STATISTICA 8.0 for Windows (Analytical software, Faculty of Agriculture, Novi Sad, Serbia), while the least significant difference (LSD) test was used for individual comparison of differences between means. Correlation analysis was performed by Statistica 8.0 package to determine the relationship among the characters according to Pearson method.

Results and Discussion

As it can be seen from table 2, in the first investigated year, applying chemical NPK type of fertiliser had a significant influence only in case of the whole plant mass. On the control plot and on plot where the biofertiliser Slavol was applied, the lowest values were achieved in comparison with other fertilised plots.

Table 2. Morphological and productive traits of anise in 2011

F	L	PH	UD	No UP	No SU	TSM	SWP	WPM	HI	SYH	EOH
-	1	53.18	6.28	19.17	104.95	4.39	9.01	19.36	47.62	1801.40	70.53
-	2	48.84	6.61	17.50	114.88	4.08	8.29	17.76	47.13	1657.39	67.62
-	3	41.19	5.90	15.21	98.42	4.77	7.22	15.90	45.51	1444.89	54.72
1	-	46.16	6.11	15.67	100.19	4.38	6.85	15.46	47.15	1371.04	52.17
2	-	47.47	6.05	16.50	104.15	4.36	7.44	16.21	46.63	1488.70	56.95
3	-	47.56	6.19	17.50	105.03	4.51	8.21	17.41	46.95	1641.16	63.85
4	-	47.21	6.38	17.50	106.19	4.36	8.27	17.88	46.50	1654.62	68.87
5	-	48.97	6.51	18.25	105.90	4.40	8.70	18.49	46.66	1740.07	67.07
6	-	49.03	6.34	18.33	115.03	4.46	9.56	20.60	46.63	1911.78	76.84
F		ns	ns	ns	ns	ns	Ns	3.54	ns	ns	ns
L		1.52	0.45	2.42	13.71	0.31	Ns	1.44	ns	ns	ns
F*L		ns	ns	ns	ns	0.76	Ns	ns	ns	ns	ns

LSD at 5% level: [ns]Not significantly different.

Location had a significant influence in case: PH, UD, No UP, No SU, TSM and WPM The highest PH, No UP and WPM were recorded at L1. On L2, the highest UD and No SU were recorded, but the smallest TSM. The highest value of TSM was recorded on L3 (4.77 g), and interaction F*L was significant only in case of this parameter.

According to table 3, in 2012, the application of different sources of fertilisers had no effect on investigation parameters. Location in this year, as in previous, had an influence on PH, No UP, No SU, TSM, WPM, but also on EOH. In this investigated year, the location was not a significant influence on UD compared to the previous experimental year. Like in the previous year, the highest PH and No UP were on L1. The highest No UP and WPM were on L2, and the highest TSM was on L3.

Table 3. Morphological and productive traits of anise in 2012

F	L	PH	UD	No UP	No SU	TSM	SWP	WPM	HI	SYH	EOH
-	1	51.36	6.62	18.17	111.47	3.66	7.39	17.52	42.26	1478.08	52.27
-	2	46.70	6.47	16.46	127.77	3.71	7.76	18.36	42.76	1552.18	59.01
-	3	40.92	6.23	14.58	107.87	4.36	6.87	15.82	43.32	1373.48	44.33
1	-	46.50	6.22	15.50	111.59	3.92	6.46	15.72	40.99	1292.99	44.94
2	-	47.02	6.62	16.25	113.53	3.88	7.13	16.58	43.21	1426.64	50.15
3	-	45.61	6.42	16.33	115.04	3.92	7.39	16.80	43.30	1477.85	50.64
4	-	46.72	6.52	16.67	116.39	3.95	7.54	17.79	43.74	1509.02	55.08
5	-	46.39	6.35	16.67	117.74	3.93	7.68	18.05	42.60	1535.50	52.45
6	-	45.71	6.53	17.00	119.94	3.87	7.83	18.46	42.82	1565.49	57.93
F		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
L		1.46	ns	2.64	13.37	0.10	ns	1.54	ns	ns	10.10

| F*L | 3.58 | ns | ns | ns | 0.12 | ns | ns | ns | ns | ns |

LSD at 5% level: [ns]Not significantly different

Morphological traits of anise (PH, No UP, No SU) relate to plant's genetic structure, growing conditions and agricultural practices. Most investigated agricultural practices are plant densities (Tuncturk and Yildirim, 2006), sowing dates (Zehtab-Salmasi et al., 2001), irrigation (Zehtab-Salmasi et al., 2001; Aloghareh et al., 2013) and fertilisation (Jevđović and Maletić, 2006; Yassen et al., 2010; Nabizadeh et al., 2012; Darzi et al., 2012). Location was also very influential, but only a couple of authors investigated this factor. Ullah (2012) investigated fruit yield and quality of anise in relation to agronomic and environmental factors in two different locations in Germany, but it was not a comparison between locations. Results of Al-Awak (2010) showed that there were significant differences between two locations in Syria regarding to production, essential oil percentage and anethole content.

In our experiment on PH in both investigated years, locations were of considerable influence and in the second year F*L interaction was significant. PH varied between 40.92 and 53.18 cm which is similar to Curioni et al. (2003) findings, who reported that the plant height varied between 52.3 and 45.17 cm, on average 49.57 cm. Results obtained by Nabizadeh et al. (2012) showed that different levels of chemical nitrogen (46% urea nitrogen) and biological nitrogen (*Azotobacter*) had no significant influence on PH, which supported our data. UD in our experiment ranged from 5.90 to 6.62 cm, and No UP 14.58 to 19.17. In an experiment conducted by Zehtab-Salmasi et al. (2001) this parameter was from 8.23 to 17.57, and Tuncturk and Yildirim (2006) achieved 9.26–12.20 umbels per plant. The total number of umbels in the investigations of Curioni et al. (2003) on average was 23.96 per plant. No SU was between 98.42 and 127.77, and TSM varied between 3.66 and 4.77 g. Ipek et al. (2004) reported that the TSM was from 4.01–5.46 g, which is a higher value than in our results. The application of different fertilisers had no influence on this parameter in our experiment, as the results of Darzi et al. (2012) indicated, TSM was not affected by vermicompost and phosphate solubilizing bacterium.

In our experiment, fertiliser or location had no influence on SWP and in the first year on average it was 8.17 g, and in the second 7.34 g. Yassen et al. (2010) reached a conclusion that this parameter in case of anise greatly varied – between 2.11 and 9.80 g depending on nitrogen fertilisers and growth tryptophan stimulants. WPM i.e. biological yield per plant in the first growing season was on average 17.67 g and in the second 17.23 g.

The HI was from 42.78 to 46.75 depending on the investigated year. As Zehtab-Salmasi et al. (2001) report, HI increased at the latest sowing date (from 39.67 to 40.31%) and in the water deficit (from 37.58 to 42.67%).

SYH was not influenced by locality or fertilisation in both investigated years. In experiments of Jevđović and Maletić (2006), the application of fertilisers had a significant influence on the yield, and the best results were achieved by biological fertilizer Bactofil. EOH was in average in the first year (64.29 kg ha^{-1}) and it did not depend on fertilisation or location. In the second investigated year, average value of EOH was lower – 51.87 kg ha^{-1}, and it depended on the growing location.

Conclusion

The weather conditions greatly affected the following parameters: plant height, quantity of seeds per umbel, weight of 1000 seeds and yield of essential oil per hectare. The influence of locality was notable in all tested parameters, except in harvest index, whereas fertilisation had significantly influenced seed yield per hectare and yield of essential oil per hectare. The application of vermicompost contributed to maximum plant height and number of seeds per umbel. The application of Royal Ofert biohumus resulted in the highest diameter of umbel

and content of essential oil. The application of microbiological fertiliser Bactofil B-10 in the pre-sowing phase enabled maximum weight of 1000 seeds. The highest value for the following parameters achieved by application of chemical fertiliser was recorded in: number of umbels per plant, seed yield per hectare, as well as whole-plant mass and yield of essential oil per hectare.

Acknowledgements

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POSSIBLE AVAILABILITY OF Mg, Fe, Mn AND Zn FROM ORGANICALY PRODUCED MAIZE

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Abstract

Trial was conducted during 2013 with aim to study application of different fertilizer combinations on availability of mineral nutrients Mg, Fe, Mn and Zn from organically produced maize grain. Fertilizer treatments included control (without fertilization), DIX 10 N and Italpolina 4:4:4, which were incorporated into soil, as well as foliarly applied $MgSO_4$. After harvest, grain yield, 1.000 grain weight and content of nutrients Mg, Fe, Mn and Zn, as well as inorganic phosphorus (P_i), phytate – as factor which affect availability of mineral nutrients and -carotene – as factor which promotes availability of mineral nutrients, were determined in grains.

The highest grain yield and 1.000 grain weight were achieved in DIX treatment. $MgSO_4$ showed positive impact on phytate decrease and -carotene increase, but in combination with Italpolina and DIX, respectively. Meanwhile, the highest content of observed mineral elements was observed in control. The highest variation in relations of phytate with examined parameters was on phytate/ -carotene content, ranging from 411.3 (DIX+$MgSO_4$) to 1825.9 (Italpolina). The desirable lowering in ratio between phytate and examined elements was achieved in DIX+$MgSO_4$ combination, for phytate/P_i, phytate/ -+carotene and phytate/Mn ratio, while Italpolina decreased phytate/Zn ratio. However, phytate/Mg and phytate/Fe ratios were the lowest in control, indicating that applied fertilizers showed negative impact on potential Mg and Fe availability. Regression analysis underlined that phytate/Fe and phytate/Zn negatively correlated with 1.000 grain weight, indicating that bigger grains could be also valuable with increased Fe and Zn availability. That could be referred to DIX as treatment with the highest -carotene content and 1.000 grain weight.

Key words: *mineral nutrients, organic production, availability, phytate, -carotene*

Introduction

Irrespective to generally lower yields, organically produced crops have increased nutritional value than conventionally produced crops. They have more dry matter, antioxidants (vitamin C, phenolic compounds etc.), essential amino acids, total sugars and more mineral compounds, such K, Ca, Mg and Fe (Rembiałkowska, 2007; Lairon, 2010). This means that organic agricultural systems have already proved ability to produce food with high quality standards.

Higher content of mineral nutrients in foods doesn't mean automatically that they will be utilized in total by human and animal organisms. Plant foods can contain inhibitors, likephytate, polyphenolics, etc., which obstruct the absorption or utilization of mineral elements. Moreover, there are also enhancing substances – promoters, like ascorbic acid, -carotene, S-containing amino acids, etc.,which promote bioavailability of mineral elements or decrease the effects of inhibitory substances (Luo Xie 2012). From this point of view, it is essential to decrease the content of various inhibitors in foods and to increase the content of

promoters, what means that well-balanced diet, as well as staple food with distinct properties can equally improve health regardless of its organic or conventional origin (Magkos et al., 2003).

The aim of experiment was to determine nutritional quality of organically produced maize grain through potential availability of Mg, Fe, Mn and Zn, issued from their relation with phytate, as inhibitor and -carotene, as promoter.

Material and methods

Experiment was conducted in rain-fed conditions during 2013, in ZemunPolje (44°52'N 20°20'E), in the vicinity of Belgrade, on a slightly calcareous chernozem type of soil, with: 0.0 % coarse, 53.0 % sand, 30.0 % silt, 17.0 % clay, 3.3 % organic matter, 7.40 pH KCl and 7.17 pH H_2O, 103.23 ppm N, 26.49 ppm P, 16.37 ppm K, 24.41 ppm Mg, 0.04 ppm Fe, 0.02 ppm Mn and < 0.0002 ppm Zn. Before ploughing, 2 organic fertilizers were applied: DIX 10 N (N:P:K=10:3:3, 72.5% organic matter) in amount of 500 kg ha^{-1} and Italpolina 4:4:4 (N:P:K-4:4:4, produced from the manure from several animal species), also in amount of 500 kg ha^{-1}, as well as control (without fertilization). Maize variety Rumenka was sowed on 23.04.2013. Every treatment included sub-treatments with foliar application of 1% $MgSO_4$ (in amount of 200 g ha^{-1}), on 29.05. and on 06.06., in phase 6-7 leaves (FF treatment).

After harvest, grain yield, mass of 1000 grains, and concentration of phytic P (P_{phy}), inorganic P (P_i), -carotene, as well as mineral elements: Mg, Fe, Mn and Zn were determined in grains. P_{phy} and P_i were determined by the method of Dragičević et al. (2011); -carotene was determined according to AACC (1995) procedure; mineral elements were determined after wet digestion in HNO_3+HClO_4 by Inductively Coupled Plasma - Optical Emission Spectrometry. The obtained results were presented with standard deviation (SD). Interdependence between the 1000 grain weight and ratio between phytate and inorganic P, -carotene, Mg. Fe, Mn and Zn were processed by regression analysis.

Results and discussion

According to results present in Table 1, grain yield varied slightly among treatments. The highest value of grain yield was obtained in DIX treatment, combined with foliar fertilizer and in control without application of foliar fertilizer, what is about 7% higher compared with control with foliar fertilizer (the lowest value of grain yield).This is in accordance with results of Thalooth et al. (2006) obtained on mungbean, with increased growth and yield components with foliarly applied Mg. In regard to the fact that phytate presents inhibitor, lowering of its content in grain could positive affect availability of mineral elements (Hunt, 2003;Dragičević et al., 2013). The lowest phytate concentration in maize grain was obtained in Italpolina + FF treatment. However, this treatment also decreased P_i accumulation in grain (it was 2.6 times lower that in DIX +FF treatment, which had the highest P_i concentration). Such situation could indicate less efficient P absorption or accumulation in grain, which could be caused by imbalanced nutrient content in soil (Nel et al., 1996). The concentration of -carotene as promoter in grain was highly and positively affected by DIX treatment, having double higher values in DIX +FF treatment in relation to control and over 4 times higher values in relation to Italpolina without FF application.

Table 1.Grain yield and concentration of phytic P (Pphy), inorganic P (Pi) and -carotene in maize grain, from plants treated with DIX 10 N and Italpolina 4:4:4, as well as foliarly applied $MgSO_4$ (FF) and without it (Ø).

Treatment		Grain yield t ha^{-1}		P_{phy} g/kg		P_i		-carotene mg/kg	
Control	FF	4.20	± 0.24	3.56	± 0.001	0.53	± 0.04	13.21	± 0.11
	Ø	4.52	± 0.45	3.86	± 0.008	0.50	± 0.25	8.04	± 0.23
DIX 10 N	FF	4.52	± 0.45	3.17	± 0.021	0.59	± 0.12	22.26	± 0.02
	Ø	4.25	± 0.48	3.26	± 0.002	0.45	± 0.13	12.09	± 0.21
Italpolina 4:4:4	FF	4.41	± 0.78	2.77	± 0.005	0.23	± 0.28	9.74	± 0.09
	Ø	4.31	± 0.47	3.28	± 0.001	0.46	± 0.08	5.19	± 0.11

Mean value ± SD

Irrespective to addition of organic fertilizers, which could improve soil and plant status of mineral elements, the highest concentration of Mg, Fe and Zn was observed in control, mostly with application of foliar fertilizer (Table 2). The highest variation in concentration of mineral elements in maize grain among applied treatments was noticed at the Mn level: the highest Mn concentration in grain was in DIX + FF treatment, what is almost 4 times higher in regard to combination Italpolina + FF. It was important to underline that the highest Mn concentration from DIX + FF treatment was linked with the lowest Zn concentration, possible induced by better P absorption (Ryan et al., 2004), what is evidenced by the highest $P_{phy}$and Pi concentration in grain.

Table 2.Concentration of phytic Mg, Fe, Mn and Zn in maize grain, from plants treated with DIX 10 N and Italpolina 4:4:4, as well as foliarly applied $MgSO_4$ (FF) and without it (Ø).

Treatment		Mg		Fe mg/kg		Mn		Zn	
Control	FF	417.5	± 7.95	13.34	± 0.22	2.31	± 0.00	16.50	± 1.59
	Ø	383.4	± 1.33	16.31	± 0.44	2.28	± 0.22	17.19	± 2.47
DIX 10 N	FF	353.1	± 0.88	9.56	± 0.53	2.56	± 0.09	10.16	± 2.43
	Ø	377.5	± 3.54	10.69	± 0.71	1.66	± 0.04	13.63	± 5.66
Italpolina 4:4:4	FF	310.6	± 1.77	9.25	± 0.71	0.78	± 0.13	14.03	± 0.66
	Ø	359.1	± 0.44	8.31	± 0.97	1.31	± 0.00	15.66	± 2.34

Mean value ± SD

Regardless to higher or lower concentration of Mg, Fe, Mn and Zn in maize grain, their availability mainly depends on their relations with inhibitor, such phytate (Walter Lopez et al., 2002; Dragi evi et al., 2013). From this point, the lowest value of P_{phy}/P_i, Phy/ -carotene and Phy/Mn was noticed at DIX + FF treatment (Table 3), indicating lower phytate impact on availability of examined mineral elements, particularly Mn. The lowest Phy/Fe ratio was obtained at control and the lowest Phy/Zn ratio was observed at Italpolina + FF, treatment with the lowest P_{phy} concentration (Table 1).

Table 3.Molar ratios between phytate (Phy), inorganic P (P_i), -carotene, Mg, Fe and Zn in maize grain, from plants treated with DIX 10 N and Italpolina 4:4:4, as well as foliarly applied $MgSO_4$ (FF) and without it (Ø).

Treatment		P_{phy}/P_i	Phy/ -carot.	Phy/Mg	Phy/Fe	Phy/Mn	Phy/Zn
Control	FF	6.75	779	1.117	80.3	455.7	76.0

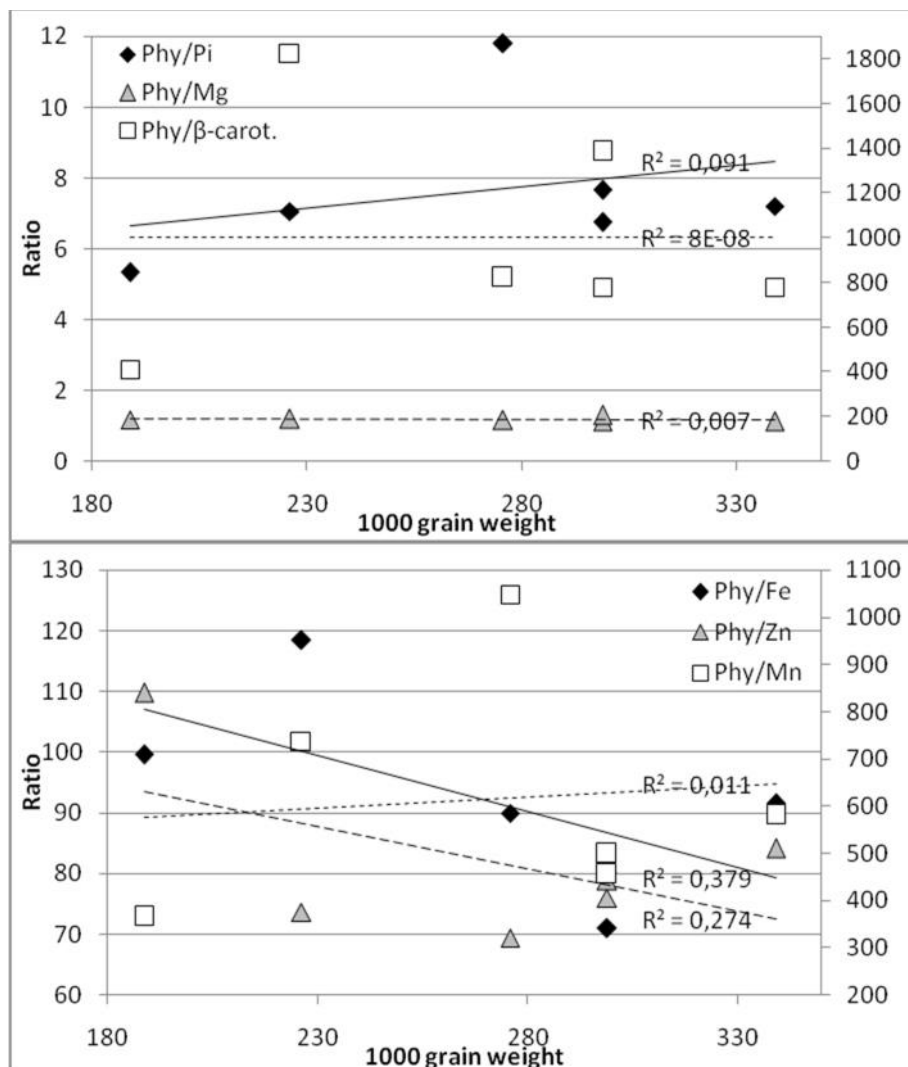|							
	Ø	7.66	1385	1.316	71.0	499.6	78.9
DIX 10 N	FF	5.34	411	1.174	99.6	365.6	109.8
	Ø	7.21	779	1.130	91.6	581.6	84.1
Italpolina	FF	11.80	822	1.167	90.0	1048.2	69.5
4:4:4	Ø	7.06	1826	1.195	118.5	738.3	73.7

Figure 1.Interdependence between 1000 grain weight and relations between phytate (Phy), inorganic P (P_i), -carotene, Mg, Fe, Mn and Zn

The interdependence of ratio between phytate P_i, -carotene and mineral elements with yielding parameter, such 1000 grain weight, indicated that there was no significant dependence between P_{phy}/Pi, Phy/ -carotene and Phy/Mg (Figure 1). Other than that, Phy/Fe and Phy/Zn status have significant and negative interdependence with 1000 grain weight, indicating better availability of Fe and Zn from bigger grains.

Conclusion

Based on obtained results from preliminary research, it could be concluded that applied fertilizers DIX 10 N and Italpolina 4:4:4 slightly affected maize grain yield, in comparison with control, with higher influence of foliarly applied $MgSO_4$. Moreover, the highest Mg, Fe and Zn concentration was observed in maize grain from control, with FF application. The lowest phytate concentration in maize grain was obtained for Italpolina + FF treatment, while

the highest -carotene concentration was observed for DIX +FF treatment. Lower phytate impact on availability of examined mineral elements (mainly Mn), expressed through decreased P_{phy}/P_i, Phy/ -carotene and Phy/Mn was noticed at DIX + FF treatment, while the lowest Phy/Zn ratio was observed at Italpolina + FF. What is more important, availability of some elements could depend on yielding parameter, like 1000 grain weight. Negative interdependence between 1000 grain weight and Phy/Fe and Phy/Zn indicated better availability of Fe and Zn from bigger grains. That could be referred to DIX as treatment with the highest -carotene content and 1.000 grain weight.

Acknowledgments

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EFFECTS OF PLANT ESSENTIAL OILS IN REDUCING FUNGAL CONTAMINATON OF ORGANIC DRIED FIGS DURING STORAGE

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Abstract

As in many other fig growing countries, aflatoxin contamination due to fungal agents is an important problem in fig production in Turkey, which is the world's biggest dry fig exporter. Contamination of fungal agents starts when fruits are still on trees and continue to progress after harvest, especially under inappropriate processing as well as storage conditions. The aim of this study was to investigate the possibilities of using some natural essential oils in reducing the post-harvest (dried fig fruits) decays caused by microbial contamination. Sarilop dried fig fruits were dipped to solutions containing essential oils of laurel *(Laurus nobilis L)* and origanum *(Origanum onites L)* at different doses. Fruits were then stored in boxes indoor conditions during 3 months. Fruit sections (each 1 g) from outside of fruits were taken 2, 30, 60 and 90 days after treatments and given to petri dishes containing potato dextrose agar (PDA) with three replications. Petri dishes were then incubated at 25 ^{0}C for 5 days. They were then evaluated for the occurrence of molds. Results showed that essential oils showed limited efficacy which can be attributed to the low doses used in the study. Also low temperature during storage caused a natural decline in microbial population, so that the effects of treatments could have been masked. Further studies are needed with higher doses of essential oils under climatic conditions favoring the growth of microorganisms.

Key words: *dried figs, essential oils, Laurus nobilis L, Origanum onites L., storage*

Introduction

Fig (*Ficus carica*) is an important crop grown in many Mediterranean countries primarily in Turkey. The world's total dry fig production is about 95 000 tones, of which Turkey produce about 50-60 000 tones corresponding about 50-60%. About 90% of Turkey's dry fig production is exported. Since fig fruits have high water activity in both ripening stage (0.91-0.97 a_w) or drying stage before falling down from trees (0.80-0.89 a_w), it is an attractive crop for microorganisms that produce mycotoxins.
Aspergillus niger, *A. flavus*, *A. parasiticus*, *Fusarium* spp and *Penicillium* spp are dominant fungal flora of dried figs causing mycotoxins formation. Aflatoxin and okratoxin A are two most important mycotoxins in dried figs. One gram dry fig contains these microorganisms in numbers from several hundreds to one thousand (Frazier anda Westhoff, 1988). Unsuitable storing conditions with high humidity and temperature can stimulate the increase of these microorganisms.
Apart from other fruits, fig fruits dry on trees and fall down by themselves to ground. They are then collected from ground and further dried under sunshine naturally. After drying period they are classified to the qualities and stored under room conditions until processing. Before processing stored fruits are dipped to salty water to remove the soil particles or dusts (Özen et al., 2007).
Since molds decay fruit quality and consequently public health, investigations on the prevention of mold formation on fruits should be investigated. General aim of the methods applied for food preservation is to avoid or limit the microbial and enzymatic activities. Since

fungis causing mycotoxins can attack fruits in orchards as well as during storage, special attention should be taken before processing the fruits. Therefore it was aimed with this study to investigate the effects of natural essential oils of two different plants laurel *(Laurus nobilis L)* and origanum *(Origanum onites L.)* in reducing the post-harvest (dried fig fruits) decays caused by microbial contamination, hence to extend the storage duration without quality loss in organic dried fig production.

Material and Methods

The study was conducted between 2th October and 31th December 2012 in Fig Research Station in Aydin province of Turkey. Sarilop variety of dry fig fruits grown organic and essential oils of laurel (*Laurus nobilis* L.*)* and Origanum *(Origanum onites* L.*)* were used as material for this study.

Experiment was designed according to randomized plot design with three replications, each replication contained 5 kg dry fig fruits. Essential oils of investigated plant species were used at three different concentrations (100 µl/l, 200 µl/l, 400 µl/l). Each concentration of essential oils was dissolved in 10 ml ethanol and given to 10 l dipping water. Dry fig fruits (5 kg) were then dipped to the solution containing essential oils for 10 seconds, while control fruits were dipped only to water without essential oils. Fruits were then stored under room conditions 90 days long.

During storage, 2, 30, 60 and 90 days after treatments, fruit samples were taken from outer parts of 10 randomly chosen fruits (each 1 g). They were then homogenized by mixing in a magnet mixer for 5 minutes within 90 ml sterilized distilled water containing 0,1 % pepton. So, 10^{-1} dilution was obtained. Further dilutions (up to 10^{-5}) were obtained by adding 1 ml from each dilution level to 9 ml sterilized distilled water containing 0,1 % pepton.

After each dilution was finished, 1 ml sample was taken from each dilution level then given to petri dishes containing potato dextrose agar (PDA) with three replications. Petri dishes were then incubated at 25 ^{0}C and after 5 days they were evaluated for the occurrence of molds (cfu/g).

Data was subjected to ANOVA and means were compared by means of Duncan multiple comparison test.

Results and Discussion

The amount of mold contaminations after 2, 30, 60 and 90 days after treatments with essential oils in different doses and non-treated fruits are shown in Table 1. ANOVA results showed that the effects of treatments on mold occurrence were not significant 2 and 30 days after treatments. Although significant differences were observed 60 and 90 days after treatments, differences among treatments were very close to each other which can be attributed to the natural population decline, rather than the application of essential oils. However, it can be generally observed that origanum treatments resulted with less mold contamination, especially at the 90th day.

Results obtained from this study showed that treatments did not affect mold occurrence significantly at the doses investigated. This can be due to that the doses used in this study were not high enough to obtain more reliable results under semi controlled conditions. Results from in vitro studies showed however that origanum had significant fungicidal effects on molds even at 50 µl/l doses (Yegen et al., 1992; Yonucu, 1997; Lambert et al., 2001; Burt, 2004). In another study Holley and Patel (2005) reported that origanum inhibited aflatoxin production. Low and inhomogeneous mold infestation of fruits can be another reason for inconsistent results in this study.

In Table 1 it can also be seen that the mold amount has decreased naturally during storage and reached to a minimum level at 60th and 90th days at all treatments. Since fruits were stored under room conditions and the storage period (3 months) was between October and

December, this reduction can be closely associated with the reduction of room temperatures during that period. It is well known that cold storage is one of the most important preservation methods for stored foods, because microbial activities are limited under such cool conditions. Özen et al. (2007) stated also that for dry figs that should be cold stored to maintain the Quality.

Table 1. Mold amounts on Sarilop dry fig fruits as affected by different essential oil treatments at different doses (cfu/g)

Days after treatment	2	30	60	90
Treatment	Mold colonie number (X 10^3 cfu/g)			
Control	7,90	1,30	0,45 bc	0,35 b
Origanum 100 µl/l	9,80	1,40	0,50 abc	0,15 c
Origanum 200 µl/l	6,50	1,25	0,60 ab	0,30 bc
Origanum 400 µl/l	5,40	2,15	0,40 c	0,25 bc
Laurel 100 µl/l	5,20	1,90	0,45 bc	0,25 bc
Laurel 200 µl/l	7,65	2,05	0,45 bc	0,25 bc
Laurel 400 µl/l	7,15	1,05	0,65 a	0,55 a
Significance (ANOVA)	0,054	0,084	0,025	0,001

Conclusion

These results showed that essential oils showed limited efficacy which can be attributed to the low doses used in the study. Also reduced temperature during storage period caused a natural decline in microbial population, so that the effects of essential oil treatments couldn't have been observed. Therefore, further studies are needed with higher doses of essential oils under storage conditions favoring the growth of microorganisms, such as high temperature with fruits having higher mold populations. So the effects of plant essential oils on mold formation can be observed more clearly.

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BIOLOGICAL, ECOLOGICAL, SUSTAINABLE AND ORGANIC FARMING SYSTEMS ‑ COMPARISON, OPPORTUNITIES, CHALLANGES AND PROSPECTS

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Abstract

This paper provides a thorough picture of what Bulgarian producers are required to do to maintain compliance with different agroecological productive systems closing the soil-plant-animal cycle in a natural and integrated manner. Bulgarian farming activities in regards to sustainable agriculture and new farming systems have no a consistent policy. The country registered 1 054 organic farms (about 0.3 % of its total holdings) in 2011. There're counted during the same year about 17 295 ha of certified organic land and more than 9 328 ha under conversion, but the total organic area (converted and in-conversion) amounted to just 0.7 % of total utilized agricultural area (UAA) in this country. On 6 521 ha of organic land are cultivated cereals, followed by 3 257 ha dedicated to industrial crops. Bulgaria had in 2011 a 4 764 ha of organic pasture and meadows (excluding rough grazing), while organic wild crops are cultivated on a surface of 543 655 ha. In 2011, there're 6 443 ha with permanent crops and cultivated organic vegetables on an area of 670 ha in this country. In organic animal farming owned 58 855 beehives, 976 bovine, 6 648 sheep and 3 397 goat heads. The certified organic animal production is presented by 1 108 T organic honey, 118 T organic white brined cheese and 74 T organic yoghurt in 2011. The aims of this are 1./ to defined terms of biological (*BFS*), ecological (*EFS*), organic (*OFS*) and sustainable (*SFS*) farming systems, 2./ to be compared to each other and with conventional farming systems (*CFS*), 3./ to evaluate and draw opportunities and challanges, and 4./ to submit alternative options for eco-efficient livestock production systems based on agricultural renewable resources management in regards to biodiversity (intra- and interspecific diversity of pasture plants, feedstuffs, and animals).

Keywords: *Farming practices, productive systems, animals.*

Introduction

The European Union (EU) prepared the first steps to organic farming in 1991 and began reform of its Common Agricultural Policy (CAP) in 2005 (European Commission, 2003). Currently, the organic sector in the EU has been rapidly developing during the last years. According to Eurostat data, the EU_{27} had in 2011 a total area of 9.6 million ha cultivated as organic, up to 5.7 million ha in 2002 according to a recent report of the European Commission (www.ec.europa.eu). During the last decade, organic area in the EU improved by about 500 000 ha per year or 5.4 % of total UAA in Europe. Most of the organic farming area (78 %) and of organic farms (83 %) are situated in the EU_{15} (www.ec.europa.eu). The Bulgarian organic farming area (certified organic + in-conversion) amounted 25 022 ha in 2011 (MAF, 2014). So, the EU_{27} *UAA* amounted to an estimated 5.4 % of the *UAA* in 2011, but in Bulgaria only 0.7 % of its *UAA* was dedicated to organic farming (*see* fig. 1). The observation of the share of in-conversion area within the total area of the organic sector (in-conversion and certified organic areas) provides an indication of the growth potential of the sector for the next few years.
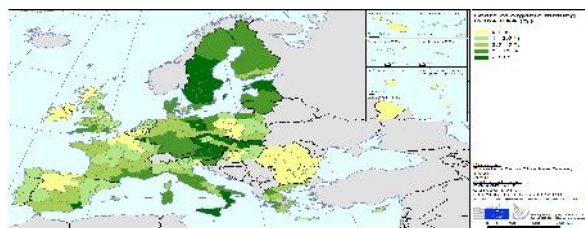
Figure 1. *Share of the organic area in total UAA (2010) at regional level* (Eurostat FSS data)

More than 270 050 organic operators, including 235 464 organic producers (87 %) were registered in the EU_{27} in 2011 as compared with 1 054 organic producers, processors and importers in Bulgaria (www.ec.europa.eu; MFA, 2014). The table below gives detailed view on the average number of organic producers (entering, registered and leaving) for 2007–2011 period.

Table 1. *Stability in the number of organic producers (average 2007-2011)*

	Registered	New	Withdrawn
Bulgaria	527.2	218.8	64.6

www.ec.europa.eu; MFA, 2014

In 2013 a total amount of 252 900 farms with total UAA of 3 708 330 ha or average 15.2 ha per farm (MAF, 2014). An animal farms number 183 300 (72 % of all) with UAA of 997 230 ha (27 % of all). At the same time, the number of agricultural holdings (as a sum of conventional and organic farms) and average surface (ha.holding^{-1}) are summarized in fig. 2. If for the EU_{27} about 48 % of total holdings have a size lower than 2 ha, only 6.2 % of organic farms are situated in this category.
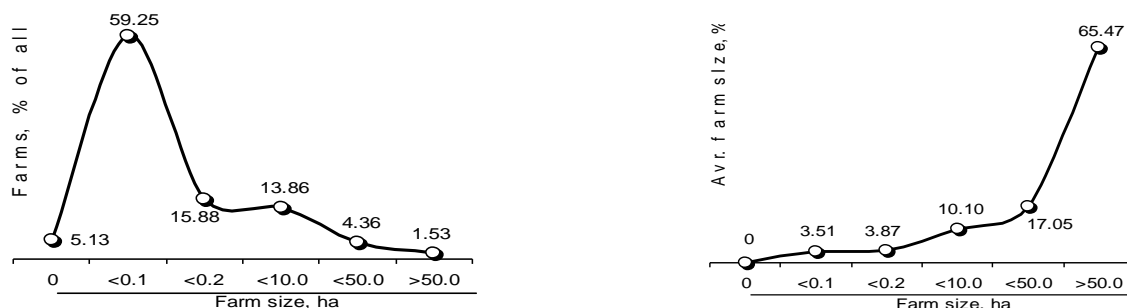

Figure 2. *Evolution of the area and number of holdings involved in Bulgarian organic sector*

Looking at the data about the level of the permanent pasture in the EU_{27} in 2011 represents the biggest part of the organic area (45 %), followed by cereals (15 %), permanent crops (13 %), etc. Conversely, cereals cover 31.8 % of the total UAA of the EU, but only 2.5 % of organic UAA. One element of explanation lies in the fact that organic production systems are more extensive than in conventional agriculture (higher reliance on grazing on permanent pastures). At the same time, permanent pastures are often eligible for agri-environmental organic payments and easier and less risky to convert to the organic sector than the other types of crops (e.g. arable crops). The breakdown and share of the main categories of organic area (ha) as per cent of the total (%) and total *UAA* (%) in 2011 at EU_{27} is presented in table 2. In regards to these data, the Bulgarian organic farming area (certified organic + in-conversion) indicated sustainable increment in 2011(3.8 %).

ble 2. Main categories of organic land in the EU_{27} (2011) [1]

	Organic land (ha)		% of total organic		% of TUAA per category	
	EU_{27}	BG	EU_{27}	BG	EU_{27}	BG
Total crops	9 613 500.0	25 022	100.0	100.0	0.49	5.4
Cereals	1 405 152.1	6 521	26.1	14.6	0.13	2.5
Dried leguminous	211 568.0	106	0.4	2.2	0.01	16.0
Industrial crops	183 804.0	3 257	13.0	1.9	0.06	1.4
Permanent grassland	4 317 285.0	4 764	19.0	44.9	0.09	7.5
Permanent crops	1 259 289.0	8 969	35.8	13.1	0.18	11.0

[1] *Eurostat data land use statistics (code: apro_cpp_luse);* TUAA-total UAA (conventional and organic).

This makes 12 % reducing of the Bulgarian total fallow lands in 2011. Looking at the area under organic farming in 2011 available data (*see* table 3) shows that organic areas cultivated with cereal crops (wheat, corn, barley, rye) represent 22 % more than 2010 (6 521 h). The share of industrial and oilseed crops registered increment. The organic sector amounts significantly decreased for fodders. Vegetable sector represents a minor part of the organic area,

ble 3. Breakdown and share of organic area per type of crop, 2011(MAF, 2014)

Organic areas, ha / Items	Certified	In-conversion	Total, % 2011/2010
Cereal crops	4 980	1 541	+ 22.1
Industrial crops	3 350	2 495	+ 19.0
including rose oil	*516*	*329*	NA
Vegetables	467	203	+ 56.5
Permanent crops	5 087	1 356	+ 11.2
Permanent grassland	1 519	2 972	+ 24.4
Fodders	771	225	– 380.1
including alfalfa	*649*	*73*	NA
Fallow land	1 057	456	– 11.8
TOTAL	17 295	9 328	+ 3.8
Wild crops	22 600	521 055	– 0.5

but it's under development in 2010/2011 (+ 56.5 %). At the Bulgarian level, the organic area of permanent crops amounts to 11 % enhance, i.e. 6 443 ha in 2011. So, the organic area of permanent pasture amounts 1.2 % of the total (organic and non-organic) area of permanent pasture. Statistics on the number of organic animals in the EU_{27} are presented in table 4. As shown,

Table 4. *Evolution of animals under organic production in the EU_{27} (2011)*

		Organic heads
Cattle		2 611 544
	including dairy	719 408
Sheep		3 957 496
Goat		480 139
Pig		855 535
Poultry		26 185 341
	including laying hen	12 746 588
		www.ec.europa.eu

the sheep and cattle production for the EU_{27} are the most important out of the total organic animal production. It make a strange impression that apart from sheep and goats, the ruminant sector (as a heads and per cent of total) would tend to develop faster than other livestock sectors at an equal parities of EU_{27} and national level (*see* table 5).

Table 5. *Heads and percentage of organic out of total animal heard (2011)*

	Organic heads		% organic out of total	
	BG	*EU_{27}*	*BG*	*EU_{27}*
Cattle	976	2 611 544	0.18	2.90
Small Ruminants	10 045	4 437 635	1.44	2.82
			www.ec.europa.eu; MFA, 2014	

So, the importance of the organic sector in relation with the whole ruminant sector is the highest as % organic out of total heads. The evolution of animals under organic production (as heads and per cent) in our country are summarized in table 6.

Table 6. *Number of certified animal heads in Bulgaria (2011)*

	Organic heads	*2011/2010, %*	% organic out of total
Cattle	976	+ 268.13	0.18
Sheep	6 648	− 0.75	0.49
Goat	3 397	+ 22.50	0.95
Bee	58 855	+ 26.76	9.60
			MFA, 2014

In 2011 there were 976 heads of certified organic cattle in Bulgaria, near trice higher 2010 (364). The largest organic producers are bee farms with a total number of 58 855 beehives and about 27 % annual increment. The higher number of organic animals resulted in higher amounts of organic animal production. So, the data about the certified organic animal production (as T and per cent of total) are presented in table 7.

ble 7. *Animal production by certified organic animal production (2011)*

Item	Organic production (T)	2011/2010 (%)	% organic out of total
White brined cheese	118	+ 22.0	0.33
Yoghurt	74	+ 162.2	0.16
Honey	1 108	+ 14.0	13.17
			MFA, 2014

Unfortunately, like their conventional counterparts, many organic growers find marketing to be the hardest part of farming management chain. While demand for organic products has greatly increased since the late 90^s, organic production has also increased. It's inevitable that the rapid rise in production will eventually reduce or even eliminate the premium prices that have attracted many new growers to certified organic production. So, the market research company *Organic Monitor* estimated the global market for organic products in 2011 at 83 billion €(up from 78 billion €) or more than 45 billion €with leading position of US market (21 billion €) (www.fibl.org). The organic market in Europe increased in 2011 (by 9 %) and it's now at 21.5 billion €– in the past years highest market shares were reached in Denmark, Austria, and Switzerland. The highest consumption of organic food (per capita) in 2011 was in Switzerland (177 €), followed by Denmark (162 €), Luxembourg (134 €), Austria (127 €), Sweden (94 €) and Germany (84 €). The obtained data for average consumption (27 €per capita) evaluate available 39 countries (Schaack et al., 2013). So, there exists challenge to emulation between social and envinronmental terms or system productivity and consumer desire for safety, nutritious, environmentally friendly functional foods (Pretty, 2008). So, current cropping systems proposed a kind of disturbance and disbalance stressed ecosystems as a result of poor managing nutrient cycles and energy flows. The input – output disharmony in cropping and livestock systems providing losses in organic matter and energy flows. Thus, using the agroecological paradigm, four essential system properties of agroecosystems have been determined: *productivity* (level of output); *stability* (constancy or persistence of output over time); *sustainability* (recovery from stress, disruptions); *equitability* (evenness of distribution among various groups). These properties are bounded by certain essential ecological laws or principles.

The interest in sustainable agriculture is driven by three main concerns: 1/. present agricultural practices are having a negative impact on environmental quality, and on resource availability and use; 2./ farming practices are contributing to a deterioration in human health; 3/. the economic situation for producers continues to decline. So, the negative environmental impacts of current conventional agricultural practices include: 1/. soil degradation; 2/. water depletion and contamination; 3/. inefficient energy use; 4/. loss of plant and animal genetic diversity; 5/. destruction of non-agricultural habitat, etc. Thereby, certain conventional products and practices are implicated in human health problems, including antibiotic resistance, nitrates in groundwater, pesticide exposure in an occupational setting, pesticide residues in foods, many food additives, and certain food processing techniques, such as removal of fibre from grains, addition of salt, refined sugar, and boiling in fat, oil or water. Although considerable scientific controversy remains, there's some evidence to suggest that conventional soil management practices are contributing to declining nutritional value in foods. So, new farming systems are perceived in many circles to provide decisions for most of these problems.

Biological (*BFS*), ecological (*EFS*), organic (*OFS*) and sustainable (*SFS*) farming systems are some kind of alternative management practices at industrialized conventional farming systems (*CFS*) and conventional input intensive production ecosystems thinking. There're

different manners to maintain productivity at most natural way and to mitigate agro-ecologo-economy risks in ecosystems. Each one of this systems has its own principles and operations, set of rules and guidelines.

Ecological farming system (*EFS*) cover soil, plant, animal, human and environment interact as an alternative to the prevailing annual monoculture input-driven *CFS*. It reducing external inputs and mitigate agro-ecologo-economy risks based on: 1/. usage of ecological processes; 2/. coverage of economic stability under the existing circumstances of population; 3/. greenhouse gas emmissions; 4/. water and soil instability, etc. environmental issues. Such kind of ecological system health is founded on reduced mechanical or chemical practices, substances cycling through endogenous inputs, balanced producer/consumer/reducer organism inter-relationships, trophic links and foodwebs in regards to biogenic cycle of sustances and ecosystem homeostasis (Darnhofer et al., 2010; Cabell and Oelofse, 2012).

in principles of *EFS* are: 1./ biodiversity maintaince; 2./ cultivate plants and animals adapted to local environment; 3./ wildlife habitat as biological pest controller and pollinator; 5./ soil biological activity, organic matter accumulation and protection; 6./ substances, materials and resources recycling practices; 7./ sustainable local nutrient and energy flows cycling; 8./ enhance productivity – water conservation, nitrogen (N) fixation, mineral cycling, soil organic matter formation, adaptable plants and animals; 9./ develop and adopt new technologies for eco–agro–socio–economic impact, etc.

Sustainable farming system (*SFS*) possess ability to continue a particular sustainable agriculture practices into the future to complex measures of biological and ecological function, social dynamics and its integrity. Therefore, its aimed to make the best use of environmental goods and services while not damaging these assets and minimizing the use of non-renewable inputs based on knowledge and skill and the capacity of people to work together (Pretty, 2008; Koohafkan et al., 2012; Malézieux, 2012). Thus, *SFS* are implemented in small farms which are self-sufficient by recycling all the farm's waste to meet its fertility needs. The *SFS* involves: 1/. design and management procedures that work with natural processes; 2/. conserve all resources; 3/. minimize waste and environmental damage; 4/. maintaining or improving farm profitability. Working with natural soil processes is of particular importance. So *SFS* are designed to take maximum advantage of existing soil nutrient and water cycles, energy flows, beneficial soil organisms, and natural pest controls. Some of the main directions as the aspects of *SFS* are: 1/. crop rotations; 2/. crop residues; 3/. animal manures; 4/. legumes; 5/. green manures; 6/. off-farm organic wastes; 7/. appropriate mechanical cultivation; 8/. minimal tillage to optimize soil biological and natural pest control activity; 9/. maintaince soil fertility and crop productivity; 10/. usage of resistant varieties; 11/. biological, biorational, and cultural controls of pests, weeds and diseases; 12/. preventative health care strategies; 13/. dietary changes at animal and human level.

Organic farming system (*OFS*) is based on: 1/. minimal use of off-farm; 2/. endogenous inputs oriented practices; 3/. biodiversity promoted; 4/. strict regulated and certificated by production standards in regards to restore; 5/. maintain and enhance environmental sustainability; 6/. provide ecological integrity and harmony. Overall, it's a type of holistic system designed to optimize the productivity and to diverse communities into an agroecological whole – soil organisms, plants, animals and people. Thus, the principal goal of organic production is to develop enterprises that are sustainable and harmonious with the environment (CGSB, 2006). This system use materials and practices that manage: 1/. natural plant fertilization; 2/. natural pest; 3/. soil biological activity; 4/. fertility and 5/. health. All these is collaborated through: 1/. crop rotation; 2/. green manures; 3/. forages in rotation; and 4/. manure or compost applications. The weeds are generally managed through cultural means such as high seeding rates or mechanical means such as tillage (Nelson et al., 2010). *OFS* have lower ecological impact and enhance the ecological balance (Bavec et al., 2012),

have increased energy efficiency (Hoeppner et al., 2006; Zentner et al., 2011) and enhance a number of soil and nutrient parameters such as organic matter, soil C and nutrient retention (Pimentel et al., 2005). *OFS* can't ensure that products are completely free of residues, but methods are used to minimize pollution from air, soil and water. Also, *OFS* is implemented in different sized farms able to meet the organic certification requirements.

Biological Farming Systems (*BFS*) is based on scientific principles and common sense that microbes are the basis of all agricultural production systems. It's a pursuit of agricultural practices that: 1/. create soil homeostasis at different level (nutrient, mineral, organic matter, organism balance); 2/. promotes organic soil carbon; 3/. increases healthy soil biota (earthworms, bacteria, fungi, etc.); and 4/. enhances micropores and humus-based substances to ensure better water holding capabilities and sustainably productive soils. *BFS* balanced producer/reducer organism interrelationships, trophic links and foodwebs in regards to sustainable microbial activity, recycle substances, carbon sequestration and capacity of organisms to work together. So, it turn back atmospheric carbon (CO_2) into soil through natural plant and soil conversions – photosynthesis, resynthesis, exudation and humification. Some of main directions as the aspects of *BFS* are soil and water quality, plant production and quality, animal health and economic viability. Healthy soil ecosystems, in regards to *BFS*, improved pasture production, provide the plants and animals with the necessary trace elements needed to develop healthy well balanced functional foods. And moreover, species found in healthy soil reducing system input (nutrients, energy, etc.). In regards to natural breakdown of organic matter and biogeochemical cycles, the picture below (**fig**. **3**) depicting the effect of soil management on soil fertility. So, by reducing tillage, soil isn't inverted and exposed into the air. Less carbon is lost to the atmosphere resulting in more soil organic carbon (**B**). This has an added benefit of carbon sequestration which can reduce green house gases (*GHGs*) and aid in reversing climate change.
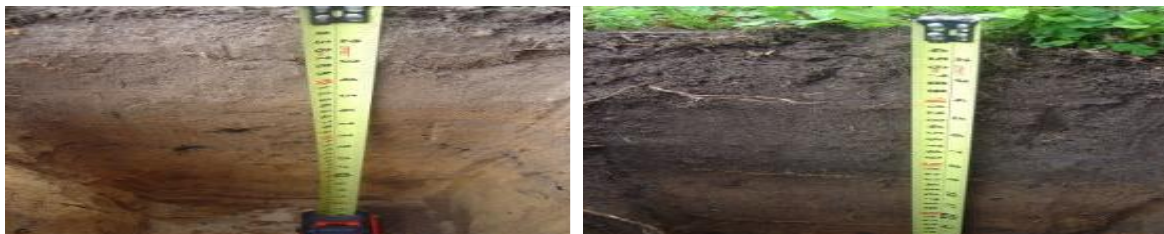

Figure 3. *Concentration of soil carbon (*www.sba.asn.au*)*

Some of the key characteristics of different farming systems are summarized in the table bellow (*see* table 8). Whereas the *OFS* is based on actual certification control in regards to strong and strict rules and norms (IFOAM, 2005), other systems are only a philosophy or way of life / thinking and mustn't be adjusted to some rules and norms. The ecological impact of different farming systems isn't envinronment–friendly in equal – *CFS* spread *N*, *P*, pesticide, etc. pollution. The same, water and food security are linked. So, water quality is worsen at *CFS*, followed by *OFS*, *BFS*, *SFS* and at least – *EFS*. Simultaneously, excepting *CFS*, water efficiency is being improved at all farming systems. In such manner energy flow efficiency passed and be negatively affected at *CFS* but in all balancing farming systems (*OFS*, *BFS*, *EFS*) efficiency increased up to 30 – 60 %. The *CFS* is having a significant and escalating impact on the biodiversity of world ecosystems, reducing both their resilience and biocapacity as a result of mass monoculture production. Also, loss of biodiversity as habitat loss and land fragmentation impact negatively biogeochemical cycles (N, C, etc.). Unlike, the organism genetic diversity is an important manner at sustainable ecosystems, so sustainable-friendling productive systems maintained rare crop cultivars and animal breeds. Although genetically modified organisms (*GMO*) are excluded from *OFS*, *SFS*, *EFS* and *BFS*,

throughout *CFS* is available *GMO* pollen contamination. Animal welfare as a well-being of animals presume *OFS* to maintain "access" to outdoors and *BFS* to maintain a natural behaviors of animal species. At *CFS* a large number of animals are reared in confinement at high stocking densities producing abnormal behaviors (European Union Council Directive 1999/74/EC). Also, another major concern for the welfare of farm animals is the ritual of slaughter – to be designed in such manner to decrease suffering of animals. The discussion about farm size is available. There's no limits for *OFS* and it can be involved large corporations as distinguished from the sustainable systems which are smaller, as a family farming model. The application and contamination with different unnatural substances is a big environmental problem. Some of the importest aspects are: 1/. in many countries, the intensive *CFS* don't excluding the practices of antibiotic and artificial hormone use in livestock feed to promote faster growth contributing food contamination and increasing the risk of the public health (Ferber, 2002; Mathew et al., 2007). In *OFS* no antibiotics and hormones can be used, nor are they fed for sustainable farming; 2/. Application of pesticides in *CFS* and runnoff effects leaves residues with toxicological significance. The *OFS*, *BFS* and *EFS* not applied such chemicals but their products can contain amounts (significantly minimize exposure) as a persistent environmental contaminants; 3/. whereas *CFS* applied chemical fertilizers providing nitrogen, phosphorus, potassium, etc., the biofertilization by green (with cover crops) and animal manure is applied in *OFS*, *SFS*, *BFS*, *EFS*. In regards to food quality and safety, *CFS* decreased nutritional value of food products, either way *OFS*, *SFS*, *BFS*, *EFS* products are more nutritious, healthy and uncontaminated. As overall, based on listed key characteristics of different farming systems we can concluded that *CFS* is short term oriented system, while *OFS*, *BFS*, *EFS* are with long term oriented perspectives.

Table 8. *Comparison between different farming systems*

	CFS	**OFS**	**SFS**	**BFS**	**EFS**
			F A R M I N G S Y S T E M S		
Certification	– – –	+ + +	+ / + +	+ / + +	+ / + +
Input/ output balance	– – – / – –	+ / + +	+/ + +	+ / + +	+ + / + + +
Environmental impact	– – –	+ / + +	+ / + + +	+ / + + +	+ + / + + +
Water quality	– – –	+	+ / + + +	+ / + + +	+ + / + + +
Energy flow efficiency	– – –	+ / + +	+ + +	+ / + +	+ +
Organism genetic diversity	– – –	+ / + +	+ + +	+ + +	+ +
Animal Welfare	– / +	– / +	+ + +	+ +	+ / + +
Inputs — Antibiotics	– – –	+ + +	+ / + +	+ +	– / +
Inputs — Hormones	– – –	+ + +	+ / + +	+ +	– / +
Inputs — Pesticides	– – –	+ + +	+ / + +	+ + / + + +	+ / + +
Inputs — Fertilizers	– – –	– / +	+ / + + +	+ / + + +	+ / + + +
Production size	– – –	– / +	+ + +	+ / + +	+/++
Foods quality	– – –	+ / + +	+ / + + +	+ +	+ +
Human health	– – –	+ + +	+ / + + +	+ / + + +	+ / + + +
Price rate	+ + +	– / – – –	– / – – –	– / – – –	– / – – –
Handle	+ + +	– / – – –	– / – – –	– / – – –	– / – – –
Marketing monopol	+ / –	– / – – –	– / – – –	– /– – –	– / – – –
Distribution/Transport	+ + +	– / +	– / – – –	– / – – –	– / – – –
inputs/costs	+ + +	– / – –	– / – – –	– / – – –	– / – – –
Net farm income	+	+ + / + + +	+ + / + + +	+ + / + + +	+ + / + + +

FS-farming systems, *BFS*-biological FS, *EFS*-ecological FS, *OFS*-organic FS, *SFS*-sustainable FS.
[+++] strong possitive; [++] expressive possitive; [+] labile possitive; [+/–] jumpy changeable; [–] labile negative; [– –] expressive negative; [– – –] strong negative.

Conclusion

In regards to EU Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan agriculture must be more oriented about series of proposals on sustainable consumption and prouction to target EU goals for environmental sustainability, economic growth and being welfare. The life cycle of such kind of sustainable products provided a lot of environmental, social, economic, etc. profits with continuous improvements. Moreover, the modernity of this policy offers different subsidies and grands. So, Bulgarian producers are required to do to maintain compliance with different agroecological productive systems closing the soil-plant-animal cycle in a natural and integrated manner. The lack of farming activities in regards to sustainable agriculture and new farming systems with a consistent policy must be took an action on the decision adopted. In regards to definitions of biological (*BFS*), ecological (*EFS*), organic (*OFS*) and sustainable (*SFS*) farming systems producers must to submit altermative options for eco-efficient crop and livestock production systems based on agricultural renewable resources management in regards to biodiversity (intra- and interspecific diversity of pasture plants, feedstuffs, and animals) as an competative choice of their future development.

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4. ENVIRONMENT PROTECTION AND NATURAL RESOURCES MANAGEMENT

ENVIRONMENTAL ASSESSMENT OF WATER EROSION IN BOVILLA CATCHMENT BASIN AND ITS IMPACTS ON WATER POLLUTION

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Abstract

Watershed basin of water Bovilla was created by surface watercourses and catchment basin groundwater of the Bovilla area. Water collected in the water basin constitutes the main reserve source of drinking water for the city of Tirana. A portion of it is planned as well to be used for irrigation of plants cultivated in this area. Catchment basin is part of the administrative geographical unit of the Tirana district. Topographic relief is relatively steep slope over 15%. The soils of the basin are used and continue to be used for the growth and expansion of forests, pastures, little agricultural plants and partly cultivated land without vegetation. Water erosion of soil in this basin is very visible and reaches very high values. The effects of erosion are visible not only in the loss of land but also in water pollution of the watershed basin. Factors that cause erosion are geological construction of the soil, climate, landscape rake, lack of vegetation cover and land composition. Solids and organic matter transported through surface and ground water are the main causes of reduced volume of water in the basin and both are the main pollution factor for the water and the environment. This study helps in recognizing the negative role of the soil erosion by water, its effects on land, water and environment around. At the same time we have studied and proposed measures to improve the situation and "making healthier" environment in the basin and catchment basins of Bovilla.

Keywords: Soil erosion, erodibility, erosivity

Introduction

Soil erosion is a natural phenomenon and a result of trends and tendencies of the different forces of the nature that causes distortions in the earth crust. Consequences of soil erosion are depending on its topographical characteristics, soil, climate, hydrographic network and land cover. Human activity is another determining factor that influence in the accelerating, minimizing or eliminating of the effects and consequences of the erosion.

Viewed in the geological timeframe, erosion constitutes the starting point of the creation of soils with a variety of land types and subtypes, setting in the same time the natural balances between eroded soil and new created one. On the other hand, climatic, biological and soil factors are giving their effects and transform the normal course of erosion development.

In this paper are presented not only theoretical aspects of water erosion but also are provided techniques and methodologies of assessment of actual and potential erosion risk. In the end, are given some measurements for preventing and minimizing soil erosion.

In the basin of Bovilla, soil erosion in the catchments, presents a potential and actual risk not only to soil loss but also in terms of transportation and deposition in the expense and surrounding environment and other elements of physical and chemical pollutants.

We have reflected the techniques and methodology for assessing potential and actual soil erosion according to CORINE method used by Food and Agriculture Organization (FAO). The results of scientific research conducted in areas close to water basins are obtained from

the study CLC - 2006 (Corin Land Cover) carried out in cooperation with the European Environment Agency.

Assessment of erosion in Basin of Bovilla is based on soil erodibility, erosivity, relieve and land cover. Syntheses elements to calculate erodibility are: soil texture, soil depth and content of stone. For erosivity the calculating elements are Fourner and Gaussen index while for the relieve those are slope angle. Finally, are given the measurements for erosion prevention and obstruction of solid materials carried out through water streams and small rivers.

Material and methods

Real and potential risk assessment caused by surface erosion water in the watershed of Bovilla basin is based on the land erosion, landscape and plant cover. To calculate the erosive elements, are considered soil texture, depth of soil profile and content of rocks in the soil layer. Erosion is evaluated through indexes and Gaussen Fourner. For relief it is estimated the slope angle of the terrain and the type of vegetation cover plant.

Methodology used to assess the actual and potential risk from soil erosion is based on the known system CORINE. This method is widely used by FAO in many Mediterranean countries (Giordano et al., 1992). Previously in our country this methodology is used in an area of Lezha and then to the watershed of coastal area in the south-western part of Albania**.** (Kovaçi and Dedaj, 2008)

To estimate actual and potential erosion risk in the CORINE model, the required database parameters are soil erodibility, erosivity, topography (slope), and land cover. Every index is the product of synthesis of elements for each factor separately. (Giordano, 1987).

Erosivity is calculated by combining two climatic indexes including the Fournier index and Bagnouls - Gaussen aridity index (BGI).

The slope data layer is generated in GIS environment from topographic maps and digital terrain models. In this study, the digital topographic maps with the scale of 1:25000 were used to generate a Digital Elevation Model (DEM) of the study area. To the land cover the data of Corine Land Cover Albania, 2006 are used.

The geostatistical analysis was performed using ArcGIS (v. 8.3.) and the extensions of Geostatistical and Spatial Analyst. Application and analyses of factors is done through Geographical Information System (GIS) refering to soil type data and its composing elements, climate, topography and land cover.

Results and discussion

General evaluations of the territory where the study was conducted.

Bovilla watershed has a water surface area of 456 ha, length of line around 33750 ml of water and it is located right in the bottom of the catchment basin, up to quote 319 m (with a maximum depth of 60 m).

Water capacity is 80 million m^3. The water source is rainfall streams through surface water and groundwater.

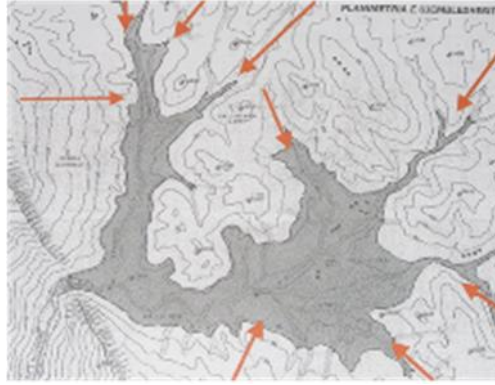Albania in Europe

Bovilla watershed

Fig No. 1 - Bovilla watershed Map

Watershed was initially planned for containing 12 million m^3 of water for agriculture, then ideas led to the creation of this basin with a capacity of 80 million m^3 of water, changing the original intention to the needs of city residents Tirana.

Volume of drinking water taken from the reservoir and used for Tirana is about 55 million m^3 of water per year. The remaining 30 million m^3 serves for irrigation.

Symmetric shapes, almost circular catchment basin on the receiving section creates powerful full bow organized in short periods, from 8 to 10 hours. Pure beauty of the landscape of the watershed basin Bovilla, located just a few kilometers from the old city of Kruja and the capital of Albania, and the ability to influence the microclimate of the area makes it attractive for foreign tourists.

Watershed is realized through the construction of the dam that interrupts the flow of river Terkuze, at the point where it enters the mountain chain of the Kruja - Dajt, 15 km north east of the city of Tirana.

Geological framework of the catchment basin.

Bovilla catchment basin within which is built Bovilla reservoir, lies in an area of 9800 ha. Maximum capacity is 80 million m^3 aquifers and processing capability of 105 million m^3 of water per year.

Basin catchment basin and watershed lie in the complex that belongs to the geological flishoid - paleogenic in whose composition are virtually impervious surfaces.

Spots cited above are located on the east side of the anticlinare structure Kruja - Dajt, in the carbonate series contained between the Upper Cretaceous and Paleocene. Shkupi, D., Alia, Sh., Muco, B., Lleshi, B., Mylius, G., and Toloczyki, M. 2000. ("*Harta e rrezikut gjeologjik të Shqipërisë*").

The entire water basin is characterized by carbonate rocks of the upper Cretaceous (Cr 20) and lower and middle Paleocene Pg1-2. *(Harta Hidrologjike e Shqiperise 1:200 000. 1984.)*
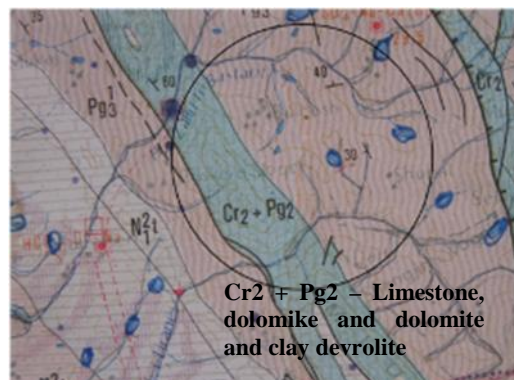

Fig No. 2 Hydrological Map of the Bovilla

Land formations are represented by the exchange of microcrystalline organogenic limestone Dolomites which underlie the entire basin.

Groundwater circulation is carried out through the soil deep cracks as a result of stratification and carstic extensions. The average value of the filtration coefficient of carbonate formation is 42 to 39 units Lugeon.

Morphological characteristics, pedo-climatic, hydrographic and biodiversity

Catchment basin and Bovilla reservoir lies in a field of steep and very steep and often with large land deformations. The slope of the terrain ranges from 8% slope in the sand near the Old Stone, up 40% slope to the Bruzi river source. The soils are different from the composition and belong granulometric types: Gleit (clay), Clay - Loam (clay) and Silt (floodplain). Zdruli. P et al Soil Region. Soils map of Albania INTEREG II.

Clay, sand, and conglomerates represented by type (Neogene), limestone Dolomitizuar (Cretaceo superior), calcareous marl (Triassic to Palaeogene Inf.e medio of up to flysch clay - sandstone (Triassic to Palaeogene superior). *(Gjoka, F., and Cara, K. 2003. Broshure "Tokat e Shqipërisë)*
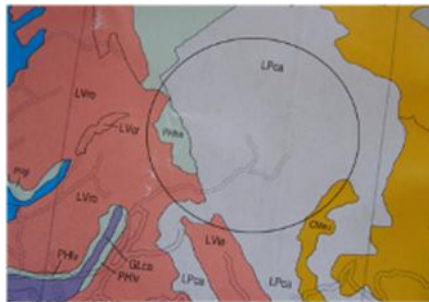

Fig No. 3 Pedological maps of the Bovilla river basin.
LPca – Calcarit Leptosol

The climate in the catchment basin Bovilla is characterized by Mediterranean - Hilly – Central climate zone indicators. Average annual temperatures range from 11° C to 13° C, while the average rainfall perennial range from 1500 mm to 2000 mm/year

Data shows that the average annual rainfall ranges from 1500 mm to 2000 mm of which 600 to 700 mm falling during the period from April to September. Absolute maximum in 24 hours it is reached in 06/18/1964 and 12/30/1962 respectively 155 mm and 170 mm. Average number of rainfall days with above 10 mm is 45 to 65 days, while the number of days with snow layer is 20 to 40 days a year. The average annual temperature is 10° to 14° C *(Instituti i Hidrometerologjisë 1981. "Atlasi Klimatik i Shqiperise").*

Hydro technical characteristics of the Bovilla catchment basin are: catchment basin has 33 small streams which carry constantly about 3.3 m^3/sec of water, with a maximum capacity of up to 105 million m^3, while the maximum plots provided with frequency 1 in 1000 years, the first in 100 years 1 to 10 years, range from 3 to 11 million m^3 of water. Plant terrestrial coverage is different, with great variety of vegetation growing tendencies. The vegetation of the "floor" of medium and high, represented by oak, shrubs, and rarely mixed forest of beech trees, pine and acacia. Herbaceous vegetation or the lowest "floor", is represented by plants which and legumes. In 3 to 5 % of the territory of the plant cover is missing. *(Dhima, S., Grazhdani. S., Kovaci, V., Gjoka, L., and Laze. P. 1998. "Vlerësimi i faktorit të menaxhimit bimor C në kushtet klimatike dhe tokësore të zonës Jug - Lindore të Shqiperisë" BBSH.Nr 2).*

Human activity

Human activity is diverse. The low zone has a very intensive human activity especially in agriculture. While, high zone has a limited agriculture and livestock as a result of the economical and social changes as well as migration on the other parts of Albania.

In both low and high zones, land fragmentation has reduced significantly effectivity of use of mechanics in agriculture. As a result, normal agriculture works are mainly soil digging, drainage and irrigation system. An important activity remains mountain tourism which despite its weakness is extended along all the area.

Depending on the development process of relieve-formation and intensity of erosion, the area for which we are talking about is part of the youth cycle (early stage), that dominates the severe erosion The form how erosion is shown, the consequences and problems that arise are different and have environmental, social and economic character. Through assessment of the erosion risk of the catchment basin of Bovilla is determined the action to minimize it. Determination of measures for the protection and preservation of soil can contribute to the prevention of physical, physico-chemical and chemical pollution of it and water in the lake basin, improving the environment, increase sustainable agricultural production, capacity of livestock and tourism in this area.

Fig No. 5 Images of good management and bad land in water basins(Kerrabe, Tirane)

Analyses of Soil, Reliefs, Climate and Vegetation Indicators.

For the completion of the research it took to pass in several phases: The first phase monitoring were composed by identification of indicators of soil, hydrography, climate indicators, and land cover of the watershed basin. The second phase - determine the causes and forms of erosion as the main factor that causes water pollution in the Bovilla watershed basin. Third phase – Collecting data for risk assessment *(Giordano, A., Bonfils, P., Karmoss, I., Roquero, C., Sequeira, E., and Yassoglou N. 1992. Published by the Commission of the European Communities. "CORINE soil erosion risk and important land resources in the southern regions of the European Community"p.7-92)*

Fourth-stage - draft measurement of their biological nature, engineering and agronomic and prioritizing them.

To monitor the Bovilla catchment basin area with a relatively large surface and apparent variability, were defined five micro basins as catchment features, relatively different from each other. For the definitions of these micro basins we used the 1:250 000 topographic maps, pedological indicators of the current state of climate and land cover. Through the first phase were identified and materialized indicators necessary to provide with data the software of the assessment of soil erosion caused by water.

In the second phase, we were focused to the surface erosion, depth erosion, erosion on both sides and the depth of streams, erosion in the form of landslides and erosion caused by frost during the winter period. We took into account the results of the measurements obtained from

direct observation in the field, and the conclusions drawn from the surfaces experimented following the methodology of the universal equation of soil loss (8).

The third phase was the most. Soils indicators are syntheses of the class assessment and the sensitivity that they have to erosion. Soil texture with three classes is named based on fraction content with different measurements (< 0.002mm up to 2.0 mm). Soil depth with three classes is named depend on the soil pit depth (< 25cm, 25 – 75cm and > 75 cm). Percentile content of surface stones with two class is based on percentile of stones in soils (>10% and   10 %). Assessment of soil erodiblity index is product of textural classes with soil depth and content of stones. Climate indicators taken in consideration are precipitation and temperatures and identified with erosivity. Erosivity is product of assessment to Fournier and Bognous-Gaussen indexes or variability index class and aridity classes. (9) Dependence of the value of product of Erozivity indexes is classified in steeps.(10) A topographic indicator is identified with slope index with four steeps which identified slope angle and length of slope. Assessment of potential erosion risk is the product of soil erodibility index with erosivity indexes. The actual risk depends on land cover and soil erosion risk depends on the land cove and their indexes. In fourth phase, we have proposed the measures to prevent and minimize erosion and water pollution in the Bovilla watershed basin. Measures depending on the effect that may have been labeled: infrastructure measures, biological and agronomic measures.

Infrastructure preventive measures, depending on the effectiveness of the construction and construction techniques are: embankment expected to be prevent the movement and transport of soil, builded with simple wooden tools (fences). Fig Nr 6 and 7 of simple embankment builded with stone material with or without mortar.
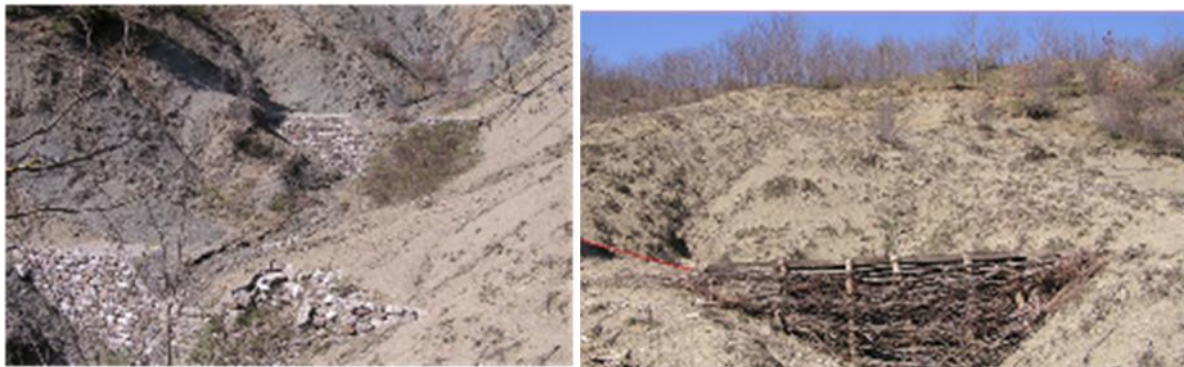

Fig.No.Fig.6 &7

Fig No. 8 Embankment built with concrete

Preventive measures of biological character, consist mainly of implantation of forest trees, shrubs and pastures. Fig 9 and 10 for building overlooking the generation of various protective vegetation.

Fig. No.9 & 10 Protection of water basins

Safeguards of agronomic character are not only highly effective in protecting the land but also they minimize and prevent chemical and physical contamination of surface water, groundwater and water basins. Safeguards of agronomic character most of the time are quite effective. How we manage land, work with it, is very important. However the application of chemicals in agriculture should be evaluated and treated with great caution, especially in the vicinity of streams and lands with high water permeability. However the administration and processing of organic fertilizers, human and animal excrement in the community, has a great importance, especially in those villages where houses are close to watercourses. Handling and processing should be done according to the rules and methodologies provided by competent institutions.

Conclusions

Determination of soil indicators, climate, landscape and vegetation in the catchment basin of Bovilla, are the result of scientific research work and study done in years, from the researcher of our scientific institutions. Application of this methodology, which is certified by many of the Mediterranean and European countries, showed that studied area has high potential and increased erosion risk.

The result indicates that:

Soils with low potential erosion risk occupied about 10%

Soils with moderate potential erosion risk occupied about 15%

Soils with high potential erosion risk occupied about 75%

and

Soils with low actual erosion risk occupied about 12%

Soils with moderate actual erosion risk occupied about 83% and

Soils with high actual erosion risk occupied about 5%

The difference, between the areas of potential and actual erosion risk, indicates the effects of land cover on soil erosion. These areas classified as high erosion risk in the potential erosion risk map were reduced from 75% to 5% in actual soil erosion risk map, after overlapping the vegetation layer. This proved that the areas subject to high erosion risk are mostly covered by forest vegetation. Among the protective measures of soil from water erosion are important primary biological measures, second-order measures hydrotecnic and the third building measures.

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ECOCLIMATIC CHARACTERISTICS OF BANJA LUKA (BOSNIA AND HERZEGOVINA) FOR THE PERIOD 1961-2009

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Abstract

Today, the conditions of the weather affect lives and health of people increasingly, hence, over the last few decades the ecoclimatic research all over the world has come into focus. However, in our region the lack of research in the field of ecoclimatology is evident. Ecoclimatology studies various relations between organisms and the perennial condition of the atmosphere, as well as the permanent connection and multiple interaction in which dominates the influence of the physical environment as opposed to a human's provoked reaction. This is why the introduction of the complex climatic connections seems practical, in order to determine the ecoclimatic influence and establish existing ecotypes. In accordance with this, the ecoclimatic research of this paper is based on equivalent temperature (air temperature and vapor pressure), physiological humidity and physiological humidity deficit (vapor pressure and maximum vapor pressure) and sultriness (temperature and relative air humidity), which have been explored on Banja Luka (Entity of Republic of Srpska, Bosnia and Herzegovina) city territory from 1961 to 2009. So far, the ecoclimatic research in this region have been scarce, also the necessity of a serious approach and the need for such research as well as the methodological structure has made this effort more complex. The research brings forth an indicator which gives a certain ecoclimatic picture of the region, which is undisputable, and also presents problems which should encourage others to do such research.

Key words: *ecoclimatology, equivalent temperature, Banja Luka*

Introduction

Climate is a set of weather phenomena and processes in the atmosphere, which are characterized by moderate physical state of the atmosphere (Duki , 1998). Moderate physical state of the atmosphere is obtained from data collected by many years of observation of meteorological elements and meteorological phenomena that should be gathered together and statistically processed. In this way is obtained a series of median years of meteorological elements, and also variations, medium, as well as extreme, of certain elements of the obtained average values (Radi evi , 1998). Creation of climate at some place or area happens under the joint influence of solar radiation, atmospheric circulation and surface conditions. Because the climate is a result of long-term climate effects of the aforementioned factors, it has the character of certain stability. Based on the climatic characteristics the regionalization of life on the Earth's surface is created (ukanovi , 1972). Ecoclimatology is the relationship between the climate and environmental effects, in particular the impact of climate on humans, and represents a separate branch of climatology. Ecoclimatology research in recent times has been extremely actualized, thanks to the technological development that performs a negative impact on the climate. Human adaptation to climate conditions of the environment in which he lives, may be faster or slower, and it depends on several circumstances: the natural adaptation of the organism, physical and mental and health status, age, activity, genetic adaptation et al. Therefore, the criteria for defining the most favorable ecoclimatic conditions

and climate comfort are different. The biggest practical application of ecoclimatic research is in health care and tourism (Trbi , 2010).

The research addressed several ecoclimatic elements for geospace of the city of Banja Luka, on the basis of which can be provided quantitative and qualitative rating of ecoclimatic characteristics. Ecoclimatic research was based on the analysis of physiological humidity and physiological deficit of humidity (water vapor pressure and the maximum pressure of water vapor), the equivalent temperature (air temperature and water vapor pressure) and stuffiness (temperature and relative air humidity) for the period 1961-2009.

Materials and methods

The data used in this study were obtained from the Hydrometeorological Service of the Republic of Srpska (RS). Data for air temperature, average annual and monthly temperature, absolute maximum and absolute minimum temperature, humidity, relative humidity, vapor pressure, precipitation, average monthly and annual precipitation and maximum daily precipitation amounts were taken from the hydro-meteorological station of Banja Luka city.

The methods by which we obtained the results are related to the formula. Equivalent temperatures are determined by the formula of Becold which is acceptable for our requirements:

$Et = T + 2e$

t - average monthly temperature

E - actual vapor pressure

Analysis of equivalent temperatures is done based on Krüger's classification of physiological feelings of heat and weather types tab. 1.

Tabela 1: Krüger's classification of physiological feelings of heat and weather types

Et (°C)	<5	5-18	18-22	22-30	30-40	40-50	50-58	58-70	>70
Philological feeling of heat	very cold	cold	very chilly	fresh	pleas ant	war m	little sultry	sultry	very sultry
Weather types	**cold**			**pleasant**			**overheated**		

According to the statement of Ramzin calculation for physiological humidity (ef) and physiological moisture deficit has been done:

e
Ef = ------- x 100% = Df E36,5-e
E36,5

EF physiological humidity

E actual vapor pressure

E36,5 - maximum pressure of water vapor at high body temperature

the body (mmHg)

DF- physiological moisture deficit

Based on Charles' method, which is based on temperature and relative humidity, it was found whether in Banja Luka, in the average for the period from the year 1961 to 2009, appears stuffiness, and in which months the occurrence of stuffiness is possible.

Results and disscusion

Banja Luka is located in the northwestern part of the RS. It is located at 44° 57' north latitude and 17° 11' east longitude, at an altitude of 163 m. Maximum distance from end, north and south points of the territory of the city is 55 km, and the western and eastern points is 40 km (Marjanac, 1994).

The city is located in the valley of the Vrbas River in the tectonic bay in the direction northeast-southwest. More specifically, as the territory of Banja Luka has a rectangular shape in the direction north-south, the eastern part of the city belongs to the catchment area of the river Vrbas, western, smaller part of the city belongs to the basin of the river Gomjenica. Vrbas River at a distance of about 50 km north of Banja Luka flows into the river of Sava (Trbi , 2005).

Banja Luka is located halfway between the equator and the North Pole in the strip of moderately warm climate. The spacious basin is 202 km far from the Adriatic Sea, from the Atlantic 1 650 km, and therefore its climate is exposed to more continental climate impacts of the Northern and Eastern Europe. This is corroborated by the characteristics of the relief, i.e. openness to the plains in the north and east. Climate of Banja Luka is temperate continental with the influences of the Pannonian belt (LEAP, 2009).

Equivalent temperatures

Using the connection between air temperature and actual water vapor pressure we have selected weather types and physiological feelings of heat (equivalent temperature) for geospace of Banja Luka.

Table 2. Ecoclimatic characteristics of Banja Luka, 1961-2009

Ecoclimatic element	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	sr.god.
x	-0.2	1.9	6.4	10.9	15.9	19.4	21.0	20.5	16.1	11.1	6.1	1.2	10.9
U	84	79	73	70	71	72	71	73	79	82	83	85	77
e	3.9	4.4	5.3	6.9	9.6	12.1	12.9	12.8	10.7	8.1	6.1	4.5	8.1
Et	7.6	10.7	17	24.7	35.1	43.6	46.8	46.1	37.5	27.3	18.3	10.2	27.1

Legend: Tx- median air temperature (oC)
U - relative humidity (%)
e - actual voltage e of water vapor (mm Hg)
Er - equivalent air temperature (oC)

Cold weather type (5°C<Et<22°C) present in the period November-March. Physiological feeleing of warmth cold (Et = 5-18° C) dominates in four months (December, January, February and March). Class very cool (Et = 18-22° C) is present in November. During the winter period, the average class very cold is not present, but it still occurs in periods of extremely low temperatures.

Pleasant weather type (22°C<Et<50) characterizes summer and much of the spring and fall, the period from April to November. It is a period of predominantly anticyclonic activity and extremely favorable bioclimatic characteristics. Class of fresh (Et = 22-30°C) is present in April and October. Class pleasant (Et = 30-40°C) is present in May and September, while the class warm (Et = 40-50°C) is present during the summer, ie. from June to August.

From the standpoint of equivalent temperatures Banja Luka during the summer period, on average does not have overheated weather type, i.e. there is no unbearable heat, so-called sultriness. However, the possibility of occurrence of stuffiness, i.e. sultriness is still present during the summer months, and a more complex evaluation will be given after ecoclymatic analysis according to Charles' method.

Physiological humidity and physiological humidity deficit

Table 3. Average physiological humidity (ef) and physiological humidity deficit (Df) of Banja Luka, 1961-2009

Parameter	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	P.A.
e_f	8,6	9,7	11,6	15,2	21,1	26,6	28,4	28,1	23,5	17,8	13,4	9,9	**17,8**
D_f	41,6	41,1	40,2	38,6	35,9	33,4	32,6	32,7	34,8	37,4	39,4	41,0	**37,4**

Based on Table 3. it is evident that the physiological humidity and physiological humidity deficit have an opposite and symmetrical annual disposition. Physiological humidity increases during the transitive period from colder to warmer months in the year, and decreases during the period from warmer to colder months, whereas the annual trend is similar to air temperature. Physiological humidity deficit has an opposite annual mode, and the trend is similar to a relative air humidity. The biggest loss of humidity from a human organism is, on average, in July, while the least humidity is lost in January. Based on the obtained data, it is evident that, on average, the loss of humidity is less in spring 38,2 mm Hg, as opposed to autumn 37,2 mm Hg, while during the vegetation period the loss of humidity is on average 34,7 mmHg.

Stuffiness

Based on Šarl's method, which rests on temperature and relative air humidity, it is determined if in Banja Luka, on the average scale for the period of 1961-2009, appears stuffiness and during which months is possible for stuffness to appear.

Table 4. Standard values of air temperature (°C) and relative air humidity (%) for determination of stuffiness according to Scharlou

t°C	16.50	18.60	20.06	22.23	24.79	27.88	31.76
U %	100.00	90.00	80.00	70.00	60.00	50.00	40.00

The data for the stuffiness limit, which separates the comfort zone from the stuffiness zone, is gained based upon the standard valued, and the data for temperature and relative air humidity for Banjaluka, is gained through data processing. There is an average level of air humidity in the comfort zone, i.e. it does not intersects of overlaps with the stuffiness limit. However, such an estimate can be given only for the perennial average 1961-2009. If a more detailed analysis was conducted for particular years, months or even days it could be determined that the stuffiness days, nevertheless, appear during the summer months, such as July and August. As an example, the July 2005 can be stated, when the average monthly temperature was 22°C, and the average monthly relative humidity was 74%. Based on these data, it is concluded that

July of 2005 was sultry. Furthermore, according to equivalent temperature, July of 2005 was, on average, „a bit sultry".

Conclusion

Today, the conditions of the weather affect lives and health of people increasingly, hence, over the last few decades the ecoclimatic research all over the world has come into focus. However, in our region the lack of research in the field of ecoclimatology is evident.

Based on the previous analysis, it has been determined that Banja Luka has, on average, favorable ecoclimatic characteristics. The cold weather type (5°C<Et<22°C) is present from November to March. Physiological feeling of warmth cold (Et=5-18° C) dominates over four months (December, January, February and March). The class very chilly (Et=18-22° C) is present in November. During the winter period, on average, the class of very cold is not present, however, it still appears with periods of extremely low temperature. Pleasant weather type (22°C<Et<50°) is characteristic for summer and most part of spring and autumn, i.e. the period from April to November. That is the period of mostly anticiclonic activity, but also extremely favourable bioclimatic characteristics. The class fresh (Et=22-30°C) is present in April and October. The class pleasant (Et=30-40°C) is present in May and September, whereas the class warm (Et=40-50°C) is present during the summer, i.e. from Jun to August. From the standpoint of equivalent temperatures Banja Luka during the summer period, on average does not have overheated period, i.e. there is no unbearable heat, so called sultriness. However, the possibility of occurrence of stuffiness, i.e. sultriness is still present during the summer months. Physiological humidity and physiological humidity deficit have an opposite and symmetrical annual disposition. Physiological humidity increases during the transitive period from colder to warmer months in the year, and decreases during the period from warmer to colder months, whereas the annual trend is similar to air temperature. Physiological humidity deficit has an opposite annual mode, and the trend is similar to a relative air humidity. The biggest loss of humidity from a human organism is, on average, in July, while the least humidity is lost in January. Based on the obtained data, it is evident that, on average, the loss of humidity is less in spring 38,2 mm Hg, as opposed to autumn 37,2 mm Hg, while during the vegetation period the loss of humidity is on average 34,7 mmHg.

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The ongoing presence of the problem imposes the need for additional research which would complete the picture of ecoclimatic determinants of Republika Srpska's biggest city.

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TOXICITY OF LEAD-ACETATE ON EXPERIMENTAL RATS INFECTED WITH *ESCHERICHIA COLI*

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Abstract

Due to the increased concentration caused by emission in traffic, lead is an important issue in environmental protection. Its toxicity depends on its chemical form administrated to the animal, the route of administration and the frequency and duration administered to animals. Bacterial infection caused by *Escherichia coli* may also lead to serious pathological processes in the body, such as sepsis or meningitis and to a variety of systemic infections, such as infections of urinary or gastrointestinal tract. The aim of study was to determine individual and synergistic toxic effects oflead-acetate and effects of infection with *E.coli* on haematological and morphometric characteristics of Wistar rats.It has been found that intoxication with lead-acetate caused a significant decrease in number of erythrocytes and leukocytes. Animals that had also been infected with *E. coli* after intoxication with lead-acetate had statistically significant reduction of number of erythrocytes and slightly increasing of number of leukocytes Mass index of kidney, liver and spleen showed statistically significant differences between individuals of the control group and individuals intoxicated with lead-acetate, while values of the mass of the heart had not statistically significant differences.

Keywords: *Lead-acetate, toxicity, Escherichia coli, blood count.*

Introduction

Lead has been used since prehistoric times, so it is a very widely distributed in the environment. Knowledge of its general toxic effects is three millenni old, and yet lead exposure continues to be a major global problem, especially in developed urban areas and third world countries. It is one of thee arliest discovered poisons (Lidsky&Schneider, 2003). Lead is emitted into the atmosphere from natural and anthropogenic sources. Natural emission includes resuspension by wind, volcanic eruptions, forest fires, sea   rosol and biogenic sources. Lead emission into the atmosphere is not entirely natural, because it is partly caused by anthropogenic deposition of lead in history (Nriagu & Pacyna, 1989). Main emission sources of lead are burning of fossil fuels, production of non-ferrous metals, iron and steel, production of cement and disposal of industrial and urban waste. For a long time the largest source of anthropogenic lead was a leaded fuel, so organisms that live near highways represent a kind of determinants of lead exposure (Strömberg*etal*, 2003). The same situation is with organisms that live near specific factories and mines.
Lead affects negative on many organ systems. Numerous experiments with laboratory animals show that lead causes changes in the function of the placenta and fetal development. It also causes various neurological disorders and behavioral changes (Seddik *et al*., 2010), decrease in body weight and length, and increase in the mass of internal organs (Sood *et al*., 2008).

According to previous research, the effects of lead-acetate on blood picture of rats are reduced number of red blood cells (anemia), increased (leukocytosis) or decreased (leukopenia) number of white blood cells, monocytosis, eosinopenia, neutrophilia and thrombocytosis. Some scientists believe that anemia sideropenica can be associated with metabolic interaction of lead with iron and copper. Increased number of leukocytesis associated with the inflammatory effect of lead on lymphatic organs (Noori Mugahi *et al*., 2003). For kidneys and liver of rats treated with lead-acetate was recorded increase of the organ weight/body weight index (Abdel-Moneim*etal*., 2011).

Bacterial infection caused by *Escherichia coli* may also lead to serious pathological processes in body, such as sepsis or meningitis, and to a variety of systemic infections, such as infections of urinary or gastrointestinal tract (Brock *et al*, 1994). Sepsis and the cancellation of many physiological functions of body can have fatal effects.

The aim of study was to determine individual and synergistic toxic effects of lead-acetate and effects of infection with *E.coli* on hematological and morphometric characteristics of Wistar rats.

Materials and methods

The experiment was realized in a stable and laboratory of the Faculty of Science and Mathematics, University of Banja Luka (Republic of Srpska, Bosnia and Herzegovina). There were used wistar rats of the same age, approximate weight of the body and equal representation of the sexes. Rats were divided into eight groups of ten specimens. All groups were kept in plexiglas cages with 12-hour light mode, at air temperature 22°C (± 2), with food and water ad libitum.

Twenty specimens were receiving lead-acetate (concentration of 1500 ppm) by water ad libitum for 14 days. After that period they got 0,2 ml of saline solution by intraperitoneal injection. Ten specimens were sacrificed 24 hours after injection (T1-24 test group), and another ten specimens were sacrificed 72hours after injection (T1-72 test group). Other twenty specimens received by intraperitoneal injection 0,2 ml of saline solution with $3x10^7$ CFU/ml of bacteria *Escherichia coli* ATCC 11755. The number of bacteria was determined by standard optical density method. Ten of them were sacrificed 24 hours after injection (T2-24 test group), and ten 72 hours after injection (T2-72 test group).The next twenty specimens were used to monitor the synergistic effects of intoxication by lead-acetate and infection with *E. coli*. They were treated with lead-acetate (concentration of 1500ppm), for a period of 14 days. After that bacterial infection was caused by intraperitoneal injection of 0.2 ml saline solution with *Escherichia coli* ($3x10^7$ CFU/ml). Ten specimens were sacrificed 24 hours later (T3-24test group), and ten 72 hours after injection (T3-72 test group). Control group, consisted of twenty animals, got intraperitoneal injection of 0.2 ml 0,9% saline solution. Ten of them were sacrificed after 24 hours (C-24control group) and ten after 72 hours (C-72 control group).

Before blood sampling animals were anesthetized by intramuscular injection of ketamine (concentration of 50 mg/kg). Blood was taken by cardiac puncture with a needle (diameter 1.2 mm) and a syringe (volume 2 ml) and delayed in vacuum blood collection tubes with anticoagulant K_3EDTA. The following hematological parameters were determined: the number of red blood cells per liter of blood, the number of leukocytes per liter of blood, hematocrit, hemoglobin concentration, MCV (the average volume of a red blood cell), MCH (the average mass of hemoglobin per red blood cell), MCHC (the average concentration of hemoglobin per liter of a red blood cell) and differential blood count.

Number of formed elements of blood was determined by counting in aThoma chamber using the appropriate solution (Hayem's solution, Türk's solution). Hematocrit was determined by micromethod with capillary hematocrit tubes and hematocrit centrifuge with reader (5 minutes

at 16000 rpm). Hemoglobin concentration was determined by method according to Drabkin with a colorimeter (Colormetar 254) and Drabkin's reagent. Hematological indices (MCV, MCH and MCHC) were determined by calculating the standard formulas. Differential blood count was determined by differentiating the blood smears that were stained by method according to Pappenheim (Ivanc & Deki , 2006).

In accordance with the instructions of Institutional Animal Care and Use Committee, all animals were sacrificed by decapitation under deep anesthesia ("Guide for the Care and Use of Laboratory Animals", 1996). Internal organs (heart, liver, kidneys, spleenand testes) were removed, measured and fixed in the shortest possible time.

The results were statistically analyzed with IBM SPSS ver. 20.0 software package. Differences among groups were determined with ANOVA statistical test, and multiple comparisons were determined with LSD test. Confidence intervals were stated at the 95% confidence level.

Results and discussion

Comparative analysis of morphometric parameters within groups of specimens under the same treatment did not show any significant differences in regard to the time interval (24 hours and 72 hours after injection). Results for morphometric parameters are summarized into four groups according to the treatment (Table 1). Comparisons of body weight gain, kidney and liver weight index showed statistically significant differences between the animals of the control group and animals of the T1 and T3 groups which had been treated with lead-acetate. Body weight gain was significantly lower for the test specimens of the T1 and T3 test groups (p=0.000/0.000), and the kidney and liver weight indices were significantly increased (p=0.000/0.000 and p=0.000/0.001). The values of the lien weight index were significantly increased at the animals of the T1 test group (p =0.001). Heart weight index had statistically significant difference only between the control and T3 test group (p =0.008). There were no statistically significant differences between control and T2 test group treated just with *E.coli*.

Table 1. Morphometrical parameters: organ weight indices and body weight gain

| Group | Weight index in % (organ weight/body weight x100) | | | | Body weight gain in % |
	Kidneys	Liver	Lien	Heart	
Test 1	0.42±0.09	3.46±0.56	0.26±0.07	0.34±0.04	8.57±3.36
Test 2	0.30±0.02	3.06±0.40	0.23±0.03	0.34±0.03	16.02±5.84
Test 3	0.38±0.05	3.43±0.36	0.22±0.03	0.35±0.03	7.71±2.58
Control	0.29±0.02	3.00±0.22	0.20±0.03	0.33±0.03	18.72±6.19

The obtained values for the control group were in accordance with the references (Sood *et al*., 2008), while the observed changes in the values of morphometrical parameters for test specimens were less than expected. For larger changes of these parameters is necessary longer exposure to lead-acetate intoxication (Sood *et al*., 2008; Abdel-Moneim *et al*., 2011).

The average number of erythrocytes per liter of blood (Table 2) in control groups of rats was 7.77 x 10^{12} (C-24) and 7.66 x 10^{12} (C-72). The observed values are in accordance with reference value for the Wistar rats which amounts 5-10 x 10^{12}/l (Sharp and LaRegina, in 1998, Pritchett and Corning, 2004). Significant reduction in number of red blood cells with regard to control group is observed in all the test groups. Maximal deviations were reached in T3 24 and T3 72 groups treated with lead-acetate and infected with *Escherichia coli*. ANOVA analysis showed statistically significant differences in number of red blood cells among the groups according to the treatment (p=0.000), and multiple comparisons showed significant

decrease in number of red blood cells in all test groups (C>T1>T2>T3). Animals treated just with a lead-acetate (T1-24 and T1-72) had lower values of RBC in regard to the control group (p=0.000), which corresponds to literature data (Noori Mugahi *et al*., 2013). Also, the number of red blood cells has been decreasing during the infection with *Escherichia coli* (T2-24 and T2-72) in regard to the control group (p =0.000). Time of exposure to the treatment in all groups There were no statistical significant differences in RBC values between T-24 and T-72 groups under the same treatment.

Table 2. Hematological values (Mean±SD) of Wistar rats exposed to lead-acetate and *E.coli*

Group		RBC count 1×10^{12}	Hemoglobin (g/l)	Hematocrit (%)	MCV (fl)	MCH (pg)	MCHC (g/l)
	h						
T1	24	5.71±2.15	98.89±9.88	0.300±0.04	62.957±31.23	20.223±8.76	334.491±63.73
	72	6.21±8.97	95.19±9.41	0.277±0.06	45.441±11.72	15.686±3.02	360.389±101.29
T 2	24	5.85±6.73	102.85±9.76	0.235±0.03	40.798±7.44	17.648±2.84	436.399±50.13
	72	5.55±6.96	90.37±12.00	0.242±0.06	43.594±9.62	16.557±3.38	393.830±102.72
T 3	24	4.67±5.80	83.70±24.02	0.282±0.05	61.375±13.42	18.225±5.85	301.568±92.62
	72	4.27±6.23	94.81±15.64	0.298±0.04	70.977±14.79	22.818±6.07	325.774±72.78
Cont.	24	7.77±5.60	130.74±14.81	0.314±0.05	40.451±6.28	16.869±1.91	420.205±30.39
	72	7.66±3.24	132.22±11.59	0.342±0.03	44.672±4.21	17.268±1.49	391.293±65.63

Hematological parameters hematocrit, MCV and MCH of control group were a little lower than reference values (Sharp & La Regina, 1998), but within normal limits for untreated Wistar rats (Brki *et al*., 2011). Values of MCHC were slightly increased. Rats of the test groups had decreased values of hemoglobin (p=0.000 for all test groups in comparison to the control) and hematocrit (p<0.05 for all test groups), while values of MCV, MCH and MCHC had different changes depending to the treatment.

Values of MCV were significantly increased at animals from groups T1-24 (p=0.001 and 0.007), T3-24 (p=0.002 and 0.013) and T3-72 (p=0.000 and 0.000) in comparison to the control groups (C-24 andC-72). MCH was significantly increased at animals from group T3-72 (p=0.011) in comparison to the control groups. MCHC values were significantly decreased at animals from group T3-24 in comparison to the both control groups (p=0.001 and 0.007), and from T3-72 group in comparison to C-72 group (p=0.010). Overall, values of hematological parameters in all treated groups showed different changes depending on the treatment and the time of exposure. According to Suradkar and associates (2009) reduced values of RBC, Hb, MCV, MCH and MCHC occur as a result of intoxication with lead-acetate, which overall results in hypochromic microcytic anemia. Changes are more evident at higher doses and longer exposure to this heavy metal. Lead inhibits synthesis of heme and shortens the life time of red blood cells. Results are increasing of red cells destruction and decreasing of hematological parameters values (Klassen, 2001).Values of white blood cells are given in Table 3. For control groups they are in accordance with reference values for the Wistar rats (Sharp & La Regina, 1998). Number of leukocytes was significantly increased at animals from groups T2-24 (p=0.000 and 0.000) and T2-72 (p=0.000 and 0.000) in comparison to the control groups (C-24 and C-72). Animals treated with lead-acetate had decreased number of white blood cells in comparison to all other groups (p=0.000-0.017). LSD test showed differences among number of WBC at animals from T2 groups in comparison to the control and all other test groups (p=0.000-0.003). Number of leukocytes was significantly higher 72 hours after infection with *E.coli* in comparison to T2-24 group (p=0.003). Different types of leukocytes showed significant differences among different experimental groups. The largest proportion of neutrophils was observed at animals from T3-

72 group (0.261) and lowest from T1-24 group (0.120). Comparing a multiple significance occurs between the specimens treated with lead acetate (24 T1) and *Escherichia* infected animals (p = 0.038 for 24 hours and 0.023 for 72 hours), and the dual treatment of the animals sacrificed after 72 hours (p = 0.000). The largest proportions of eosinophils and monocytes were observed at animals from control group. The largest proportion of lymphocytes was observed at animals treated with lead-acetate, indicating neutropenia and lymphocytosis. Basophils showed the lowest proportion (0.003) at animals infected with *E. coli*.

Table 3. Number of leucocytes and proportion of their specific types (Mean±SD)

Group	h	WBC count 1×10^9	proportion of specific types of leukocytes				
			Neutrophil	Eosinophil	Basophil	Limphocyte	Monocyte
Test 1	24	5.42±4.69	0.120±0.06	0.007±0.01	0.023±0.02	0.846±0.06	0.004±0.01
	72	5.43±5.31	0.169±0.05	0.008±0.01	0.018±0.01	0.804±0.06	0.001±0.00
Test 2	24	6.74±4.93	0.182±0.04	0.001±0.00	0.003±0.01	0.812±0.04	0.002±0.00
	72	7.25±3.34	0.188±0.04	0.005±0.01	0.002±0.01	0.803±0.04	0.002±0.00
Test 3	24	6.02±1.25	0.169±0.09	0.003±0.01	0.026±0.01	0.801±0.09	0.001±0.00
	72	6.04±2.14	0.261±0.06	0.004±0.01	0.018±0.02	0.716±0.06	0.001±0.00
Control	24	5.84±2.69	0.193±0.09	0.029±0.03	0.032±0.02	0.734±0.10	0.012±0.01
	72	5.71±3.63	0.122±0.07	0.035±0.01	0.011±0.01	0.821±0.07	0.011±0.01

Noori Mugahi et al (2003) and Okediran et al (2010) noted that the total number of leukocytes in animals treated with lead-acetate significantly increased (leukocytosis), with expressed neutrophilia and monocytosis. On the other hand, Suradkar *et al* (2009), Ibrahim *et al* (2012) noted leukopenia and lymphopenia at higher doses of lead-acetate. Many scientists believe that the immune response of rats to intoxication with lead-acetate depends on received dose and rat's age and sex.

Conclusion

Results of morphometric analysis showed significant changes at rats treated with lead-acetate. Body weight gain was significantly lower and kidneys and liver weight indices were significantly higher. Lead also showed hematotoxic effect on animals. There has been a significant decrease of the total number of red blood cells, hemoglobin and hematocrit in comparison to the control group. Parameters of white blood cells also showed decreased values: number of leukocytes and proportions of neutrophilles, eosinophilles, basophilles and monocytes were lower in comparison to control group. Only proportion of limphocytes was significantly higer in comparison to control and T3 group. Animals infected with *E. coli* had lower values of RBC, hemoglobin and hematocrit and the highest values of WBC in comparison to control group, especially 72 hours after infection. Proportion of neutrophilles increased, but proportion of other WBC elements decreased. Animals treated with lead-acetate and infected with *E. coli* showed the largest changes of hematological parameters. Number of erythrocytes, concentration of hemoglobin and MCHC were the lowest and MCV was the highest in all groups of animals. Number of leukocytes was higher in comparison to control and T1 group, but lower in comparison to group infected with *E. coli*.

Acknowlegdements

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THE IMPACT OF AGRICULTURAL MEASUREMENTS ON WATER QUALITY PARAMETERS AT FISHPOND BARDAČA

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Abstract

The impact of agricultural measurements on water qulity at fishpond Barda a was studied during the year 2011. On the basis of physical, chemical, bacteriological, biochemical and saprobiological water analysis it can be concluded that the water of fishpond Barda a is highly loaded with organic matter. High organic production reflected also in the increased development of phytoplankton and water in basin Sinjak in 2011 belonged to the category of eu-polytrophic water. The greatest amount of basic nutrients in the water was recorded at the beginning of the year despite the fact that in the period from April to June fertilization was carried out in order to increase primary production of pond. Higher concentrations of these compounds were found also after maximum development of phytoplankton, and after increased degradation of dead planktonic organisms. On the other hand, during the summer, usually in July, there was a complete consumption of basic nutrients from the water. The limiting factor for phytoplankton development was the lack of nitrogen compounds, while orthophosphates could have been found in the water throughout the whole year, at least in low concentrations. Fertilization and introduction of calx into the water had great influence to the composition of the phytoplankton.

Keywords: *water quality, fishpond, Barda a.*

Introduction

The Barda a fishpond is located near the confluence of the river Vrbas into the river Sava. It is a system of 11 ponds separated by dikes. At February, 2nd, 2007 Barda a has been declared as a Ramsar site number 1658 as "Important Bird Area" and on that way it has been confirmed its international importance. Unfortunately, after gaining this prestigious status, under human influence, there was a significant devastation and ruining of this vulnerable ecosystem. Currently, only three ponds are in use for fish farming (Sinjak, Rakitovac and Brzajski). This is a warm-water pond with primarily production of carp, and to significantly lesser extent, bighead carp and grass carp. In the carp ponds occur particularly complex physical, chemical and biological processes since it is necessary to ensure the optimal environment for fish life and to rationally exploit the biological cycling of matter in the water. Since the depth of the water in the pond ranges usually from 1 to 3 meters, temperature of the water and concentration of dissolved oxygen have great importance to the chemical and biological processes in pond. The optimal temperature for the cultivation of carp is between 20 and 28 °C, and the optimal concentration of dissolved oxygen in the water is between 6 and 9 mg/l. For fish, as well as for the lower aquatic organisms, the presence of ammonia in the water, mostly from anaerobic decomposition of proteins, is very harmful. Nitrogen in water occurs also in the form of nitrate NO_3^- and nitrite NO_2^- ions which are essential nutrients necessary for the development of primary producers. The nitrogen content in the ponds

usually increases by the addition of mineral fertilizers to achieve its concentration of 1 to 1.5 mg/l. Another essential nutrient for the growth of primary producers is phosphorus that is present in the water in the form of phosphates. Phosphates can also take in the water by fertilization in order to achieve a desirable concentration of 0.2 - 0.3 mg/l (Bogut et al., 2006). The main aim of these agricultural measures is to encourage the development of primary producers in the pond and to reduce additionally feeding of fish. High concentration of nutrients in the water can disrupt homeostasis in aquatic ecosystems. It can lead to excessive production of algae which leads to daily fluctuations in the concentration of dissolved oxygen and pH values and, at the end, to the increased mortality of fish and other aquatic organisms (Sigee, 2004). In order to prevent an excessive growth of algae and aquatic plants, calx can be thrown into the water periodically during the vegetation period. Fertilization and additional feeding of fish increase organic production of the pond, but at the same time they deteriorate physical and chemical characteristics of water (Boj i et al., 1982).

Materials and methods

Samples for analysis of water quality in the basin Sinjak of fishpond Barda a were collected monthly during the year 2011.Water samples were collected in sterile dishes in aseptic terms by prescribed procedure (Karakaševi , 1967). Water and air temperature, pH values, electroconductivity, concentration of dissolved oxygen, oxygen saturation and turbidity were determined on the spot. Then, samples were transported on ice on temperature of +4°C. Concentrations of dissolved ammonia, nitrates, nitrites and orthophosphates were determined with spectrophotometer HACH DR2800, so as total suspended substances (DR2800, 2009). Biochemical oxygen demand is determined with oxymeter. (Petrovi , 1998). Total number of bacteria is determined by indirect breeding methods (Hribar, 1978; Petrovi et al., 1998). Membrane filter method was not used because this method is not suitable for water with high turbidity (Chapman, 1996). The concentration of chlorophyll "a" was determined by a standard spectrophotometric method by extraction of chlorophyll with 90% aqueous solution of acetone(APHA-AWWA-WEF, 1998). Identification of the algae is carried out by using the following keys for determination: Cvijan & Blažen i (1996), Hindak (1978, 2005 i 2008), John et al (2005), Krammer & Lange-Bertalot, (1988a; 1988b), Lazar (1960) and www.algaebase.org.

Results and discussion

The lowest water temperature of pond Sinjak was measured in January (2.5 °C), and the highest (29.8 °C) was measured in July. During the whole year water was alkaline, with an annual average value of 8.32. The high abundance of phytoplankton is possible cause for higher values of pH. In the process of photosynthesis phytoplankton consumes CO_2 from the water. CO_2 usually bonds with water molecules, forms a carbonic acid and decreases pH value of water (Sigee, 2004). Conductivity varied from the 291 µS/cm in September to 582 µS/cm in March. During the period from July to October 2011 water of pond Sinjak was loaded by a high concentration of suspended solids (above 60 mg/l), which caused high turbidity (52.3 NTU in September) and low opacity (below 40cm). Water was well saturated with dissolved oxygen during the whole year. Lower saturation value was measured only in May (84.1%). Due to the intensive development of phytoplankton and intensive process of photosynthesis from June to September, oxygen saturation was above 130%. In 8 of 12 measurements during the year water was hypersaturated, with an annual average saturation of 115%. Concentrations of basic nutrients in water were lower than the recommended values for fishponds. The average annual concentration of ammonia nitrogen in water was 0.19 mg/l, nitrite nitrogen 0.010 mg/l and nitrate nitrogen was 0.74 mg/l. The highest concentration of nitrates was measured in April (1.4 mg/l), after the pond was drained and fertilized, and in August (1.3 mg/l), after significant decreasing of phytoplankton abundance. Phytoplankton

reached its annual maximum abundance in July. The intensive development of phytoplankton led to a complete depletion of ammonium, nitrate and nitrite nitrogen (Chart 1). The lowest concentration of orthophosphate (0.05 mg/l) was also measured in the same sample. Depletion of basic nutrients in water caused the decreasing of phytoplankton abundance in August (Chart 2). Due to degradation of their dead cells, there was an increase in concentrations of basic nutrients in water.
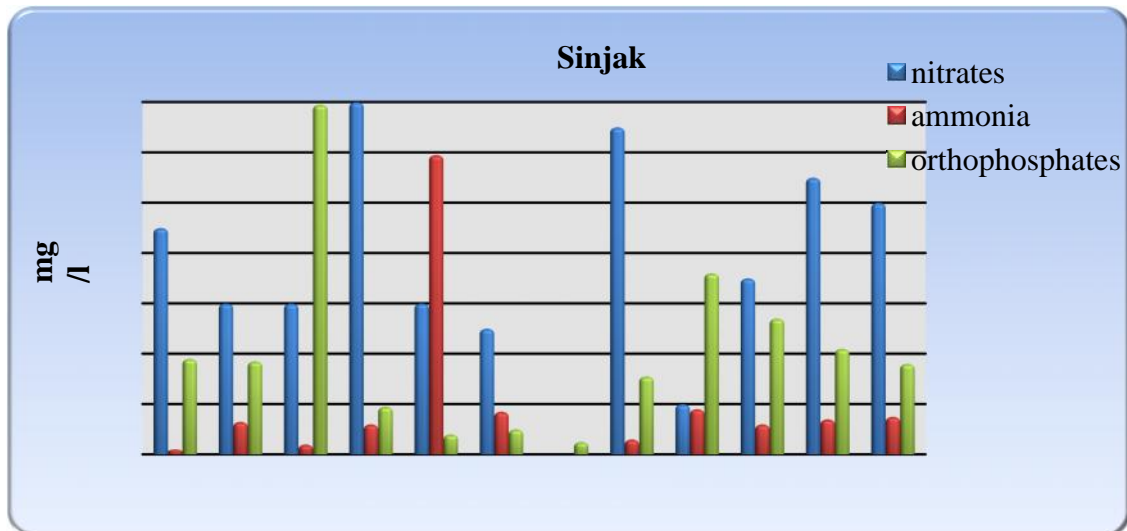

Chart 1. Distribution of basic nutrients in water of pond Sinjak (Barda a).

The highest concentration of ammonia in water was measured after fertilization in May. Orthophosphates were present in higher concentrations than recommended for a fishponds during the whole year, with an average annual concentration of 0.41 mg/l. The greatest amount of basic nutrients in water was recorded at the beginning of the year (March and April), despite the fact that in the period from April to June fertilization was carried out in order to increase primary production of pond.

With an increase of water temperature during the year, the number of heterotrophic bacteria was also increasing. This group of microorganisms had reached a maximum abundance in May (121514 CFU/ml) corresponding to III-IV class by Kohl. According to this parameter, water quality in June and July corresponded to III class by Kohl. The number of bacteria increased again in August, when abundance of phytoplankton decreased, and water quality of pond Sinjak again responded to III-IV class by Kohl. The average annual value of biochemical oxygen demand (BOD$_5$) was 5.71 mgO$_2$/l, which is an indicator of the - - mesosaprobic water by Felföldy (Petrovi et al, 1998). However, in the period from May to August there were recorded higher BOD$_5$ values which were indicators of   -mesosaprobic water. In the same period the largest amount of bacterioplankton was isolated, too. These two parameters are closely related because bacteria consume available oxygen in processes of oxidation of organic matter (Sigee, 2004).
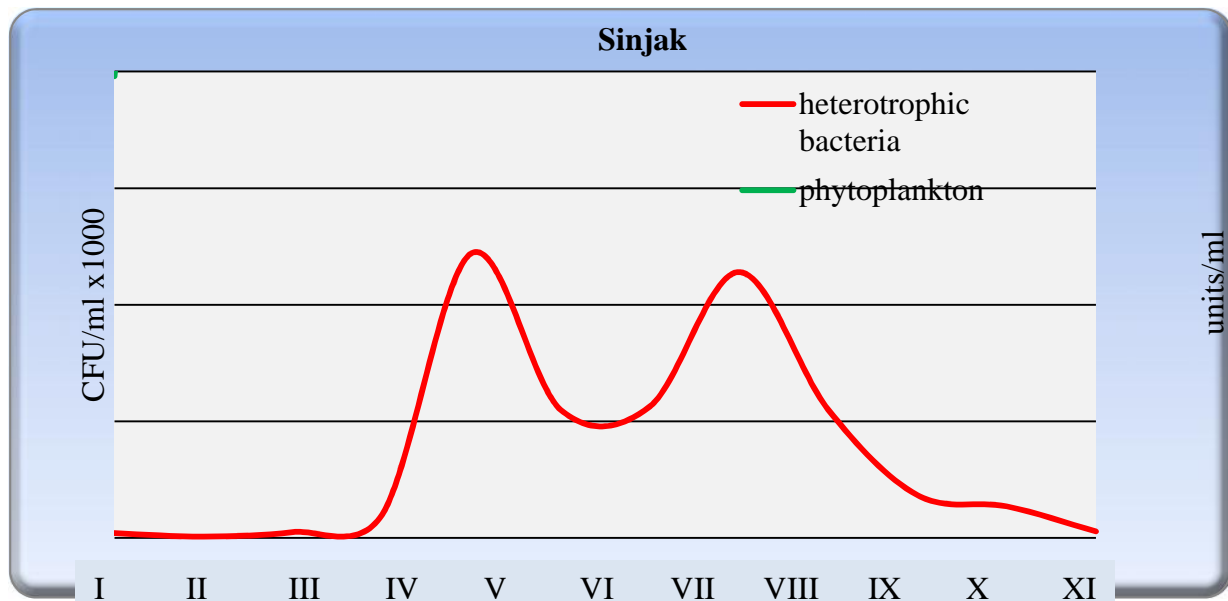
Chart 2. Distribution of heterotrophic bacteria and phytoplankton in water of pond Sinjak (Barda a).

During the year 2011 in water of fishpond Sinjak 95 different algal taxa were identified, including cyanobacteria. The lowest number of phytoplankton was recorded in sample from January (295337 units/liter). After that, abundance of phytoplankton was slowly increasing and in July it reached a maximum number of 27.04×10^6 units/liter. Already in August, due to the lack of nitrogen compounds in the water, that number dropped to 7.81 x 10^6 units/liter. The number of algae in water again increased in September (14.01×10^6 units/liter). The high abundance of algae in July was a result of intensive development of cyanobacteria from the genus *Microcystis* and *Aphanizomenon*, which also dominated in August. Beside them, three different groups of algae dominated in September: green algae from the genus *Pediastrum* and *Mougeotia* and silicate algae *Nitzschia acicularis*. There was an algal bloom of cyanobacteria *Oscillatoria sp.* in October which accounted for 53% of total phytoplankton. In spring, from April to June, the most numerous algae in the water were representatives of the genus *Pediastrum* and *Scenedesmus*. Green algae *Crucigenia tetrapedia* dominated in May, and in June began the development of a *Microcystis*. Boj i et al (1982) reported that in ponds during the summer generally dominated green algae and cyanobacteria. However, in water of fishpond Barda a we cannot ignore the presence of silicate algae, which are present in the water column in large numbers throughout the whole year. The cause for that can be thick layer of mud and shallow water. The concentration of chlorophyll "a" varied within the interval of 10.50 mg/m^3 in January to 132.54 mg/m^3 in July. Extremely high values of this parameter in July, September and October have contributed to its average annual value (50.23 mg/m^3) corresponds to eutrophic waters, which in some periods (July and October) had the characteristics of eu-polytrophic water by Felföldy.

Distribution of bacterioplankton and phytoplankton in pond Sinjak is not common in shallow reservoirs. It is expected that the intensive development of phytoplankton occurs much earlier in the spring time, and after that there should be pure water phase (Sigee, 2004; Grgin evi & Pujin, 1998). Also, it is expected that the maximum development of bacterioplankton in a shallow reservoirs occurs after the vernal and autumnal maximum development of phytoplankton when it starts to die (Straskrabova & Komarkova, 1979). Significant impact on the seasonal dynamics of bacterioplankton and phytoplankton had agricultural measures. Once a month from April to June calx was thrown into the water to reduce the development of cyanobacteria. There was also carried out chlorination in May to prevent the growth of

pathogens of fish. Due to intensive water treatment with aggressive chemicals there was no conventional spring maximum development of phytoplankton. On the other hand, the first peak bacterioplankton had in May, when implemented agricultural measures increased amount of dead organic matter in the water. High values of BOD_5 in May also indicate that water was loaded with organic matter. Aerob heterotrophic bacteria decompose the dead organic matter to mineral forms which phytoplankton then use for their own development (Sigee, 2004). The main objective of implemented agricultural measures was achieved only partial: algae bloom was delayed, but undesirable cyanobacteria that had no nutritional value for fish, developed in large number. Cyanobacteria also produce a lot of cyanotoxins which have negative impact on fish and human health (Simeunovi et al, 2005). Kvet and colleagues also pointed out that agricultural measures, such as fertilization and insertion of calx, could lead to the changes of phytoplankton seasonal dynamics (Kvet et al, 2002).

Conclusion

On the basis of physical, chemical, bacteriological, biochemical and saprobiological water analysis it can be concluded that the water of fishpond Barda a is highly loaded with organic matter. Availability of nutrients and high temperature of water resulted in intensive bacteriological activity which abundance matched to the III-IV class by Kohl. High organic production was reflected also in the development of phytoplankton and high concentrations of . chlorophyll "a". The greatest amount of basic nutrients in water was recorded in March and April, when rain was bringing the surrounding land into the water. Limiting factor for phytoplankton development was the lack of nitrogen compounds, while the orthophosphates could be found in water all year round, even in low concentrations. Insertion of calx into water and chlorination led to the changes of phytoplankton seasonal dynamics. Because of permanent high content of organic matter in the water and because of fertilization, there was no pure water phase. From the perspective of fishery, the largest problem of pond Sinjak was extremely high organic production of those species of phytoplankton which zooplankton can not eat. Men with agricultural measures change the composition of phytoplankton and zooplankton. However, those measures had not lead to the development of desirable species of phytoplankton from the group of green algae.

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THE IMPACT OF THE THERMAL POWER PLANT IN GACKO ON LAND DEGRADATION

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Abstract

In the process of a thermal power plant operation (Gacko, East Herzegovina) there is a huge amount of ashes which is mostly deposited near it. In the process of coal exploitation and thermal power operation, a soil damage occurs by means of surface mines, material disposal as well as by sedimentation of aeroprecipitates created at the operation of the thermal power plant. This paper presents the results of detailed field and laboratory research of morphological, physical and chemical properties, 2 deposol profile and 4 profile natural autochthonous soil near to the dump with the aim to characterize the soil damage. In relation to the autochthonous soil, deposols are characterized by a greater depth of solum, heavier mechanical composition, increased alkalinity and carbonate status and lower contents of humus and overall nitrogen. The total contents of Cd, Pb, Cu on an autochthonous soil and deposols is below the MAC. The value of contents of total Zn in deposols is below the MAC, while in the natural autochthonous soil is above the MAC (339.03 ppm) and it indicates a contamination which can be of geochemical origin.

Key words: *kalkocambisol, deposol, heavy metals*

Introduction

In the process of thermal power plant Gacko leads to disruption soil and to its destruction. With these processes have already been affected area of 752 ha. In the process of the plant's operation creates an enormous amount of ash that is usually deposited in the vicinity. These dumps usually occupy considerable areas of cultivated land, thereby disconnecting the of primary production. The subject of the research is "Dražljevo" locality where the ashes from the first day of operation of the mine and thermal power plant in Gacko have been stored. At the beginning of the Nineties, a recultivation of the ash dump Dražljevo was performed, and the thickness of the added layer of humus was about 45 cm. 20 years later, there has been noticed a spontaneous self-healing by means of vegetation. A significant erosion has been noticed, especially at the south side of the dump where even spontaneous vegetation has not appeared.

Some soils are directly exposed to the influence of waste technogenic materials, which are excreted into the environment during the industrial process, and have a harmful effect to the soil. As an example, numerous dumps can be mentioned which are mostly in close proximity to factories, farms, mines, oil-gas exploration drill holes and other objects. In practice up to now, the ways of waste materials disposal lead to significant changes in the entire ecosystem of the endangered area (Neši et al. 2006).

oki and Obradovi (2006) are of the opinion that at the location of a mine, during the performing of exploitation operation, a permanent degradation of the entire space occurs, changes in local topography occur, and temporary dumps of waste material are formed, consisting mostly of waste rock (pedological layer and a small amount of raw minerals) grabbed at the mechanical removal of waste rock. Šubranovi et al, (2011) stated that the coal

exploitation in Gata ko polje created: areas degraded by surface mines (at the areas which had already been degraded, internal landfills of tailings and dump of ashes and slag were formed), areas degraded by external landfills of waste rock and tailings, surfaces occupies by objects of the surface mine and thermal power station, the industrial circle and sanitary protection zone around the surface mine and landfill.

The aim of this paper is to determine the characteristics of recultivated dumps and autochthonous soil spreading around the dump, through a pedological research, and thus get an objective insight into the type, degree, and range of the soil damage.

Material and methods

The pedological research consisted of field and laboratory work. The six pedological profiles were opened, i.e. 2 at the dump and 4 on the autochthonous soil next to the dump. After the profiles were opened, the internal and external morphology of the soil was examined in detail and soil samples were taken for the laboratory testing.

Laboratory testing of physical and chemical properties of the soil were performed at the laboratory of the Faculties of Agriculture in East Sarajevo and Zemun, pursuant to generally accepted methods (JDPZ, 1966, 1971 and 1997) for this type of research. The extraction of heavy metal traces on the atomic absorption spectrometer by means of graphite and flame furnace was performed in the laboratory of Federal Agro-Mediterranean Institute in Mostar.

Results and discussion

On the basis of field and laboratory research it has been determined that on the examined area the following systematic units of soil have been present: recultivated dumps of ashes (profiles 1 and 2) and calcomelanosol (profile 3, 4, 5, 6) as autochthonous soil.
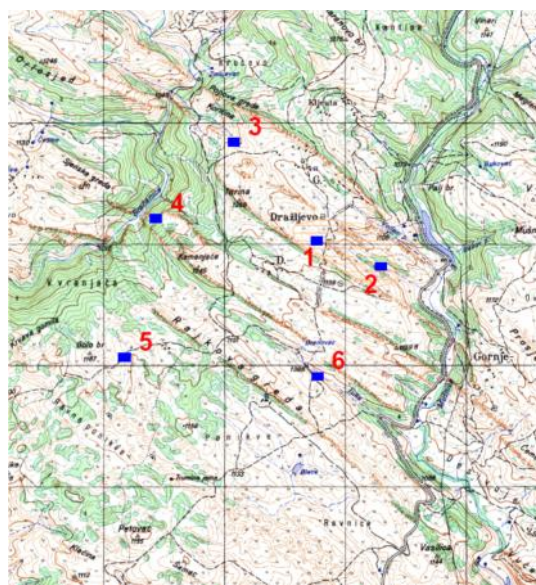

Figure 1. Position of tested soil is shown on the map R=1:50000

Calcomelanosol pursuant to the classification of soil of Yugoslavia (Škori et al. 1985) and Resulovi et al. (2008), belongs to the section of automorphic soils, class of humus-accumulative, subtype of organomineral black soil, variety: cliff, with A-C profile build, with molic horizon. According to WRB classification (FAO, 2006) is Molic Leptosol.

   Surface layers of created technogenic soils in the previous period have been determined and classified in different ways. Under deposol (Resulovi , 1979) considered to be those lands that have started to create the dumps, landfills, material excavated during surface mine

operations.

Internal morphology of profile

I (0-10 cm) - brown horizon (10 YR 3/4), dark brown in dry and humid state (10 YR 3/2). Pursuant to texture, it is clay loam with powdery structure, carbonaceous, strongly permeated with tendrils of grass vegetation.
II (10-33 cm) - brown horizon (10 YR 4/4), dark brown in dry and humid state (10 YR 3/4). Pursuant to texture, it is powdery clay loam with crumbly structure, carbonaceous.
III (33-42 cm) - brown horizon (10 YR 4/3), dark brown in dry and humid state (10 YR 3/3). Pursuant to texture, it is powdery clay loam with prismatic structure, carbonaceous.
IV (42-63 cm) - yellow-brown horizon (10 YR 5/4), brown in dry and humid state (10 YR 4/4). Pursuant to texture, it is sandy loam with prismatic structure, carbonaceous.

Figure 2. Profile 2

Pursuant to Rasulovi et al. (2008), the newly created soils belong to the section of automorphic-terrestrial soils, class of technogenic soils – technosols, with six subclasses. Deposols and recultisols on the altered natural substrate belong to the first subclass. With the profile build: Y1-Y2-Y3… soil (deposols) and jY-Y1-Y2 (recultisols). According to the classification of soils of Yugoslavia (Škori et al. 1985), deposols belong to the section of automorphic soils, class of technogenic soils. On the basis of subtype, they are divided pursuant to the type of material (soil, ores, slag), with profile built: I, II, III… and according to the WRB classification (FAO, 2006) the new soil creations belong to the class Technosols, Spolic Anthrosols.

According to the the concept of FAO (WRB, 1998) Anthropomorphic soil materials - the consolidated mineral or organic matter, ie. Anthrosols (AT) anthropogenic-technogenic soil Anthrosols (AT) and Technosols (TE) make the group of "soils with strung human influence", according to WRB (2006), although there is a minor conflict between AT and TE. Anthrosols have been formed by long-term human activities. Technosols are soils with fresh sediments of artificial origin or soil which carries the products of foreign origin.

mo (0-9cm) - brown horizon (10YR 3/2) in dry and humid state dark brown (10 YR 3/1). Pursuant to texture, it is powdery clay loam with powdery structure, carbonaceous, strongly permeated with tendrils of grass vegetation.

Figure 3. Profile 3

The main purpose of the WRB classification is to build an unique worldwide basis to the land as a common "scientific language", by which he will be able to correlate national

classifications Stjepan et al. (2009).

Mechanical composition and physical properties of deposols and black soil on firm limestone are presented in Table 1.

Deposols are heterogeneous at a small distance because the mass of deposols has been obtained by imperfect mixing and is characterized by insufficient homogeneousness. Deposols are characterized by physical properties which are mostly much worse in relation to the properties of autochthonous soils on which the dumps have been formed.

Table 1. Mechanical composition of deposols and black soil on firm limestone

Profile No.	Horizon	Depth in cm	Coarse sand 2.00-0.2 %	Fine sand 0.2-0.05 %	Dust 0.05-0.002 %	Clay < 0.002 %	Skeleton (%)	Texture class
1	I	0-9	18.80	17.50	46.58	17.12	3.48	Loam
	II	9-22	6.80	11.90	53.42	27.88	0.00	Powdery clay loam
2	I	0-10	8.40	13.40	47.64	30.56	0.33	Clay loam
	II	10-30	3.70	5.80	50.58	39.92	0.00	Powdery clay loam
	III	30-42	4.20	8.60	53.32	33.88	0.00	Powdery clay loam
	IV	42-60	46.70	24.20	24.46	4.64	27.67	Sandy loam
3	mo	0-8	20.30	10.80	44.02	24.88	64.48	Loam
4	mo	0-9	9.00	4.40	53.08	33.52	7.17	Powdery clay loam
5	mo	0-14	25.10	11.30	45.48	18.12	0.65	Loam
6	mo	0-11	15.10	7.30	45.84	31.76	27.79	Clay loam

Black soil to sail limestone characterized by a higher content of the skeleton in the surface horizon (0.65-64.48%).

Table 2. Basic chemical properties of deposol and black soil on firm limestone

Profile No.	Horizon	Depth in cm	pH		CaCO₃ %	Humus %	N %	mg/100 g of soil	
			1 KCl	H₂O				P₂O₅	K₂O
1	I	0-9	7.48	8.17	5.72	11.31	0.23	19.20	9.99
	II	9-22	7.13	8.04	4.14	4.70	-	7.07	21.70
2	I	0-10	7.14	8.20	2.70	3.99	0.22	11.90	17.07
	II	10-30	7.05	8.05	2.41	3.08	-	6.94	22.73
	III	30-42	7.07	8.25	3.55	3.21	-	3.30	23.08
	IV	42-60	7.67	7.94	16.20	4.80	-	14.18	6.88
3	mo	0-8	6.37	7.29	0.59	8.50	0.62	9.78	26.89
4	mo	0-9	6.75	7.76	0.48	8.48	1.07	10.08	34.99
5	mo	0-14	6.31	7.29	0.48	9.17	0.61	4.10	39.21
6	mo	0-11	5.80	6.82	0.00	7.75	0.39	2.62	40

Autochthonous soil, calcomelanosol, is characterized by (Table 2) a weakly acid to neutral reaction (5.80-6.75%). Profiles 3, 4 and 5 are carbonates, while the profile 6 is noncarbonates in the humus accumulative horizon (Table 2). Surface horizons of soil profiles is 7.75 to 9.17% with humus. The contents of total nitrogen is in accordance with the humus contents. The contents of easily accessible phosphor in the surface horizon is low (2.62-10.08mg/100g), while the contents of easily accessible potassium is in the class of highly supplied soils (26.89-40 mg/100g).

Chemical properties of deposols are characterized by neutral to weak alkaline reaction in surface horizon. They are carbonaceous from the surface, well supplied with humus and total nitrogen. The contents of easily accessible potassium and phosphor is within the limits of

medium supply.

On the basis of the aforementioned, it can be concluded that deposols are characterized by beneficial physical and basic chemical properties.

Heavy metals are also present in traces in non-polluted soils, as a result of geochemical origin. The concentrations in which the metals occur depend on the sources of pollution and features of the system they are in, where the values may vary from the level of traces to extremely high concentrations which can be extremely toxic for an ecosystem, pursuant to Belanovi et al. (2003), Sehgal et al. (2012) Kosti et al. (2012).

Table 3. Minimum, maximum and mean values of heavy metals calkomelanosol

	Depth in cm	Cadmium (Cd)	Lead (Pb)	Copper (Cu)	Zinc (Zn)	Nickel (Ni)
Min.	10	1.34	35.70	38.60	333.50	65.50
Max	10	1.61	42.90	19.30	348.00	186.70
Average	10	1.50	39.73	29.70	339.03	143.90

To estimate the soil contamination by heavy metals (Table 3), i.e. by dangerous and harmful materials, the Maximum Allowable Concentration (MAC) criteria (for agricultural soils) have been used, threshold value on which soil quality and remediation value are sustainable (for non-agricultural soil) (Official Gazette of the Republic of Serbia 1994 and the Decree of the Official Gazette of the Republic of Serbia 2010).

The total contents of Cd, Pb, Cu on an autochthonous soil and deposols is below the MAC. The value of contents of total Zn in deposols is below the MAC, while in the natural autochthonous soil is above the MAC (339.03 ppm) and it indicates a contamination which can be of geochemical origin.

The contents of total Ni in all tested samples is above the MAC, as well as above the threshold value on which the soil quality is sustainable. Talking about the criterion for non-agricultural soils, which is a bit milder than the MAC, the total contents of all the tested elements is below the remediation values, i.e. the value which indicates that the basic soil functions have been endangered or severely damages and require remediation, repairing and other measures (Off. Gazette of the RS 88/2010).

Results of the research (Report on the state of soil in Serbia, 2009) showed that the average content of cadmium in soils Serbia 0.81 mg/kg, lead 40 mg/kg, copper content was on average 27 mg/kg, the average content of zinc is 48 mg/kg, an average of nickel content of 58 mg/kg.

The total content of Cd, Zn and Ni on autochthonous soil is above the adjusted threshold value where the sustainable soil quality, and Pb and Cu below the adjusted threshold value. The total content of Cd, Cu and Ni in deposols are above the adjusted threshold value where the sustainable soil quality, and Pb and Zn below the adjusted threshold value for deposol.

Table 4.   inimum, maximum and mean values of heavy metals of recultivated landfill

	Depth in cm	Cadmium (Cd)	Lead (Pb)	Copper (Cu)	Zinc (Zn)	Nickel (Ni)
Min.	10	0.38	59.50	26.92	35.01	128.08
Max	10	1.72	67.63	58.60	135.12	184.70
Average	10	1.14	63.06	47.07	100.41	159.35
Min.	20	1.01	41.10	27.00	30.10	134.00
Max	20	2.41	58.26	54.99	150.40	174.90
Average	20	1.78	51.91	42.26	100.23	149.98

Conclusion

On the basis of the performed research, it has been determined that deposols are characterized by beneficial physical and basic chemical properties.

The presence of carbonate in the black soil on limestone sail can be explained by the scattering of the landfill where ash spreads easily with weaker winds and falling on surrounding land.

The total contents of Cd, Pb, Cu on an autochthonous soil and deposols is below the MAC. The value of contents of total Zn in deposols is below the MAC, while in the natural autochthonous soil is above the MAC (339.03 ppm) and it indicates a contamination which can be of geochemical origin.

The contents of total Ni in all tested samples is above the MAC, as well as above the threshold value on which the soil quality is sustainable. Talking about the criterion for non-agricultural soils, which is a bit milder than the MAC, the total contents of all the tested elements is below the remediation values, i.e. the value which indicates that the basic soil functions have been endangered or severely damages and require remediation, repairing and other measures.

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ASSESSMENT OF THE LAND SUITABILITY FOR APPLES AND HAZELS GROWING

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Abstract

Agricultural land in the region of Virovitica-Podravina County (Croatia) present important natural resources for the development of this county. Of special interest are agricultural land used in growing of fruits. The main goal of this work is to estimate the value of these agricultural land for the growing of apples and hazels, pointing out at the possibilities of the further development of this branch of agriculture. Considering the characteristics of soil, climate and relief as well as the claims for the intensive growing of apples and hazels, the evaluation of the land suitability was made and it was determined that there are 51.839,2 hectares of suitable land for growing of apples and 39.728,8 hectares for hazels in the region of this county. These areas represent significant land resources, and to eliminate or reduce the already existing constraints, primarily related to physical and chemical properties of the soil, it is necessary to carry out individually or in combination the following land improvement measures when raising new plantations : vertical deep ploughing, subsoiling, organic and mineral fertilizing, calcification, the removal of stones and rocks, basic and detailed drainage, irrigation.

Keywords: *land suitability, apples, hazels, Virovitica-Podravina County*, *Croatia*

Introduction

Virovitica-Podravina county is located in the Republic of Croatia and covers an area of 2.021 km^2, of which the agricultural area of 1.168 km^2 (approximately 58%). Representation of orchards in the total of used agricultural land is 1.6%, which is lower than the national level of 2.1% (Statistical Year Book of Croatia, 2012). In the structure of production, the appels and hazels are the most represented. Their growing according to the development plans of the county intends to expand because of the significant interest for them. Therefore, the main aim of this paper is to establish agro-ecological features or characteristics of the soil, climate and relioef of the area, and taking into account the requirements of apples and hazelnuts to make an assessment of soil suitability for their cultivation. This information may additionally be used for planning and managing agricultural policy in these areas, as well as for the financing of loans for the family farms.

Materials and methods

Soil classification is determined according to the current classification of soils (Škori et al., 1986), and the distribution and characteristics of soils were determined according to the Basic Soil Map of Croatian measuring scale 1: 50.000 and accompanying interpreters, sections Bjelovar 2 and 4, Podravska Slatina 1, 2, 3 and 4, Donji Miholjac 2 and 4. which cover an area of Virovitica-Podravina county. Features of the relief obtained on the basis of topographic maps at the scale 1: 50.000. The conducted analysis of climatic characteristics was based on data of meteorological station Virovitica and includes precipitation and air temperature for the period 1967-2010. Assessment of the land's suitability for fruit growing in the area of Virovitica- Podravina county, respecting type and intensity limitations to their

intensive use, was made by the modified method of Food and Agriculture Organisation (FAO, 1976; Vida ek, 1976). When preparing the soil map, as well as the suitability maps for growing of apples and hazels the ESRI software package was used.

Results and discussion

Geographical position

Virovitica- Podravina County extends at the border of central and eastern continental Croatia. To the west it is bordered by low mountains Bilogora, and further south continues to Papuk and Krndija. Northern natural boundary is the river Drava and the Republic of Hungary. Geographically Virovitica- Podravina County occupies the space between 16°10' and 17°17' east longitude and 45°25' and 46°00' north latitude.

Climatic features

Generally it can be said that the climate of Virovitica- Podravina County is a temperate continental and according to value of Lang rain factor (75.8) has a semi humid characteristics. The average annual rainfall (period 1967-2010) is 810.8 mm, with a large annual variation of 552.6 mm to 1302.8 mm. During the active growing season (IV-IX month) average fall is 454.9 mm, while the outside of the growing season (X-III month) 355.9 mm. The average annual air temperature (period 1967-2010) is 10.7°C, with the annual variation of 9.3°C to 12.7°C. The average air temperature during the active growing season is 17.2^{0}C, the coldest month is January with an average temperature of -0.1°C, while the monthly mean temperature of the warmest month - July is 21.0°C. Mean daily temperature above 10°C (effective active temperature) occurs in April and ceases during October. The average annual value of insolation in the Virovitica-Podravina County is 2119.8 hours, the highest average insolation is in July (293.6), and lowest in December (60.3).

Relief

Virovitica-Podravina County is characterized by three relief units.
1. Holocene plateau in the north part of County, which stretches along the valley of the river Drava, with altitudes ranging from 90 to 120 m.
2. Pleistocene terrace, which continues on plateau with altitude up to about 200 m.
3. Slopes and hills to Bilogora 500 m above sea level and the mountains of Papuk with altitude 500-850 m. Hence, the altitude of Virovitica-Podravina County varies between 90 and 850 meters above sea level, (Figure 1).
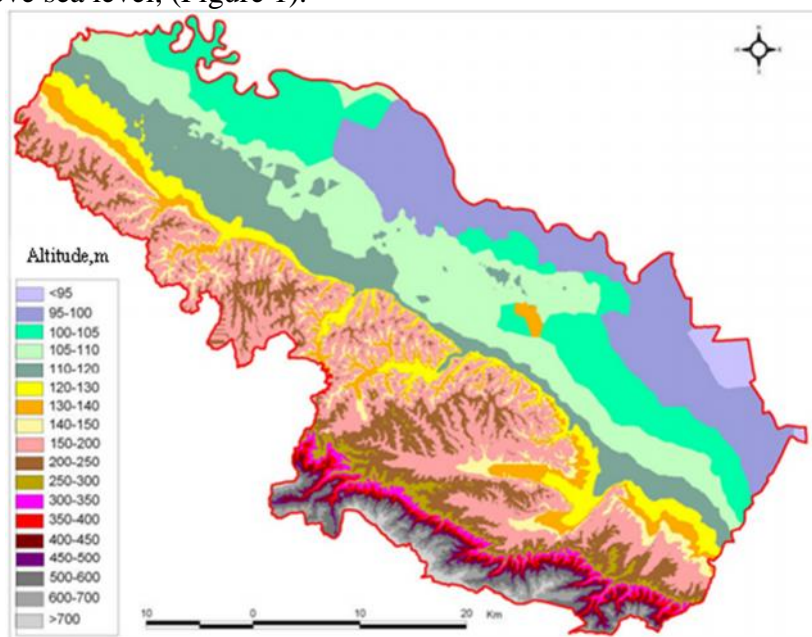

Figure 1: Altitude of the terrain in Virovitica-Podravina County

Soil

According to the Basic soil map of Croatian scale 1:50 000, in the area of Virovitica-Podravina County there are 86 soil mapping units, from the division of automorphic and hydromorphic soils, whose spatial distribution is shown on soil map scale of 1:100 000, figure 2. Ten types of soil were found, from automorphic division (rhegosol, colluvial soil, calcomelanosol, rendzina, ranker, distric cambisol, eutric cambisol, calcocambisol, luvisol and rigosol), six types of soil from hydromorphic division (fluvisol, pseudogley, pseudogley-gley, humofluvisol, eugley and histosols) and hydroameliorated soils drained with pipe drainage. Basic physical and chemical properties of certain types of soil are described according to the results of previous field and laboratory studies, and are found in expositors of Basic soil map sections Bjelovar 2 and 4, Podravska Slatina 1, 2, 3 and 4 and Donji Miholjac 2 and 4.
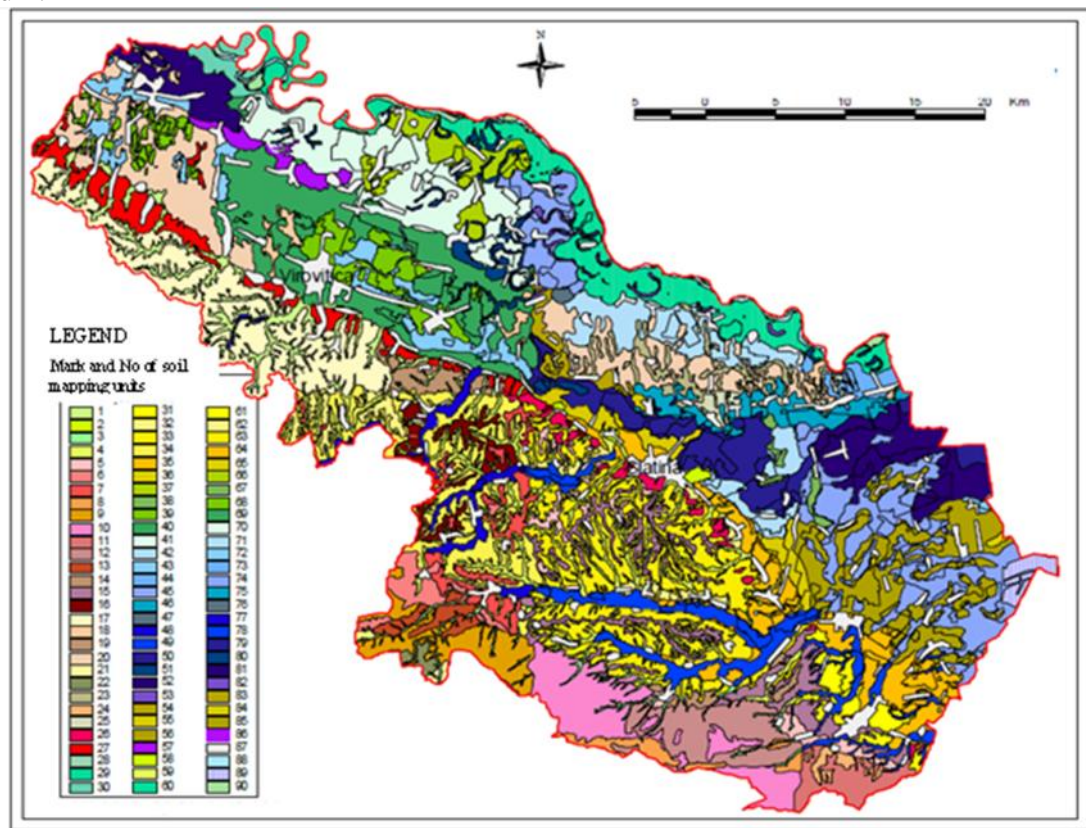

Figure 2: Soil Map of Virovitica-Podravina County, scale 1:100.000 with a legend

Evaluation of land for fruit growing
Concept and evaluation criteria

Land as an object of evaluation includes physical space - climate, relief, soil, geology, hydrosphere, vegetation, and the results of past and present human activities (drainage and irrigation, terracing, deep tillage, chemisation etc.), to the extent of their impact on benefits and features dedicated using (modified according to FAO, 1976, Vida ek, Ž., 1976).

Evaluation of land suitability Virovitica-Podravina County for apples and hazels growing is primarily qualitative and based on relevant soil properties and qualities and/or limitations of systematic soil units. Classification structure consists of orders, classes and subclasses suitabilities for fruit growing. Orders determine the suitability (P) or unsuitability (N) of soil for fruit growing; classes determine suitability degree: P-1 good or suitable soil for fruit growing without major restrictions, P-2 moderately suitable soil for fruit growing with individual limitations and P-3 limited suitable soil for fruit growing with a number of serious limitations.

Class N-1 temporarily unsuitable soils for fruit growing that require radically arranging and class N-2 permanently unsuitable soils for fruit growing because their arrangement is not possible or not economically justified. Subclasses of soil suitability and unsuitability determine the types and intensity of limitations, which are shown in table 1.

Table 1: Types of restrictions with the intensity and the criteria used in the evaluation of land suitability for apples and hazels growing

Landforms (r)	Terrain inclination (n)
r1 = narrow stream valleys	n1 = 0-1% flat
r2 = narrow river valleys	n2 = 1-3% almost flat
r3 = closed depression	n3 = 3-8% gentle slopes
r4 = plains	n4 = 8-16 moderate slopes
r5 = hills	n5 =16-30% moderate steep slopes
r6 = mountain	n6 > 30% stepp slopes
Ecological depth of soil (du)	**Drinage (dr)**
du1 = very shallow 0-15 cm	dr1 = very weakk
du2 = shallow 15-30 cm	dr2 = wea
du3 = medium deep 30-60 cm	dr3 = incomplete
du4 = deep 60-120 cm	dr4 = moderately good
du5 = very deep >120 cm	dr5 = good
	dr6 = slightly excessively
Climate (k) - frost, fog	dr7 = excessively
Soil acidity (a)	**Humus content (hu), %**
a1 = very acid < 4,5	hu1 = very low < 1%
a2 = acid 4,6-5,5	hu2 = low 1-3 %
a3 = weakly acid 5,6-6,5	hu3 = moderate 3-5 %
a4 = neutral 6,6-7,2	hu4 = high 5-10%
a5 = basic > 7,2	hu5 = very high > 10%
Active lime (vp), %	**Soil water regime**
vp1 = little < 5	mv = periodic water deficiency in the soil
vp2 = moderately 5-15	vv = periodic excess water in the soil
vp3 = much >15	v = stagnant surface waters
	pv = flood waters
	V = high level of underground water
Supply of physiologically active phosphorus, mg P_2O_5/100 g of soil (fv)	**Supply of physiologically active potassium, mg K_2O/100 g of soil (kv)**
fv1 = poor < 12	kv1 = poor < 20
fv2 = moderately 13-20	kv2 = moderately 21-35
fv3 = good 21-30	kv3 = good 36-50
fv4 = very good >30	kv4 = very good >50

Results of the assessment of land suitability

Figures 3 and 4 shows the results of evaluation of the suitability of agricultural land of Virovitica-Podravina County for apples and hazels growing, respecting the data of the soil properties, relief and climate.
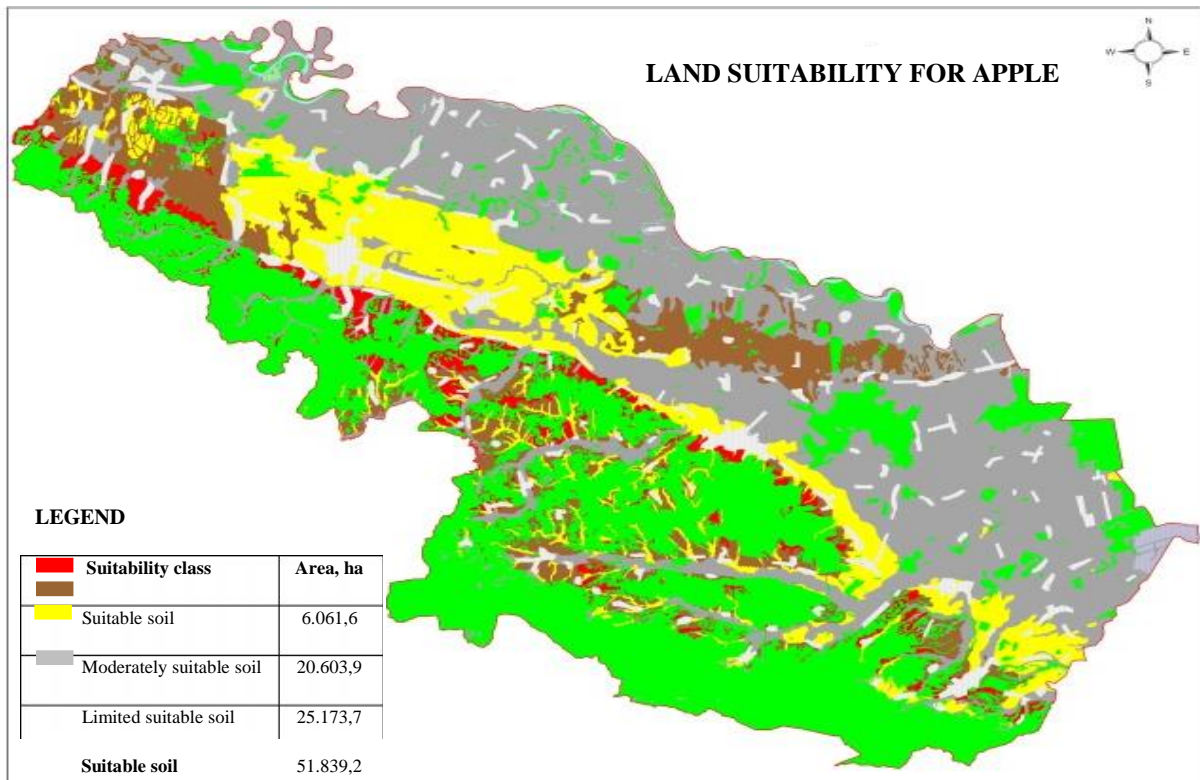
LAND SUITABILITY FOR APPLE

LEGEND

Suitability class	Area, ha
Suitable soil	6.061,6
Moderately suitable soil	20.603,9
Limited suitable soil	25.173,7
Suitable soil	51.839,2
Permanently unsuitable s.	68.288,9
TOTAL	120.128,1

Figure 3: Suitable agricultural land for the cultivation of apples
in the Virovitica-Podravina County

LAND SUITABILITY FOR HAZEL

LEGEND

Suitability class	Area, ha
Suitable soil	6.887,5
Moderately suitable soil	5.556,6
Limited suitable soil	27.284,7
Suitable soil	39.728,8
Permanently unsuitable s.	80.399,3
TOTAL	120.128,1
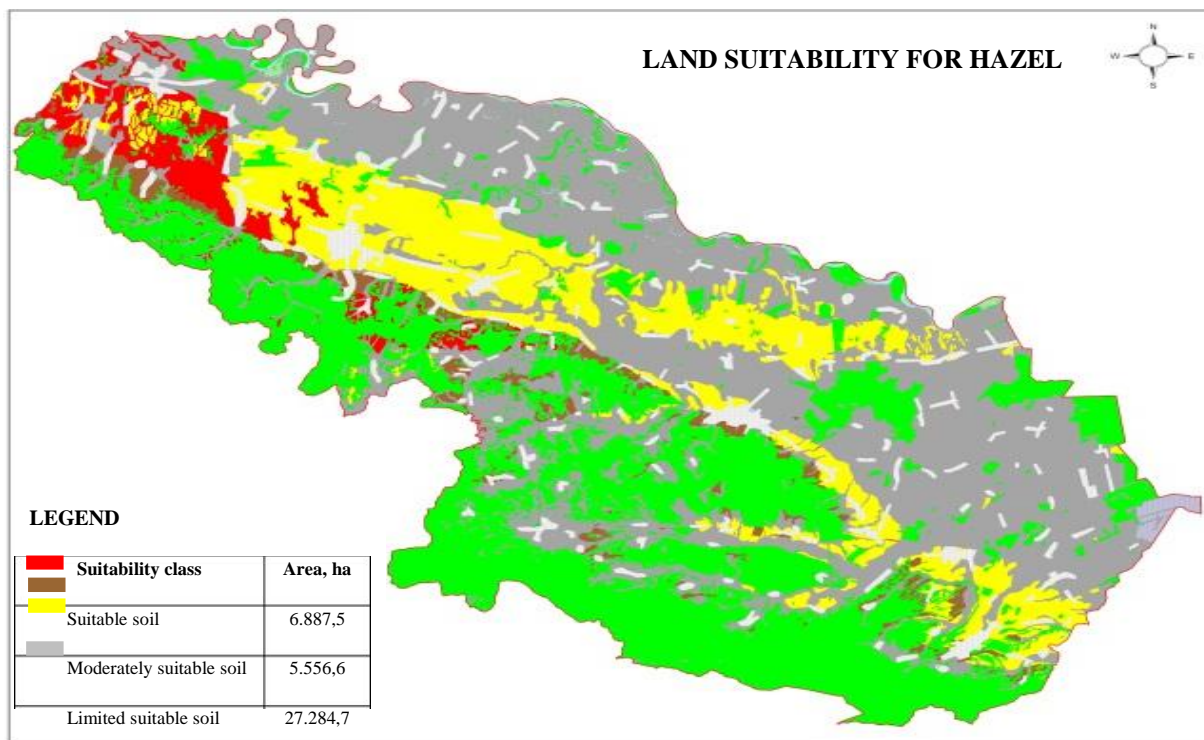
Figure 4: Suitable agricultural land for the cultivation of hazels
in the Virovitica-Podravina County

In the area of Virovitica-Podravina County there are total 51.839,2 hectares of suitable land for apples' growing and 39.728,8 hectares of suitable land for hazels' growing, table 2. Good suitable soils for fruit growing (class P-1 – red colour on the map) have-6.061,6 ha for apples

growing and 6.887,5 ha for hazels growing. Moderately suitable soils for fruit growing (class P-2 - brown colour on the map) have 20.603,9 ha for apples growing and 5.556,6 ha for hazels growing. Limited suitable soils for fruit growing (class P-3 – yellow colour on the map) have 25.173,7 ha for apples growing and 27.284,7 ha for hazels growing.

Table 2: Areas of land suitability classes of Virovitica-Podravina County for apples and hazels growing

Suitability classes	Apples	Hazels
P-1	6.061,6 ha	6.887,5 ha
P-2	20.603,9 ha	5.556,6 ha
P-3	25.173,7 ha	27.284,7 ha
P	51.839,2 ha	39.728,8 ha
N-1	-	-
N-2	68.288,9 ha	80.399,3 ha
N	68.288,9 ha	80.399,3 ha

Conclusion

The main limiting factors for the apples and hazels' growing in Virovitica-Podravina County are climate (fog and frost), relief (exposure and inclination), the presence of excess water and restrictions on the physical and chemical properties of the soil (compaction, ecological depth, drainage, moisture regime, soil reaction, low humus content and supply of physiologically active nutrients). For a successful intensive apples and hazels growing is necessary to carry out the following hydro and/or agromelioration measures, individually or in combination: drainage, irrigation, deep tillage, subsoiling, calcification, humization and ameliorative fertilization. The relief can be corrected by contour tillage or terracing.

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BIOSTIMULANT APPLICATION IN TRANSPLANTS PRODUCTION *OF Allium Sativum* L. AND *WILD ROSES* (*Rosa Canina* L.)

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Abstract

Advantages of *in vitro* propagation of some vegetable and flower transplants is that can be started with very little amount of plant material that represents initial explants, which is very important in the protection of endangered and rare species. Slavonian winter garlic is an old, indigenous variety of garlic grown on Slavonia and Baranya fields, east Croatia. Today, unfortunately, due to the introduction of foreign varieties into production, lack of local seed source, the increasing commercialization of vegetable production and the depopulation of rural areas, large part of the local varieties of garlic may be lost forever. Method of *in vitro* propagation provides a rapid propagation and large number of plants as a single mother plant can produce up to several thousand of seedlings. Aim of this study was to investigate the influence of biostimulant on adaptation of garlic and wild rose in vitro seedlings. *In vitro* transplants of *Allium sativum* L. and *Rosa canina* L. were transplanted in commercial substrate and treated with biostimulant Radifarm® by watering. Influence of biostimulant had positive effect on shoot number and root weight. Investigation shows how biostimulant application in *Rosa canina* and *Allium sativum* transplants production improves growth and development of root and above-ground mass which is important for faster plant adaptation on stress during transplanting.

Key words: *biostimulant, winter slavonian garlic, wild roses, in vitro propagation*

Introduction

In vitro culture of plant cells, tissues and organs is a special branch of plant biotechnology, which is a set of techniques for sterile breeding and vegetative propagation of plants, plant organs, tissues and cells in a defined nutrient medium and under controlled environmental conditions. Largest application of tissue culture methods is in the reproduction of many plant species, especially those that are difficult to reproduce by seeds. Advantages of *in vitro* propagation is that the propagation can start with very little amount of plant material that represents initial explants, which is very important in the protection of endangered and rare species. Slavonian winter garlic is an old, indigenous variety of garlic grown on Slavonia and Baranya fields. Today, unfortunately, due to the introduction of foreign varieties into production, lack of local seed source, the increasing commercialization of vegetable production and the depopulation of rural areas, large part of the local varieties of garlic may be lost forever. *In vitro* propagation of garlic has been reported in many studies using a variety of micropropagation methods (Nagakubo *et al*., 1993; Khan *et al*., 2004; Ayabe and Sumi, 1998).

The usage of *Rosa canina* plant is various and therefore it found its place in culinary, decorating, cosmetic industry, horticulture and as medicinal plant. The most commonly used part of the plant for its medicinal properties is the fruit which are well known to contain a large amount of vitamin C (Daels-Rakotoarison *et al*., 2002; Kilicgun *et al*., 2009). Thus it is

considered to be an astringent, carminative, diuretic, laxative, ophthalmic and tonic. Besides being used for its medicinal properties, wild roses found a place in floriculture as rootstock for grafting or breeding of cultivated species of roses. The propagation of roses can be performed with difficulties caused by poor germination of seeds (if they reproduce generative) or poor rooting of cuttings (if they reproduce vegetative) (Šindrek et al., 2013). A modern method of tissue culture provides faster reproduction of wild roses rootstocks and thus shortened breeding time to one year. After successful propagation of *in vitro* seedlings, the problem can occur in adaptation phase when only 50% of seedlings survives. Application of biostimulants can influence on better root development of seedlings which contributes to more successful adaptation with minimal losses. Biostimulants which contains glycosides, amino acids, arginine and asparagine promotes root hair growth and root function in higher plants (Garcia *et al*., 2006). Research by Zeljkovi et al. (2010) confirmed that application of biostimulant compared to untreated plants of *Salvia splendens* L. transplants immediately after transplanting positively affects plant growth and development. Furthermore, it has been reported that *Tagetes patula* L. transplants treated with biostimulants had improved root and above-ground part growth (Para ikovi et al., 2009). Thus, the aim of this study was to investigate the influence of biostimulant on adaptation of garlic and wild rose *in vitro* seedlings.

Materials and methods

Plant Material and Sterilization

Rosa canina plant material have been collected from the rural area of Slavonia - Baranya County, whereas cloves of Slavonian winter garlic was taken from personal production in July 2013. The plant material of both species was firstly washed with running tap water. After cutting, nodes of wild rose stem and peeled garlic cloves were washed again under tap water followed by addition of two drops of liquid soap for about 15 minutes. Sterilization was conducted by immersing the prepared garlic and wild rose plant material in a series of solutions: initially with 70% ethanol for 1 min, then by 10 % bleach, with a drop of detergent solution for 20-30 min and then again 70% ethanol for 1 min and finally washed five times with sterile distilled water. During the course of the sterilization treatments, the plants were periodically stirred.

Culture media and conditions for shoot regeneration

The basal medium consisted of MS mineral salts and organics (Murashige and Skoog, 1962) supplemented with 30 g sucrose and solidified with 6.4 g agar powder. The pH was adjusted to 5.8 prior to autoclaving at 121°C with a pressure of 1.5 bar for 20 min. For experimental trials, the basal medium was supplemented with 1 mgl^{-1} Indole-3-butyric acid (IBA) and 5 mgl^{-1} 6-benzylaminopurine (BAP). Cultures were incubated at 20°C for 30 days under a 16-h light/8-h dark photoperiod. Light was supplied by cool white fluorescent lamps (20–30 molm^2 s^{-1}).

Elongation and rooting

After 4 weeks of culture, garlic and wild rose explants with regenerated shoots were transferred to fresh MS medium containing the same concentrations and types of plant growth regulators supplemented with NAA (5 mgl^{-1}) and cultured under light conditions for shoot elongation and rooting. The number of normal elongated and rooted shoots was recorded after 4 weeks of growth.

Acclimatization of regenerated plants

Regenerated plants with well-developed roots were removed from culture bottles, washed free of agar with warm water and transferred to container containing commercial substrate (Fruhstorfer Erde, Premium Blumenerde).

Acclimatization of plants was observed in growth chamber for 4 weeks at 20°C with 12-h light regime.

Forty plants of wild rose and forty plants of garlic were transplanted in four repetitions representing treatment and control. Treatment with biostimulant Radifarm® (Valagro SpA, Italy) in the concentration of 0.25% was carried out immediately after the transplantation and each following week. Radifarm® belongs to a group of biostimulants containing glucosides (energy growth factors) and amino-acids (arginine and asparagine) which stimulate root development. After four weeks the transplants were transferred to small pots containing the same substrates where its development and Radifarm® treatment was continued. When the wild rose plants were sufficiently developed for permanent transplantation, root length and mass were recorded. Garlic plants were grown till end of the vegetation when they were harvested and following parameters were recorded: total plant mass, bulb mass and number of cloves per bulb.

Results and discussion

The treatment with biostimulant showed a significant difference of wild rose root mass compared to control plants (p = 0.01). The greatest root mass was recorded on plants treated with the biostimulant (21.010 g), while the smallest root mass was recorded on control plants (15.670 g). Plants treated with biostimulant had 13.96% greater root mass than control plants. Similar results were presented by Vinkovi *et al.* (2009) in whose research the largest root mass of tomato were recorded in plants treated with biostimulant Radifarm ®.
Root length was not significantly influenced by biostimulant (Table 1).

Table 1. Influence of biostimulant on root length and fresh mass of wild rose

Wild rose	Control	Treatment	Mean
Root length	**19,045**	**19,800**	**19,422**
Root mass	**18,163**[b]	**21,010**[a]	**19,586**

	Root length	
LSD	Radifarm	
0,01	ns	
0,05	ns	
	Root mass	
LSD	Radifarm	
0,01	1,1542	
0,05	0,7619	

Statistical analysis of the data showed that the total garlic plant mass was under significant influence (P 0.01) of treatment with biostimulant (Table 2). On plants treated with biostimulant highest total mass of 25.66 g had been recorded, while on control plant smallest total mass of 12,96 g.

The LSD test showed statistically significant difference (P 0.01) in the garlic bulb mass between control plants and plants treated with biostimulant. The highest bulb mass was

recorded on treated plants 25,19 g, while the smallest bulb mass was recorded on control plants 10,54 g.

Treatment with biostimulant also showed a significant difference (P 0.05) in number of cloves per bulb. The largest number of cloves was found in garlic plants treated with biostimulant 14, and the smallest in control garlic plants 7.

Table 2. Influence of biostimulant on total garlic plant mass, bulb mass and number of cloves per bulb of garlic

Garlic	Control	Treatment	Mean
Total garlic plant mass	**16,17[b]**	**20,56[a]**	**18,365**
Bulb mass	**15,27[b]**	**19,04[a]**	**17,155**
Number of cloves per bulb	**9,80[b]**	**12,74[a]**	**11,270**
Total garlic plant mass			
LSD	Radifarm		
0,01	2,7054		
0,05	1,1729		
Bulb mass			
LSD	Radifarm		
0,01	2.0896		
0,05	0,9059		
Number of cloves per bulb			
LSD	Radifarm		
0,01	6.6886		
0,05	2.8998		

The result in this research showed positive affect of biostimulant on almost all investigated parameters of both wild rose and garlic. This might be due to the fact that biostimulants work by increasing mineral uptake and improving the nutrient use efficiency (Para ikovi *et al*., 2013). Biostimulant used in this investigation consist of amino acid, vitamins, humic acid, glucosides, nucleotides and mineral nutrients. Stimulatory effects of humic acid on other plants were presented on lettuce (Young and Chen, 1997), tomato (Adani *et al*., 1998), garlic (Abdel-Razzak and E-Sharkawy, 2013), gerbera (Nikbakhta *et al*., 2008).

Similar results in recording greater number of cloves per bulb and achieving overall better morphological characteristic were presented by Shalaby and El-Ramady (2014) and (Abdel-Razzak and El-Sharkawy, 2013).

According to El-Nemr *et al*., (2012) positive effect on plant growth, fruit set and improvement of cucumber production can be achieved by application of biostimulators.

Conclusion

Positive effect of biostimulants on growth and development of almost all agricultural crops initiated increasing interest in using biostimulant in everyday crop production. This study confirms positive effects of biostimulant on all investigated parameters on both wild rose and garlic plants. Treated plants of wild rose had significantly greater root mass, while garlic plants had significantly greater total plant mass, bulb mass and number of cloves per bulb in comparison with control plants. Biostimulant application can be considered as good practice, especially for overcoming stress during the transplantation as well as improved plant growth and development after transplanting.

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ALCARBON FOOTPRINT OF FARM INPUTS USED IN AGRICULTURE SECTOR IN ALBANIA

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Abstract

Evaluation and monitoring environmental performance of agriculture idealistically viewed in a life cycle perspective, is crucial for achieving better management of natural resources approaching sustainability, economic and technological development. In this study a simple LCA model approach was used to estimate GHG emission generated from farm inputs (fuel, machinery, agrochemicals) on regional level in Albania. Emissions were estimated by multiplying activity data obtained from national statistics for year 2012 and emission factors through the consultation of literature using Tier 1 IPCC 2006 methodology. The total GHG emissions from farm inputs was estimated $1075.8*10^3$ tonCO$_2$eq. The results indicated that farm machinery production accounted for 53% of total GHG emission while agrochemicals and fuel for 46% and 1%, respectively. The main emitting regions were Fieri, Vlora and Tirana with 24, 12 and 11% share in total GHG emissions, respectively. The lowest emitting region was found to be Kukesi. Management measures should be developed in an integrated manner for increasing productivity and economic benefits and reducing negative environmental impacts. Practically, Albania need investments in agricultural mechanization, irrigation systems and extension services. Further research and harmonisation of LCA impact assessment models for GHG emission are considered essential toward a sustainable development.

Keywords: *Agricultural production, Green economy, GHG emission, Farm management, LCA*

Introduction

Agriculture plays a major role in the flow of greenhouse gasses - especially carbon dioxide (CO_2), nitrous oxide (N_2O), oxides of nitrogen (NO_x) and methane (CH_4). Emissions of these gases may occur from livestock such as cows, agricultural soils and rice production. Agricultural emission from crop and livestock production increased by 14% from 2000 to 2011 according to FAO estimation. This increase occurred mainly in developing countries due to expansion of total agricultural outputs.

Agriculture is the most important sector in Albania in terms of value added and employment, contributing more than half of Gross Domestic Production (GDP). Hence, increasing agricultural production is vital process not only develop the economy and reduce unemployment, but also to enable the reduction of prices of main products and the country's dependence on imports. According to first national communication to the united nations framework on climate change , Albania's contribution to the global greenhouse gas emissions is relatively low, estimated at 7619.90 Gg in 2000, where main source of CO_2 was energy sector with 44% followed by agriculture with 27.12% of total GHG emissions and Land Use Change & Forestry (21.60%). However, rural exodus, lack of irrigation and drainage systems, low level of technologies in use, weak organization of farmers, low level of development of agro – processing are threatening farms systems and rural communities. Emissions from all regions are expected to grow as increasing of population will drive increased demand for

food. If no measures to reduce greenhouse (GHG) emissions are taken, the GHG emissions for Albania will increase in the years to come as agriculture is becoming the backbone of economy. The main objective of this study is quantification of direct and indirect GHG emission from agriculture sector in Albania generated from production and combustion of fossil fuels used in agriculture sector, farm machinery production and agrochemical production, packaging, storage and transportation and use.

Materials and methods

Life Cycle Assessment (LCA) is commonly employed to undertake a complete evaluation of emissions. LCA is an internationally standardized method (ISO 14040, ISO 14044) where the environmental impacts of products and processes are analysed from 'cradle to grave', such that both direct and indirect emissions from agricultural practices are included. Emissions were estimated by multiplying activity data with emission factors for each resource. The emissions estimates were computed from official national statistics data for 2012 using Tier 1 IPCC 2006 methodology. Tier 1 approaches provide for simple estimations, based on generalized emission factors and other parameter values that are specified either globally or regionally. In line with international greenhouse accounting practice (IPCC, 2006), emission factors are expressed as carbon dioxide equivalents per unit mass of fertiliser product (eg. kg CO_2eq / kg fertiliser) or element (eg. kgCO_2eq/kg N). To calculate carbon footprint the latest 100-year global warming potential for GHGs published by the IPCC were used.

GHG emissions from manufacturing of farm machinery

GHG emissions from farm machinery includes direct emission arising from combusting diesel fuel in engines and indirect emissions from manufacturing, transport from the plant to a farm, repair of machines and discarding/recycling. A detailed analysis for indirect GHG emissions for every machine is impossible due to the workload and missing data. Hence, in this study the GHGs through the manufacture farm equipment (e.g., tractors) were only considered. On average, approximately 83.7 MJ of energy is required to produce one kg of farm machine (Maraseni et al., 2007). Since 1 KWh = 3.6 MJ, 23.25 KWh are required for each of those machinery kilos. In Table 1 are presented the data about tractors registered in each region in Albania.

Table 3. Number of agricultural machineries registered in Albania

Region	Tractor with Wheels	Minitractor	Sowing Machinery	Mower
Berat	514	240	100	80
Diber	348	103	104	45
Durres	471	305	199	151
Elbasan	870	546	403	154
Fier	2315	947	830	566
Giirokaster	283	100	99	94
Korce	1226	1065	529	191
Kukes	273	196	162	58
Lezhe	449	274	182	198
Shkoder	892	313	156	287
Tirane	504	427	243	180
Vlore	574	292	285	147
TOTAL	8719	4808	3292	2151

To deal with high range of machines found in market the average weight of different types of tractors was used. The average weight of a tractors and accessory equipments were derived from tractor data. The respective average weights were 4007 kg for tractor with wheels, 1474 kg for minitractors, 310 kg for sowing machineries and 260 kg for mowers. Each kWh of

energy consumed produces 0.4365 $kgCO_2eq$. The CO_2 emission factor associated with electricity, heat, and/or steam consumption was obtained from Defra 2012 and is average reference value for Europe.

GHG emissions from the production and use of fossil fuels

Use of fossil fuels in agriculture results in CO_2 emissions from production, transportation and combustion of diesel in farm operations. GHG emission from fuel use for agriculture purposes was calculated as a product of fuel consumed multiplied by the appropriate default emission factors. Emissions factor for diesel combustion and life cycle production were obtained from Defra 2012. Each litre of diesel produces 2.4637 $kgCO_2eq$ during its combustion and 0.522 $kgCO_2eq$ from production. Thus the total GHG emissions during the production and combustion of 1 L of diesel is 2.9857 kg CO_2eq.

GHG Emissions from Production, Packing, Transportation and Application of Agrochemicals

Agrochemicals include fertilisers and chemicals (herbicides, insecticides, fungicides and plant growth regulator), with their production, packaging, storage and transportation requiring energy and thereby contributing to GHG emissions (Maraseni, 2012). Three types of fertilizers (Table 2) commonly used in Albania are Urea, Ammonium Nitrate (AN) and Diammonium Phosphate (DAP). Albania.

Table 4. Use of chemical fertilizers on regional level in Albania (All values are in ton)

Region	Urea (U)	Ammonium Nitrate (AN)	Di-amonium Phosphate (DAP)	Mean P	Pesticides
Berat	3322	1405	4223	773	44.77
Diber	973	3396	2225	380	3.98
Durres	3481	2695	4021	262	28.13
Elbasan	3722	3996	5299	11	20.17
Fier	10686	5607	12457	1256	93.76
Gjirokaster	497	783	619	316	6.56
Korce	1800	3499	3999	9	31.80
Kukes	287	733	693	19	3.18
Lezhe	2147	2137	1989	50	12.67
Shkoder	2725	3188	2322	101	37.01
Tirane	3848	3444	7303	189	45.30
Vlore	5274	4907	1939	0	9.90
TOTAL	38762	35790	47089	3366	337.217

The proportions major fertiliser elements (such as N, P, K, S) were estimated using their chemical formula and their molecular and atomic weights. The proportions of fertiliser elements (N, P, K, S) are 46-0-0-0 for Urea, 33.5:0:0:0 for Ammonium Nitrate, 18:46:0:0 for Diammond Superphosphate and 0-33.5-0-0 for mean P fertilizer (Wood and Cowie, 2004). Since ammonium nitrate contains 46% phosphoric acid the percent of phosphorus was converted from concentrations of this content. For pesticides was assumed that they are used as herbicides. The common type of herbicide in Albania is Raundup (a.i glyhosphate 36%). Emission factor was converted to kilograms of carbon dioxide equivalent per kilogram of active ingredient (kg CO_2eq/kg a.i.). Active ingredient (in herbicide, insecticide and plant regulators) were obtained from interview with phyto pharmacists. Emission factors for indirect agrochemical emissions were collected from Lal, 2004. Following Lal, 2004 they were converted into CO_2eq by multiplying by 3.67 (molecular weight of CO_2/atomic weight of C = 44/12).

In addition to the GHG emissions associated with the manufacturing and acquirement of N fertilizers, their application results in direct and indirect N_2O emission from agricultural soils. Specifically, N_2O is produced by microbial processes of nitrification and de-nitrification taking place on the addition site (direct emissions), and after volatilization/re-deposition and leaching processes (indirect emissions). The emissions were estimated at Tier 1 following IPCC, 2006: Vol. 4, Ch. 11. The IPCC Guidelines methodology for calculation of direct and indirect nitrous oxide emissions from agricultural soils is based on an emission factor per kg N in the applied nitrogen. Default IPCC methodology uses a default direct emission factor of 1% NO_2-N emissions kg-1 of applied N and 30% for fraction of N lost in leaching and runoff where 0.75% of this N is indirectly emitted as N_2O-N. In addition, it assumes that 10% of the fertilizer and 20% of the manure N applied to agricultural fields is lost through NH_3-N volatilization and NO_x-N emissions, and about 1.0% of this N is later emitted as N_2O-N. Conversion between emission gases was made according to the standard suggested by the IPCC (Eggleston et al., 2006).

Results and discussion

In Figure 2 are presented the machinery-related GHG emissions including emissions from the production of the machinery and those from fuel usage. Machinery manufacturing was the major contributor to emissions, with 53% share on total GHG emission. This is due to high energy used in machine manufacturing. As expected, the highest source for indirect emission from farm machinery manufacturing was Fieri region due to the highest number of machineries. In fact this region has the most intensive agricultural production in Albania. Compared with the European average, Albania obtain 3 times less yield for unit area because only 54% of farm households have the opportunity to use agricultural mechanics, 46% use animal and hand work. From the total of registered tractor, only 60% of tractors (even these very old) are in working condition. Optimal needs are estimated to around 14,000 tractors.
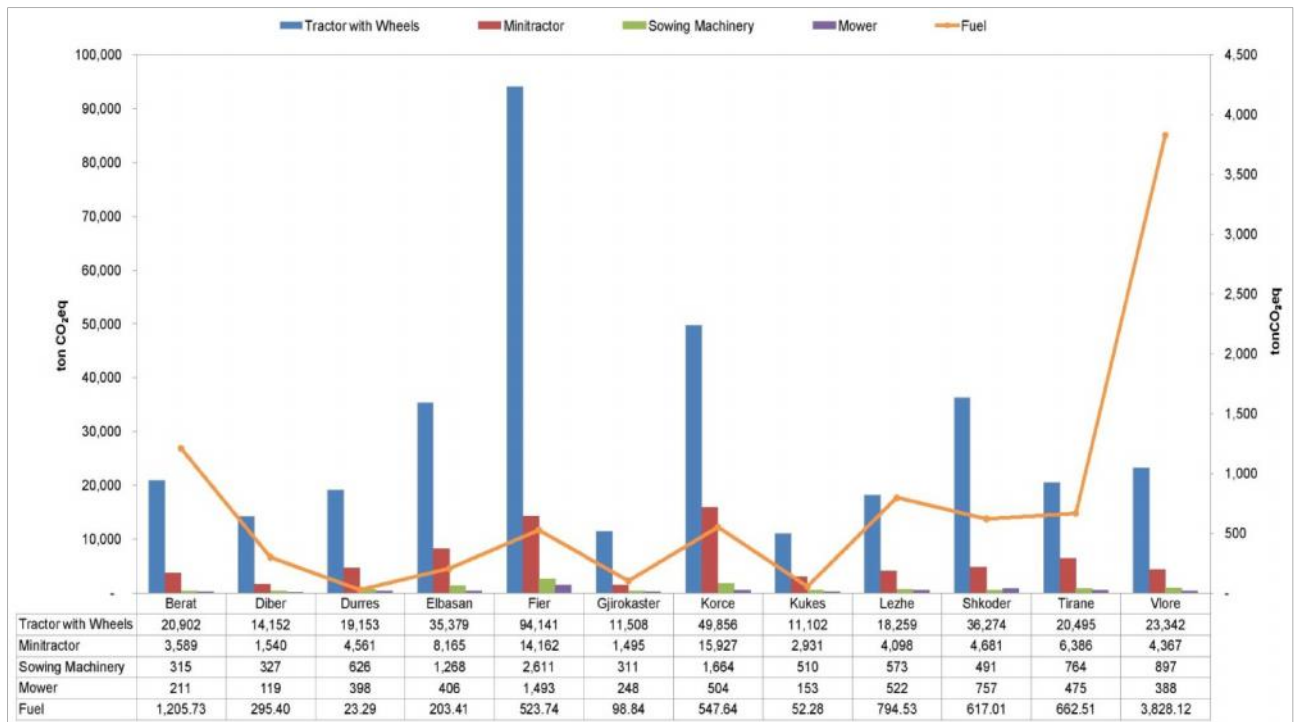
	Berat	Diber	Durres	Elbasan	Fier	Gjirokaster	Korce	Kukes	Lezhe	Shkoder	Tirane	Vlore
Tractor with Wheels	20,902	14,152	19,153	35,379	94,141	11,508	49,856	11,102	18,259	36,274	20,495	23,342
Minitractor	3,589	1,540	4,561	8,165	14,162	1,495	15,927	2,931	4,098	4,681	6,386	4,367
Sowing Machinery	315	327	626	1,268	2,611	311	1,664	510	573	491	764	897
Mower	211	119	398	406	1,493	248	504	153	522	757	475	388
Fuel	1,205.73	295.40	23.29	203.41	523.74	98.84	547.64	52.28	794.53	617.01	662.51	3,828.12

Figure 8. Machinery and fuel consumption related emissions

The total GHG emissions from fuel consumed was estimated at $8.85*10^3$ tonCO$_2$eq where 83% were produced as direct emission (diesel combustion) and 17% as indirect emission (diesel production). Fuel related emissions ranged from 0.69 kgCO$_2$eq/ha (Diber) to 99.9 kgCO$_2$eq/ha (Vlora) with an average of 24.7 kgCO$_2$eq/ha. Agriculture in mountain areas such as Diber and Kukes is dominated by small farms size (average 0.61 ha) and fragmented in the plots which has led to the limitation of agricultural machinery use. In contrast with agriculture machinery emissions, the highest source for fuel related emission was Vlora which has the highest quantity of fuel consumed. This might be explained with the level of farming mechanization needed as the farm size in this region is increased by 43% from year 2000 to 2012. Fuel consumption per unit of work in Albania is much greater than all countries in the region due to the farm zoning, bad fuel quality and obsolescence of agricultural equipment.

Figure 2 presents the agrochemical GHG emissions on regional level. Agrochemical related total GHG emission were estimated as $419.9*10^3$ tonCO$_2$eq. Indirect agrochemical GHG emissions were estimated as $182.5*10^3$ tonCO$_2$eq. The highest relative contribution to total indirect emissions by 46% was attributed to Urea which contains higher amount of N than ammonium nitrate (AN) and diamond phosphate (DAP).

	Berat	Diber	Durres	Elbasan	Fier	Gjirokaster	Korce	Kukes	Lezhe	Shkoder	Tirane	Vlore
Urea Emission (tCO$_2$eq)	7,284	2,133	7,633	8,161	23,431	1,090	3,947	629	4,708	5,975	8,437	11,564
Ammon.Nitrate (tCO$_2$eq)	2,244	5,423	4,303	6,381	8,953	1,250	5,587	1,170	3,412	5,091	5,499	7,836
Di-amm phosphate (tCO$_2$eq)	3,624	1,909	3,450	4,547	10,689	531	3,432	595	1,707	1,993	6,267	1,664
Mean P fertilizier (tCO$_2$eq)	64	31	22	1	103	26	1	2	4	8	16	-
Pesticides (tCO$_2$eq)	0.538	0.048	0.338	0.242	1.126	0.079	0.382	0.038	0.152	0.445	0.544	0.119
Indirect N$_2$O (tCO$_2$eq)	4,195	3,019	4,908	6,089	13,740	916	4,136	764	3,135	4,165	6,445	6,719
Direct N$_2$O (tCO$_2$eq)	12,908	9,290	15,102	18,736	42,277	2,818	12,726	2,350	9,645	12,817	19,830	20,674

Figure 9. Agrochemical related GHG emission

Comparing the regions the highest and lowest indirect emissions was observed for Fieri and Kukesi, respectively. Fieri region is characterized by high amount of Urea used while in Kukes are used more the phosphate fertilizers which has in average 42% lower quantity of nitrogen content. Regarding to emission from fertilizer application the largest source of N$_2$O was nitrification and denitrification which accounted for 75% of total N$_2$O emissions. The total direct nitrous oxide emissions (N$_2$O) from agricultural soils were estimated at 382 ton N$_2$O or 179.1*10^3 ton CO$_2$eq. The total indirect nitrous oxide emissions (N$_2$O) from agricultural soils were estimated at 124.4 ton N$_2$O or 58.2*10^3 tonCO$_2$eq. Indirect emissions accounted for 69% in leaching and runoff and 31% was produced from volatilization. Thus, the total N$_2$O emission was estimated 507.8 ton N$_2$O or 237.4*10^3 ton CO$_2$eq. Average FAO estimation of N$_2$O emission from the application of synthetic fertilisiers in Albania for period 2007-2011 was 205.9*10^3 ton CO$_2$eq, which is close to the value estimated in this study. It should be noted that level of emission may vary year to year depending on fertilizers input.

The GHG estimated in this study are associated with uncertainties from activity data. According to IPCC uncertainties in estimation of emission from agriculture (crops and livestock production) range from 10-150 %. In general, emission estimates for agriculture at national level have uncertainties in the range 10-70% . CO$_2$ emissions from fossil fuels— which represent the majority of anthropogenic emissions—are characterized by a 10-15% estimation uncertainty.

Conclusion

In this study a simple model approach was used to estimate GHG emission generated from farm inputs (fuel, machinery, agrochemicals) on regional level in Albania. This work was developed in order to identify the critical areas and some opportunities for emission reduction through changes to management practices that can simultaneously improve productivity and increase the resilience of production systems in the future. A variety of options exists for mitigation of GHG emission in agriculture. 'Minimum' (or 'reduced') and 'zero' (or 'no')

tillage practices are currently spreading throughout the world (Soane et al. 2012). In south-western Europe the uptake of no-tillage is currently increasing because of perceived environmental advantages and reduced costs. Conversion to organic pastures and agriculture could mitigate 40 percent of agriculture's GHG emissions, rising to 65 percent when combined with zero tillage and that organic farming could reduce irrigation needs by 30-50 percent (Niggli et al., 2009). Reduced tillage also save energy by reducing direct energy consumption and CO_2 from fossil fuel combustion (Jane, 2007). However, such practices are frequently combined with periodical tillage, thus making the assessment of the GHG balance highly uncertain.

Improving N use efficiency can reduce N_2O emissions and indirectly reduce GHG emissions from the energy consumed in its manufacture. Improvements in fertilizer efficiency, water and food security through better management, placement and precision application, as well as through slow-release formulations, can reduce N_2O losses from cropping. Nitrous oxide is a byproduct of fuel combustion, so reducing mobile fuel consumption in motor vehicles can reduce emissions. Improving energy efficiency is among the most cost-effective of the many actions needed for achieving green growth and mitigating climate change. Extensive research must be undertaken to examine effective ways to accelerate the adoption of low emission vehicles or to increase vehicle fuel efficiency, looking primarily at the constraints, such as infrastructure requirements and safety. A number of alternative fuels and technologies are already developed that have the potential to significantly reduce CO_2 emissions and local air pollutants. Significant mitigation is possible with improved water management as Albania is still based in traditional irrigation methods. In fact introducing large scale pressurized irrigation systems using electricity could generate significant CO_2 reduction since 90% of electricity in Albania is generated from hydro-energy which generally has low emission factor. Moreover, pressurized irrigation systems can improve nutrient use efficiency since this systems allows precise application of water-soluble fertilizers and other agricultural chemicals. Furthermore, it is worth pointing out that social conditions also play an important role in examining the efficient use of natural resources. The literature reveals many areas where farmer's education has led to conservation and better use of available water supplies (e.g., Kilpatrick, 2000).

Clearly, there is a big room for improvement for agriculture in Albania, but a wider transition towards a more sustainable agriculture will not occur without some external support and money. Thus, by supporting eco-innovation, regional and national authorities can help to transform the way in which the stakholders interact with local ecosystems and bring value to the local economy.

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LAND DEGRADATION, AGRICULTURE PRODUCTIVITY AND FOOD SECURITY

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Abstract

Land degradation can be defined as a change in one or more of lands properties that result in a decline in land quality The extent to which land degradation affect agricultural productivity and poses a threat to productivity growth and food security is fundamentally influenced by economic, environmental and institutional factors. Furthermore, the important role of the farmer responses to land degradation and its potential impacts on agriculture productivity and food security. Recent estimates suggest that 5 – 6 million hectares of arable land worldwide are irreversibly lost each year as a result of soil erosion, salinization and other degradation processes. Degradation induced yield losses may become more significant in relation to yield growth in the future, as yield growth rates are projected to fall below one percent per year over the next few decades. This is likely to be more sever in arid and semi arid regions due to a combination of resource ; economic factors and infrastructure lack.

The process of rehabilitation of degraded lands is essentially a long-term development that requires the enactment of appropriate policies and supporting institutions as well as enabling environment that ensure the farmers participation and other land users.

Technology development, acquisition and adaptation are central for combating land degradation. Various technologies can be employed to benefit and to have a positive influence on the lives of the people. New technologies innovations in fields such as land use and soil water conservations are needed most. Equally, research needs to move from research centres and stations to farmer's lands, who are the target beneficiaries. The experiences gained and the know-how achieved in these centres need to be harnessed for the benefit of the land users.

In the Mediterranean where land degradation is widely increasing, priorities, should be directed for further progress in understanding and addressing the links between resource quality, agricultural productivity and food security including targeted improvements in data analysis, technology development and policy. Those issues will be discussed in this paper.

Keywords: *Soil, Degradation, salinization, land quality, land rehabilitation, food security*

Introduction

Land degradation will remain an important global issue for the 21st century because of its adverse impact on agronomic productivity, the environment and its effect on food security and the quality of life. It is a massive, global environmental problem (FAO/UNAD/UNEP 1994; FAO/UNEP, 1995; Scerr, 1999). Overall degraded lands worldwide are about 18.1 million km[2] where 92% to mismanagement and 38% to overgrazing.

Land degradation, a decline in land quality caused by human activities has been a major global issue during the 20th century and will remain high on the international agenda in 21st century. The importance of degradation among global issues is enhanced because of its impact on world food security and quality of the environment. High population density is not necessarily related to land degradation that determines the extent of degradation. The Mediterranean, this degradation is manifested in general decline of soil fertility and soil structure, degradation of irrigated land, and erosion of biological diversity eventually leading

to the diminution of affected land's biological potential to sustain life. In the region, continued process of desertification has now far reaching sequences: it manifests itself as a problem of sustainable development, its sever negative impacts on the socio-economic conditions, its responsibility for reducing the regenerative capacity for affected ecosystem and its profound impacts to the wide spread poverty (Eswaran et al., 2001).

Land degradation can be considered in terms of loss of actual or potential productivity or utility as a result of natural or atrophic factors. In context of productivity, land degradation results from a mismatch between land quality and land use (Beinorth et al., 1991).

Land degradation indicates temporary or permanent long-term decline in ecosystem function and productive capacity. It may refer to the destruction or deterioration in health of terrestrial ecosystem, thus effecting the associated biodiversity, natural ecological processes and ecosystem resilience. It also considers the reduction and loss of biological / economic productivity and complexity of crop lands, pasture, woodland, forest, etc.

Across the world over 20% of cultivated areas, 30% of forests and 10% of grasslands are suffering from degradation, affecting about 1.5 billion people this degradation may be the result of numerous factors or combination thereof including anthropogenic activities such as unsustainable land management practices and climatic variations (Bai et al., 2008).

Land degradation occurs in the form of depletion or total loss vegetative cover, and loss of its biophysical and economic productivity through exposure of the soil surface to wind erosion and water erosion, and through salinization and water logging, leading to deterioration of the physical, chemical and biological properties of soil. The continued loss of vegetation through salinization and human activities also depletes the world's biodiversity, and it reduces the ability of natural environment for carbon sequestration, with the consequent long-term effects of global warming and climate; overgrazing in the case of rangelands in particularly serious in arid regions.

Such conditions surrounded with very complex arising problems hitting severely the human well being allow us to state plainly that we are in need to efficient programmes to be implemented in order to face the enormous challenges we are no facing to achieve our goal towards a sustainable use of the natural resources Land and Water.

Land Degradation: Meaning, Definitions, Causes and impacts.

Data on land degradation of global scale are scarce, but recent estimates suggest that 5-6 million hectares of arable land worldwide are irreversibly lost each year as a result of soil erosion, salinization and other degradation processes (Scherr, 1999b). If that degradation occurs in rough proportion to total arable land, then roughly half (about 2-3 million hectares per year) could be assumed to occur in developing regions.

Following FAO definition 1999, in the capacity of land to produce benefits from a particular land use under special form of land management, agricultural mismanagement and overgrazing are two major factors of human induced physical soil land degradation (FAO, 1999).

Agricultural mismanagement, deforestation excessive use of fertilizers, pesticides and other chemical are major causes of chemical soil degradation. Biological soil degradation is associated with lowering or depletion of soil organic matter, continuing negative soil nutrient balance, imbalance in fertilizer application.

Chemical soil degradation occurs due to loss of nutrients and / or organic matters, salinization, acidification or pollution from industrial activities such as mining. Degradation impacts of land degradation are due to decline in land quality on site where degradation occurs (erosion) and offsite where sediments are deposited. However, the onsite impacts of land degradation on productivity are easily masked due to use of additional inputs and adoption of improved technology. On the whole, the numerous studies carried out in different

parts around the world suggest that land degradation to date had had significant impacts on the productivity or quality of cropland in some areas, out not in others impacts are sensitive to location – specific biophysical and economic factors and thus remain unclear at regional and global scales. How much might continued degradation affect productivity in the future? Given that crop yields are projected to increase more slowly in percentage terms than food demand over the next several decades, even small degradation induced losses of productivity raise concerns ((UNEP, 1992).

Causative factors of land degradation, and environmental mismanagement in general are poverty and under evaluating of natural resources (Figure 1)
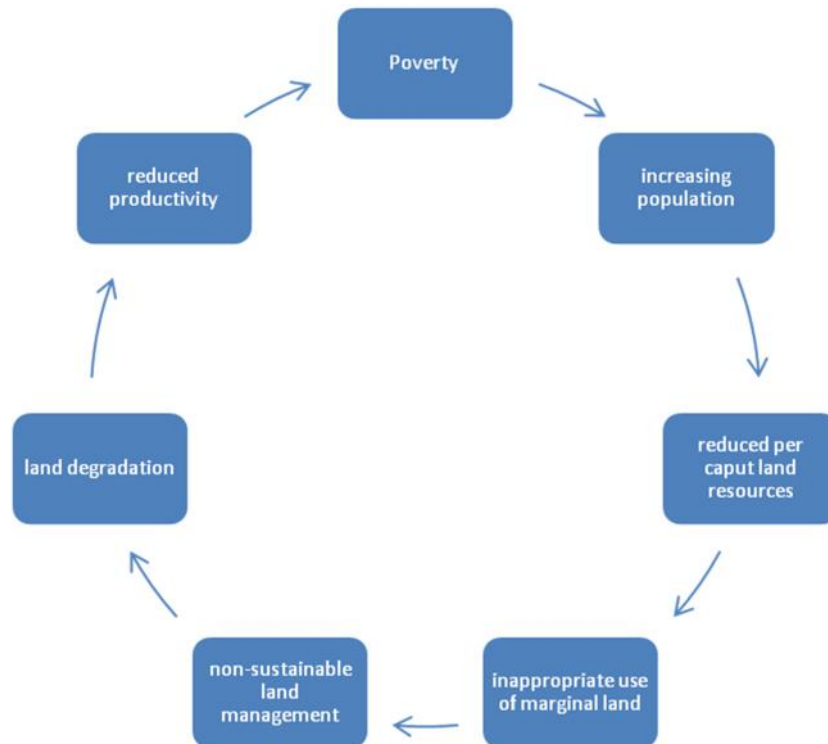
Figure 1: The vicious cycle of land degradation (UNCCD 2013)

Data on land degradation at a global scale are scarce, but recent estimates suggest that 5-6 million hectares of arable land worldwide are irreversibly lost each year as a result of soil erosion, salinization, and other degradation processes (Scherr 1999). If that degradation occurs in rough proportion to total arable area, then roughly half (about 2-3 million hectars per year) could be assumed to occur in developing regions.

Land degradation, desertification and drought: some facts and figures.

More than 50% of agricultural land are moderately to severely degraded.

Land degradation directly affects 1.5billion people globally.

15 billion tons of fertile soil disappears per year.

12 million ha/year lost due to drought and desertification.

Six million km2 of dry lands bear a legacy of desertification.

Biodiversity: 27000 species lost each year due to land degradation.

110 countries have dry lands that are potentially at risk, over 250 million people are directly affected and one billion under threat or risk.

Global desertification costs us$ 42 millions.
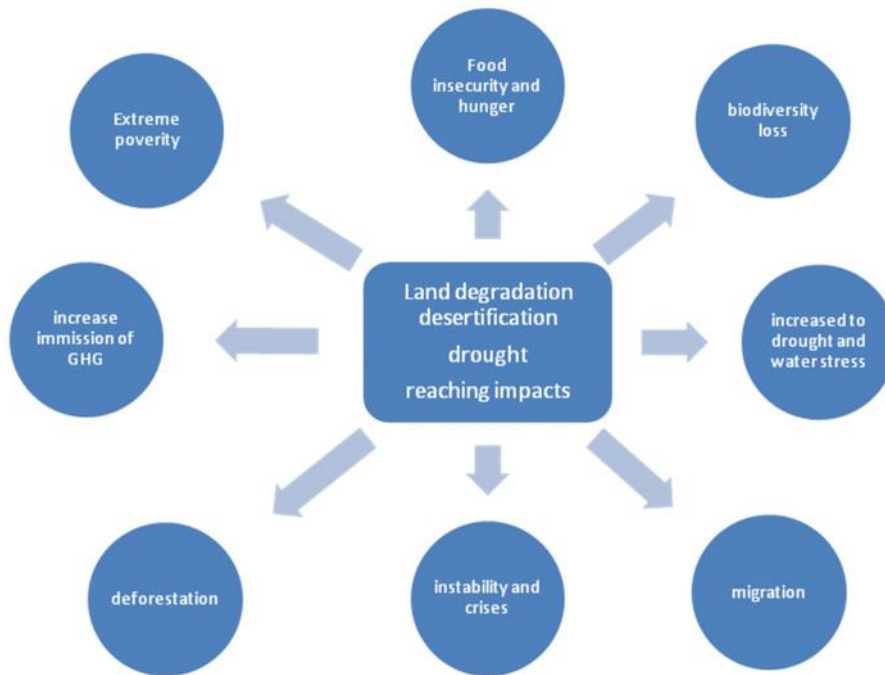
Figure 2. Land degradation: the surrounding question, issues and challenges

There are sufficient studies and reviews (Barro, 1991, Blaikie and BrookField 1987, Johnson and Lewis 1995) that clearly demonstrated that land degradation affects all facets of life, in the mean time it is evident that inspite of the new technologies to reduce degradation and also the techniques to access and monitor land degradation a number of questions are still remaining unanswered including:

Is land degradation inevitable?

Are there adequate early warning indicators of land degradation?

Who pays, who wins in the economics of land degradation?

How to create greater awareness on the perils of land degradation in society and political leadership?

How the absence of land tenure and the resulting lack of stewardship be resolved?

What is the societal in declining soil quality resulting largely from human-induced degradation?

How can soil scientists better participate in developing public policy and local action plans including the restorative inputs to enhance productivity?

What are the areas of collaboration and the tools to be provided by international organizations?

Land degradation, yield growth and food security

Degradation included yield losses may become more significant in relation to yield growth in the future, as yield growth rates are projected to fall below 1 percent per year over the next few decades. Land degradation's effects on more sever in some regions and local areas due to a combination of resource factors (soils and precipitation) and economic factors (poverty, insecurity and lack of infrastructure) (Wiebe K. 2003).

Model results suggest that number of people with nutritionally inadequate diets in low income developing countries would decline 5 percent if average annual yield losses to land degradation in those countries were reduced to 0.2 percent to 0.1 percent.

Reduced yield losses to land degradation is not an easy matter to achieve, hence actual interactions between land quality and productivity are shaped by technical, physical and biological processes many of which are complex, highly interdependent and dynamic.

Land degradation's impacts on productivity may affect food security in some areas both through losses in aggregate production and thus higher food prices for all consumers and through losses in income for those who derive their livelihoods from agricultural land or agricultural labor.

Food security is defined in terms of secure and sustainable access to sufficient food for active and healthy lives, whether access derives from production or exchange. Most studies of the effects of land degradation may also affect food security, through its impacts on food production as well as on incomes and food prices.

Giving the importance of yield growth as a source of production growth in most regions, and the regionally varied impacts of land degradation on productivity, the crucial issue is how food security might be affected by land degradation over time, even if cropland is not lost irreversibly to degradation (Scherr 1999b).

The potential impact of land degradation on food security at a global scale is difficult to quantify, given limited data and complex interlinkages, but, preliminary findings are provided by recent efforts using global simulation models of agricultural production and trade.

On the local, regional and international level, the emerging question which is under continuous debate is: how differences and changes in land quality affect agricultural productivity and food security?. Generally and for land degraded countries most studies of the effects of land degradation focus on selected measures of productivity, but, without carefully considering that land degradation may also affect food security through its impacts on food production as well as on incomes and food prices. Econometric analysis using new data on soil and climate and controlling for the effects of agricultural inputs and other measures of resources quality confirm that differences in land quality contribute to significant differences in agricultural productivity, and food security between countries.

Recent improvements in data and methods allow a new look at these interactions at a variety of scales. For example, existing data on soil properties and new data on climatic characteristics can now be overlaid with high resolution satellite data on land cover to create spatially referenced indicators of crop land quality. These indicators can be used to refine our understanding of the link is between land degradation and agricultural productivity and food security (Wiebe K. 2003).

For most arid and semi arid countries those suffering land degradation further progress is needed for understanding and addressing the links between resource quality, agricultural productivity and food security including targeted improvements in data analysis, technology development and policies that modify the incentives and decisions to mitigate land degradation adverse impacts.

Farmers response to land degradation

Farmers responses to land degradation affect how potential impacts on yields may translate into actual impacts on agricultural productivity. Econometric and simulation analysis show how differences in land tenure and other factors that combine with differences in land quality do influence decisions about practices that reduce erosion and nutrient depletion.

A variety of activities may be considered conservation practices because they maintain or improve soil fertility or reduce soil erosion and runoff and pesticides. These activities include management practices, such conservation tillage, soil-conserving crop rotations, and land improvement. These practices differ from one another and from conventional management practices in the expected magnitude and timing of their costs and returns to the farmer some practices such as conservation tillage may be profitable in the short term due to reduced labours and machinery costs (Rahm and Huffman 1984). Others may become profitable only over the medium term such as contour farming or the long term terracing as they control erosion and maintain and enhance soil fertility and thus improve productivity and land values.

The farmer problem is to choose production practices that maximize present and future net returns, it should be well recognized that impacts of land degradation depends critically on farmers choices, which change overtime in response to and in anticipation of changing economic and environmental conditions.

Indeed, degradation is a slow imperceptible process and so many people are not aware that their land is degrading, creating awareness and building up a sense of stewardship are important in the challenge of reducing degradation. Consequently, appropriate technology is only a partial answer. The main solution lies in the behaviour of the farmer who is subject to economic and social pressures of the community / country in which he/she lives.

Historical and socioeconomic evidence suggest that farmers often respond to degradation by modifying the farming system or practices, either through independent innovation or by adopting practices known elsewhere (Mermut and Eswaran, 1997).

Land degradation prevention and control measures:

The global extent, the significant negative on-and offsite impacts of land degradation on the atmosphere, terrestrial and aquatic ecosystems, food security, continuing degradation of ecosystems, and the high human toll due to land degradation require a concerted effort by the international community to prevent and control it. Well-meaning efforts in the past to address this issue were not very effective mainly because they were based on a sector-by-sector approach that had the unintended effect of fragmentation of policies, institutions, and sustainable land management measures. Therefore, a holistic and integrated approach to land degradation prevention and control, covering both ecosystem and socioeconomic dimensions, is needed.

The package of interventions, with both global environment and sustainable development benefits, -- policies, regulations, institutions, incentives, investments,-- to address land degradation prevention and control may include sustainable land use measures to:

(a) stabilize the global climate and regional system by reducing carbon emissions and increasing carbon sequestration;

(b) promote conservation and sustainable use of diverse ecosystem products (including biodiversity);

(c) maintain the stability of ecological processes such as the hydrological cycle and nutrient cycle; and

(d) improve the economic and social well being of people in areas experiencing land degradation or areas vulnerable to land degradation.

UNCCD united nations convention to combat desertification
Package intervention should include land management activities that can contribute positively to the ability of global and regional climate system and the maintenance or restoration of ecosystem structure and function:
(a) development of participatory sustainable land management planning processes;
(b) assessment of land resources and land use practices as the basis for management measures;
(c) development of information management systems for decision-making on sustainable land management as part of broader management activities;
(d) on-the-ground measures on land management activities to conserve and rehabilitate biological resources; and
(e) development of policies, regulations, incentives, institutions, and on-the-ground investments, to ensure that good practices in sustainable land management are viable and sustainable under local conditions.
Integrated soil fertility management (ISFM). It forms a part of prevention mitigation, and restoration of land from desertification and land degradation it is a set of agricultural practices adopted to maximize the efficiency of nutrient and water use and improve agricultural productivity. IFSM attempts to make the best use of inherent soil nutrient stocks, locally available soil amendments and mineral fertilizers to increase land productivity while maintaining or enhancing soil fertility. Farmers have adopted IFSM technologies have more than doubled their agricultural productivity and increased their farm level incomes by 20 to 50 percent and was the most effecting profitable method to improve degraded areas (Divyalakshne et al., 2013).
A critical factor to keep in mind when thinking about IFSM strategies is that it is very important to consider the socio economic aspects of technological interventions recommended.
Most countries of arid and semi arid regions are now facing important challenges to diminish the increasingly land degradation and to improve the land productivity. However to achieve such goal we are in need to the followings:
To mobilize the scientific community to mount an integrated programme for methods, standards, data collection and research networks for assessment and monitoring of soil and land degradation.
To develop land use models that incorporate both natural and human induced factors that contribute to land degradation and that could be used for land use planning and management.
To develop information systems that link environmental monitoring, accounting and impact assessment to land degradation.
To help develop policies that encourage sustainable land use and management and assist in the greater use of land resources information for sustainable agriculture.
To develop economic instruments for the assessment of land degradation of land resources.
To standardize methods of assessment of extent of land degradation.
To overcome the difficulty in evaluating the on farm economic impact of land degradation on productivity there is an urgent need to productivity, there is an urgent need to address these issues through a multi disciplinary approach, but the most urgent need is to develop an objective, quantifiable, and precise concept based on scientific principles.
Successful land degradation prevention implies the set up of driven training programmes to build local capacity on viable policies, regulations, institutions arrangements. Such training could include participatory workshops involving key government and governmental

organizations on measures needed for sustainable land management programme that address in holistic and integrated manner, global environment and sustainable development issues.

Also an effective response to land degradation calls for improving the incentives for farmers to care for their land and improving their access to knowledge and inputs required for proper care. In this connection it is recommended (UNCED, 1992)

Concluding remarks and recommendations

- Steps to improve the enabling environment to combat land degradation involve overcoming institutional, financial legal and science policy challenges and finding solutions that cross multiple levels and sectors.

- A framework that outlines national priorities for sustainable dry land development is required to provide overall guidance to actors and groups across levels (Herz 2006). The national framework should be incorporated in the mandates of all relevant sectors, providing overall guidance for investment in sustainable land management SLM and promoting public awareness on land degradation and SLM. Furthermore, to prevent policy frameworks from quickly becoming absolute, policy formulation and supporting legislation need to be flexible (Porschè et al 2009), and forward looking to encourage the institutionalisation of planning and implementation measures (Jones et al 2009).

- There are many on- initiatives both at national and international levels to address land degradation problems. While appropriate technologies and information to avoid mismanagement of resources exist for many problems, they have not been sufficiently disseminated and implemented. Although many international, regional networks have been established and are in operation, many of them have not been sufficiently effective and efficient. What further measures should be taken, especially to facilitate dissemination of appropriate knowledge/information and technologies at grass-root levels? What should be done to reactivate existing networks to effectively and efficiently achieve their objectives?

Reasonable answers to the above raised questions could be found through considering the following suggestions.

Existing networks should be reviewed and reorganized, where necessary, to more effectively and efficiently achieve their objectives. Regional, sub-regional networks for specific topics, such as waterlogging and salinization, afforestation/reforestation to prevent sand dunes, may be considered useful.

Dissemination of appropriate information/knowledge and capacity building should have the highest priority for such networks; and

Community-based organizations may need to be established at local community level to bridge gabs between scientific information/knowledge and individual end-users, most likely farmers in dry areas. Education and awareness raising among such end-users and the general public is essential (Katsunori, 2003).

An effective response to land degradation calls for improving the incentives for farmers to care for their land and improving their access to the knowledge and inputs required for proper care. Based on lessons learned from past successes and failures in managing land degradation, the following policy actions should be considered:

Increase research and technology development for land management, and improve the spread of information, through widely linked, user-friendly information systems for farmers.

Promote land-improving investments (for example, building up soil organic matter, planting trees, and installing small-scale irrigation) through technical assistance and new financing arrangements suitable for low-income farmers.

Encourage long-term land improvements by securing property rights and rights of access to natural resources, particularly for the poor.

Develop planning systems for sustainable land use that involve key resource user groups. Improve the economic environment for farmers by developing market infrastructure, correcting distorted price incentives, and encouraging rural income growth and diversification.

For marginal regions, encourage more public investment in infrastructure, social services, and agricultural support services.

A range of powerful scientific methodologies is available that could considerable improve the accuracy, precision and insightfulness of monitoring and assessment of dry land degradation and sustainable land management. However, their use is currently constrained by inadequate institutional protocols and formats within the global scientific community locks a mechanism for distilling and communicating its knowledge in ways that are relevant to and easily understood by non scientific communities such as decision makers and land users. Methods developed by local farmers as well as those developed through scientific research should receive greater recognition and dissemination.

Many types of land degradation can potentially be reserved, but the process requires long term commitment. Land improving investments and better land management can definitely be encouraged through appropriate policies, improved information systems and increased research and technology development.

And above all capacity development through effective training programmes those to cover and respond to the needs of all the stakeholders involved in land degradation management and maintaining land productivity at a relatively high rate.

A coordinated international effort is needed to prioritize research investments efficiently and effectively. Growing international investments in land resources provide potential for assess the global economics of land degradation and to implement recommended actions.

Food security, environmental balance, and land degradation are strongly inter-linked and each must be addressed in the context of the other to have measurable impact. This is the challenge of the 21st century for which we must be prepared.

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EFFECT OF GRASS MULCH ON SOIL PROPERTIES IN TEA PLANTATION

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Abstract

Some farmers in Shizuoka Prefecture, which locates in middle south part of Japan,have conventionally applied large amount of grass scraps to tea fields. This agricultural method, called "Chagusaba agricultural method",was designated as Globally Important Agricultural Heritage Systems (GIAHS) in 2013. It is expected that the grass mulch on soil surface prevents soil and nutrient erosion, weed growth and drastic change in soil temperature, but the effect grass mulch on soil properties has not been clarified. The obtained data from the measurements of soil physical properties of a grass mulch and non-mulch field shows that saturated hydraulic conductivity and air permeability of surface soil increased by the grass mulch but the differences of these properties are small. Pruned branchesand leaves of tea tree in the non-mulch field may play a same role with grass mulch in promoting water and air permeability. Readily available moisture for plant growingin grass mulch field is larger than that in non-mulch field especially in surface layer. It is indicated that this increase of available moisture may contribute the high quality of tea in grass mulch field.

Key Words: *soil physical properties, organic matter content, soil compaction*

Introduction

Some farmers in the central area of Shizuoka Prefecture, which locates in middle south part of Japan (**Fig.1**), have conventionally applied large amount of grass scraps to tea fields.These farmers have also managed large fields, which are called "Chagusaba", to cultivate bamboo grass or reed for the application.And the area of Chagusaba reaches almost 70 % of that of the tea plantation fields (Kakegawa Tourism Association 2014).Some researchers have reported that the rare species lived in Chagusaba and that quality of tea harvested in the grass mulched field tended to be high.This Chagusaba agricultural method is appreciated on codependence between agricultural

Fig.1 Location of Shizuoka Pre. and cities where Chagusaba fields are distributed

production and biodiversity in this area and this traditional tea-grass integrated system was designated as Globally Important Agricultural Heritage Systems (GIAHS) in 2013.

It is reported that the grass mulch on soil surface prevents soil erosion (Adekalu et al.,2007),and decreasesdrastic change in soil temperature and soil water loss by evaporation (Chen et al., 2007; Jun et al., 2014). These changes in soil conditions would bring about increasing in plant growth as Kar and Kumar (2007) but Chen et al. (2007) presented grain yield of winter wheat reduced by straw mulch. A comprehensive understanding of the optimum amount or timing of mulch for plant growth is still lacking.

Mulch grass in the tea fields applied Chagusaba agricultural method is compacted by traveling of a tractor and human walk and surface soil and the grass are mixed after the application of

chemical fertilizer to the soil. These actions could also change physical properties of the surface soil but the effect grass mulch on soil properties has not been clarified.

The objective of this study is to clarify changes in soil physical properties by grass mulch and mixture.

Site and methods

Research was carried out at two contiguous tea fields in Shimada City in Shizuoka Prefecture (Latitude: 34°49/N; Longitude 138°11/E; Altitude 110m above mean sea level). Upland and Average annual air temperature and precipitation in this area are 14.8°C and 2,150 mm, respectively (1981-2010).These fields are located at the edge of Makinoharaupland and soil at the fields is classified red-yellow soil.

Surface soil of one field was mulched by scraps of Phragmites leaf and stark cut into length of 5 - 10 cm (MF in **Fig.2**). The Chagusaba agricultural method (grass mulch practice) has been done for more than 20 years in this field. The scraps were scattered on the soil surface generally in winter (from October to February) in this field and the thickness of the mulch layer is 5 - 10 cm (**Fig. 3**). The farmer of MF applies chemical fertilizer in

Fig.3 Photos of grassmulch in MF (a: just after mulching, b: 10 months after mulching)

early spring and harvests the tea leafs twice, in May and in June. After the second harvest, branches of tea trees are cut for 10 –15 cm to promote the growth of the tree in winter and the pruned branches were scattered. Another tea field (NM) was managed without grass mulch but many large pruned branches whose maximum length was 15 cmwere observed.

Soil samples were obtained from 5 points (point A - E in **Fig. 2**) in MF and 2 points (point a and b) in NM. Sampling depth was 0 - 5, 5 - 10, 10 - 15, 20 - 25, 30 - 35 cm and two undisturbed sampleswith 5.0 cm in diameter and 5.1 cm in height and one disturbed sample were taken at each depth. The field surveys were conducted on 11 October (point A, B and a), the 6th of November (point C, D and b), and the 29th of November (point E).

Ignition loss, which indicated the content of organic matter, was calculated from the difference between the weight of the oven dried sample and that of the sample heated to 800 °C for 3 hours in a muffle furnace. Bulk density of the sample was measured by oven dry (105 °C, 24 hours) with the undisturbed sample. Saturated hydraulic conductivity of the undisturbed sample was determined by falling-head method. Volumetric water content of the undisturbed soil whose matric water potential was adjusted to be 9.8 and 61.8 kPa by the pressure plate method was measured to estimate the soil water characteristic. Readily available moisture for plant (RAM) was calculated by the difference of the water contents of

the soil whose matric water potential is 9.8 kPa and 61.8 kPa.

Results and discussion

Measured ignition loss of disturbed soil was shown in **Fig. 4**. The values of ignition loss in NM were larger than those in MF. This result conflicts with that expected from the general opinion which grass mulch practice enhances the organic material and the carbon stock in soil profile. This discrepancy is due to the effect of the left large pruned branches in NM. Thelength of pruned branches, which is determined by the farmer of the field, in NM is tend to be larger than that in MFandlarge undecomposed fraction was remained in surface soil layer of NM. It is proposed that the organic matter content of surface soil in a tea field was affected not only by the grass mulch but also by the left pruned branches.

Bulk density of the soil in MF is larger than that in NM except at surface layer (**Fig. 5**). It is expected that mulching and mixing of grass husks decreased the density and hardness of soil and this result also conflict with the expected one. The higher soil density in MF than in NM can be explained in term of the difference of the agricultural machineused in each field. Soil in MF is more compressed by treading strass of the larger and heavy machine used for harvest and prune in MF The density of top soil in MF was very small compared with that of
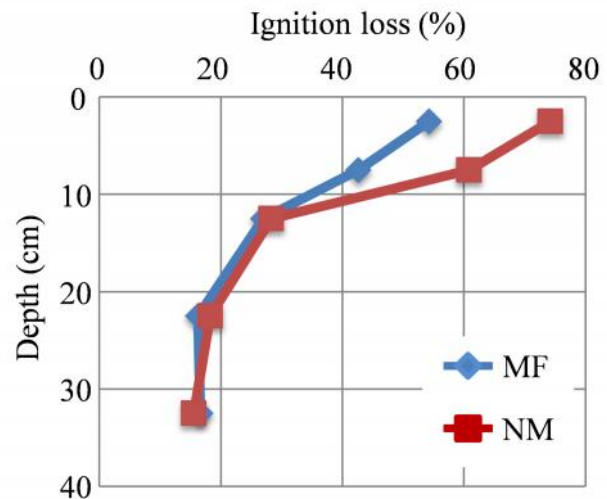
Fig.4 Distribution of ignition loss of soil
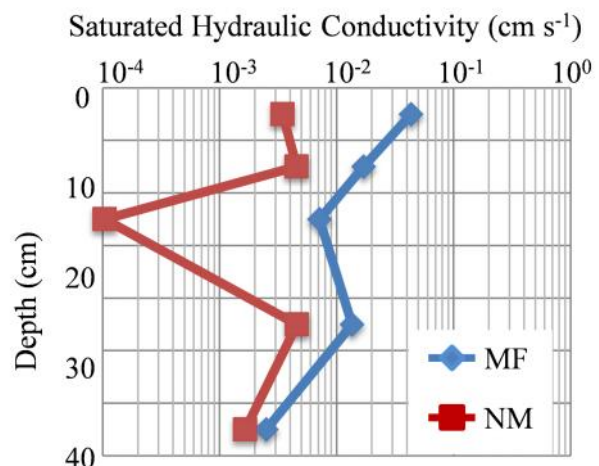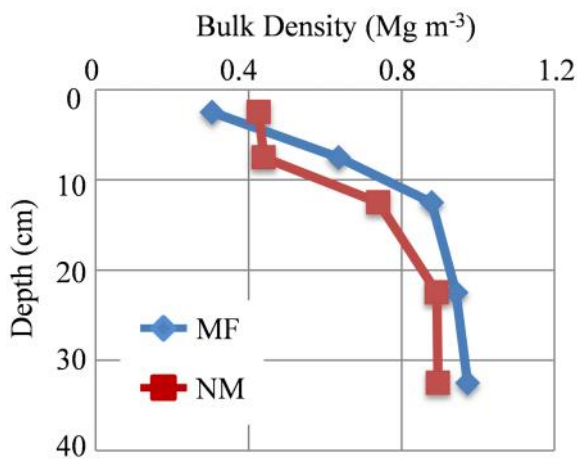
Fig.5 Changes in bulk density of soil with depth

Fig.6 Changes in hydraulic conductivity with depth

other depth and was also smaller than that of top soil in NM. It is suggested that grass mulch in MF controlled the compaction of surface soil. Soil hydraulic conductivity in MF was larger than that in NM (**Fig. 6**). It is expected that high bulk density in MF reduced the hydraulic conductivity of soil because the pore spaces had been compressed during the compaction. The high hydraulic conductivity in MF can be explained by change in the pores size distribution of soil. Many large pores made by mulched and mixed grass kept the hydraulic conductivity high after the compaction although the total amount of pore space was increased.

Volumetric water content of the soil samples whose matric water potential wsa adjusted to 9.8, 61.8 kPa were shown in **Fig.7**. The water content of the soil in MF is smaller than that in NM compared with same drainage condition. It is demonstrated that the surface soil in MF had high drainage property. This high drainage property in MF is consistent with the
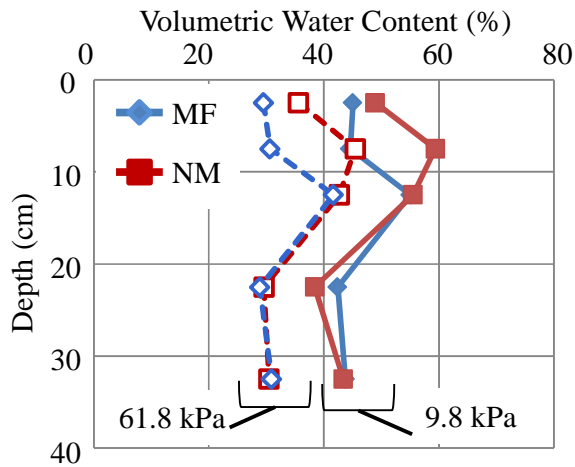
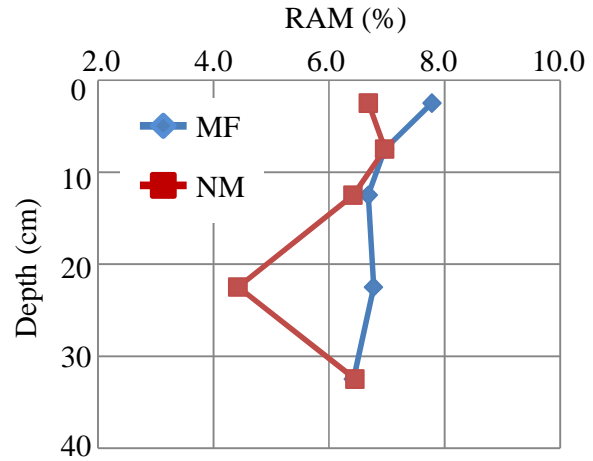**Fig. 7** Volumetric water content of soil drained by pressure plate method

Fig. 8 Distribution of readily available moisture for plant (RAM) of soil

suggestion that many large pores existed in the soil in MF. Tea trees are easy to take wet injury and prefer high drainage soil. It is considered that large pores made by the grass promote the quality of harvested tea leafs with increasing the hydraulic conductivity and drainage property. From the estimation of RAM, it can be stated that the grass mulch also increased the RAM (**Fig. 8**). The larger pores cannot hold much water after irrigation or rainfall because their retention force of water is small and water in the smaller pores is not available for the plant because their retention force is larger than the water adsorption force by the root. It is proposed that the size of grass husk which affects the pore size distribution of soil may play an important role in the high tea quality in this area.

Conclusion

Some farmers in Shizuoka Prefecture, which locates in middle south part of Japan, have conventionally applied large amount of grass scraps to tea fields. To clarify the effects of grass mulch in tea field, the field survey was carried out. The obtained data from the measurements of soil physical properties of grass mulch (MF) and non-mulch (NM) field shows that the values of ignition loss in NM were larger than those in MF. It is proposed that the organic matter content of surface soil in a tea field was affected not only by the grass mulch but also by the left pruned branches. Soil hydraulic conductivity in MF was larger than that in NM although bulk density of the soil in MF is larger than that in NM except at surface layer. This contradiction was interpretedas the large pores made by mulched and mixed grass.These pores were thought to be kept the hydraulic conductivity high after the compaction although the total amount of pore space was increased. The water content of the soil in MF is smaller than that in NM compared with same drainage condition. From the estimation of readily available moisture for plants, it can be suggested that the grass mulch also increased the RAM. It is proposed that the size of grass husk which affects the pore size distribution of soil may play an important role in the high tea quality in this area.

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ASSESSMENT OF SOIL EROSION IN THE LIPNICA WATERSHED, POLIMLJE, MONTENEGRO

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Abstract

Assessment of soil erosion risk is of great importance for management of natural resources, allowing decision makers to modify land use properly implementing environmental strategies more sustainable in the long-term. Inappropriate land use and land management is often viewed as main cause of accelerated erosion rates. Modelling soil erosion rates is key to understand the impact of future land management and climate change on land degradation. Polimlje is one of five river basins in Montenegro that drains toward the Danube and is divided into fifty-seven sub basins. Lipnica watershed is one of them where we studied soil erosion processes using the IntErO model, with the Erosion Potential Method embedded in the algorithm of this computer-graphic method. For the current state of land use, calculated maximal outflow from the river basin is 58 m^3s^{-1} for the incidence of 100 years and the net soil loss is 469 m³year^{-1}, specific 92 m³ year^{-1} per square kilometre. With the results obtained we were able to conclude that the river basin belongs in „Destruction Category V", according to the classification system of Gavrilovic; the erosion process is very weak. This study has shown that the IntErO model and Erosion Potential Method are useful tools for researchers in calculation of sediment yield at the level of the river basins for the South East European region.

Key words: *Erosion, Soil erosion assessment, watershed, Land use, IntErO model.*

Introduction

Soil is one of our most precious natural resources. Proper soil management is a key to sustainable agricultural production. Soil management involves six essential practices: proper amount and type of tillage, maintenance of soil organic matter, maintenance of a proper nutrient supply for plants, avoidance of soil contamination, maintenance of the correct soil acidity, and control of soil loss – erosion (Simmons and Nafziger, 2014).

Watersheds are often affected by natural disasters, above all floods, overflows, inundations, erosion problems, landslides and pollution (Tazioli et al., 2015). The estimation of the erosion in a watershed is therefore essential to encompass a lot of environmental problems and to evaluate the amount of sediment moved, transported and deposited in and out of the basin.

Direct measurements of erosion in a watershed are possible with multi-years measurement of solid transport in the closing-section (Tazioli, 2009). Due to lack of sediment gauging station in some catchments, for anticipating and evaluating of catchment's erodibility within catchment's programming and making priority in soil conservation for evaluating erosion and sediment yield, it is necessary to use quantitative and qualitative models. By using models for calculation of erosion intensity we are able to locate erodible areas, but major problem is their

calibration and reliability which should be done with high precision (Zia Abadi and Ahmadi, 2011).

The authors of this study used the computer - graphic IntErO model (Spalevic, 2011) for prediction of soil erosion intensity and maximum outflow from the catchment area. This model is calculating inputs using analytics of the Erosion potential method (EPM), originally developed by Gavrilovic (1972). The method has been tasted earlier in many catchments area in Bosnia & Herzegovina, Bulgaria, Croatia, Czech Republic, Italy, Iran, Montenegro, Macedonia, Serbia and Slovenia (Behzadfar, et al., 2014; Kostadinov et al., 2006; Spalevic et al, 2012b). In Montenegro have been successfully used in the Region of Polimlje (Spalevic et al. 2014a, 2014b, 2014c, 2014d, 2014e, 2014f, 2013a, 2013b, 2013c, 2013d, 2013e, 2013f, 2012a).

The goal of this research is the characterization of the erosion processes in relation to the recent state of the runoff and sediment yield in the Lipnica Watershed of the Polimlje River Basin.

The results are consistent with previous researches under similar conditions and it appeared that analytical output results are compatible with field observations of Kostadinov (2014), Tazioli (2009), Spalevic (2011), as well as Maleki (2003), Khaleghi (2005), what is leading to the conclusion that the modelling of the sediment yield by the EPM and IntErO model is one of the possible options for studying the river basins similar to the Lipnica watershed of Polimlje, Montenegro.

Material and methods

The study area refers to the Lipnica catchment a left-hand tributary of the river Lim located in Polimlje Region of Montenegro. The total area of the catchment, F, is 5.1 km^2; perimeter, O, is 12.59 km; with a natural length of the main watercourse, Lv, of 4.12 km; as well as a minimum elevation of 560 m and maximum of 1096 m above the sea level. The terrain type of the catchment is predominantly hilly with average slope of 29% indicating that in the river basin steep slopes prevail.

Using the data of the Hydro-meteorological Institute of Montenegro, station Bijelo Polje for the period 1948 – 2014 we concluded that the climate of the area is characterised by dry summers; rainy autumns and springs; and cold winters. The absolute maximum air temperature is 35°C and the low temperatures can fall to a minimum of -29.8°C. The amount of torrential rain, hb, is 84.7 mm. The average annual air temperature, t0, is 8.9 °C. The average annual precipitation, H_{year}, is 893 mm. The temperature coefficient of the region, T, is calculated on 0.99.

We drew on the earlier geological research of the Institute of Geology of Montenegro using the geological data from the Geological map of Montenegro (Zivaljevic, 1989) related to the structure of the river basin, according to bedrock permeability. The geological structure of that part of Montenegro consists mainly of Paleozoic clastic, carbonate and silicate volcanic rocks and sediments of the Triassic, Jurassic, Cretaceous-Paleogene and Neogene sediments. Our analysis shown that the structure of the river basin, according to bedrock permeability, is the following: f0, poor water permeability rocks, 86%; fpp, medium permeable rocks, 14%; fp. The coefficient of the region's permeability, S1, is calculated on 0.96.

Based on the previous results of soil research (Fustic and Djuretic, 2000; Spalevic, 2011), as well as the original fieldwork and laboratory analysis, we concluded that major soil types in the river basin are Dystric cambisol (91%); Calcomelanosol (8%) and some Fluvisol (1%), close to the confluence of Lipnica into the Lim River.

We used the program Intensity of Erosion and Outflow - IntErO (Spalevic, 2011) for calculation of soil erosion intensity and forecasting of maximum runoff from the river basin, a programme driven by the Erosion Potential Method (Gavrilovic, 1972).

The Erosion Potential Method calculates coefficient of erosion and sediment yield (Z) of a Catchment area by following equation:

$$Z = Y \times Xa \times (\varphi + I)^{½}$$

where:
Y is coefficient of rock and soil resistance to erosion ranging from 2 to 0.25;
Xa is a Land use coefficient, ranging from l.0 to 0.05;
φ is the coefficient, observed erosion processes ranges from 1.0 to 0.1, based on the severity of erosion;
I is the average land slope in percent.

Sediment production is estimated as:

$$W = T \times H \times \pi \times Z^{3/2}$$

where:
W is the average annual specific production of sediments per km^2 in $m^3 year^{-1}$;
T is a Temperature coefficient, calculated as:

$$T = (t/10 + 0.1)^{½}$$

with t, the mean annual temperature in degrees Celsius (^{o}C).
H is the average yearly precipitation in mm.

Results and discussion

Soil erosion represents key environmental issue worldwide and primary driver of land degradation. Water-induced soil erosion is the result of the complex effect of a whole group of factors. In their research Curovic et al (1999), Djekovic et al. (2013), have shown that erosion intensity is commonly influenced by the land properties and use, increasingly so in the anthropogenius period of their evolution.

Over the last thirty years, anthropogenic factors have significantly increased pressure on agricultural and forest land, degrading the vegetation cover, which eventually results in serious degradation and loss of fertile soil.

We used the software IntErO to process the input data required for calculation of the soil erosion intensity and the maximum outflow. A complete report for the Lipnica river basin is presented in Table 1.

Table 1. Part of the IntErO report for the Lipnica river basin

River basin area	F	5.11	km²
The length of the watershed	O	12.59	km
Natural length of the main watercourse	Lv	4.12	km
Shortest dist. betw. the fountainhead and mouth	Lm	4.03	km
Basin length - by a series of parallel lines	Lb	5.85	km
The area of the bigger river basin part	Fv	3.04	km²
The area of the smaller river basin part	Fm	2.07	km²
The lowest river basin elevation	Hmin	560	m
The highest river basin elevation	Hmax	1096	m
A very permeable products from rocks	fp	0	
Medium permeable rocks	fpp	0.14	
Poor water permeability rocks	fo	0.86	
A part of the river basin under forests	fs	0.54	

grass, meadows, pastures and orchards	ft	0.42	
Bare land and plough-land	fg	0.05	
The volume of the torrent rain	hb	84.7	mm
Incidence	Up	100	years
Average annual air temperature	t0	8.9	°C
Average annual precipitation	Hyear	893.3	mm
Types of soil products and related types	Y	0.7	
Coefficient of the river basin planning	Xa	0.47	
No equival. of clearly exposed erosion process		0.29	
Coefficient of the river basin form	A	0.6	
Coefficient of the watershed development	m	0.51	
Average river basin width	B	0.87	km
(A)symmetry of the river basin	a	0.38	
Density of the river network of the basin	G	0.81	
Coefficient of the river basin tortuousness	K	1.02	
Average river basin altitude	Hsr	765.54	m
Average elevation difference of the river basin	D	205.54	m
Average river basin decline	Isr	29.6	%
Height of the local erosion base of the river basin	Hleb	536	m
Coeff. of the erosion energy of the basin's relief	Er	113.47	
Coefficient of the region's permeability	S1	0.96	
Coefficient of the vegetation cover	S2	0.7	
Water retention	W	1.7216	m
Energ. potent. of waterflow during torrent rains	2gDF^½	143.58	m km s
Temperature coefficient of the region	T	0.99	
Coefficient of the river basin erosion	Z	0.275	
Production of erosion material in the basin	Wyear	2059	$m^3 year^{-1}$
Coefficient of the deposit retention	Ru	0.228	
Real soil losses per year	Gyear	469.15	$m^3 year^{-1}$
Real soil losses per km^2 per year	Gyear/km²	91.78	$m^3 km^{-2} year^{-1}$

According to our analysis, the portion of the river basin under forest cover is 54%; grass, meadows, pastures and orchards covering 42%; bare land, ploughed land and ground without grass vegetation are less than 5%. The coefficient of the river basin planning, Xa, is calculated as 0.47. The coefficient of the vegetation cover, S_2, is calculated as 0.7. Structure of the land use in the Lipnica basin is presented in Figure 1.
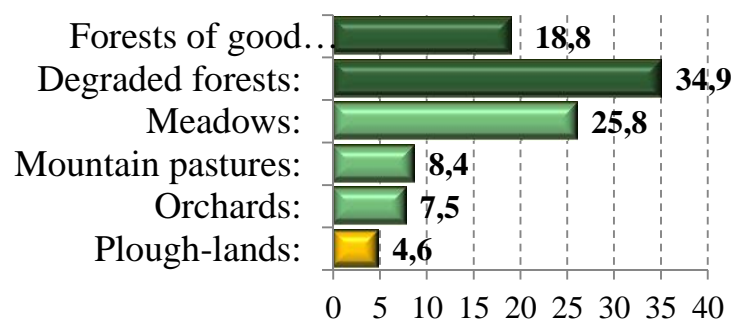
Figure 1. Land use structure of the Lipnica watershed (%)

The dominant erosion form in the studied river basin is sheet erosion with a removal of a relatively uniform thin layer of soil from the land surface by rainfall and largely un-channelled surface runoff (sheet flow).

(A)symmetry coefficient indicates that there is a possibility for large flood waves to appear in the river basin. The value of G coefficient of 0.81 indicates that there is medium density of the hydrographic network. The value of Z coefficient of 0.275 indicates that the strength of the erosion process is weak, and according to the erosion type, it is mixed erosion. The production of sediments in the basin, W_{year}, is calculated as 2059 m^3 $year^{-1}$; and the Coefficient of the intra-basin deposition, Ru, at 0. 228. Sediment yield at catchment outlet (G_{year}) was calculated as 469 $m^3 year^{-1}$; and specific sediment yield at 92 $m^3 km^{-2} year^{-1}$, what indicates, according to Gavrilovic, that the river basin belongs to 5th category. It is a region of very weak erosion.

Conclusions

The study was conducted in the area of the Lipnica Watershed, a left-hand tributary of the river Lim in Montenegro. According to our findings, it can be concluded that there is a possibility for large flood waves to appear in the studied river basin. Calculated peak flow is 58 $m^3 s^{-1}$ for a return period of 100 years.

The value of Z coefficient of 0.275 indicates that the strength of the erosion process is weak, and according to the erosion type, it is mixed erosion. Sediment yield at catchment outlet (G_{year}) was calculated as 469 $m^3 year^{-1}$; specific sediment yield at 92 $m^3 km^{-2} year^{-1}$, what indicates, according to Gavrilovic, that the river basin belongs to 5th category, out of five. According to Gavrilovic classification (1972), the river basin is a region of very weak erosion. Findings of this research lead to the conclusion that the Erosion Potential Method and the IntErO model is an efficient tool for computing erosion potential and sediment yield being useful tools for researchers in calculation of sediment yield at the level of the river basins for the South East European region.

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CALCULATION OF SOIL EROSION INTENSITY IN THE BOSNJAK WATERSHED, POLIMLJE RIVER BASIN, MONTENEGRO

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Abstract

Soil erosion is considered as one of the main processes of land degradation. These effects are often related to changes in land use e.g. deforestation, etc. Such land use changes are a major global environmental problem involving sedimentation, ecological degradation, and nonpoint source pollution. Understanding the processes of soil erosion, can help in identifying the erosion prone areas and the potential measures to alleviate the environmental effects. Most of the studies focus on small spatial units, while little attention has been given to the amount of sediment yield at the catchment scale. A small spatial unit approach neglects the transfer of sediment through catchments as well as the scale-dependency of erosion processes. Furthermore, approaches focusing on small spatial units do not consider important off-site impacts of soil erosion, such as sediment deposition in reservoirs, flooding as well as ecological impacts. The erosion response of catchments to changes in land use or climate often differ strongly from the responses resulting from changes at the plot scale. This study aims to illustrate the possibility in calculating the sediment yield at the catchment scale using the model IntErO which is based on the Erosion Potential Method of Garilovic. We apply the mode in the study region, the Bosnjak watershed. Our results suggest that the calculated maximal outflow from the river basin was 94 m^3s^{-1} for the incidence of 100 years and the net soil loss was 738 m³ per year, specific 111 $m³km^{-2}$ per year, what indicates, according to Gavrilovic classification, that the river basin belongs to the V category; it is a region of very weak erosion. The method we used in this study can also be of interest for sediment modelling in other basins, because of its simple and reliable identification of critical areas of soil erosion in watersheds.

Key words: *Erosion, Soil erosion assessment, watershed, Land use, IntErO model.*

Introduction

The occurrence of natural and anthropogenic extreme phenomena all around the world makes us pay more attention to their environmental and economic impacts (Ristic *et al.*, 2012; Schmidt *et al.*, 2006; Lerner, 2007). Soil erosion is one of them and is a growing problem in South East Europe, especially in the Mediterranean countries. Land degradation caused by soil erosion is especially serious in Montenegro (Spalevic *et al.*, 2014c). According to Kostadinov *et al.* (2006), water erosion has affected 95% of the total territory of Montenegro. The off-site impacts of runoff, sedimentation, loss of reservoir capacity, flooding is increasing in this Region.

Quantitative information on soil loss and runoff is needed for erosion risk assessment. This requires collection of field data and observations, various measurements by estimating the sediments accumulated in reservoirs or using suspended sediment yield data of rivers

(Bagarello *et al.*, 2011; Della Seta *et al.*, 2009; Zeng *et al.*, 2009; de Vente *et al.*, 2008; van Rompaey *et al.*, 2005), laboratory experiments (Leone and Sommer, 2000; Piccolo *et al.*, 1997; Torri and Poesen, 1992), as well as processing of those data through the predictive models.

During the past decades, research has primarily focused on the development and application of models able to indirectly predict the magnitude, frequency, scope and temporal spacing of soil erosion (Borrelli *et al.*, 2014). Most of these studies are based on the Universal Soil Loss Equation - USLE (Wischmeier and Smith, 1978) and its revised and modified versions (e.g., MUSLE — Williams, 1975; RUSLE — Renard *et al.*, 1997; SEDEM/WaTEM — van Rompaey *et al.*, 2001). Many researchers reported good performances of these models in predicting soil erosion risk and quantifying of soil erosion rates in different environments (among others, Amore *et al.*, 2004; Onori *et al.*, 2006; Märker *et al.*, 2008). However, despite the comprehensive number of variables considered by these models, their capability to predict the sediment yield on the watershed scale is still problematic (van Rompaey *et al.*, 2005).

Blinkov and Kostadinov (2010) evaluated applicability of various erosion risk assessment methods for engineering purposes for the Southern east European region. Factors taken into consideration depended on scale, various erosion tasks as well as various sector needs. The Erosion Potential Method - EPM (Gavrilovic, 1972) was, according to their findings, the most suitable on catchment level for the watershed management needs in this Region.

Position of Blinkov and Kostadinov, but also our prior experience in the Region, leads the authors of this study to analyse the sediment yield for the studied area of Bosnjak River Basin using the Intensity of Erosion and Outflow - IntErO model (Spalevic, 2011), which is based on the Erosion Potential Method. The main outcomes are new specific information about the state of the runoff and sediment yield in formats that may be used in its efficient management and protection, illustrating the possibility of modelling of sediment yield with such approach.

Material and methods

Study area. The north eastern parts of Montenegro are very mountainous, with the presence of deep incised valleys (in Limestone Mountains) but also a rather hilly (Lenaerts, 2014). In this region the Prokletije mountains are the highest massive of the Dinaric Alps, reaching a height of 2694m (Maja e Jezercë) in Albania and containing Zla Kolata, the highest peak of Montenegro at a height of 2534 m, Dobra Kolata (2528 m a.s.l.) and Rosni Vrh (2525 m a.s.l.) although there is some discussion about this subject (Annys *et al.*, 2014). Rivers in this region drain to the Black Sea. Some of these rivers form deep canyons in limestone formations, but further downstream they form broader valleys flowing through softer Paleozoic material (Boskovic and Bajkovic, 2002).

The study was conducted in the area of the Bosnjak River Basin, a left-hand tributary of the river Lim. The basin area lies on the steep slopes of Petrovo Brdo (1250m a.s.l.) and Crepuljska Kosa (1100 m a.s.l.) on the south; the Orlujak and Crkvine (1318m a.s.l.) on the north, above the villages of Gornje and Donje Zaostro. There is a small flat area on the lower alluvial terrace in the village of Donje Zaostro, close to the inflow of Bosnjak to the river Lim.

The river basin encompasses an area of 6.6 km^2 and is categorized in the group of the small watersheds of the natural entity of the Polimlje region. The average slope gradient in the river basin, Isr, is calculated on 33%, indicating that in the river basin prevail very steep slopes. The average river basin altitude, Hsr, is calculated on 937.6m; the average elevation difference of the river basin, D, is 282.6m. The natural length of the main watercourse, Lv, is 2.8 km. The shortest distance between the fountainhead and the mouth, Lm, is 2.5 km (source: original).

Fieldwork. During the field work, specific data, needed as inputs for the processing by the EPM methodology, were collected and later used for the calculation of the intensity of soil erosion; e.g. data on the status of plant cover, the type of land use, measures that are done to reduce or mitigate the erosion processes. Morphometric methods were used to determine the slope, lengths, exposure and slope shape, the depth of the erosion base and the density of erosion rills.

Soils. We drew on the earlier pedological research of the Agricultural Institute in Podgorica (Fustic and Djuretic, 2000), who analysed the physical and chemical properties of all Montenegrin soils, including those in the study area of the Bosnjak River Basin. Furthermore, some pedological profiles had been opened recently, and soil samples were taken for physical and chemical analysis.

Vegetation and land use. Estimating soil erosion and sediment yield requires comprehensive recognition of various factors, but identification of the parameters is difficult because of the complexity of soil erosion phenomena (Eisazadeh *et al.* 2012). Vegetation plays and important role in improving the soil quality, reduction of runoff and reduction in loss of soil (Thompson *et al.* 2005), that is, in increasing the infiltration capacity and reduction of soil erodibility (Bochet et al. 1999). It alleviates the destructive force of rain drops and their effect on soil. Plants pose an obstacle to the flow of water down the slope, so more water is absorbed by the soil, and one part of it is used by plants for their own needs. Thus, less water runs off the slope, and in such cases it usually does not cause erosion and it reaches brooks and rivers clear (Saric, T. *et al.* 1999). Analysis of the status of the plant cover, the type of land use in the catchment is part of the set of the required actions in defining the needed parameters for calculation of the parameters.

The land cover data were derived from satellite imagery. We drew on the earlier filed work of the Institute of Forestry of Montenegro in Podgorica (1998) who analysed the status of the plant cover, the type of land use of all the Montenegrin forests including those in the study area. All those data, together with official statistics from the MONSTAT (Statistical office of Montenegro) were further processed according to the EPM methodology and used to characterise the watershed, evaluating the intensity of runoff and soil erosion.

Soil loss model application. We used the Intensity of Erosion and Outflow - IntErO program package (Spalevic, 2011) to obtain data on forecasts of maximum runoff from the basin and soil erosion intensity, with the Erosion potential method (Gavrilovic, 1972) embedded in the algorithm of this computer-graphic method. This methodology is in use in: Bosnia & Herzegovina, Bulgaria, Croatia, Czech Republic, Italy, Iran, Montenegro, Macedonia, Serbia and Slovenia (Spalevic *et al.*, 2014c; Kostadinov *et al.*, 2014). In Montenegro have been successfully used in the Region of Polimlje (Spalevic *et al.* 2014a, 2014b, 2013a, 2013b, 2013c, 2013d, 2013e, 2013f, 2012a, 2003).

Results and discussion

Climatic characteristics. The climate in the studied area is continental, i.e. with cold winters and warm, wet summers. The absolute maximum air temperature is 37.8°C; the negative temperatures can fall to a minimum of -28.3°C. The average annual air temperature, t_0, is 9°C. The average annual precipitation, H_{year}, is 944mm (Source: Data from the Meteorological stations Berane & Bijelo Polje, Institute of Hydrometeorology of Montenegro). The temperature coefficient of the region, T, is calculated on 1.00; the amount of torrential rain, h_b, on 71.9 mm.

The geological structure and soil characteristics of the area. A geological map of Montenegro, extracted from the Geological Atlas of Serbia (Dimitrijevic, 1992) made known that the major part of Montenegro is covered by Mesozoic sedimentary rocks. Dimitrijevic has divided Montenegro into 5 geotectonic zones. The northernmost zone is the East Bosnian-

Durmitor block, where the studied river basin is located, representing different nappes - thrust sheets. These nappes consist of Late Palaeozoic and Lower Triassic clayey-marly-sandy beds, Middle Triassic eruptive rocks and Middle and Upper Jurassic diabase-chert formation rocks (Radulovic and Radulovic, 1997).

Our analysis, extracting the geological data from the Geological map of Montenegro (Zivaljevic, 1989), shown that the structure of the river basin, according to bedrock permeability, is the following: f_0, poor water permeability rocks, 78%; f_{pp}, medium permeable rocks, 9%; f_p, very permeable products from rocks: 13%. The coefficient of the region's permeability, S_1, is calculated on 0.89 (source: original).

The most common soil type in the studied area are Dystric cambisol (93%); Calcomelanosol (7%); with small area of Fluvisol close to the inflow of Bosnjak to Lim (Fustic and Djuretic, 2000; Spalevic, 2011).

Vegetation and land use. The studied area is located in Dinarid Province of the Middle-Southern-East European mountainous bio-geographical region. Most of the river basin is covered by beech forests (*Fagetum montanum*). *Fagetum montanum* differentiated into several associations of which the most characteristic are *Fagetum montanum typicum, Luzulo - Fagion moes*iacae, and *Fagetum montanum drymetosum*. Beech forests are characterized by dense canopy, especially association *Fagetum montanum typicum* (Curovic *et al.* 2011). Due to intensive harvesting of firewood beech forests near settlements and roads are degraded. On the southern exposures there are forests of Sessile oak and Turkish oak (*Quercetum petraeae-cerridis* Lak.). A narrow belt near the river in the lower part of the river basin is covered with hygrophilic forest (*Alnetea glutinosae, Salicetea herbacea*). At the higher parts of the basin there are mixed of broadleaves and deciduous tree species (*Abieti - Fagetum moesiacae* Blec and Lak.*)*. In last decades climate changes affected on forest ecosystems in changes and slightly movement of the Vegetation vertical layout belts (Curovic and Spalevic, 2010).

According to our analysis, portion of the river basin under forest cover is 60%; grass, meadows, pastures and orchards covering 31%; bare land, ploughed land and ground without grass vegetation 9%. The coefficient of the river basin planning, Xa, is calculated on 0.41. The coefficient of the vegetation cover, S2, is calculated on 0.70. Structure of the land use in the Bosnjak watershed is presented in Figure 3.
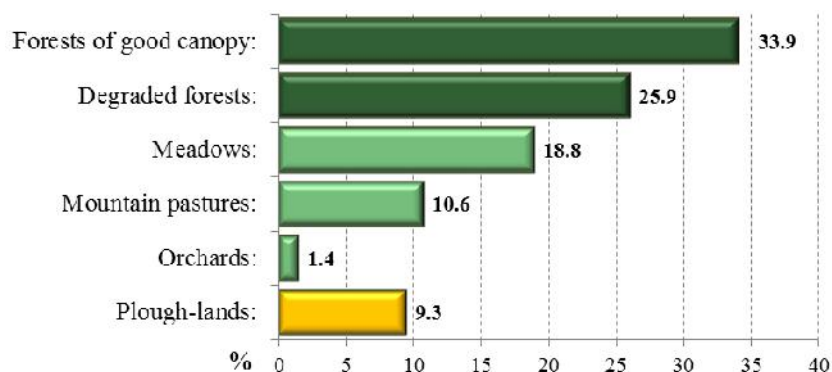

Figure 3. Land use structure of the Bosnjak watershed (%)

Soil erosion and runoff characteristics. Watersheds are in fact often affected by natural disasters, above all floods, overflows, inundations, erosion problems, landslides and pollution (Tazioli *et al.,* 2015). The dominant erosion form in this area is sheet erosion and has taken place in all the soils on the slopes, with the effect that this erosion is the most pronounced on the steep slopes with scarce vegetation cover. We used the software IntErO for calculation of the soil erosion intensity and the maximum outflow. Part of the detailed report for the Bosnjak river presented in the Table 1.

For the current state of land use, calculated peak flow is 94.86 m^3s^{-1} for a return period of 100 years. In addition, using the option of altering the incidence in the IntErO software, we

received the information on the calculated peak flow for the return period of 5, 10, 20, 25, 50 and 100 years (m^3s^{-1}), presented in the Figure 4.
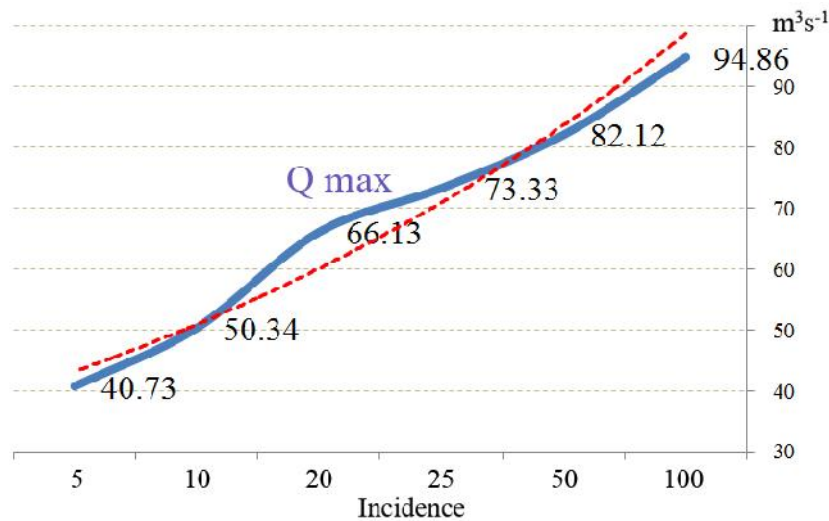

Figure 4. Calculated peak flow for the return period
of 5, 10, 20, 25, 50 and 100 years (m^3s^{-1})

Analysis further shown that the coefficient of the river basin form, A, is 0.85. Coefficient of the watershed development, m, is 0.31 and average river basin width, B, is 1.16 km. (A)symmetry of the river basin, a, is calculated on 0.18 and indicates that there is a possibility for large flood waves to appear in the river basin. Drainage density, G, is calculated as 0.43 km km^{-2} which corresponds to low density of the hydrographic network. The height of the local erosion base of the river basin, Hleb, is 663 m. Coefficient of the erosion energy of the river basin's relief, Er, is calculated on 131.67.

The value of Z coefficient of 0.256 indicates that the river basin belongs to the fourth destruction category out of five. The strength of the erosion process is low, and according to the erosion type, it is mixed erosion.

The production of sediments in the basin, W_{year}, is calculated as 2537 m^3 $year^{-1}$; and the Coefficient of the intra-basin deposition, Ru, at 0.291.

Sediment yield at catchment outlet (G_{year}) was calculated as 738 m^3year^{-1}; and specific sediment yield at 111 $m^3km^{-2}year^{-1}$.

Conclusions

Relatively large river basins of the north of Montenegro, such as the Lim, Tara, Piva, Cehotina and Ibar consist of a great number of tributaries. A large variety of different geomorphologic and sedimentary processes are acting in its watersheds. Those complex and huge tributary systems need to be analysed individually because of the different responses to the different climate conditions, geological substrate, pedological composition and land use.

We calculated the soil erosion intensity and runoff in the area of the Bosnjak River Basin, a left-hand tributary of the river Lim in Montenegro, using the InTErO model (Spalevic, 2011). Several important points were suggested by the model results:

- According to our findings, it can be concluded that there is a possibility for large flood waves to appear in the studied Bosnjak river basin.
- The value of Z coefficient of 0.256 indicates that the river basin belongs to the fourth destruction category out of five. The strength of the erosion process is low, and according to the erosion type, it is mixed erosion.

- Calculated peak flow is 94 m^{3}s^{-1} for a return period of 100 years.
- The calculated net soil loss from the river basin was 738 m³ per year, specific 111 m³km^{-2} per year, what indicates, according to Gavrilovic classification (1972), that the river basin belongs to the V category; it is a region of very weak erosion.
- The soil loss rates in the catchment (111 m³km^{-2}year^{-1}) and in the wider Polimlje region (350 m^{3}km^{-2}year^{-1}) are very low in comparison to adjacent watersheds of the Coastal zone of Montenegro where the soil loss is around 1900 m³km^{-2}year^{-1} in some watersheds (Spalevic *et al.*, 2014c; Spalevic *et al.*, 2012b). This shows that vegetation cover and land management in northern Montenegro are effective in protecting the land from erosion as was also observed by Nyssen *et al.* (2014).

This study further confirmed the findings of Kostadinov (2014), Tazioli (2009), as well as Spalevic (2011), what leads to the conclusion that the Gavrilovic method as well as the IntErO model is a useful tool for researchers in calculation of runoff and sediment yield at the level of the river basins of south east Europe, similar to the Polimlje basin of Montenegro.

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SOIL EROSION IN THE ZIM POTOK WATERSHED, POLIMLJE RIVER BASIN, MONTENEGRO

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Abstract

The negative impact of sediments on the environment and water resources is widely acknowledged with many watercourses in Montenegro and in the South Eastern European Region. To reduce sediment exports from the big river basins discharging to the accumulations, it is essential to identify the sources: critical sub basins and the quantity of its sediment yield and runoff. The off-site impacts of runoff and eroded soil, eutrophication of water bodies, loss of reservoir capacity, muddy flooding of roads and communities, are increasingly recognised. Establishing the correlation between on-site erosion rates with off-site impacts is complicated because of the limited data on soil erosion processes in Montenegro and the dynamic nature of this process over space and time. The use of computer-graphic methods allowed the quantification of the environmental effects of soil erosion. We used modelling of sediment yield and runoff for calculation of soil erosion intensity for a Zim Potok watershed of Polimlje, Montenegro. Ecological factors, which are the basis for the calculation of soil erosion intensity, are included in the IntErO simulation model, with the Erosion potential analytical method of Gavrilovic embedded in the algorithm of this computer-graphic method. Our results shown that the calculated maximal outflow from the river basin may be 144 m^3s^{-1} for the 100 years return time flood. The sediment yield was calculated as 689 m^3yr^{-1}, specific 155 $m^3km^{-2}yr^{-1}$. The important results of this study are the determination of erosion processes in the study watershed and new particular information about the recent state of runoff and sediment yield in formats that can facilitate its efficient management and protection, illustrating the possibility of sediment yield modelling with such approach.

Key words: *Soil erosion, sediment yield, watershed, IntErO model.*

Introduction

Soil erosion is one of the biggest environmental problems the world faces. It is a critical threat to food security and to the environment (Ebrahimpour *et al.,* 2011). In Europe 17% of total land area is roughly estimated to be affected by soil erosion, of which 80% is topsoil loss and 20% terrain deformation (Gobin *et al*., 2004).

Land degradation caused by soil erosion is an especially serious problem in Montenegro and water erosion is the most important erosion type (Spalevic *et al.*, 2014c), due to precipitation and consecutive runoff primarily, but also by fluvial erosion in water streams (Kostadinov *et al.,* 2006). According to Kadovic (1999) water erosion has affected 95% of the territory of Montenegro (13,135 km^2 out of 13,812 km^2). Alluvial accumulation characterises the remaining area of 677 km^2.

Reduction of soil erosion to preserve soil quality and to maintain land productivity constitutes a major challenge for mountainous soils. Soil erosion can be reduced by appropriate land

management. It requires both the collection of field data and the use of predictive model for the evaluation of different management scenarios for the protection of soils. Field measurements of erosion and sedimentation using classical techniques are time - consuming and expensive (Bujan *et al.,* 2000; Albaradeyia *et al.,* 2010).

The modelling of the erosion process has progressed rapidly, and a variety of models have been developed to predict both runoff and soil loss (Zhang *et al.* 1996). Several software have been developed to predict soil erosion. The authors of this study used the computer - graphic IntErO model (Spalevic, 2011) for prediction of soil erosion intensity and maximum outflow from the catchment area.

The objective of this research is the characterization of the erosion processes in relation to the recent state of the runoff and sediment yield in the Zim Potok Watershed of the Polimlje River Basin. The results are consistent with previous researches of other authors under similar conditions, in formats that may be further used for the efficient management and protection, illustrating the possibility of modelling sediment yield by the IntErO model.

The objective has been met based on literature review, past experience and field measurements at the Polimlje River Basin. Such set of information about the mountainous areas of Montenegro are important for the development of soil protection strategies in the Region. We showed that IntErO can be applied for the assessment of soil erosion at the national scale and may be a useful tool for similar studies in the southern east Region of Europe.

Material and methods

The study is conducted in the River Basin of Zim Potok (Figure 1), a left-hand tributary of the river Lim located in the upper part of the Polimlje region of Montenegro. The whole catchment of the Zim Potok covers an area of 4.5 km^2, with a river length of 0.7 km.

The methodological approach consisted of collection and processing of data related to general characteristics of the area: climate, geological and pedological features, including investigations on the state of vegetation as well as physical and geographical parameters of river channels and river basins.

Simultaneous theoretical, experimental and field research required specific methodological approaches: fieldwork, laboratory and empirical methods, as well as use of computer graphic methods which generated data to predict maximum runoff from the river basins and the intensity of soil erosion.

Fieldwork was undertaken to collect detailed information on specific data needed to calculate soil erosion intensity and runoff.

We drew on the earlier geological research of the Institute of Geology of Montenegro extracting the geological data from the Geological map of Montenegro (Zivaljevic, 1989) related to the structure of the river basin, according to bedrock permeability.

We used the results of the pedological research of the Agricultural Institute in Podgorica led by Fustic and Djuretic (2000), who analysed the physical and chemical properties of all Montenegrin soils in the period from 1964 to 1988, including those in the study area of the Zim Potok River Basin.

Assessment of sediment yield at the catchment scale plays an important role for optimal design of hydraulic structures, such as bridges, culverts, reservoirs, and detention basins, as well as making informed decisions in environmental management. Many experimental studies focused on obtaining flow and sediment data in search of unique relationships between runoff (specifically, volume and peak) and sediment characteristics.
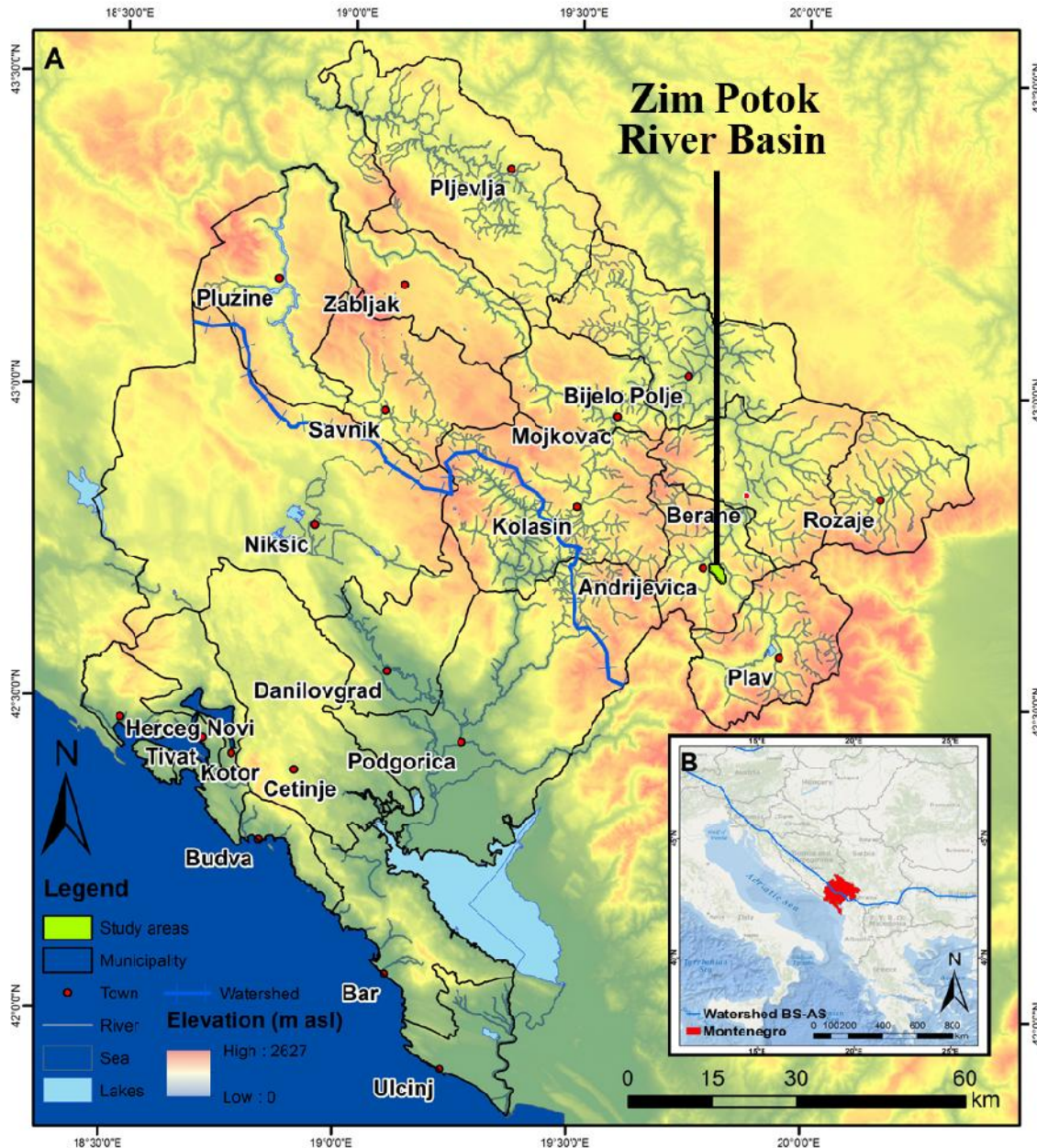
Figure 1. A) Montenegro and the study area subjected to detailed soil erosion research;
B) Position of Montenegro in South-eastern Europe (Lenaerts, 2014).

Spatial modelling has emerged as an important tool in soil erosion studies and especially at the watershed scale (Memarian *et al*. 2012). The use of computer-graphics in research on runoff and soil erosion intensity has been demonstrated in Montenegro, specifically in the Region of Polimlje (Spalevic *et al*. 2014a, 2014b, 2013a, 2013b, 2013c, 2013d, 2013e, 2013f, 2012a, 2003) and that approach was used in the research on the Zim Potok River basin.

There are a number of empirical evaluation methods that may contribute to such an assessment. These methods involve several steps: data acquisition, model specification and estimation (Gavrilovic, S., 1960, 1961, 1964a, 1964b, 1972, Madureiraa *et al*. 2011). We used the program Intensity of Erosion and Outflow - IntErO (Spalevic, 2011) for calculation of soil erosion intensity and forecasting of maximum runoff from the river basin, a programme driven by the Erosion Potential Method (Gavrilovic, 1972).

Results and discussion

Many authors have studied the **physical-geographical characteristics** of the study area. Cvijic (1921) called attention to the geographical individuality of the Region. Knezevic and Kicovic (2004) described the natural characteristics; Pavicevic (1956, 1957), and Spalevic (1999a, 2011) characterised erosion processes of the upper part of the Polimlje Region.

The river basin of Zim Potok stretches from its inflow to Lim, where Hmin, is 741 m asl, to the tops of the Jerinja Glava, where the Hmax is 1503 m asl. The average slope gradient in the river basin, I_{sr}, is calculated as 44%, indicating that in the river basin very steep slopes prevail. The average river basin altitude, H_{sr}, is calculated as 1036 m asl; the average elevation difference of the river basin, D, is 295.9 m.

The **climate** of the area is characterised by dry summers; rainy autumns and springs; and cold winters. The absolute maximum air temperature is 35°C. Winters are severe, so much so that low temperatures can fall to a minimum of -29.8°C. In terms of rainfall, there are two characteristically rainy periods of the year: the first-cold period (October-March) and the second-warm period (April-September). The amount of torrential rain, hb, is 62.3 mm. The average annual air temperature, t0, is 9 °C. The average annual precipitation, Hyear, is 1183 mm. The temperature coefficient of the region, T, is calculated to be 1.00.

Sediment yield is also a function of basin **geological structure**. In the structural-tectonic sense, the study area belongs to the Durmitor geotectonic unit of the inner Dinarides of Northern and North-eastern Montenegro (Zivaljevic, 1989). The geological structure of that part of Montenegro consists mainly of Paleozoic clastic, carbonate and silicate volcanic rocks and sediments of the Triassic, Jurassic, Cretaceous-Paleogene and Neogene sediments. Our analysis shows that the structure of the river basin, according to bedrock permeability, is the following: f0, poor water permeability rocks, 3%; fpp, medium permeable rocks, 40%; fp, very permeable products from rocks: 57%. The coefficient of the region's permeability, S1, is calculated on 0.54.

Based on the previous results of **soil research** (Fustic and Djuretic, 2000; Spalevic, 2011), as well as the original fieldwork and laboratory analysis, we concluded that major soil types in the river basin are Dystric cambisol (71%); Calcomelanosol (13%) and Fluvisol, close to the confluence of Zim Potok into Lim (16%).

Land cover/use and management are the most important factors that influence soil erosion (Gobin *et al.*, 2003). Overall, during the last decades, vegetation cover has strongly increased in Montenegro. The industrialisation that expanded in the 1950s led to strong urbanisation. Despite steadily increasing population (with the notable exception of the mountain region), the vegetation cover has increased markedly everywhere. This denser vegetation has led to higher infiltration of rainfall (Nyssen *et al.*, 2014).

Zim river basin forest vegetation is characterized by beech forests *Fagetum montanum*, which dominate on the basin northern slope near Jerinja Glava. With regard to the structure it can be said that stands of the researched area have a structure close to even-aged stands. The dimensions of the beech trees indicate the high production potential of these forests. These stands are characterized by the high cover value of the tree layer (0.7-1.0) (Curovic *et al.*, 2011). The canopy is dominated by beech trees and in some areas maple trees (*Acer pseudoplatanus*), providing little light to the understory. As regards the characteristic species of the herb layers which are typical for these forests, the highest abundance is that of *Asperula odorata*, *Cardamine bulbifera*, *Lamiastrum galeobdolon*, *Anemone nemorosa* etc. In areas with lower pH is a larger number of acidophilic species. Among them, the highest abundance is that of fescue (*Festuca drymeia*), followed by *Oxalis acetosella*, *Lamiastrum galeobdolon* and numerous Bryophytes.

At the higher parts of the basin there are small areas covered by mixed forests of broadleaves and deciduous tree species (*Abieti – Fagetum moesiacae* Blec and Lak.*)*.

According to our analysis, the portion of the river basin under forest cover is 50%; grass, meadows, pastures and orchards covering 48%; bare land, ploughed land and ground without grass vegetation 2%. The coefficient of the river basin planning, Xa, is calculated as 0.34. The coefficient of the vegetation cover, S_2, is calculated as 0.7. Structure of the land use in the Zim Potok watershed is presented in Figure 2.
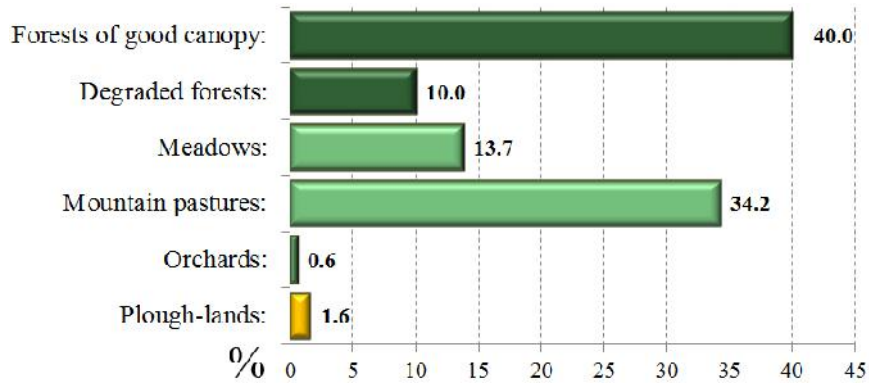

Figure 2. Land use structure of the Zim Potok River Basin (%)

Water-induced **soil erosion** is the result of the complex effect of a whole group of factors. In their research, Baver (1959), Djekovic et al. (2013) showed that erosion intensity is commonly influenced by the land properties and use, increasingly so in the anthropogenous period of their evolution.

The dominant erosion form in the studied river basin is sheet erosion with a removal of a relatively uniform thin layer of soil from the land surface by rainfall and largely un-channelled surface runoff (sheet flow). A small amount of material is washed through the soil, but the more important erosion processes take place at the surface. Material is detached by raindrop impact and flow traction and transported by overland water flow. Final results of the combinations of these detachment and transport processes caused by rainsplash, rainwash, but taking into considerations the other specific climate conditions, physical-geographical conditions of the studied watershed, as well as geological and soil characteristics are presented in the Report 1.

Report 1. Part of the IntErO report for the Zim Potok (without listing on Input data)

Results: Coefficient of the river basin form, **A**, 2.87; Coefficient of the watershed development, **m**, 0.09; Average river basin width, **B**, 1.22 km; (A)symmetry of the river basin, **a**, 0.33; Density of the river network of the basin, **G**, 0.15; Coefficient of the river basin tortuousness, **K**, 1.07; Average river basin altitude, **Hsr**, 1033.84 m; Average elevation difference of the river basin, **D**, 292.84 m; Average river basin decline, **Isr**, 45.96 %; The height of the local erosion base of the river basin, **Hleb**, 762 m; Coefficient of the erosion energy of the river basin's relief, **Er**, 167.15; Coefficient of the region's permeability, **S1**, 0.54; Coefficient of the vegetation cover, **S2**, 0.70; Analytical presentation of the water retention in inflow, **W**, 0.834 m; Energetic potential of water flow during torrent rains, **2gDF^½,** 159.61 m km s; Maximal outflow from the river basin, **Q_{max}**, 144.4 $m^3 s^{-1}$; Temperature coefficient of the region, **T**, 0.1; Coefficient of the river basin erosion, **Z**, 0.26; Production of erosion material in the river basin, **W_{year}**, 2186 m³/god; Coefficient of the deposit retention, **Ru**, 0.316; Real soil losses, **G_{year}**, 689.96 m³ per year; Real soil losses per km^2, **G_{year} per km²**, 155.61 $m^3 km^{-2}$ per year.

(A)symmetry coefficient indicates that there is a possibility for large flood waves to appear in the river basin. The value of G coefficient of 0.15, indicates there is low density of the

hydrographic network, what indicates a high infiltration rates which should result in low overland flow and hence low rate of soil detachment.

The value of 45.96% indicates that in the river basin prevail almost vertical slopes.

Runoff is the most important direct driver of severe soil erosion. Processes that influence runoff must therefore play an important role in any analysis of soil erosion intensity. The highest computed peak discharges is 144 m^3s^{-1} (32.5 $m^3s^{-1}km^{-2}$) for a return period of 100 years. Using the option of altering the incidence in the IntErO software, we received the information on the calculated peak flow for the return period of 5, 10, 20, 50 and 100 years (m^3s^{-1}), as presented in the Figure 3.
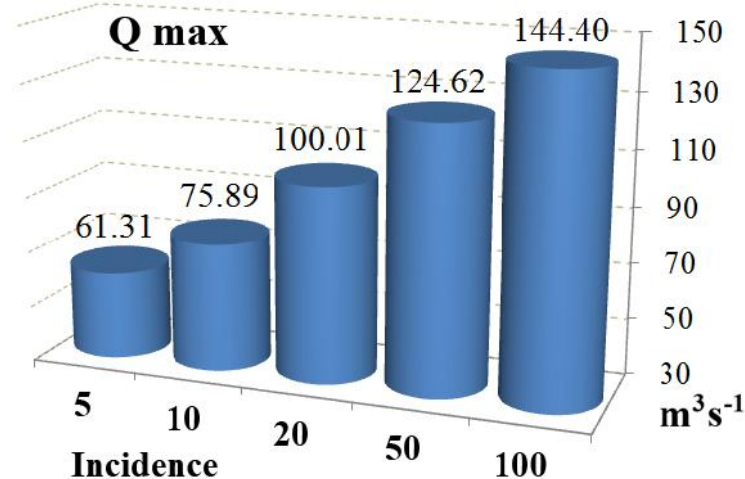
Figure 3. The highest computed peak discharges for the
return period of 5, 10, 20, 50 and 100 years (m^3s^{-1})

The value of Z coefficient of 0.260 indicates that the river basin belongs to the fourth destruction category out of five. The strength of the erosion process is low, and according to the erosion type, it is mixed erosion.

Sediment yield at catchment outlet (G_{year}) was calculated as 689.96 m^3year^{-1}; and specific sediment yield at 155.61 $m^3km^{-2}year^{-1}$. According to Gavrilovic classification (1972), the river basin is a region of very weak erosion.

Conclusions

The study was conducted in the area of the Zim Potok River Basin, a left-hand tributary of the river Lim in Montenegro. We calculated the soil erosion intensity and runoff using the IntErO model (Spalevic, 2011). According to our findings, it can be concluded that there is a possibility for large flood waves to appear in the studied Zim Potok River Basin. Calculated peak flow is 144 m^3s^{-1} for a return period of 100 years. The value of Z coefficient of 0.260 indicates that the river basin belongs to the fourth destruction category out of five. The strength of the erosion process is low, and according to the erosion type, it is mixed erosion.

Sediment yield at catchment outlet (G_{year}) was calculated as 689.96 m^3year^{-1}; and specific sediment yield at 155.61 $m^3km^{-2}year^{-1}$. According to Gavrilovic classification (1972), the river basin is a region of very weak erosion.

The results show the importance of considering lithological (the type and characteristics of minerals present) and hydrological (precipitation, water storage capacity of soil, runoff) factors under the current conditions of land usage.

The soil loss rates of the studied Zim Potok River Basin (155 $m^3km^{-2}year^{-1}$) and in the wider Polimlje region: 350 $m^3km^{-2}year^{-1}$, (Babic Mladenovic, 2003); 458 $m^3km^{-2}year^{-1}$ (Fustic and Spalevic, 2000); 111 $m^3km^{-2}year^{-1}$ (Spalevic *et al*. 2014a); 219 $m^3km^{-2}year^{-1}$ (Spalevic *et al*. 2014b); 645 $m^3km^{-2}year^{-1}$ (Spalevic *et al*. 2013a); 115 $m^3km^{-2}year^{-1}$ (Spalevic *et al*. 2013b);

37 m^{3}km^{-2}year^{-1} (Spalevic *et al.* 2013c); 133 m^{3}km^{-2}year^{-1} (Spalevic *et al.* 2013d); 315 m^{3}km^{-2}year^{-1} (Spalevic *et al.* 2013e); 154 m^{3}km^{-2}year^{-1} (Spalevic *et al.* 2013f); 117 m^{3}km^{-2}year^{-1} (Spalevic *et al.* 2012a); 121 m^{3}km^{-2}year^{-1} (Spalevic *et al.* 2003); are very low in comparison to adjacent watersheds of the Coastal zone of Montenegro where the soil loss is around 1900 m³km^{-2}year^{-1} in some watersheds (Spalevic *et al.*, 2014c; Spalevic *et al.*, 2012b). This shows that vegetation cover and land management in northern Montenegro are effective in protecting the land from erosion as was also observed by Nyssen *et al.* (2014).

The results of this analysis can contribute to the improvement of planning processes and the implementation of development projects in watersheds of the southern east European river basins.

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PHYLOGENETIC RELATIONSHIPS OF THREE SPECIES OF *CUCURBITA* SPP. FROM PORTUGAL EVALUATED BY SSR MARKERS

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Abstract

Cucurbita species were introduced in Europe after the discovery of America and are now used in many parts of the world. In this genera *Cucurbita pepo* L., *C. moschata* Duch. and *C. maxima* Duch. are the most economically important species. To evaluate the genetic diversity, 54 *C. pepo*, 21 *C. moschata* and 32 *C. maxima* populations, all from northern and inner center of Portugal, were studied using six microsatellite primers. The percentage of polymorphism found for the three species was 100%. The observed heterozygocity values for individual *loci* ranged from 0.065 to 0.540, with an average of 0.316, while expected heterozygocity ranged from 0.275 to 0.598 with a mean of 0.447. The polymorphism information content varied from 0.604 to 0.787 with an average of 0.688. AMOVA indicated that about 54% of variation in the data set was from genotypic variations among species and the remaining 46% of differences among and within populations, indicating a degree of population structure. A Neighbor-joining dendrogram based on shared allele distance showed a clear separation of the three species. Principal Coordinated Analysis showed that the three most informative principal coordinates explain 66.3% of the total variation and clearly separated the three species of *Cucurbita*. The genetic diversity found on these species of *Cucurbita* can provide relevant information for the diversity conservation and it will be useful to identify local selections for preservation and use in breeding programs.

Keywords: *C. maxima, C. moschata, C. pepo, microsatellites, genetic diversity*

Introduction

The three most economically important *Cucurbita* species are *Cucurbita pepo* L., *C. maxima* Duch. and *C. moschata* Duch. which have different climatic adaptations and are widely distributed in agricultural regions worldwide (Robinson and Decker-Walters, 1997). *Cucurbita* species were introduced in Europe after the discovery of America and are now used in many parts of the world. The genetic diversity within and among *Cucurbita* species has been evaluated using several molecular markers, such as SSR, RAPD, SRAP, ISSR and AFLP (Katzir et al., 2000; Paris et al., 2002; Hernandez and Eguiaete, 2002; Ferriol et al., 2003, 2004; Esteras et al., 2008; Gong et al., 2008; Tsivelikas et al., 2009; Inan et al., 2012). Comparisons of ribosomal DNA (Torres-Ruiz and Hemleben, 1991) and ISSR and SSR analysis (Katzir et al., 2000; Ferriol et al., 2003) were performed with the same purpose. However, the majority of these studies used improved commercial cultivars. Simple sequence repeat (SSR) markers are one of the major tools in the evaluation of genetic diversity and phylogenetic relationships of species based on sequence conservation because of its high efficiency, codominant nature, reproducibility, and high degree of polymorphism (Kalia et al., 2011). Genetic relationships among the species of *Cucurbita,* has been studied using SSR markers (Gong et al., 2012, 2013). The production of *Cucurbita* in Portugal is based in local cultivars, landraces, and is mainly for self-consumption (human food or animal feed) and is

sale on local markets. The landraces are a very important source of genetic diversity, and are an important genetic resource for plant breeders. This variability is maintained by deliberate selection for specific traits by farmers. At the research level, the diversity of genetic resources in germplasm collections may increase the efficiency of efforts to improve a species (Geleta et al., 2005). The aim of the present study was to evaluate the genetic diversity and relationships between three *Cucurbita* species from Northern and inner center of Portugal.

Materials and methods

A collection of 107 populations derived from three species of *Cucurbita* was evaluated in this study. It included 54 populations of *C. pepo*, 21 of *C. moschata* and 32 of *C. maxima* collected between 2011 and 2013. Total genomic DNA was extracted using the DNeasy kit (Qiagen) (Hilden, Germany), according to the manufacturer's instructions. A minimum of 20 seedlings per landrace were sampled in bulk, and six *Cucurbita* SSR markers were used in this study. The total volume of the PCR mixture was 20µl, and contained 12.5µl of 2x Qiagen multiplex PCR Master Mix (QIAGEN Multiplex PCR Kit), 2.5µl Q-Solution, 0.125µl each of forward and reverse primers and 10 ng of template DNA. The PCR program consisted in an initial denaturation of 15min at 94°C followed by 35 cycles of a 30s denaturation step at 94ºC, a 90s annealing step at the optimum annealing temperature, and a 30s extension step at 72ºC. There was a final 10min extension step at 72ºC. PCR products were separated on an ABI Prism 3100 Genetic Analyser (Applied Biosystems, FosterCity,CA). DNA fragment sizes were determined using GeneMapper software (Applied Biosystems). The population genetic analysis was performed using GenAlEx software package version 6.5 (Peakall and Smouse 2006) to calculate expected heterozygosity (H_e), observed heterozygosity (H_o) and the analysis of molecular variance (AMOVA) in order to partition of genetic variation among populations and within populations (Schneider et al. 2000). The significance of each variance component was tested with permutation tests (Excoffier et al. 1992). Wright's F_{ST} was used to estimate population differentiation. Genetic distances were estimated according to Nei (1978) and principal coordinate analyses (PCoA) (Gower 1966), was performed to identify genetic variation patterns among the *Cucurbita* genotypes. The polymorphism information content (PIC) value of a locus ranges from 0 (monomorphic) to 1 (highly informative), and it was calculated using The Excel Microsatellite Toolkit (Park 2001). Genetic similarity matrices based on the proportion of shared alleles and Neighbor-joining cluster analysis were used to construct genetic trees by Populations software. Dendrogram was visualized using TreeView (Win 16) 1.04 software (Page, R. 1997).

Results and discussion

Several powerful marker techniques are currently available for genetic analysis of plant species. The choice of the most appropriate technique for a specific study is not obvious and depends principally on the purpose of the research, the biology and the genetic structure of the species. In this study the 107 populations of three *Cucurbita* species evaluated by six SSR markers, showed a high genetic diversity. The observed heterozygocity (H_o) values for individual *loci* ranged from 0.065 to 0.540, with an average of 0.316, while expected heterozygocity (H_e) ranged from 0.275 to 0.598 with a mean of 0.447. These values can be considered high compared with other *Cucurbita* studies. Hernandez and Eguiaete (2002) and Inan et al. (2012) registered a $H_e = 0.40$ and $H_e = 0.30$ in 16 and 24 accession of *Cucurbita* species, respectively. In *C. pepo* Barzegar et al. (2013) found a $H_e=0.40$. The polymorphism information content varied from 0.604 to 0.787 with an average of 0.688 (Table 1).

Table1. Description of six SSR *loci* in three *Cucurbita* species

SSR *locus*	Ho	He	PIC
P61	0.468	0.562	0.787
M90	0.514	0.544	0.765
P5	0.215	0.331	0.631
P102	0.441	0.474	0.698
P98	0.194	0.319	0.604
M54	0.064	0.451	0.645
Mean	0.316	0.447	0.688

H_e, expected heterozygosity; H_o, observed heterozygosity;
PIC, polymorphic information content.

Barzegar et al. (2013) in *C. pepo* also reported a high mean value for PIC (0.779). Markers with high PIC values could be effectively used in genetic diversity studies of *Cucurbita* species. Boststein et al. (1980) suggested that PIC value >0.5 indicates a highly informative marker. The PIC values obtained suggested that SSR markers employed in the present study resulted adequate and efficient for the diversity analysis of the three species evaluated. AMOVA showed that about 54% of variation in the data set was from genotypic variations among species and the remaining 46% of differences within species, indicating a degree of population structure. Wright (1978) suggested that Fst values between 0.05 and 0.15 indicated moderate genetic differentiation while values above 0.25 indicated high differentiation. The Fst result obtained was 0.543, revealing a high differentiation. This result was in accordance with the values found by Barzegar et al. (2013) in *C. pepo* populations. A Neighbor-joining dendrogram based on shared allele distance showed a clear separation of *C. maxima, C. moschata* and *C. pepo* species (Figure 1). These results are in agreement with Gong et al. (2013), which found a clear separation of 88 accessions of *Cucurbita* in nine species. Principal Coordinated Analysis showed that the three most informative principal coordinates explained 66.3% of the total variation. The PCoA scatter plot showed a clear separation of the three species, spreading the 107 *Curcubita* populations into three groups (Figure 2). The first group comprised the *C. pepo* populations, the second group the *C. moschata* populations and the third group the *C. maxima populations*. The genetic diversity found on these species of *Cucurbita* can provide relevant information for the diversity conservation and it will be useful to identify local selections for preservation and use in breeding programs.
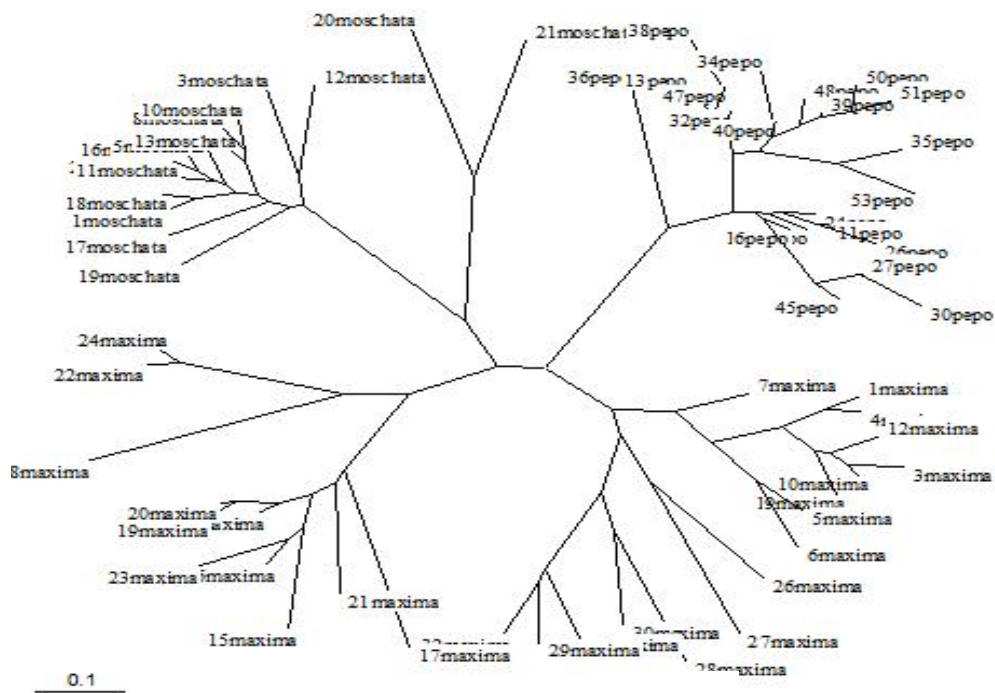
Figure1. NJ cluster analysis of 107 populations based on the proportion of shared allele distance for six dinucleotide containing SSRs.
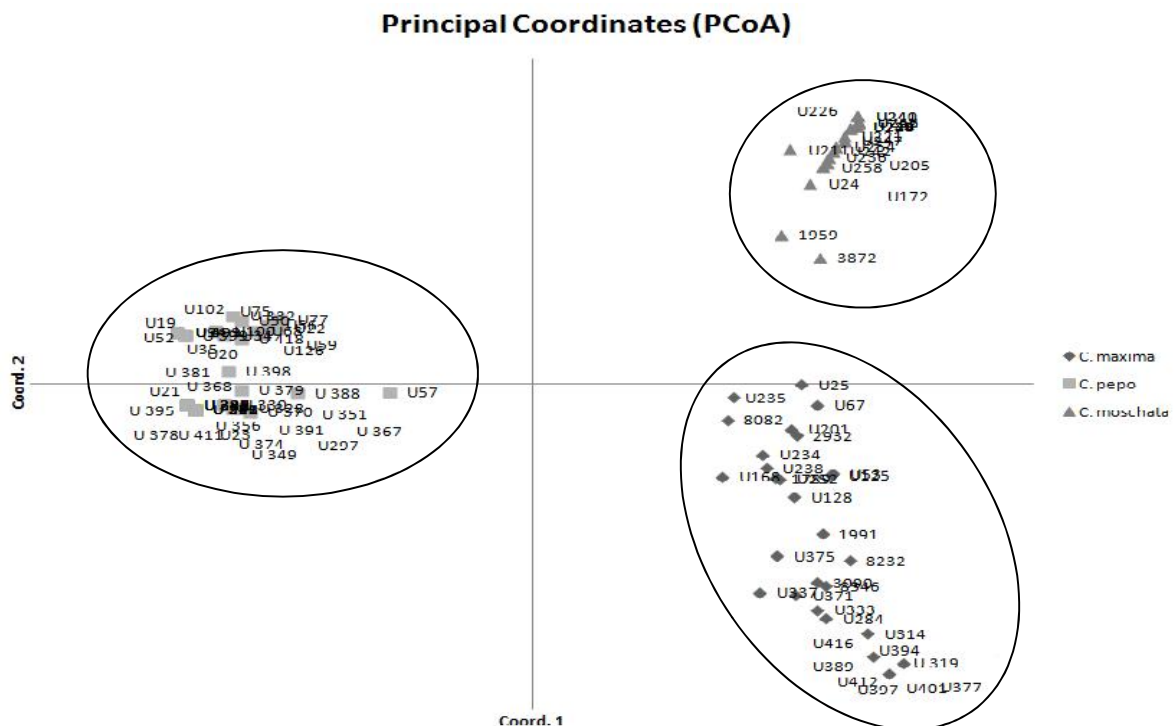

Figure2. Projection of the 107 *Cucurbita* populations in a two-dimensional graph defined by PC1 and PC2

Conclusions

Estimates of genetic similarity using genetic fingerprinting data are a useful tool in plant breeding. The knowledge of genetic variation and the genetic relationship between genotypes can be an important approach for efficient rationalization and utilization of *Cucurbita* sp. resources. The SSR markers used in this set of *Cucurbita* populations proved to be useful for analyzing the genetic diversity. They clear separated pumpkin populations belonging to the *C. maxima*, *C. pepo* and *C. moschata* species. The high genetic diversity found in this collection of Portuguese *Cucurbita* populations provide relevant information for future genetic and morphological-pathological studies.

The high genetic diversity found in this work can be important for the management and conservation of the material in a genebank.

Acknowledgment

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SOIL EROSION: CAUSES AND EFFECTS WITHIN PERILO SMALL CATCHMENT (WESTERN SERBIA)

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Abstract

This study deals with the evaluation of soil erosion in a small catchment. Mean annual and total specific erosion-induced sediment yields in the Perilo Brook catchment are induced by both natural and anthropogenic factors. The catchment erosion factors evaluated in this study, viz. relief, geological substrate, soil, climate and vegetative cover, have contributed to the annual erosion intensity of 162.90 m^3 km^{-2} of soil in the catchment area of the Perilo, classified as a small torrential brook and a dry watercourse.

Keywords: *erosion factors, erosion intensity, soil, catchment*

Introduction

Land degradation and soil loss are global events. Human induced pressures on natural ecosystems are still in progress, along with conservation efforts (Hacisalihoğlu et al., 2010). The main factor causing soil degradation worldwide is water erosion, which threatens 56% of the world's arable land (Oldeman et al., 1990).

Over 90% of the total land area in the Republic of Serbia suffers from different types and intensities of erosion (Djorović and Kadović, 1997). The erosion process can have both direct and indirect impacts, inducing permanent soil disappearance. The calculated value of the total annual sediment yield suggests that some 16.0 cm of soil are annually eroded off the 21,000 ha of land in Serbia (Spalević, 1997). In the Republic of Serbia (Central Serbia), there are 1.221 million ha of eroded soil, and 36,000 ha are in a steady state, now (Statistical Yearbook, 2008).

Erosion has mostly affected strongly sloping, deforested or cultivated shallow soils on slopes, formed on impermeable geological substrates, due to the effects of intense rainfall and fluctuating air temperatures (Spalević, 1997).

The tendency of air temperature to increase and of rainfall to decrease is quite evident in the region of Čačak (Šekularac, 2002). Climate change leads to degraded soil physical properties, increases soil erodibility and reduces the protective role of vegetation.

The above factors cause intensification of both surface and deep-cutting processes of erosion.

Given the above, the objectives of this study are quantitative assessment of soil erosion induced by a range of factors and estimation of sediment yield in one part of the catchment area of the Kamenica River (part of the Zapadna Morava catchment) i.e. its subbasin, including its first order left-hand tributary the Perilo.

Materials and methods

The Perilo is located near a ak ($43^0 53^{'}$ N; $20^0 21^{'}$ E), Western Serbia, and belongs to the catchment of the Zapadna Morava river.
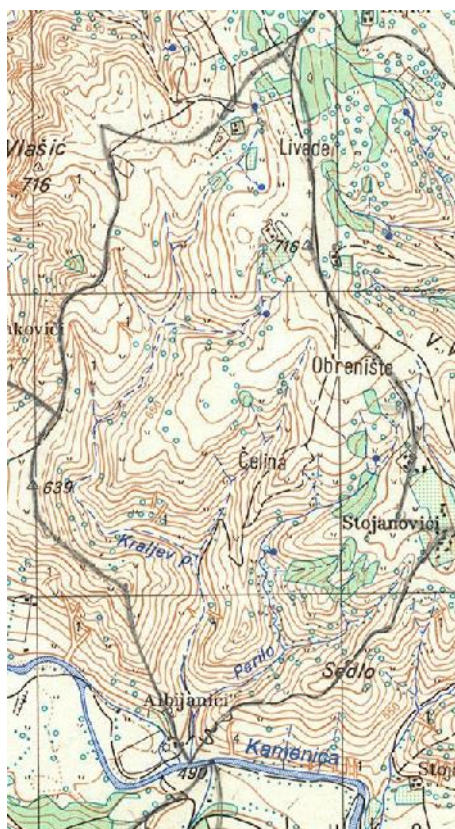

Figure 1. Perilo catchment

Natural characteristics of the Perilo Basin were studied using map data (hydrography, relief, geological substrate and soil), literature data (elements of climate: rainfall and air temperature) and data obtained through an immediate reconnaissance survey of the area (vegetation).

Maps of the studied area have the following scale: topographic map (1:25,000, Fig. 1; 1:50,000) by the Military Geographical Institute (1971), geological map (1:500,000) by the Institute of Soil Science (1966) and pedological map (1:50,000) by the Institute of Soil Science (1964).

Meteorological parameters for the catchment area were calculated using the method of interpolation of rainfall data (Republic Hydrometeorological Bureau, 1930-1961) by the rainfall gradient (Bonacci, 1984), and air temperature (Centre for Research in Agriculture, 1949-1995) calculations for any altitude (Duki , 1984).

Erosion-induced soil losses can be predicted by various analytical models.

However, according to the experience of a number of researchers, the Erosion Potential Method – EPM (Gavrilovi , 1972) is the most suitable on catchment level for watershed management purposes in this Region and is used in: Bosnia & Herzegovina, Bulgaria, Croatia, the Czech Republic, Italy, Iran, Montenegro, Macedonia, Serbia and Slovenia. This is why quantitative indicators of soil erosion in this research were calculated using the Erosion Potential Method - EPM.

The basic analytical equation for the calculation of erosion-induced soil losses, as developed

by Gavrilovi (1972), is as follows:

$$G_{yr \times sp^{/1}} = T \times H_{yr} \times f \sqrt{Z^3} \times R_u \qquad (1)$$

where:

$G_{yr\,sp}^{-1}$ – specific annual total erosion-induced sediment yield reaching the confluence, m^3 yr^{-1} km^{-2}

T – temperature coefficient of the catchment

H_{yr} – amount of rainfall, mm

 – 3.14

Z – coefficient of erosion

R_u – coefficient of retention of soil in the catchment.

Results and discussion

The size, length, circumference and shape (perimeter) of a catchment area are among major catchment elements of importance for soil erosion. The Perilo catchment is 1.81 km^2 in area (F), 2.17 km in length (L), and 6.22 km in circumference (C).

The major physical and geographical elements of the Perilo catchment, viz. relief characteristics, geological substrate features, soil type and soil utilisation method, are quantitative parameters or soil erosion in the catchment.

Table 1. The basic parameters of the Perilo catchment relief

Catchment Name: Perilo	
The lowest point of the main watercourse and catchment (B), m	492
The highest point of the main watercourse (C), m	670
The highest point of the catchment (E), m	726
Average slope of the main watercourse in the catchment (I_a), %	10.8
Mean catchment altitude (M_{sl}), m	631.59
Mean catchment altitudinal difference (D), m	139.59
Mean catchment slope (I_m), %	23.2
Coefficient of catchment relief erosion energy (E_r), m/km$^{1/2}$	63.76

Table 1 presents the Perilo relief which plays a primary role in the occurrence of soil erosion. The mean altitude (A_m) of the Perilo is 631.59 m and the mean altitudinal difference (D) is 139.59 m. The mean slope (I_m) is 10.8%. Relief of a region can also be determined by the coefficient of relief erosion energy (E_r), the value thereof for the Perilo catchment being 63.76 m $km^{-1/2}$. An increase in relief parameter values results in increasing intensity of soil erosion in the catchment.

Geological substrates contribute significantly to the erosion process within the Perilo catchment area (Table 2). Erosion resistance of geological substrates is directly related to water permeability. The geological substrate of the Perilo catchment is serpentine (100.00% of the total catchment area) and exhibits poor permeability. The water permeability coefficient of the serpentine geological substrate (S_1) is 1.00, suggesting non-resistance of the geological substrate to the erosion process (Table 2).

Table 2. Geological substrate of the Perilo catchment, coefficient of water permeability (S_1) and erosion resistance

Catchment name: Perilo		
F_{ppr}-Poorly permeable rocks		
Serpentine	km^2	1.81
	%	100.00
Coefficient of geological substrate water permeability (S_1)		1.00
Resistance of geological substrate to erosion		Non-resistant

As an erosion agent, soil and its properties contribute, to a lesser or greater degree, to the erosion process. Due to the effect of pedogenetic factors, the soil type covering the Perilo catchment area is humus-siliceous soil on serpentine rock. It is classified as shallow soil. The profile of the humus-siliceous soil on serpentine is of A_h–C type. A strong degree of erodibility is found in the humus-siliceous soil on serpentine (Šekularac, 2000).

Table 3. The structure of the Perilo catchment according to type of land use and vegetative cover coefficient (S_2)

Catchment Name: Perilo			
F_f	Forests and coppice of good spacing	km^2	0.05
		%	2.76
F_g	Orchards	km^2	0.00
		%	0.00
	Meadows	km^2	0.12
		%	6.63
	Pastures and devastated forests and coppices	km^2	1.60
		%	88.40
Σf_g		km^2	1.72
		%	95.03
F_b	rable land	km^2	0.04
		%	2.21
	Infertile soil	km^2	0.00
		%	0.00
Σf_b		km^2	0.04
		%	2.21
Vegetation cover coefficient (S_2)			0.80

The most aggressive climate elements inducing and contributing to soil erosion include rainfall, air temperature, and soil temperature (indirectly, through air temperatures). This region has a temperate continental climate. The mean annual rainfall total (R) for the Perilo catchment is 784.2 mm, and the mean annual air temperature (T) is 8.5^{0}C. The data on rainfall reaching the catchment surface indicate an important role of rainfall as a climate element in soil erosion in the catchment area observed.

The contribution of the other soil erosion agents i.e. vegetation, both autochthonous and anthropogenic, and vegetative cover coefficient (S_2) is given in Table 3. The total area of land under forests and coppice of good spacing (F_f) in the Perilo catchment is 0.05 km^2 (2.76%), most of the land – 1.72 km^2 (95.03%) is under grass vegetation ($\sum F_g$), and 0.04 km^2 (2.21%) of land are under bare soil ($\sum f_b$). These forms of land-use facilitate the protection of the studied area against erosion (vegetative cover coefficient, $S_2 = 0.80$).

The devastating potential of the watercourse can be determined from the hydrographic and hydrologic traits of the region analysed. The traits pertaining to the family of the Perilo torrent (F_c) are as follows: F_c: D; IV; Z=0.37, meaning that the Perilo is a dry watercourse and a small torrential brook (D) classified as class IV of erosion category (a deep type of erosion) and having an erosion coefficient (Z) of 0.37 (weak erosion intensity).

The above traits of the erosion factors in the Perilo catchment result in sediment production and soil erosion of particular intensity.

The scale of erosion of the Perilo catchment is manifested through the mean annual erosion-induced sediment yield, W_{yr} of 951.11 m^3 yr^{-1}.

The mean annual volume of the total sediment yield (G_{yr}) reaching the Perilo confluence is 294.84 m^3 yr^{-1}, whereas the specific annual total erosion-induced sediment yield reaching the confluence with the Kamenica River ($G_{yr\,sp}^{-1}$) is 162.90 m^3 km^{-2} yr^{-1}. This finding regarding the weak erosion intensity is comparable to that on the low-intensity erosion of the Grliška River region (Eastern Serbia) of ($G_{yr\,sp}^{-1}$) 209.12 m^3 km^{-2} yr^{-1} (Stefanovi et al., 2007). Using the method of EPM, in research of the Djuricka river basin (North of Montenegro), predicted that the soil losses were 645 m^3 km^{-2} per year (Spalevic et al., 2013). The said erosion intensity on the Perilo catchment is manifested through the relief erosion energy coefficient of 63.76 m km$^{-1/2}$, the erosion coefficient (Z) of 0.37, mean annual rainfall of 784.2 mm and average annual air temperature of 8.5^{0}C, with about 95.03% of land area under grass vegetation ($\sum F_g$), and the dominating humus-siliceous soil on serpentine rock.

The above data show that, in view of the annual sediment yield, about 0.48 ha of soil up to 20 cm depth are eroded off the Perilo catchment area i.e. about 0.71 t ha^{-1} of soil are lost annually. The amount of the eroded soil material can be categorised as class I (0-1 t ha^{-1} yr^{-1}) of permissible or tolerable erosion (Hacisaliho ly et al., 2010).

Conclusion

The Perilo is a dry watercourse during the summer and a small torrential brook at other times of the year. The value of Z coefficient of 0.37 indicates that the river basin belongs to destruction category IV. The strength of the erosion process is weak, and deep erosion dominates in the studied area. These and the other soil erosion agents analysed in the catchment area have resulted in the mean annual erosion-induced sediment yield of 951.11 m^3 yr^{-1}, and erosion intensity of 162.90 m^3 km^{-2} yr^{-1}. The erosion observed in this region is of weak intensity, and the anthropogenic factor is the key agent in the process governing soil utilisation, soil conservation and protection from further erosion-induced degradation.

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COMPARATIVE ANALYSIS OF FOREST ADMINISTRATION IN SERBIA WITH REGIONAL COUNTRIES

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Abstract

There is variability in the organizational forms of the forest management, which is caused by a variety of geographic position, natural and socio-economic characteristics and interests of individual countries. Regardless of the institutional reforms of the forestry sector there is no guaranteed "success model" of public forest administration. Aim of research is comparative analysis of state forest administration in Serbia with countries in region: Slovenia, Bosnia and Herzegovina and Montenegro. Purpose of researching is identification of similarities and differences between different organizational forms based on benchmark analysis in accordance with supervisory, regulatory and advisory function of state forest administration. In the article are applied classical methods of researching: analysis, synthesis, induction, deduction and comparison. The organization of state forest administration depends on the history of forest utilization and sector policies, traditions, stakeholders, institutional framework, economic conditions, and changes of ownership models, state forest fund as well as political will.

Key words: *forestry, institutions, public administration, organization, Serbia*

Introduction

State forest administration is part of public sector and represents main authority of forest policy. Implementation of forest policy is based on efficiency of forest institutions. Directorate of Forests in Republic of Serbia represents the main forest authority with the aim of formulating forest policy and supervision of forest legislation. Comparative analysis of state forest organization in Serbia and region countries is based on three main functions of state forest administration: regulatory, supervisory and advisory function.

Reform of state forest administration is possible after defining role and aims of forest authorities. Successful implementation requires precisely formulated forest policy and represents main aim of state forest administration. Recognizing and defining issues with proposed solutions are the most important for successful forest policy. Implementation of forest policy is based on political program with defined aims through forest legislation but also through professional, technical, informational and financial support to forest users.

In South East Europe countries state forest administration has been developed through development of public administration and forest economy. Though history, forestry represents one of the most important areas of economy, and with country development forestry became more important. With historic review of state forest administration in Serbia and previous countries on Balkan region, forestry had the important role in public administration.

Aim of research is comparative analysis of state forest administration in Serbia with countries in region: Slovenia, Bosnia and Herzegovina and Montenegro. Purpose of research is identification of similarities and differences between different organizational forms based on benchmark analysis in accordance with supervisory, regulatory and advisory function of state forest administration.

Materials and Methods

Research is based on secondary data analysis by collecting and processing data that are already used in some previous researches or studies. Professional and scientific literature is used as well as legislative, available internal documentation, reports and studies. Data analyses include domestic sources as well as foreign sources of literature.

Scientific methods mostly used in organization of state forest administration are general system theory, analysis and synthesis, historical method, normative and comparative method. System analysis describes organizational issues and their causes, finding the basic necessities in the organization and defining the issues based on existing legislation and stakeholder's interests.

Method of analysis and synthesis was used to analyze the legislation of the forestry sector and define conclusions based on collecting, processing and literature review related to the organization of the forestry sector and the functions of the state forest administration. Historical method was applied to analyze development of forest administration, and normative method considered legal frameworks in terms of institutional capacity, economic policy and resources needed for the implementation of forest policy. The comparative method is applied for benchmark analysis of state forest administration in Serbia with selected countries in South East Europe: Slovenia, Bosnia and Herzegovina (Republic of Srpska/Federation of Bosnia and Herzegovina) and Montenegro, based on main functions of state forest administration. The countries were selected in accordance with size of the forestry sector, dynamic of reform process, type of forest management and the EU accession process.

Results and Discussion

Serbia – By Law on Ministries from 2004, Directorate of Forests was organizational unit within the Ministry of Agriculture, Forestry and Water Management until April 2014, when the adoption of the new Law on Ministries prescribe competencies of agriculture, forestry, water management, environmental protection and natural resources under the newly formed Ministry of Agriculture and Environment Protection. Directorate of Forests is responsible for professional activities including forest policy, forest preservation, promotion and use of forests and wildlife, the implementation of measures to protect forests and wildlife, control of seeds and seedlings in forestry, inspection supervision in the field of forestry and hunting performed in accordance with the law and other statutory duties. Forest and hunting inspection as part of Directorate of Forests have supervision over the implementation of forestry and hunting legislative.

Slovenia – On the beginning of 1990s reorganization of forestry sector started with Act on Forests from 1993 and continues with new one adopted in 2002. With reorganization of forestry sector, the public forest services were excluded from the former forest management entities. At the level of state forests activities of the public forest service, activity of forest management and forest authorities were separated. Forestry sector today is part of the Ministry of Agriculture, Forestry and Food. Main documents of forest management in Slovenia are Law on Forest of the Republic of Slovenia and the National Forest Programme, which defines the national forest policy. The Slovenia Forest Service is a public institution, established by the Republic of Slovenia (The Act on Forests, 1993), which performs public forestry service in all Slovenian forests, irrespective of ownership.

Federation of Bosnia and Herzegovina - Ministry of Agriculture, Forestry and Water Management of the Federation of Bosnia and Herzegovina is responsible for forests and forestry sector at the entity level. Ministry is also responsible for providing guidance to cantonal administrations for forestry and forest companies and supervise the work of the Federal Forest Administration, which delivers strategies, programs and plans and provides technical support, collection and processing of forestry information (including information

provided by the cantons) and a variety of projects in the field of forestry in the Ministry. The cantonal government (Department of Forestry) is responsible for monitoring, reporting and organization of protection of forest fires and disease control, as well as for the development and approval of forest management plans for all forests in their canton.

Republic of Srpska - Supervision in forestry at the entity level is done by Inspection of the Republic of Srpska (aside from the Ministry of 2005), which include 12 inspectorate and within it forest and hunting inspection. This inspection has 6 territorial parts with a total of 17 inspectors. It performs inspections of state (24 forest entities based on 10-year and annual plans for forest management) and private forests (based on municipal forest management plans). Work is based on a sophisticated electronic system that includes the planning of inspection, description of duties and tasks of each inspector, checklists and forms, inspection reports, registry violations, etc. All inspectors have appropriate professional training. On this way supervisory function in Republic of Srpska is standardized in accordance with rules and procedures, with a clear legal basis for the work and achievement quality performance.

Montenegro – Directorate of Forests is the state authority responsible for forest management based in Pljevlja and includes 15 regional units. Boundaries of units correspond to municipal boundaries. Directorate include sector for forest management units for the cultivation and protection of forest use and forest concessions and unprotected plant species, department of economic affairs, department for the construction of forest infrastructure and administration department, which deals with legal issues, accounting, procurement, personnel records, disciplinary actions, etc.

Table 1 shows types of organizations of state forest administration in selected SEE countries: Serbia, Slovenia, Bosnia and Herzegovina (Federation of Bosnia and Herzegovina, Republic of Srpska) and Montenegro. The table highlights the relevant ministries of forestry, as well as relevant state bodies performing regulatory, supervisory and advisory functions in the forestry sector.

Table 1. Organization of state forest administration in SEE countries

State	The competent Ministry	Regulatory function	Supervisory function	Advisory function
Serbia	Ministry of Agriculture and Environmental Protection	Directorate for Forests	Forestry-hunting inspection	Not established
Slovenia	Ministry of Agriculture, Forestry and Food	Sector for Forestry	Inspection	Local entities
Federation of Bosnia and Herzegovina	Ministry of Agriculture, Forestry and Water Management	Federal Directorate of forests	Forest Inspection	Not established
Republic of Srpska	Ministry of Agriculture, Forestry and Water Management	Agency for Forests	Inspection	Not established
Montenegro	Ministry of Agriculture and Rural Development	Sector for Forestry	Inspection-Department for forestry, hunting and plants	Not established

Source: original

Forestry sector in South East European countries is under supervision of Ministry of Agriculture, as well as regulatory function of state forest administration which are in the form of directorate, department or agency. The supervisory functions of state forest administration are defined in form of inspection and also belong to the relevant ministries. Slovenia as EU member has clearly defined advisory function for forest users, while this is not the case in Serbia, Bosnia and Herzegovina and Montenegro.

Forestry sector has very important role in the economic development of analyzed countries, especially in the improvement of sustainable rural development. In Serbia, like other countries, functions of forest authority and forest management are separate while advisory function still not organized on efficient way. Employment is not uniform, taking on mind that number of employees in state administration is high, while the number in public sector is significantly higher, and on that way is satisfied social function of sustainable forest management.

Analysis of the regulatory functions of the state forest administration showed that in terms of formal structures based on laws, rules, regulations and norms of hierarchical structure. Employment limitation in state administration is main issue for engagement of educational staff and system of professional improvement does not exist. Political influence on employment, small salaries in state administration and organizational culture make state forest administration passive.

Supervisory function of state forest administration is based on existence of inspection within the regulatory function as the case in Serbia or within the inspection on state level as the case in Slovenia. Inspection is established in every analyzed country but there are differences on organizing way and equipment. In Slovenia situation is a little better, until other countries in region are limited in improvements with limited budget funds. It is extremely important on which way inspection will be organized within the regularly function of state forest administration.

Advisory function is equally important as previous two described functions of state forest administration. In accordance with EU legislative, in Slovenia forest entities has that role. Other countries are faced with lack of precisely defined aims of advisory service, but that does not mean that current units in state forest administration are not available for any kind of advice for forest users, in accordance with procedures. Through research, studies and papers importance of advisory service establishment is extremely emphasized but until now nothing has been done.   Advisory service is primarily based on help and support to private forest owners, small and medium enterprises in forestry and non-governmental sector.

Needs of state forest administration of analyzed countries are:

Recruitment of high quality and well-educated staff that will be able to contribute to the improvement of stat forest administration;

Training of existing forest and hunting inspectors and better coordination of inspections;

Organizational changes that would clearly define activities and competences of state forest administration and contribute to more efficient work;

Clearly define the criteria for budget fund allocation;

Development (improving) of the information system and

Development of advisory services for support to private forest owners and small and medium enterprises in forestry.

Conclusion

State forest administration is under dynamic changes in terms of pubic informing, employment policy and requirements for training and development of employees. Work of the competent authorities of the public forest administration was observed in the overall organizational structure that relies on laws, rules, standards, regulations, and hierarchical

structures. System of training for professional is not established and on that way employees have lack of motivation for improvement because of the political influence in employment is very strong.

Improvement and development of forest sector require political will, leadership and commitment of the most important stakeholders in the sector. Primarily is important to resolve organizational issues and main causes of the problems in the sector, what will lead to real changes that should result in efficiency of sector, motivated staff, and increase transparency in business, sustainable organizational change as well as increasing employment in the process of European integration and better understanding of forestry sector in public.

It should be noted that regardless of the institutional reform of the forestry sector there is no guaranteed "success model" of public forestry sector, what depends on many factors: history and use of forest sector policy, tradition, stakeholders pressure, institutional framework, economic conditions and changes, the model of ownership, forest growing stock as well as political will.

To improve efficiency of state forest administration it is required to:

• motivate employees in state administration;

• achieve higher transparency in the implementation of policies and procedures;

• find the most efficient organizational solutions;

• increase the ability to use financial resources from EU funds;

• contribute to a better public understanding of forestry.

Main issues of state forest administration are reflected in inefficient work, political influence, and high number of employees in public administration, non-appropriate internal organization and inadequate control of public enterprises in forestry. Reform of state forest administration is definitely needed and necessary for the development and improvement of the forestry sector.

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EVALUATION OF QUALITY PSEUDOGLEY SOILS BASED ON ITS WATER-AIR PROPERTIES

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Abstract

This paper provides an overview of the most important water-air soil properties (water retention capacity, permanent wilting point, plant available water capacity, soil water permeability and air capacity) in order to assess the quality of its productive properties.The study has been conducted on arable soil type pseudogley on the Agro-chemical School Dr. Djordje Radic in Kraljevo farm. The gained results of investigation showed unfavorable water-air properties, as the result of the unfavorable shape of porosity. Also, in the humic and Eg horizons, there have been determined low values of plantavailable water capacity, on the one hand, and high values of moist of permanent plants wilting, on the other hand.Unfavorable water regime of the soil is in a large extent a consequence of its low permeability of water, even in the Ah and Ahp horizon, where the ratio of water filtration is rarely higher than 30 mm/hour, whereas the individual values were less than 10 mm/hour. Extremely low permeability of soil water was in Btg horizon, which in the rainy seasons was becoming practically impermeable for water.Examined soil shows low values of absolute air capacity in Ah and Eg horizons (<10 vol. %), which does not provide sufficient aeration during periods of moderate humidity. Unfavorable water-air properties of the studied pseudogley soil require the application of appropriate pedomeliorative measures such as are: deep loosening of soil, deepening of arable horizon, breaking formed an impermeable layer, as well as the application of liming measures with humization in this soil type.

Key words: *permanent plant wilting, pseudogley, retention capacity, soil, soil-water properties, water permeability.*

Introduction

Pseudogley is the soil type, which is characterized by the alternation of wet and dry phases of moist. The cause of such a water-air regime is the presence of compacted horizon, which is impermeable or poorly permeable to water. In the case of higher rainfall, due to this provision upper soil profile becomes saturated with water, which it is stagnant and prevents normal aeration of the soil. Hence, during the dry season surface layers are very dried and deeper impermeable horizon hardens "like concrete".

Above hardly permeable horizon upper groundwater occurs, which causes anaerobic environment which produces reduced compounds toxic to plants (Caron et al., 1992; Ezeaku and Alaci, 2008). Shallower pseudogleys, where low permeability horizon lies close to the surface, quickly saturated with water in the winter and spring months. When rainfall in the sesoils during winter plant species suffer from a lack of oxygen, since all land pores are filled with water. With deeper pseudogley, the situation is better and it can be better used.

Estimation of some forms of soil water and its efficient use is related to the variability of soil physical properties and characteristics of water present, and the pronounced variability in

space and time in which it observes the air-water properties (Gao et al. 2011, Timm et al., 2011; Cajazeiraand Assis Junior, 2011).

Unfavorable soil water regime (high value permanent wilting moisture, low level of productive moisture and filtration coefficient in the soil, very low air capacity), is consequence of the occurrence of severe soil compaction, low porosity and usually unfavorable and unstable structures (Isirimah, 2004; Ezeaku and Alaci, 2008). Also, increased density of soil, prevents the filtration of water flow sufficient quantities of oxygen to the root zone, which inhibits the growth and reduces yield of the crops. Large compaction of the soil reduces aggregate stability (Caron et al., 1992) and leads to a decrease in macro porosity (Swartz et al., 2003). Therefore, the consequences of these changes are environmental degradation of land, which includes the loss of water of life, biodiversity and other plant resources (Isirimah, 2004; Ezeaku and Alaci, 2008).

Poor humic soil, with low levels of divalent alkali cations have substantially larger compressing than the very humic soils. According to Aggelides and Londra (2000) the introduction of large amounts of soil organic matter content leads to the increase in the retention of water in soil, and also to reduce its hardness.

The aim of our study was to determine the productive capacity of arable pseudogley on the most important water-air-soil properties (water retention capacity, permanent wilting humidity plants with a capacity of productive moisture, soil permeability to water and air capacity) and based on the condition of the studied trait propose the necessary pedomeliorative measures to increase the level of its productive value.

Materials and methods

Investigations were carried out on the experimental field of the Agricultural chemical school "dr Djordje Radic" on pseudogley soil in 2010/11. At the work of the stationary field experiment soil profiles are opened. From the open pits of which are previously described morphologic, soil samples were taken in the undisturbed condition. Samples were taken at three replications with Kopecki cylinders 100 cm^3 in volume from three levels, or three most important horizons of pseudogley (Ah, Eg and Btg).

Samples were taken at the same moisture content that corresponds to the field capacity. The samples in the undisturbed state analyzes were performed of water-air properties of soil, namely: water retention capacity (0.033 MPa), the method of Richards, with Pressure Plate Extractor-a; wilting humidity (1.5 MPa), the method of Richards, by Pressure-Membrane Apparatus and; plants accessible (productive moisture) was calculated from the difference between the water retention capacity and wilting humidity, filtration, variable pressure, calculated by Darcy, and air capacity has been by computed.

Results and discussion

Unfavorable water regime arable pseudogley (Table 1), it is certainly the result of a very pronounced evaporativity, which is associated with an unfavorable structure, which leads to the formation of rain after a thick crust on the soil surface and the establishment of strong capillary, with a small proportion of pore aeration.

The values of the water retention capacity values are close to the field or rain water capacity and include the maximum amount of hygroscopic, film water and capillary water in the soil. Results of analysis (Table 1) showed no significant difference in the size of the water retention capacity between Ah and Eg horizons in profile pseudogley (35.90 and 37.22 %vol.). Significantly higher values of the capacity of retention of water were found in the horizon Btg (43.50% vol.), which are of 7.60% vol. higher than in Ah and 6.28 vol%. Eg with respect to the horizon. Values close to the film-capillary capacity from 36 to 43% by volume (Ah, Eg and Btg horizon) and slightly higher Eg in relation to the Ah horizon showed that the

cultivated profiles of Kraljevo pseudogley whose water features were examined by Dugalic (1998). Also, the value of the water retention capacity and its availability in the soil affects significantly the mineralogical composition. Thus, if the land is dominated by minerals montmorillonite (crystal lattice type 2:1) (Btg horizon) value of the water retention capacity is higher than in the soil with a dominant clay mineral kaolinite group (crystal lattice ratio 1:1) (Gaiser et al. 2000).

Table 1.Water properties of arablepseudogleyof Kraljevo

Horizons	Depth (cm)	Water retention capacity, pF 2.5		Moisture permanent wilting, pF 4.2		Productive capacity of moisture, pF 2.5-4.2		Filtration coefficient
		% vol.	mm	% vol.	mm	% vol.	mm	mm/hour
Ah	0-15	35.90	53	18.90	32	16.00	25	22
Eg	15-40	37.22	92	20.60	55	14.38	38	40
Btg	60-80	43.50	86	25.00	49	19.20	35	48
	0-80		231		136		98	

Test results show extremely high levels of humidity permanent wilting in all horizons of the profiles (Table 1). Also, there are significant differences in these values between the studied horizons, especially between Ah and Btg (6.10% vol.). Significant differences between the observed water constants can be interpreted as a significant difference in clay content between the horizons, and a very pronounced differences in the structure of soil depth profiles (Rendig and Taylor, 1989; Ezeaku and Alaci, 2008). Expressed in mm water column, permanent wilting humidity of the deep zone from 0 to 80 cm (Ah, Eg and Btg horizon) is 136 mm and is noticeably greater than the moisture capacity of productive moisture (98 mm) in the same depth zone. Therefore, the results of the analysis indicate a very unfavorable physical environment (water) traits studied pseudogley. High levels of humidity permanent wilting, especially in Ah and Eg horizons which are mainly located the roots of plants, suggesting that it is necessary to take adequate pedomeliorative measures to reduce non-productive capacity of moisture in these soils. Similarly, mostly of the high moisture content of permanent wilting has been noted in the works of other authors (Stojicevic, 1961; Dugalic, 1998).

As can be seen from the data in Table 1, the productive capacity of moisture for the observed horizons (Ah, Eg, Btg), by volume or height in mm of water column, shows a lot of close losses (16.00, 14.38, 19.20). Also observed in the entire depth profile of the study (0-80 cm), the productive capacity of moisture is considerably smaller (relative to 38%) relative moist of the permanent wilting. Similar results were obtained by Dugalic (1998) by examining the properties of water from 21 profiles of forest, meadows and valleys of field pseudogley of Kraljevo.

Profile cultivated pseudogley (Table 1), the largest water filtration coefficient is significantly different. So, quite dense Ah horizon shows the lowest (22 mm/hour) coefficient of water filtration that is considered unsatisfactory. However, in the Eg and Btg horizons revealed significantly higher value of this ratio (40 and 48 mm/hour), which can be considered quite satisfactory. The appearance of much higher value of the coefficient of filtration of water in these two horizons (Eg and Btg) compared to the topsoil horizon is unusual and suggests the possibility of applying measures to undermine pedomeliorativne (loosening) the two sub-plowing horizons.

Throughput of arable land in the water, among other things dependent and application of certain cultural practices that affect the content of his large pores (pore aeration). Thus, the compaction of the surface layer there is a decrease, and wherein the dispersion to increase its permeability to water. The results presented in Table 2 show that the rate of water absorption in the horizon Ah was satisfactory (36 mm for 60 minutes), that is 0.60 mm/minute. However, the lower (Eg) during a horizon of 60 minutes pseudogley absorbed water is 25 mm, or an average of 0.42 mm/minute, which is 1:44 for times less than in the topsoil (Ah) horizon. According Sasal et al. (2006) classic treatment plot shows the positive impact of the change in total porosity, especially surface soil horizons.Also, the processing of land favorably affect the physical properties, particularly porosity, which significantly affects the change in the coefficient of filtration and increases the productive capacity of soil moisture (Lipiec et al., 2006; Lampurlanés and Cantero- Martínez, 2006; Farkas et al., 2009).

Table 2. Filtration rate in the Ah and Eg horizons profile of the pseudogley

Horizons	Current humidity	A layer of absorbed water	The duration of filtration	Mean filtration	Rating of filtration
	(%)	(mm)	(min)	(u mm/min)	
Ah	16	36	60	0.60	Satisfactory
Eg	15	25	60	0.42	Unsatisfactory

The results presented in Table 3 show the absolute size of the air capacity of the land of cultivated pseudogley.

Table 3. The air capacity in the investigated horizons of cultivated pseudogley and its level of adequate aeration of soil

Horizons	Depth (cm)	Air Capacity (% vol.)	Air Capacity Grade	Adequate aeration level
Ah	0-15	5.4	Low	Weak
Eg	15-40	4.5	Very low	Very weak
Btg	60-80	2.1	Very low	Very weak

Regarding the horizons of the studied soil air capacity ranges from 5.4 (Ah) to 2.1 (Btg). All three studied profiles show low and very low absolute values of air capacity to enable poor or very poor aeration, which is one of the most unfavorable physical characteristics of the land. Although small in all horizons, the absolute capacity of the air is considerably lower than in the horizon Btg (2.1% vol.), with respect to Eg and Ah horizons (5.4 and 4.5% vol.). Similar results were obtained by Dugalic (1998) while studied the water properties of field pseudogley in Cacak-Kraljevo basin.

Cause of the very low air capacity of the land lies primarily in poor mechanical and aggregate content of the soil, as well as a large degree of soil compaction due to improper cultivation at high or low levels of humidity. High compression of soil conditions and very poor aeration reduced water permeability, and the roots of cultivated plants. Other authors in the past have reached similar results in the past (Dugalic, 1998; Al Majou et al., 2008; Dieckowet al., 2009).

Conclusion

Based on the research results of the most important water-air features of cultivated pseudogley in Kraljevo basin in order to assess its productivity following conclusions can be drawn: Unfavorable situation porosity has a very bad water and air qualities, which is one of the most important causes of their small effective fertility. Adverse water properties of these lands are mostly a consequence of the low value of the productive capacity of moisture and high humidity values of permanent wilting plants in the Eg horizon. Productive capacity of moisture is slightly larger, and in some sections and less than permanent wilting humidity. Unfavorable water regime pseudogley land is to a significant extent and consequences of its low permeability to water, even in the Ah horizon, where the ratio of water filtration is rarely greater than 30 mm/hour. Absolute air capacity of the studied area shows low values, especially in the Btg horizon (2.1% vol.), which results in very poor aeration during periods of moderate humidity.Unfavorable water-air properties of the studied pseudogley soil require the application of appropriate pedomeliorative measures such as are: deep loosening of land, deepening of plow horizon, breaking formed an impermeable layer, as well as the application of liming measures with humization in this soil type.

Acknowledgements

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CHARACTERISTICS, APPLICABILITY AND INFLUENCE ON ENVIRONMENT OF THE PRODUCT "VESTA AGRI"

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Abstract

In this paper characteristics, applicability and influence on the environment of the product "Vesta Agri" are presented. The product "Vesta Agri" represents mixture of catalytic thermostable enzymes, which are bonded with saprophytic bacteria and relative eutrophic compounds. This combination allows very fast degradation and fermentation of organic matters. Use of this product is for initiating of biological process in the newly constructed lagoons or objects. Too, it is used in the case of big organic load of wastewaters.

The results of physicochemical properties of this product are showing that the product is in the form of fine granules with the smell of yeast, moderate solubility and has pH value 6.20. Microbiological properties are given of the following content: cellulase 2.93 %, protease 1.50 %, amilase 0.43 %, lipase 0.17 % and total bacteria 149.6 million ufc g^{-1}. Regarding of radiological properties, the activity concentrations of all investigated radionuclides were less than minimum detectable concentration (MDC).

The obtained results of all analysis showed that the product "Vesta Agri" meets the safety criteria. After all examination of the bacterial enzyme mixture called "Vesta Agri" it is concluded that there is no adverse effects on the environment and it is not harmful to the health of the people who come into the contact with this product.

Keywords: *"Vesta Agri"; Enzymes; Radioactivity; Ecological influence*

Introduction

Available resources of fresh water are exhausting steadily and this presents global catastrophe (Adulkar and Rathod, 2014). Increasing water consumption for anthropogenic activities significantly is affecting the reduction of available water resources. Water pollution due to toxic metals and organic compounds is a serious environmental and public problem (Crini, 2005).

Wastewaters from different processing industries may contain high concentrations of oil and grease, solids and chemical oxygen demand levels, which are difficult to treat through conventional biological treatment system mainly due to slow biodegradability (Jeganathan et al., 2007). If not treated, presence of these substances may cause gross pollution of land and water with their high damage (Cammarota and Freire, 2006). Some conventional methods for wastewater treatment include biological processes. These are mainly aerobic processes, but in the last two decades anaerobic reactors have been increasingly applied (Cammarota and Freire, 2006). Anaerobic treatment processes are considered to be better than aerobic processes because of valuable biogas production, less biomass production, higher organic loading application and less energy consumption (Lettinga, 1996). Conventional biological treatments of wastewater are not given satisfactory results always. Hence, today in focus of research is application of preparation based on enzymes, as enzymes which have been isolated from plants, fungi and bacteria.

Company WEST CHEMIE BGD uses two groups of technology in biological wastewater processing. One of them is technology based on bioaugmentation, while the other is based on selected microorganisms. The main advantage of these methods is better and bigger performance in comparison with biological processes. The aim is simply application on existing systems with infrastructure which is built. These technologies are effectively used in lagoons (both aerobic and anaerobic), as well as in water treatment plants.

The aim of this study is showing of characteristics with special emphasis on the radiological characteristics, applicability and influence on the environment of the product "Vesta Agri", which is used in the above technologies of biological wastewaters processing.

Materials and methods

The product "Vesta Agri" represents mixture of catalytic thermostable enzymes (cellulase, protease, amylase and lipase), which are bonded with saprophytic bacteria (*Bacillus subtilis*, *Lactobacillus acidophilus* and *Aspergillus oryzae*) and relative eutrophic compounds to provide of organic carbon (dextrin). "Vesta Agri" is used in the next cases: starting of biological processes in new lagoons or objects and big loads in existing lagoons or objects (bigger organic loads of wastewater). This product is not adding only in the case when need to be increased number of microorganisms or degradation of corresponding organic pollution. Addition of this product is performed that to be introduced organisms, which should better adapt to the conditions which are quickly changing (pH, temperature, etc.). The characteristics of the product "Vesta Agri" which is taken on 10 January 2012 are given in *Table 1*.

Table 1. The characteristics of sample of bacterial enzyme mixture named "Vesta Agri".

Characteristic	Value
Form	fine granules with the smell of yeast
Solubility	moderate
pH	6.20
Cellulase	2.93 %
Protease	1.50 %
Amilase	0.43 %
Lipase	0.17 %
Bacteria (total)	149.6 million ufc g^{-1}

The preparation of sample for measurement of the gross alpha and beta activity was performed used MARLAP method (MARLAP, 2004). Sample (about 130 mg) was transferred into a stainless−steel planchet and the planchet was placed directly into the detector for measurement of the gross alpha and beta activity. The preparation of sample for gamma spectrometric measurement included weighing and placing into a plastic box of 200 mL in volume (IAEA, 1989). Since the purpose of measurement is screening, the counting of the sample was conducted immediately after preparation.

The gross alpha and beta activity were determined by / low level proportional counter Thermo Eberline FHT 770 T (ESM Eberline Instruments GmbH, Erlangen, Germany). The counting time was 3600 s. Calibration was performed by using a standard source of [90]Sr (EM 145, Prague, Czech Republic) with an activity of 189.4 Bq on the day 1 August 2011 for beta activity and a standard source of [241]Am (EM 445, Prague, Czech Republic) with an activity of 224 Bq on the day 1 August 2011 for alpha activity. The counting gas was a mixture of 90 % argon and 10 % methane. The counting efficiencies for

the system were 26 % for alpha and 35 % for beta. The background of each detector was determined by counting an empty planchet for 3600 s.

Minimum detectable the gross alpha and beta activity concentration was calculated by the *Equation (1)* (Sarap et al., 2014):

$$MDC = \frac{LLD}{m}$$ (1)

where *LLD* is the detection limit (1/s) and *m* is the mass of the sample (kg).

Gamma spectrometric measurement was performed using a HPGe Canberra detector (Canberra Industries, Meriden, Connecticut, USA) with counting efficiency of 20 %. Counting time interval was 9000 s. The spectar was analyzed using the program GENIE 2000 (Canberra Industries, Meriden, Connecticut, USA). The activity of ^{226}Ra and ^{232}Th was determined by their decay products: ^{214}Bi (609 keV, 1120 keV and 1764 keV), ^{214}Pb (295 keV and 352 keV) and ^{228}Ac (338 keV and 911 keV), respectively. ^{235}U was determined via 186 keV corrected for ^{226}Ra. ^{238}U was determined via ^{234}Th (63 keV) or by ^{234}Pa ($t_{1/2}$=1.17 min, 1000 keV). The activities of ^{40}K and ^{137}Cs were determined from its 1460 keV and 661.6 keV, respectively.

The calibration of detector for measurement of items of general use in powder form was performed using a plastic box of 200 mL in volume. Secondary reference material was obtained from the primary reference liquid radioactive material (9031−OL−427/12, type ERX, Czech Metrological Institute, Prague, Czech Republic) spiked with a series of radionuclides (^{241}Am, ^{109}Cd, ^{139}Ce, ^{57}Co, ^{60}Co, ^{203}Hg, ^{88}Y, ^{113}Sn, ^{85}Sr, ^{137}Cs and ^{210}Pb) with total activity of 72.4 kBq on the day 31 August 2012. Energy calibration is checked in whole region before applying usual quality control (QC) procedure for gamma spectrometry measurement. The total activity of calibration source is used to check the efficiency calibration and the general operating parameters of the gamma spectrometry system (source positioning, contamination, library values, and energy calibration). The detector shield background, detector efficiency, peak shape, and peak drift are measured and verified if they are within the warning and acceptance limits. For that purpose ^{60}Co and ^{133}Ba sources were used.

Minimum detectable concentration (MDC) of gamma emitters was calculated by the *Equation (2)* (Sarap et al., 2014):

$$MDC = \frac{LLD}{t \times P_x \times E_f \times m}$$ (2)

where *LLD* is the detection limit, $LLD = 2.71 + 4.65\sqrt{B}$, B is count of the background, *t* counting time (s), *P* probability of gamma decay (%), E_f detector efficiency (%) and *m* mass of the sample (kg).

Results and discussion

Table 2 shows the result for gross alpha and beta activity concentration for analyzed sample "Vesta Agri". The gross alpha activity was <120 Bq kg^{-1} , while the gross beta activity was <171 Bq kg^{-1}. The Republic of Serbia has no regulations about recommended levels of the gross alpha and beta activity for items of general use in powder form.

Table 2. The gross alpha and beta activity of the product "Vesta Agri".

Gross alpha activity (Bq kg^{-1})	Gross beta activity (Bq kg^{-1})
< 120	< 171

The results of gamma spectrometric measurement in the same sample are presented in *Table 3*. The activity concentrations of all investigated radionuclides were below the MDC. The limits of the radionuclides content, whose half–life is longer than 60 days, in powder substances intended for general use and for which limit values are not set by the Rulebook on registration and notification of sources of ionizing radiation, are equal to the values that are ten times greater than the limits of radionuclide content in drinking water (Official Gazette of the Republic of Serbia, 2011). Volume of 1 L of drinking water is replaced by a mass of 1 kg. Derived concentrations of individual radionuclides in drinking water expressed in Bq L^{-1} are 2.9, 3.0, 0.49, 0.59 and 10 for ^{235}U, ^{238}U, ^{226}Ra, ^{232}Th and ^{137}Cs, respectively (Official Gazette of the Republic of Serbia, 2011). Based on the results presented in *Table 3*, it can be seen that the criteria of recommended levels of each radionuclides in investigated product are met.

Table 3. The activity concentration of individual radionuclides in the product "Vesta Agri".

Radionuclid	^{235}U	^{238}U	^{226}Ra	^{232}Th	^{40}K	^{137}Cs
Bq kg^{-1}	< 0.8	< 8	< 3	< 0.5	< 12	< 0.5

In addition to determination of the radionuclides content in the product "Vesta Agri", physico chemical characteristics of wastewater that is treated with this product were determined, too. The results of physico chemical laboratory examinations of wastewater that was treated with enzymatic product "Vesta Agri" are presented in *Table 4*. Sample of wastewater was taken in December 2013.

Table 4. A physico chemical characteristics of wastewater that was treated with the product "Vesta Agri".

Parameter	Value	Maximum allowed value	Standard/Method
pH	7.6	6.0 9.0	ISO/10523:1994
Consumption of $KMnO_4$ (mg L^{-1})	189.1	/	PRI[a]/P IV 9a
Chemical consumption of O_2 (from $K_2Cr_2O_7$) (mg L^{-1})	183	500	VDM 0181[b]
Biochemical consumption of oxygen (BPK$_5$ diluted) (mg L^{-1})	76	400	SRPS EN/1899 1:09
NH_4^+ (mg L^{-1})	131.8	15	ISO/14911:1998
NO_2 (mg L^{-1})	0.065	35	EPA/300.1
NO_3 (mg L^{-1})	< 0.1	50	EPA/300.1
Cl (mg L^{-1})	122.3	500	EPA/300.1
SO_4^2 (mg L^{-1})	18.5	300	EPA/300.1
P (mg L^{-1})	6.31	/	EPA/200.7Rev 5
Total nitrogen (mg L^{-1})	136.4	/	SRPS EN/12260:2008
Total inorganic nitrogen (mg L^{-1})	131.87	/	/
Conductivity at 20 ^{0}C (µS cm^{-1})	1880	/	SRPS ISO/27888:2009
Dry residue at 105 ^{0}C (mg L^{-1})	776	/	SMEWW[c] 19th/m 2540 B
Suspended solids at 105 ^{0}C (mg L^{-1})	84	500	SMEWW[c] 19th/m 2540 D
Sedimentary materials by Inhoff after 2 hours	< 0.1	2	SMEWW[c] 19th/m 2540 F

	(mL L^{1})			
Fats and oils by Soxhlet (mg L^{1})		9.2	40	SMEWW^{c} 19th/m 5520 D

[a] Drinking water, Standard methods for hygienic safety, SZZZ, Belgrade, 1990.
[b] Manufacturer instructions for equipment Lovibond.
[c] Standard methods for Examination of Water and Wastewater, 19th Edition, 1995.

As can be seen from *Table 4*, the obtained values of investigation of physico−chemical characteristics of bacterial enzymatic product are in the range of allowed values, except for content of amonium ion.

Conclusion

Catalytic thermostable enzymes in the composition of the product "Vesta Agri" perform degradation of proteins, carbohydrates, fats and derivates of cellulose which are found in wastewater. Enzymes are used in wastewater treatment to develop a remediation processes that are environmentally less aggressive in compared to conventional techniques.The obtained results of analysis of physico−chemical characteristics are showed that the product "Vesta Agri" met the safety criteria. In Serbia, based on the regulation (Official Gazette of the Republic of Serbia, 2011) limit values of activity concentrations of certain radionuclides are defined for different materials, inter alia for items for general use in powder form. On the obtained results of determination of radionuclides content, it can be concluded that enzymatic preparat "Vesta Agri" is met the criteria for radiological safety.

Acknowledgement

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PRESENCE OF DIFFERENT GROUPS OF MICROORGANISMS DEPOSOL IN RECLAMATION AT STANARI COAL MINE

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Abstract

This paper studied the presence of certain groups of microorganisms in deposol during the phase of biological reclamation with different crops. At the site of the overburden collection site at the Stanari coal mine, in 2011, the small grains, potato, soybean, corn, grass-clover mixture were sown in previously treated deposol. Since the dominance of certain groups of microorganisms dictate the processes of synthesis and degradation and determines the quality of the soil, this paper represents the total number of bacteria, *Azotobacter sp.*, ammonifiers, oligonitrophiles, actinomycetes and fungi. In microbial community, the bacteria dominated by the quantity in the control deposol and deposol in process of reclamation. Oligonitrophiles, like ammonifiers present in significant numbers in the control deposol, and their number has increased by applying the measures of reclamation. Also, the conditions for activity of *Azotobacter sp.* have been improved by application measures of reclamation. Since the pH control deposol is acid, the number of fungi in it is higher than number of fungi in deposol in the reclamation process, except deposol under grass-clover mixture. The highest total number of bacteria (351×10^5) , ammonifiers (1778×10^3) and oligonitrophiles (1361×10^3) is in the soil under grass-clover mixture, while the largest concentration of *Azotobacter sp.* in the soil under soybean (133×10^2). The presence of actinomycetes was not recorded in control deposol. The best effect of the reclamation processes on restore deposol fertility was recorded in deposol under grass-clover mixture.

Keywords: *Overburden collection site, biological reclamation, microorganisms*

Introduction

Coal mining not only visibly disrupts the aesthetics of the landscape, but disrupts soil components such as soil horizons and structure, soil microbe populations, and nutrient cycles that are crucial to sustaining a healthy ecosystem. At the beginning of the mining process soil is completely removed and stockpiled causing soil structure and soil microbial functions to be adversely affected. This disturbance can have a range of negative impacts on soil properties and microorganisms including organic matter and a potential for impaired nutrient cycling in reclaimed surface mine soils (Insam and Domsch, 1988; Bentham et al., 1992).

Mining operations on surface mine Raškovac and future surface mine Ostružnja significantly accelerated the degradation of the environment and the entire ecosystem (Malic et al., 2012). To restore or reclaim disturbed ecosystems, functioning stable soils must be reestablished. Biological reclamation is the old technology for the restoration of lands damaged by human activity.

Soil microorganisms during reclamation of surface mine sites, are extremely important to sustainable ecosystem function. They themselves are involved in major soil processes, such as humification, recycling, and mineralization of organic residues, leading to the plant availability of nutrients. Thus, they represent an important link in the soil – plant system and

contribute to the enhancement of soil fertility (Emmerling et al., 2002; Kourtev et al., 2002; Golic et al., 2006).

The composition of the soil microbial community may be influenced by the diversity of plant species (Balser and Firestone, 2005). Soil microbial community structure is increasingly being marketed as ecologically-relevant endpoint and it can realistically be incorporated for assessing the potential risks associated with soil amendment strategies on sustainability of soil ecosystems.

The aim of this paper was to obtain information about presence of different groups of microorganisms in deposol in the process of biological reclamation with five different plant species at Stanari coal mine. Measurement of microbial communities in soil provides answers to important questions such as the success of ecosystem restoration and return to its core functions and biodiversity.

Material and method

This research with different crops was performed in three years period (2011/2013), on the experiment plot of technogenic soil of the mine, within the inside part of overburden deposition site, near Raskovac pit, which is the part of Stanari coal mine. Stanari coal mine is located in north of the Republic of Srpska and Bosnia and Herzegovina at the municipality Doboj.

Small grains were sown manually, during the autumn sowing date, with 250-280 kg/ha of seed. During sowing, starter fertilizer was used at doses of 60 kg/ha of pure nutrients (N, P_2 $_5$, K_2). The nitrogen fertilizer KAN (27% N) in a dose of 200 kg/ha was used at the beginning of tillering. Potato, soybean, corn and grass-clover mixture were sown during spring sowing date. Seeding rate for potato, soybean and corn was standard, and for grass-clover mixture was 30-40 kg/ha. During the sowing period, application of fertilizers was performed through the average use of 60-80 kg/ha of nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O), while during the vegetation period supplemental recharge of 50-80 kg/ha of nitrogen was conducted.

Before seeding these crops, implementation of sudangrass growth (one year) was performed with the green manure fertilization of deposol and it represents an agro-technical phase of reclamation process within the mine.

Samples were collected from deposol without measures of biological reclamation (deposol control) and deposol in the reclamation process. Chemical analysis of deposol determined the parameters as follows: pH values (determined in a 1:25 ratio of soil/distilled water and in KCl), humus content (dichromate method by Tjurin in modification by Simakov), total content of nitrogen (determined by burning with the Kjeldahl procedure), availability of potassium and phosporous (Al-method by Egner-Riehm-Domingo).

Microbiological analyses involved determination of the number of particular systematic and physiological groups of microorganisms using the method of dilution on specific solid media. The following was determined: total number of bacteria (on the 1/10 strength Trypton Soya agar), soil fungi (on Czapek-Dox agar), actinomycetes (on the synthetic agar, Krasilljnikov, 1965), ammonifiers (on the nutrient agar), oligonitrophilic bacteria (Fyodorov's medium, Anderson and Domasch, 1958), count of *Azotobacter sp.* (Fyodorov's medium by the fertile drop method, Anderson, 1965). Incubation was followed by identification and counting of the colony forming units per 1 g of absolutely dry soil.

Results and discussion

Chemical properties of deposol

Since there is a very close connection between the microorganisms in the soil and their environment, the main chemical properties of deposol (without measures of biological reclamation) and deposol in the process of reclamation were determined (Tab. 1).

Chemical analysis of this technogenic soil were carried out before the start of reclamation (sample no. 1) and sowing, and then in the process of reclamation at the end of 2013 (sample no. 2). Based on the control results of active and potential soil reactions, deposols samples are classified into a category of highly acidic and moderately acidic reaction. The content of humus, total nitrogen and available phosphorus was recorded under detection level. According to the readily available potassium content, deposols are classified into a category of very poor content of these elements.

Tab. 1. Results of chemical analysis of the deposol (control) and deposol in the reclamation process

N^o	Variant (phase of deposol)	$_2$	KCl	Humus (%)	N (%)	Plant available	
						P_2O_5 mg/100g	K_2O mg/100g
1.	Deposol (control)	5,2	4,1	0,0	0,0	0,0	1,0
2.	Deposol in the reclamation process	6,3	5,0	0,2	0,01	2,3	5,9

The results of repeated chemical analysis of deposols in the reclamation process at the end of 2013 showed to a certain extent improvement of basic chemical properties. Precisely these changes are specific for the previously determined meliorated deposol (Malic, 2010). A decrease in the acidity at sample no. 2 was noticed, compared to the state before the start of reclamation process. The prominent changes were noted in the increase of humus and content of available phosphor and potassium.

Microbial properties of deposol

Microbial activity is a key factor affecting the functioning of all terrestrial systems. It has an important role in decomposition and nutrient cycling. Measurement of process rates governed by the soil microflora and general metabolic activities of these organisms is used to evaluate the reclamation efforts (Mummey et al., 2002; Izquierdo et al., 2003). The total number of bacteria in control deposol was lower than the total number of bacteria in deposol in the reclamation process, especially in deposol under potato, soybean and grass-clover mixture (tab 2). In deposol in the reclamation process, the total number of bacteria was the highest in the soil treated with grass-clover mixture. Somewhat lower number of bacteria was recorded with potato and soybeans, and the lowest one with corn.

Tab. 2. The number of the microbial groups in deposol in the reclamation process and control deposol

Species of microorganisms		Phase of the deposol					
		Small grains	Potato	Soybean	Corn	Grass-clover mixture	Deposol (control)
Total number of bacteria x $10^5 g^{-1}$		54	194	153	55	351	47
Ammonifiers	total x $10^3 g^{-1}$	296	1120	200	350	1778	960
	sporogenic x $10^3 g^{-1}$	63	167	96	24	53	7
Oligonitrophiles x $10^3 g^{-1}$		751	1171	697	587	1361	961
Azotobacter x $10^2 g^{-1}$		120	93	133	19	68	5
Actinomycetes x $10^3 g^{-1}$		70	548	41	57	21	0
Fungi x $10^3 g^{-1}$		168	248	294	220	391	365

Ammonification, as a significant process of crude protein decomposition and their transformation into mineral or organic forms is carried out by ammonifiers (Jarak et al, 2003). Since these compounds are common microbial origin in the soil, the number and activity of ammonifiers in the soil represents an index of its general biogenity. Based on these results, we can notice a significant presence of total number of ammonifiers in control deposols (960 x $10^3 g^{-1}$). The higest number of ammonifiers in deposol under different vegetation cover was recorded in the deposol under grasses-clover mixture (1778 x 10^3). In contrast to that, the lowest number of ammonifiers was recorded in deposol under soybeans (200 x 10^3). Compared to the total number of bacteria, a relatively high number of the ammonifiers was manifested, suggesting the organic matter decomposition processes as being normally proceeding, whereas the mineralisation process was slowed down. The number of sporogenic ammonifiers was lower in control deposol (7 x 10^3) than the number of sporogenic ammonifiers in deposol in the reclamation process. The lowest number of sporogenic ammonifiers in deposol in the reclamation process was recorded in deposol under corn (24 x10^3) and the highest number of sporogenic ammonifiers was in deposol under potato (167 x 10^3).

Oligonitophiles, as fixation factors of the atmospheric nitrogen for meeting their own needs and suppliers of plants with accessible forms of nitrogen (Bogdanovic, 1990), represented the dominant physiological group of microorganisms in deposol in the phase of reclamation, except in deposol under grass-clover mixture. This indicates unfavourable nitrogenous regime of deposol. Oligonitrophiles, like ammonifiers, are present in significant number in the control deposol (961 x $10^3 g^{-1}$), and their number increased by applying the measures of reclamation. In deposol in the reclamation process, the lowest number of oligonitrophiles was found in the soil under corn (587 x $10^3 g^{-1}$) while the highest number of oligonitrophiles was found in the soil under grass-clover mixture (1361 x $10^3 g^{-1}$).

Azotobacter sp. as indicator of fertile soil and the strongest associative fixation factor of the atmospheric nitrogen showed low presence in the control deposol in comparison with the number of *Azotobacter sp.* in deposol in the reclamation process. The application measures of reclamation have improved conditions for activity of this nitrogen fixation factor. The lowest number of *Azotobacter sp.* was found in the soil under corn (19 x $10^2 g^{-1}$), while the highest number of *Azotobacter sp.* was found in the soil under soybeans (133 x $10^2 g^{-1}$).

Actinomycetes are able to degrade hardly degradable compounds such as lignin and chitin, but also participate in the formation of humus. The number of actinomycetes in deposoil in reclamation process ranged from 21 x $10^3 g^{-1}$ in deposol under grass-clover mixture to 548 x $10^3 g^{-1}$ in deposol under potato. The presence of actinomycetes was not recorded in deposol - control. Miloševi et al. (2003) points out that the presence of actinomycetes is highest in

slightly alkaline soil. Deposol pH value increased after reclamation measures, which led to a higher number of actinomycetes in deposol.

Fungi are responsible for the important process of decomposition in terrestrial ecosystems as they degrade and assimilate cellulose, the component of plant cell walls. Fungal growth was maximal at pH 4.5, and decreased by a factor of more than 5 toward the high pH end (Rousk et al, 2010). Because pH control deposol is acidic, the number of fungi in this control deeposol is higher than number of fungi in deposol in the reclamation process, except deposol under grass-clover mixture.

The number of fungi in deposol in reclamation process ranged from 168 x 10^3 g^{-1} in deposol under small grain to 391 x 10^3 g^{-1} in deposol under grass-clover mixture.

Conclusion

Reclamation is an essential part in developing mineral resources in accordance with the principles of ecologically sustainable development. In addition to the chemical properties of soil, reclamation of overburden dumps can be managed effectively when microbiological properties of soil are accurately determined. The application of reclamation measures increased the biological activity in deposol. Acidic deposol reaction is probably influenced on the higher number of fungi in control deposol than in deposol under small grains, potato, soybeans and corn. The highest total number of bacteria, total number of ammonifiers, number of oligonytrophils and fungi was found in deposol under grass-clover mixture. The presence of actinomycetes was not recorded in control deposol. Reclamation of the deposol with small grains, potato, soybeans, corn, and grass-clover mixture will be able to restore the deposol fertility and accelerate ecological succession. The best effect of the reclamation processes on restore deposol fertility was recorded in deposol under grass-clover mixture.

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WATER AND PHYSICAL PROPERTIES OF URBISOLS

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Abstract

In urban areas, the soil is exposed to dynamic changes that may lead to its degradation. Urban soil is mostly anthropogenic and polluted due to the proximity of busy roads, industrial facilities and fossil fuel combustion. Urban soil is formed by direct human activity and as such has very different properties, which are generally less favorable than properties of natural soil. Although this type of soil is not used for agriculture its importance is great because in an urban environment it is a medium in which different types of plants are grown which leads to better environment of the city. The group of the most vulnerable soil includes the soil of city roads which is almost continuously changed by human activities such as various works on infrastructure networks, as well as the roads and paths. This paper presents the results of water-physical soil properties along Car Lazar Boulevard in Novi Sad, as one of the busiest roads. Along the boulevard alley, several types of lime are present which have different requirements of the soil. The analysis shows that the soil texture ranges from clay loam to coarse sandy loam and the coefficient of filtration of the samples is in the range from 1.35×10^{-3} to 7.43×10^{-4} cm/sec in the layer of 0-30 cm, respectively from 1.42×10^{-3} to 6.99×10^{-3} cm/sec in layer 30-60 cm. The total porosity ranges from 39.41% to 49.65% in the shallow, and from 41.97% to 47.56% in the deeper layer of the soil. The results suggest disparities of soil characteristics at the sites, making them difficult to use.

Keywords: *degradation, urban soil, water-physical properties*

Introduction

Due to the accelerated development and construction of cities naturally formed soils in these areas are experiencing major changes. These newly formed soils according to the Food and Agriculture Organization (FAO) (1988) soil classification (Dugali and Gaji , 2012), are labeled as urbisols, while World Reference Base (WRB) for soil classification (2006), defines them as an urbic anthrosol. According to the FAO classification urbisols belong to the class of technogenic soils and their profile structure depends on the profile of naturally occurring soil in this area, as well as the depth of the impact of human activity. Human activity had the most pronounced influence on the genesis of urbisols compared to the other soil forming factors.Urbisols usually have one or more horizons and thickness of at least 50 cm, and the horizons are composed of different materials that are formed by mixing, compaction, addition of substrate, synthetic materials etc. (Zemlyanitsky, 1963; Craul, 1985). As such, urbisols is most often characterized by less favorable characteristics compared to naturally formed soils, but if the area of urbisols is not significantly changed physically, then all physical properties have a basic characteristics of natural soil from the contact zone (Resulovi et al., 2008). It can be said that the most vulnerable area of urban areas are soils next to road which is almost totally changed by constant human activities. During the year that includes the various works on infrastructure networks, water supply, sewerage and electricity lines, and also to the roads and paths. Large impact on the chemical properties of the soil, in addition to the nature of the material from which they originated, have the exhaust gases of vehicles and industrial facilities which through the atmosphere and dust are placed on the surface, while the physical

properties that have the greatest impact is a man with their local activities (Harrison et al., 1981; Gibson and Farmer, 1986; Thornton, 1991; cit. Christoforidis A. 2009). Even though this soil is not used for agricultural production, its importance is great, because in an urban environment it is a medium in which different types of plants, especially trees, are grown. Trees along the roads are designed as a green line, which in an urban area has a technical-technological, environmental and decorative function. In this regard, the main task of alleys along the street is the isolation of pedestrian flows and lateral building of motor vehicle traffic, creating favorable sanitary-hygienic and micro-climate conditions for the residents, and they also increase the aesthetic quality of urban landscapes (Vujkovi , 2008). Trees along the roads are sentenced to live in artificially created environment and they are constantly exposed to the underground and over ground stress (Grey and Deneke, 1986; Miller, 1988; Bradshaw et al., 1995), and therefore their life expectancy is shorter than their biological potential (Gilbertson and Bradshaw, 1985; Insley and Buckley, 1986). It is important to note that a large impact on the growth and development of plants in addition to chemicals, and water have the physical properties of soil so that any deterioration or improvement of the physical properties of soil entails changes in plant nutrition, water supply, microbiological processes etc. The aim of this study, based on field and laboratory tests, is to determine the water and physical properties of urbisols in Novi Sad, Serbia.

Materials and methods

In this study, soil next to the road along Car Lazar Boulevard, which is one of the busiest roads in Novi Sad, has been used. Along the Boulevard there is an alley, with several types of linden which are more than 30 years old. Different types of linden require different production capacity of soil and the trees during the early summer months have evident symptoms of chlorosis on the leaves. The cause of chlorosis is attributed to the high content of soluble salts in the soil near road (Clatterbuck., 2003; Nesic, 2004). Significant impact on the ultimate effect of salinity have other environmental factors and soil properties (Shannon et al., 1994). Area in which the trial is conducted is in geomorphologic point of view of the alluvial terrace of the Danube. Urbisols, in this area of the city, are formed in natural soil type fluvisol, which is hydromorphic soil and belong to class of underdeveloped fluvial soils with soil profile (A) or G (A)-C. These soils are recent, river, sea and lake deposits with layers. Pedogenetic processes are poorly expressed due to youth of deposit or because of sedimentation prevails pedogenesis. Physical and chemical properties depend on the number of layers and their thickness, texture, origin and sequence. Some typical characteristics are rarely discussed and they are different from profile to profile (Živanov and Ivanisevic, 1986). By the construction of defensive levees leakage of the river is prevented and consequently the natural process of genesis of fluvisol is stopped.

Field studies were conducted in three representative locations, next to the busiest intersections. At these places three soil profiles 0-60 cm were opened from which the samples were taken in a natural, undisturbed state with Kopecky cylinders and in the disordered state by probe. Sampling was performed at two depths of 0-30 cm and 30-60 cm, as this is the part of the bulk of the solum developing roots. Land from a nearby park was taken as a control site. The collected samples were analyzed in the Laboratory of Soil and Irrigation, Faculty of Agriculture, University of Novi Sad. Modern, recognized methods were used for this type of research (JDPZ, 1997).

Laboratory studies include the determination of texture according to International B-pipette method with preparation in sodium pyrophosphate; determination of particle density according to Albert-Bogs method using xylol as inert liquid; determination of bulk density using Kopecky cylinders (100 cm^3); total porosity (%) calculated using values of specific and volume mass of soil; soil water permeability that is Darcy's coefficient; soil moisture, drying

in an oven at 105 °C until constant weight; value of the packing density of particles; moisture retention at a pressure of 0.33 bar using porous plate; moisture retention at a pressure of 6.25 and 15 bar using pressure membranes; useful water capacity (water accessible to plants), calculated from the difference of water retained at a pressure of 0.33 and 15 bar; air capacity was calculated from the difference of total porosity and water retained under pressure of 0.33 bar (%).

Results and discussion

Physical properties of soils are important for understanding many of its properties. These properties depend mostly on water, air and soil thermal regime (Miljkovi , 1996). Tables 1 and 2 show the main values of three replicates for each site and depth for all tested parameters. Based on the results (Table 1) it can be stated that the soil of the examined sites belong to loam textural classes, with small variations, texture and composition which ranges from coarse sand to clay loam. In all tested samples the largest share has sand fraction. The average value of this fraction ranges from 53.97 to 78.06%. The highest content of sand fraction has a control site, 69.4% in the surface layer and 78.06% in the deeper layers of soil. The highest percentage of coarse sand is in Location 3, then Location 2, and finally in Location 1. Control site has a low percentage of this fraction. The fraction of fine sand has a maximum value at the control site which is typical for natural fluvisol near Novi Sad, which is examined by Sekulic et al. (2007) and Nesic et al. (2010). Other sites have a lower content of fine sand particles than the control site. The value of the dust particles is the smallest in the Location 3 and at the Control site, in deeper layers of soil and their values were 13.57 and 15.57%. Other sites have similar values of the dust particles as well as natural fluvisols near Novi Sad. The content of the clay fraction of the studied sites in the surface layer ranges from 13.53 to 17.50%, while the deeper layers of soil values range is from 9.83 to 16.18%. Urbisols of examined localities have a higher clay content than natural fluvisols in a protected part of the Danube at Novi Sad, while the content of this fraction in the control site is not different than natural fluvisols. According to data shown in Table 2, the average value of the specific soil mass is in range of 2.38 to 3.02 g/cm^3, and they vary in depth and on locations so they are not shown in a certain orderliness. According to Biol evu et al. (1963) cit. Živanov (1977), the specific mass of the soil in the Danube valley is in the range from 2.53 to 2.93 g/cm^3. High values of specific mass are probably the consequence of the high proportion of coarse sand in certain locations. The values of volume soil mass were in the range of 1.38 to 1.63 g/cm^3, and they indicate that there are no significant differences between urbisols and control site. Values at Location 2 (1.38 g/cm^3) and control site (1.40 g/cm^3) in the 30-60 cm layer compared to the other sites, which have higher values of volume mass, show similarities with natural fluvisol of Novi Sad.

Tab. 1. Granulometric composition of urbisols.

Location	Depth	Coarse sand %	Fine sand %	Dust %	Clay %	Total sand %	Total clay %	Texture class
		2-0.2 mm	0.2-0.02 mm	0.02-0.002 mm	<0.002 mm	2-0.02 mm	0.02 mm	
Location 1	0-30 cm	6.67	47.30	28.53	17.50	53.97	46.03	Clay loam
	30-60 cm	8.00	51.47	24.36	16.17	59.47	40.53	Clay loam
Location 2	0-30 cm	18.83	38.97	28.32	13.88	57.8	42.2	Loam
	30-60 cm	34.67	37.53	18.20	9.60	72.2	27.8	Fine sandy loam
Location 3	0-30 cm	39.00	29.03	18.43	13.53	68.03	31.96	Coarse sandy loam
	30-60 cm	37.33	36.03	13.57	9.73	73.36	23.3	Coarse sandy loam
Control	0-30 cm	7.03	62.37	26.17	4.23	69.4	30.4	Fine sandy loam
	30-60 cm	8.73	69.33	15.57	6.36	78.06	21.93	Fine sandy loam

Tab. 2. Water and phisycal proprieties of urbisols.

Location	Depth	Sm g/cm^3	Vm g/cm^3	Total porosity vol%	Soil compaction	Moisture retention at 33.77 kN/m^2		Moisture retention at 633.28 kN/m^2		Moisture retention at 1519.87 kN/m^2		Useful water %	Air capasity %	K-Darcy cm/sec
						mas.%	vol.%	mas.%	vol.%	mas.%	vol.%			
Loc. 1	0-30 cm	2.69	1.51	43.60	1.66	22.11	33.38	15.98	24.13	16.57	25.02	8.36	10.22	7.43 · 10^{-4}
	30-60 cm	2.82	1.44	45.03	1.59	19.63	28.27	8.85	12.74	12.52	18.03	10.24	16.76	4.41 · 10^{-3}
Loc. 2	0-30 cm	3.02	1.50	49.65	1.62	18.43	27.65	8.04	12.06	12.67	19.01	8.64	22.00	1.35 · 10^{-3}
	30-60 cm	2.38	1.38	41.97	1.46	14,57	20.11	10.45	14.42	9.92	13.69	6.42	21.86	1.42 · 10^{-3}
Loc. 3	0-30 cm	2.61	1.55	40.61	1.67	19.28	29.88	1.99	3.08	10.38	16.09	13.79	10.73	2.84 · 10^{-4}
	30-60 cm	2.92	1.57	46.23	1.65	16.76	26.31	9.05	14.21	8.91	13.98	12.33	19.92	6.99 · 10^{-4}
Control	0-30 cm	2.69	1.63	39.41	1.66	17.32	28.23	14.86	24.22	15.75	25.67	2.56	11.18	2.78 · 10^{-3}
	30-60 cm	2.67	1.40	47.56	1.46	10.73	15.02	5.28	7.39	5.18	7.25	7.77	32.54	

Soil compaction in all analyzed samples is in range from 1.46 to 1.67 g/cm^3 and according to Racz (1981), they are classified as medium compacted. It is notable that there are no significant differences in soil compaction between urbisols and control site. The values of total porosity are ranged from 39.41 to 49, 65%. There are no significant differences in total porosity between urbisols and control site. According to Kacinski (1965) cit. Vucic 1987, studied soil has a satisfactory or good porosity and compared to the fluvisol of Novi Sad (Sekulic et al. 2007), these values are lower by 10 percent or more. Low values of field capacity, 15.02 to 33.38%, and the small difference between these values and the values of wilting humidity result in low-physiologically beneficial soil water. In percentages, the physiologically useful water ranges is in interval from 2.56 to 13.79%. On the other hand the capacity of soil to air tested at these sites, according to the English criteria (Dugalic and Gajic 2012), is very good, or even too high. Filtration coefficient of tested samples ranged from 1.35 x 10^{-3} cm/sec to 7.43 x 10^{-4} cm/sec, and the soil according to Vukasinovic (JDPZ, 1997), is classified as highly to moderately leaky.

Conclusion

Based on the detailed research of urbisols along Car Lazar Boulevard in Novi Sad we came to the following conclusions:
The research results are heterogeneous and it cannot be noticed regularities in the properties of urbisols. One reason for this is that urbisols in this part of the city lies on the natural soil fluvisol, whose properties are uneven due to the nature of the material which was deposited, and the second cause is a human who disrupts the schedule of the particles in the soil during anthropogenization.
Common to the all of test samples is that they belong to the loam textural class, as this land is classified as soil with good physical characteristics.
Texture of tested urbisols does not significantly differ from the texture of natural fluvisol.
The sand fraction has a highest shareand unlike fluvisol, these soils have a higher content of clay fraction.
As the consequence of the high content of sand fraction in the soil, the high values of particle density has appeared, as well as, low value of FWC and physiologically useful water.
Unfavorable water regime of soil has a negative impact on cultivated plants, which are suffering from lack of water during the summer months..

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CHANGES IN WINE GRAPE YIELD AND COMPOSITION FOR THE REGION OF SREMSKI KARLOVCI

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Abstract

The study aimed to evaluate changes in wine grape yield and composition in response to observed warming and advanced phenology in the region of Sremski Karlovci over last few decades. The analysis was based on long-term observations (1986–2007) of temperature, phenology, yield, grape cluster mass, sugar content and total acidity in the must for Riesling Italian and Lemberger, the most common grape varieties in the studied region. A significant temporal trend was observed only for yield in Riesling Italian, while in Limberger, both yield and grape cluster mass showed significant positive change over time. The yield in both varieties was most affected and positively correlated with warm growing season of pre-harvest year. For sugar content in the must, the most influential temperature variable was growing season diurnal temperature range in Riesling Italian, while in Limberger that was diurnal temperature range during ripening. The number of warm days (maximum daily temperature >90th percentile) for Riesling Italian and the number of cool nights (minimum temperature <10th percentile) for Limberger were identified as temperature variables in the harvest year that could explain, to a certain extent, variation in total acidity in the must.

Key words: *Riesling Italian, Limberger, yield, composition, Serbia*

Interduction

Climate is one of the most important factors controlling grape and wine production from selection of a suitable grapevine varieties to the type and quality of wines produced (Gladstones, 1992). Climate change is now unequivocal. Thirteen of the 14 warmest years on record have all occurred in the 21st century (WMO, 2014). Changes in climate are not uniform and may have positive or negative effects on viticulture depending on the region and the ways in which the climate changes. Recent warming generally improved the quality of wine (Nemani et al., 2001; Jones and Goodrich, 2008; Ramos et al., 2008), especially in cooler vineyard regions (Caprio and Quamme, 2002; Lisek, 2008). The warming was recognized as a problem in viticultural regions where grapevine is grown close to temperature optimum (Webb et al., 2008).

Viticultural regions of Serbia have not been much studied in this regard. Ruml et al. (2013a) analyzed temperature-based indices in the region of Sremski Karlovci over the last few decades and found considerable changes in both average and heat-related temperature indices. In response to increased temperature the significant advances of grapevine phenology was detected in the vineyard area of Sremski Karlovci (Ruml et al., 2013b). Advances in the phenological events resulting in ripening during a warmer period may hasten the ripening process and affect the balance between sugar content and acidity in grapes at harvest (Bock et al., 2010). The aim of this study is to examine how recent changes in climate and phenology affected the yield and composition characteristics of Riesling Italian and Limberger, two most planted grape varieties in the wine producing area of Sremski Karlovci.

Materials and methods

Phenological and temperature observations were performed at the experimental station of the Novi Sad Faculty of Agriculture (45°10' N, 20°10' E, 110 m a.s.l.), located in Sremski Karlovci. The climate is mid-latitude moderate continental with mean annual air temperature of 12.3°C and mean annual precipitation of 650 mm. The coldest month is January, the warmest July. The precipitation maximum occurs in May and June. Experimental vineyard was established in 1979 on Mt. Fruška Gora's slopes by the Danube River.

Four phenological stages were analyzed for wine grape varieties Riesling Italian and Limberger over the period 1986–2007: beginning of budburst, beginning of flowering, beginning of veraison and harvest. Production and quality data included: yield, grape cluster mass, sugar content and total acidity in the must. Sugar content in the must was measured with a refractometer, while total acid in the must was determined by neutralization method. Temperature was measured with standard National Weather Service thermometers at 2 m above the soil surface at climatological station located in the experimental vineyard. Precipitation data were not included in the study, because these measurements did not pass quality control.

A number of climatically important parameters for viticulture (Table 1) were derived from daily mean, maximum and minimum temperatures for calendar year, growing season and different grapevine growth periods. Pearson correlation coefficient (R) was used to relate yield and composition characteristics of Riesling Italian and Limberger to phenology and temperature variables of both harvest and pre-harvest years.

Table 1. Definition of indices based on daily mean (TM), maximum (TX) and minimum (TN) temperatures used in the study

Index	Descriptive name	Definition	Unit
TN90p	Warm nights	Number of days with TN > 90th percentile	days
TN90p	Warm nights	Number of days with TN > 90th percentile	days
TX90p	Warm days	Number of days with TX > 90th percentile	days
TN10p	Cool nights	Number of days with TN < 10th percentile	days
TX10p	Cool days	Number of days with TX < 10th percentile	days
ndTX>25	Summer days	Number of days with TX > 25°C	days
ndTX>30	Tropical days	Number of days with TX > 30°C	days
ndTX>35	Hot days	Number of days with TX > 35°C	days
ndTN>20	Tropical nights	Number of days with TN > 20°C	days
ndTN<0	Frost days	Number of days with TN < 0°C	days
ndTN<−2.5	Moderate cold days	Number of days with TN < −2.5°C	days
ndTN<−10	Extreme cold days	Number of days with TN < −10°C	days
LF	Last spring frost	Date of last day in spring with TN < 0°C	Day of year
FF	First autumn frost	Date of first day in autumn with TN < 0°C	Day of year
FFP	Length of the frost-free period	Number of days between the last date in spring and the first date in autumn with TN < 0°C	days
DTR	Diurnal temperature range	Average difference between TX and TN	°C
GDD	Growing Degree Days	Sum of TM above 10°C	°C

Results and discussion

Time series of yield, grape cluster mass, sugar content and total acidity in the must are shown in Figs 1 and 2 for Riesling Italian and Limberger, respectively. Significant temporal trends were detected in yield for Riesling Italian and in yield and grape cluster mass for Limberger. The yield trend for Limberger exhibited greater slope, higher coefficient of determination and higher level of statistical significance than yield trend for Riesling Italian. No significant temporal trends were found in data on sugar content and total acidity in the must for both varieties. Periodicity in data series can be noticed for all variables in both

varieties, most clearly for total acidity in the must for Riesling Italian. Future research should investigate this very interesting finding about periodicity of data using in-depth statistical analysis.
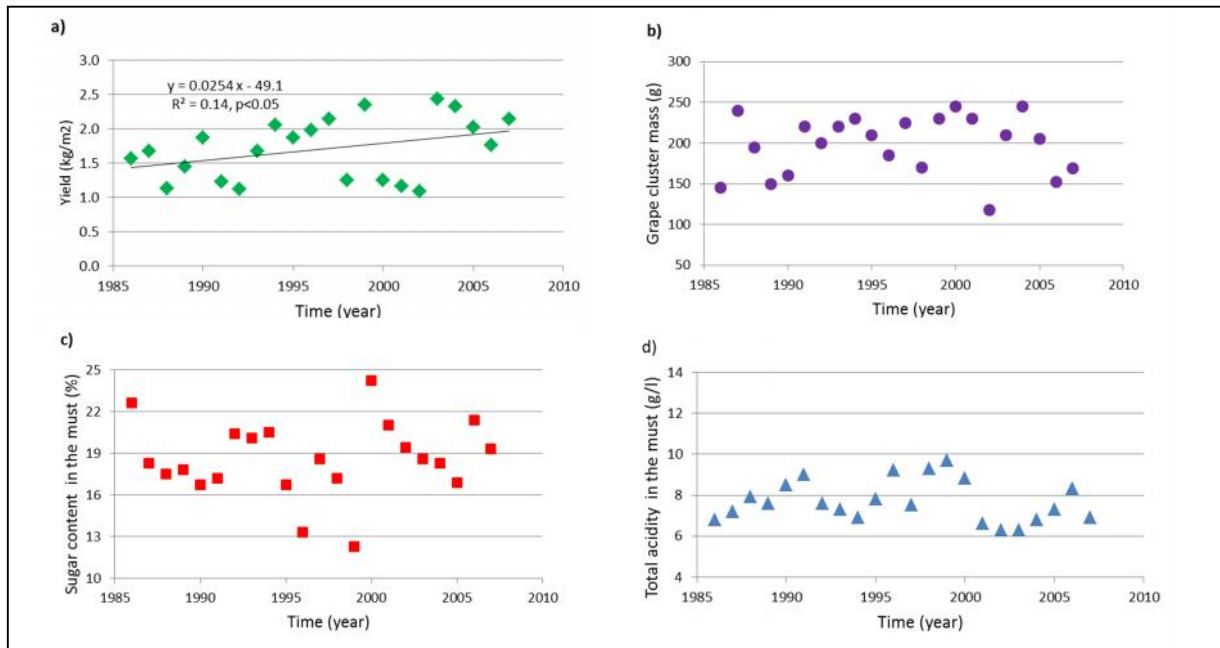

Figure 1. Time series and linear trends of a) yields, b) grape cluster mass, c) sugar content in the must, d) total acidity in the must for Riesling Italian grown in Sremski Karlovci (1986–2011). Line represents best-fit linear regression for significant trend.
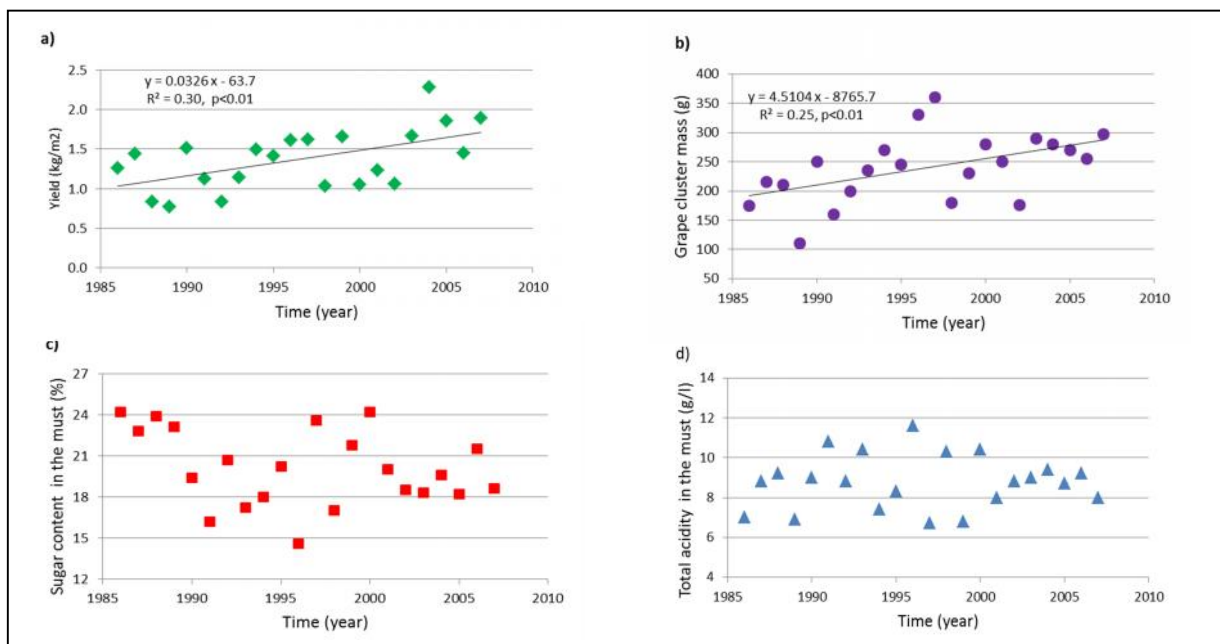

Figure 2. Time series and linear trends of a) yields, b) grape cluster mass, c) sugar content in the must, d) total acidity in the must for Limberger grown in Sremski Karlovci (1986–2011). Lines represent best-fit linear regressions for significant trends.

Correlation analysis between production and composition characteristics of studied varieties showed that in Riesling Italian, sugar content in the must were significantly correlated with yield (R=0.38, p<0.05) and total acidity in the must (R=0.48, p<0.05). In Limberger, sugar content were significantly correlated with total acidity in the must (R=0.56, p<0.01), while yield showed significant correlation with mass of grape cluster (r=0.68, P<0.001).

Correlation coefficients significant at the 5% level between the production and composition data and the phenological timing and temperature indices are displayed in Tables 2 and 3 for Riesling Italian and Limberger, respectively. In cases with no significant correlations, the relationship with the highest coefficient of correlation is shown.

Table 2. Correlation matrix between production and composition data for Riesling Italian and data on phenological timing and temperature for the region of Sremski Karlovci over the period 1986–2007. The highest correlation for each variable is displayed in bold.

HARVEST YEAR

	Calendar year								
	FW* date	TN	TX	TX90p	ndTX>25	ndTX>30	ndTX>35	ndTN>20	ndTN<−10
Yield (kg/m2)									**-0.31#**
Grape cluster mass (g)	**0.34#**								
Sugar content (%)	-0.50	0.43	0.51	0.48	0.51	0.50	0.39	0.52	
Total acidity (g/l)				-0.36					

	Growing season (1 Apr – 31 Oct)				Budburst – flowering (1 Apr – 31 May)			Flowering – veraison (1 Jun – 31 Jul		Veraison – harvest (1 Aug – 30 Sep)	
	TM	TX	DTR	GDD	TM	TN	TX	ndTX>25	ndTX>30	TM	ndTN>20
Yield (kg/m2)											
Grape cluster mass (g)					0.33#	0.32#	0.31#				
Sugar content (%)	0.56	0.57	**0.59**	0.51			0.41	0.35	0.52	0.50	0.47
Total acidity (g/l)											

PRE-HARVEST YEAR

	Calendar year												
	TM	TX	TX90p	TN90p	ndTX>25	ndTX>30	ndTX>35	ndTN>20	ndTN<−10	FF	FP	TX Jun	TM Apr-Jul
Yield (kg/m2)			0.36										**0.57**
Grape cluster mass (g)		0.43				0.37			-0.42			**0.58**	
Sugar content (%)													
Total acidity (g/l)	-0.39	-0.41	-0.46	-0.40	-0.43	-0.49	-0.61	-0.40		-0.48	-0.41		

	Growing season (1 Apr – 31 Oct)				Budburst – flowering (1 Apr – 31 May)			Flowering – veraison (1 Jun – 31 Jul)							
	TM	TX	TN	GDD	TM	TN	TX	TM	TX	TN	DTR	ndTX>25	ndTX>30	ndTX>35	ndTN>20
Yield (kg/m2)					0.38	0.36	0.39	0.38		0.37				0.41	
Grape cluster mass (g)	0.41	0.45		0.40	0.45	0.46	0.41			0.40					
Sugar content (%)															
Total acidity (g/l)	-0.50	-0.51	-0.40	-0.39	-0.44	-0.49		-0.38	-0.42	-0.39	-0.39	-0.41	**-0.64**	-0.41	

#significant at the 0.1 level
*FW – the beginning of flowering

Phenology was not significantly correlated with production and composition data, except the beginning of budburst in Frankovka that showed significant correlation with mass of grape cluster and the beginning of flowering in Riesling Italian, which was significantly correlated with sugar content in the must. None of examined temperature variables showed strong correlation with yield and composition characteristics of studied varieties. The strength of significant correlations was mostly moderate. The yield and mass of grape cluster in both varieties were positively related with warm growing season of pre-harvest year and negatively, to a lesser extent, with the number of days with negative temperatures during harvest year. Among examined temperature indices, the strongest correlation coefficient with sugar content in the must exhibited growing season diurnal temperature range in Riesling

Italian and diurnal temperature range during ripening in Limberger. Interestingly, acidity in the must in Riesling Italian was more affected by temperature regime in the pre-harvest year than in the harvest year. Even though we do not have a physiologically-based explanation for dependence of sugar and acidity levels in the must on temperature regime in pre-harvest year, this finding cannot be ignored, since the strength of these correlations were comparable with others and even the highest coefficient of correlation (R=–0.64) among all examined variables was displayed between acidity in the must for Riesling Italian and temperatures higher than 35°C in the period from flowering to veraison in the pre-harvest year.

Table 2. Correlation matrix between production and composition data for Limberger and data on phenological timing and temperature for the region of Sremski Karlovci over the period 1986–2007. The highest correlation for each variable is displayed in bold.

HARVEST YEAR

	BB* date	TN10p	ndTN<-2.5	ndTN<−10	TX June	Flowering − veraison (1 Jun – 31 Jul) DTR	Veraison − harvest (1 Aug – 30 Sep) DTR
	Calendar year						
Yield (kg/m2)			**-0.40**	-0.39			
Grape cluster mass (g)	**0.45**		**-0.44**	-0.41	0.36		
Sugar content (%)		-0.37					**0.44**
Total acidity (g/l)		**0.51**				0.40	

PRE-HARVEST YEAR

	TM	TX	TX90p	TN90p	TX10p	ndTN>20	ndTN<0	ndTN<−2.5	ndTN<−10	FF	FFP
	Calendar year										
Yield (kg/m2)			0.39	0.43		0.40					
Grape cluster mass (g)					0.41						
Sugar content (%)	-0.39	-0.38					0.38	0.48	**0.50**		
Total acidity (g/l)								-0.37	-0.31	**-0.43**	-0.40

	Growing season (1 Apr – 31 Oct)					Budburst - flowering (1 Apr – 31 Jul)			Flowering - veraison (1 Jun – 31 Jul)				Budburst - veraison (1 Jun – 31 Jul)			Rippening (1 Aug-30 Sep)
	TM	TX	TN	GDD	DTR	TM	TX	TN	ndTX>30	TM	TX	DTR	TM	TX	TN	DTR
Yield (kg/m2)	0.36	0.35	0.45	0.41		0.52	0.47	0.56	0.39	0.37	0.42		0.54	0.46	**0.60**	
Grape cluster mass (g)						-0.39	-0.38	-0.39								**-0.48**
Sugar content (%)						-0.44	-0.46	-0.41								
Total acidity (g/l)					-0.38					-0.39		-0.38				

*BB – the beginning of budburst

Conclusion

The results from this study can be used to assess the potential impacts of predicted climatic changes on grape and wine production. According to climate projection for Serbia (Ruml et al., 2012), rising trends of temperature and frequency of heat-related extremes will likely continue and become even stronger. Since it was found that grape composition of studied varieties is influenced by temperatures, possible consequences of predicted warming may include changes in wine styles or necessity of costly measures to maintain the regional tipicity of wines. On the other hand, revealed relationship between grape yield and temeperature suggests that projected reduction in frost occurrence with longer frost-free period and warmer growing season could lead to increased yields and thus favor grape production.

Acknowledgement

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WATER QUALITY OF THE DRINA RIVER AS A SOURCE OF IRRIGATION IN AGRICULTURE

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Abstract

The paper presents the results of testing the quality of water for irrigation during the summer season in 2013, in the basin of the Drina River, that flows through Serbia from Salaš Crnobarski to Bajina Bašta (Bušinsko polje), in three monitoring cycles on 12 selected sites belonging to agricultural area under irrigation. It was established that the quality of the surface water corresponded to the standards for irrigation according to temperature, pH, conductivity (ECw), total dissolved solids (TDS), ion balance: Ca^{2+}, Mg^{2+}, K^+, Na^+, chlorides (Cl^-), sulfates (SO_4^{2-}), Sodium Adsorption Ratio (SAR).
Based on the presented and analyzed results of testing of the quality of water for irrigation, it can be concluded that the tested samples of water for irrigation of crops and soils are adequate for usage to the certain limitations and the need for frequent checks of water quality during the summer months in relation to classification of Neugebauer and Stebler, which provide a rough assessment of the usability of water for irrigation without assessing the impact of the water used on the plant and equipment and modern classification of FAO, U.S. Salinity Laboratory, RSC-Residual Sodium Carbonate.

Key words: *water, quality, irrigation, agriculture*

Introduction

The scope of the research conducted in this paper is the study of quality of irrigation water from the River Drina, complies with the requirements of FAO and U.S. Salinity Laboratory classification (Doneen and Westcot, 1988; U.S. Salinity Laboratory Staff, 1954), designed for usability evaluation of irrigation water. Irrigation means the artificial watering the soil in order to wet the rhizosphere layer at a time when the amount of available soil moisture is insufficient to meet the optimum energy crops. Irrigation is a hydro-reclamation measure that aims to improve the physical properties of the soil by adding water to achieve optimum moisture during the growing season and thus achieve optimum yield. It may be applied during part of the growing season or during the whole growing season. Irrigation of cultivated plants on agricultural soil involves the use of water of appropriate physical, chemical and biological properties, so it is very important to examine the quality of water used for its intended purpose in order to assess the impact on soil and plants. Intensification of irrigation depends primarily on the provision to the required amount of water of adequate quality.

Anthropogenic impacts and natural processes can affect the quality of surface waters and threaten their use as drinking water, and for use in industry, agriculture, and for other purposes (Carpenter et al., 1998; Jarvie et al., 1998; Simeonova et al., 2003).

The aim of this study is to assess the current water quality of the River Drina in order to be used for irrigation of agricultural soil near the streams and highlight the pollution risk. Pollution risks are mainly the direct consequence of the discharge of waste water from industrial plants, agricultural intensification or anthropogenic factors.

The major pollutants of surface water in the country are industrial enterprises, farms and settlements with sewage systems, without built facilities for waste water treatment, and such with acting, but technically outdated (Konstandinova et al., 2013).

Agricultural lands used for intensive agriculture and fertilized with nitrogen and phosphate, treated with pesticides, and manure from livestock farms are one of the major sources of diffuse pollution (mainly nitrogen, phosphorus and biodegradable organics).

Description of the study area

In geographical terms, the basin of Drina River in the flow through Republic of Serbia lies between $43^{o}00^{'}$ and $44^{o}52^{'}$ of north latitude and $19^{o}15^{'}$ and $19^{o}20^{'}$ of east longitude (Figure 1).
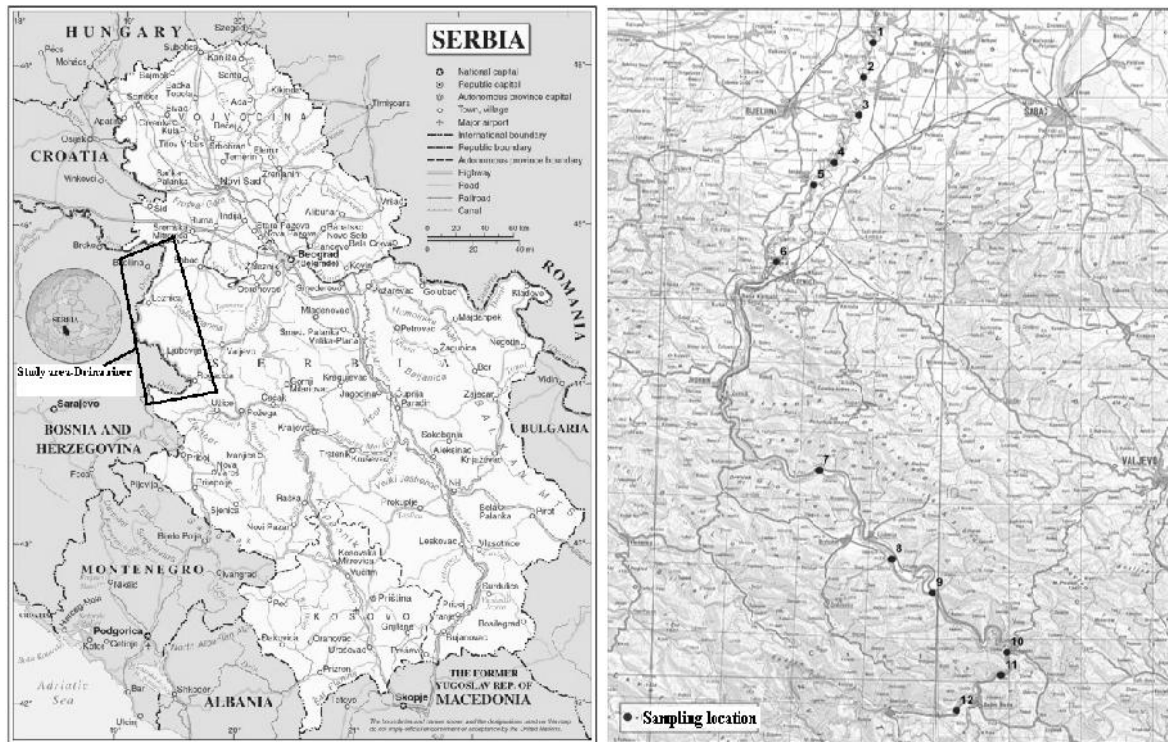
Figure 1. Location map of Drina valley with selected sample sites.

The Drina is a 346 km long international river, which forms large portion of the border between Bosnia and Herzegovina and Serbia. It is the longest tributary of the Sava River and the longest karst river in the Dinaric Alps which belongs to the Danube river watershed http://sh.wikipedia.org/wiki/Drina

River Drina basin covers the southwestern and western part of Serbia, the northern part of Montenegro and the eastern part of Bosnia and Herzegovina. Direction of its flow is from south to north and has a lot of tributaries. Water regime of the River Drina belongs to the typical modes of type snow-rain, with the primary peak of the water level in April and a secondary peak in December. Most of the stream is running through the mountains, while the entire upper stream is located in the high mountains of the Dinaric Alps, creating conditions that heavy precipitation and snows melting are leading to high flows. Decline of River Drina flow is very high, almost 2000 meters for less than 350 km of length, (spring is at about 2000 meters above sea level, while the confluence is on 80 meters above sea level). With an average flow of 395 m³ / s at the confluence, Drina is richest tributary of the River Sava.

Soils suitable for irrigation are primarily alluvial soils along the River Drina and meadow soils that are heavier texture from alluvium. Water physical properties of the soil along the Drina are very heterogeneous composition. Represented are applied gravel, sandy gravel, sandy, loamy and clay composition. All of these can be irrigated land varying amounts of

water. The basic soil types in the river basin are Fluvisols, Eutric Cambisols and Distic Cambisols.

Sampling and collection of water samples

A total of 36 water samples were collected from 12 (twelve) sampling points. Water samples were collected in three cycles of sampling, in in July, August and September 2013, using 2000 ml plastic bottles. The sampling bottles for heavy metal determination were pre-soaked overnight with 10% HCl, then, rinsed with distilled water and also rinsed using river water before sample collection. Sampling bottles for the determination of physicochemical parameters were cleaned and rinsed using distilled water only. Preservation of water samples was done by adding 2 drops of concentrated HNO_3 to each water sample before storage below 4°C until it was analyzed.

Analytical methods

The measured parameters were determined by the following methods: temperature is determined *in situ* by a calibrated thermometer, pH -potentiometric (SRPS H.Z1.111:1987), electrical conductivity (ECw)- conductiometric (SRPS EN 27888:1993), total dissolved solids (TDS)-gravimetric (Greenberg et al., 1998), Cl^- - volumetric, K^+; Na^+ - plamenfotometric (APHA , 1992). Sodium Adsorption Ratio (SAR)- calculation (Rhoads et al., 1992). SO_4^{2-} ; Ca^{2+}; Mg^{2+} was determined using EPA 200.7 methods, as well as an ICAP 6300 ICP optical emission spectrometer (ICP-OES).

Results and discussion

The seasonal and annual averages of physicochemical characteristics are given in Table 1.
The **pH** is an important factor that determines the suitability of water for a variety of purposes, inter alia, for irrigation. All tested samples showed pH values from neutral to slightly alkaline (Figure 2).

Conductivity is a measure of the ability of an aqueous solution to carry an electric current. Increasing levels of conductivity and cations are the products of decomposition and mineralization of organic materials (Begum and Harikrishnarai, 2008). The aqueous salt solution and dissociated are broken down into positive and negative ions. Electrical conductivity in natural waters is generally with values less than usual. Measurement of the conductivity is performed at a specific temperature and it corresponds to the presence of dissolved salts. These are most commonly sodium chloride, and may be present, and sodium sulphate, calcium chloride, calcium sulfate, magnesium chloride, etc. Salts dissolved in the water influence on increase of the water conductivity values. In all three cycles of analyzing the water from Drina River (Figure 2), according to FAO classification, the samples belong to a class of water for drinking and irrigation, and as well to a class for irrigation water. By classification of U.S. Salinity Laboratory, all of the samples belong to the C2 S1 class of water, where ECw values range from 0.250 to 0.750 dSm^{-1} and, as such, it can be used for irrigation of the plants with medium tolerance to salt.

Table 1 Average value of the water quality parameters of irrigation water, along with the standard limits by irrigation water US and FAO and by Republic of Serbia

Parameters/ Dimension	Mean±STDEV (n=36)	Standard limits		
		US Duncan et al., 2000	FAO Ayers et al., 1994	R. Serbia Official Gazette, 1994/2012
Temperature(^{o}C)	20.2±2.57			30
pH	8.17±0.17	6.0-9.0	6.5-8.4	
Ecw 25°C (dSm^{-1})	0.22±0.01		<0.7	<1.0[#]
TDS (mg l^{-1})	282.88±126.36		0-2000	
SAR	0.09±0.03	5.7	0-15	
Cl$^-$ (mg l^{-1})	0.30±0.07		0-30	50[#]
SO$_4^{2-}$(mg l^{-1})	0.20±0.05		0-20	50[#]
Ca^{2+} (mg l^{-1})	2.75±0.15	20-60	0-20	
Mg^{2+} (mg l^{-1})	0.43±0.06		0-20	
K$^+$(mg l^{-1})	0.07±0.02	5-20	0-2	
Na$^+$(mg l^{-1})	0.11±0.04		0-40	

[*]References (listed below in reference list); bdl-below detection limit
 - in me/l = mill equivalent per liter (mg/l ÷ equivalent weight = me/l); in SI units, 1 me/l= 1 mill mol /liter adjusted for electron charge.

Total dissolved solids (TDS) are an important characteristic for determination of the quality of water for irrigation because it expresses the total concentration of soluble salts in water. Dissolved solids in water include all inorganic salts, silica and soluble organic matter (Atekwana et al., 2004; Ahipathy and Puttaiah, 2006). Pure water must be free from most suspended particles, which are responsible for turbidity. TDS was the highest in summer due to evaporation and reduced inflow which contributed to an increase in concentration, and had the minimum value in the rainy season, due to the increased entry of rain and a corresponding reduction in concentration at all locations (Figure 3).

Chlorides and sulfates are among the basic components found in fresh water. Some of the anthropogenic sources of chlorides in surface water are agricultural activities (organic and mineral fertilizers), sewage, landfill leakage, industrial wastewaters etc. Scientific investigations proved that water with chloride concentrations > 150 mg l^{-1} are inappropriate for irrigation due to their toxicity to crops (Konstandinova et al., 2013; Szynkiewicz et al., 2008). Sulfates distribution in surface and ground waters is principally controlled by dissolution processes and precipitation of mineral and amorphous solid phases, dissolved oxygen concentration, atmospheric precipitation, biological interactions, point and non-point pollution sources (Hudak et al., 2003; Souligny et al., 2002). Concentration of chlorides, sulfates, Ca and Mg in observed samples are in recommended values. (Table 1).
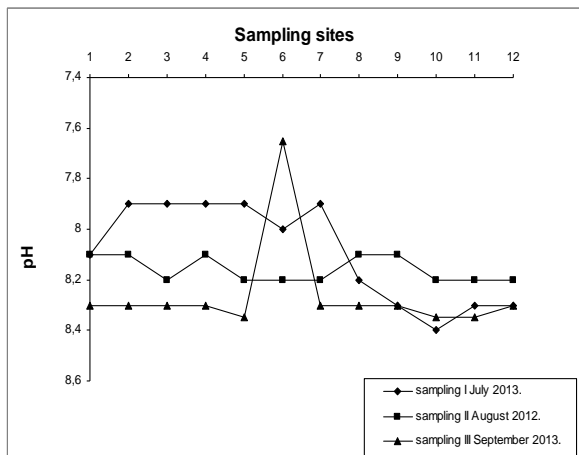
Figure 2. pH value of the tested water samples in batches of monitoring
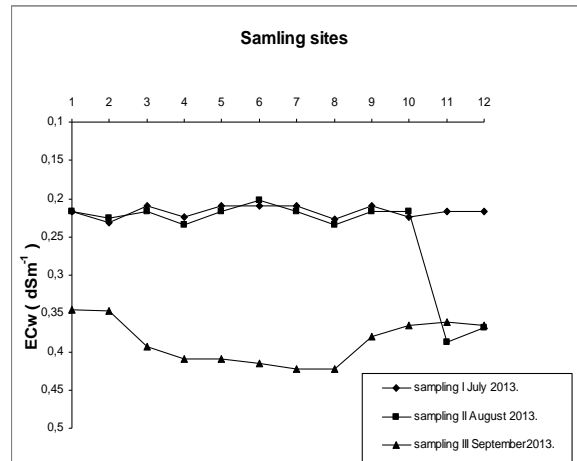
Figure 3. ECw value of the tested water samples in batches of monitoring
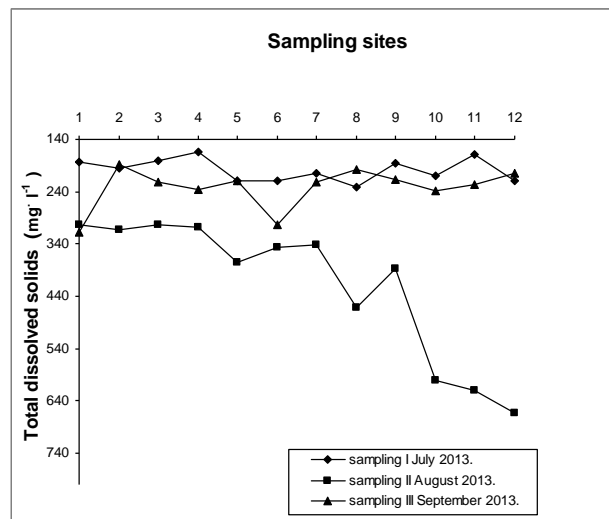
Figure 4. TDS value of the tested water samples in batches of monitoring

In all three cycles of analyzing the water from Drina, according to FAO classification, the samples belong to a class of water for drinking and irrigation, and as well to a class for irrigation water.

By classification of U.S. Salinity Laboratory, all of the samples belong to the C2 S1 class of water, where ECw values range from 0.250 to 0.750 dSm^{-1} and, as such, it can be used for irrigation of the plants with medium tolerance to salt.

Sodium adsorption ratio of irrigation water, SAR (showed in Table 1) is used to determine whether sodium (Na) levels of water will cause soil structure to deteriorate. Unadjusted SAR considers only Na, Ca, and Mg (Ayers et al., 1994).

Analysis of water quality for irrigation of the Drina in all cycles of monitoring shows that water samples according to the classification of FAO belong to a class of water for drinking and irrigation. According to the classification of U.S. Salinity Laboratory analyzed samples belong to class C2-S1 (C2-medium saltwater-medium risk of soil salinization (ECw from 0.250 to 0.750 dS m-1). Moderately saline water can be used for plants with medium tolerance to salt and only if the conditions for flushing salts from the upper soil layers. The water could be irrigated relatively permeable soil without special measures for combating

salinization. S1 (SAR 0-10) - Water from the low-sodium has a low risk of alkalization. It is suitable for irrigation of all types of soils.

According to the classification of Neugebauer, tested samples of the River Drina, belong to the Ia class of water with low salt concentration and a very favorable ratio of divalent cations to the sum of Na and K, or only for Na. These waters are excellent for irrigation.

By classification of Stebler, tested water samples from the River Drina, are classified as good water for irrigation (can be used without special measures for the accumulation of harmful salts in the soil), and sample no. 8 in the first cycle; samples No.1-12 in the second test cycle; samples No.1-3, 5-11 of the third test cycle, which belong to the class of satisfactory water (It takes measures to prevent salinization, except for land with good drainage characteristics).

By classification RSC Residual Sodium Carbonate, all of the tested samples are belonging to the class of good water.

Conclusion

Based on the obtained and analyzed results of testing the quality of water for irrigation from the Drina River, it can be concluded that it can be used for irrigation of crops and soil according all presented classification for irrigation water with restrictions and frequent quality checks during the summer months.

Acknowledgment

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FOLIAR INJURY OF OZONE ‐ LEVEL II ‐ MONITORING PLOT

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Abstract

The aim of our study was to investigate the long-term, cumulative ozone concentrations in relation to the occurrence and development of visible foliar injury to leaf mass. In addition, in order to assess the impact of environmental factors (abiotic and biotic) that modify the information on air quality in a given forest ecosystems and is evaluated experimentally established symptoms in the field, in order to develop a regional risk assessment based on monitoring of ozone and data modeling. So, it will be necessary to evaluated visible ozone depletion in the selected area (Level II) and evaluated the effect of tropospheric ozone at locations where monitors ozone injury, as well as risk assessment of ozone effects on forest ecosystems. Methodologies, including quality assurance, such as data harmonization, completeness and plausibility tests have been applied according to the ICP Forests Manual, Parts VIII - Assessment of Ozone Injury. Specific targets are set as follows: quantification of injuries ozone on the selected parcel level II in Europe; detection of temporal trends in the selected plot level II in Europe (significant changes within 10 years with a 95% level of significance of individual plots). Results from a Level II will be documented in maps covering Europe, characterized by an area of increased risk of ozone to European forest ecosystems. However, the development of ozone-induced injury is specific to inter and intra - species, and depend on the local ambient concentrations of ozone and other environmental as well as biotic and climatic factors. Due to the complex nature of diagnosis and investment limitations, the findings of trees and vegetation assessment should be considered as semi-quantitative.

Keywords: *Ozone, injury, monitoring plot.*

Introduction

Ozone (O3) is a pollutant that is in the lower part of the atmosphere and is formed due to the reaction of hydrocarbons and nitrogen oxides in the presence of sunlight. Natural sources of ozone exists, but these are much smaller than those produced by the action of a man's process. However, there is growing concern about how to lower atmospheric ozone affects the health of our forests (Smith, 1990). One way to assess the impact of ozone on plant life is documenting visible injuries on sensitive plant species, which are known as bioindicators. Bioindicators are actually plants that exhibit well-defined symptoms of elevated concentrations of ozone in the air. Foliar injury on plants from ozone has been documented in studies in a number of national parks (Bartholomay et al., 1997; Benoit et al., 1982; Chappelka et al., 2003; Chappelka et al., 1997; Chappelka et al., 1999a; Chappelka et al., 1999b; Duchelle and Skelly, 1981; Duchelle et al., 1983; Eckert et al., 1999; Hildebrand et al., 1996; Neufeld et al., 1992; Peterson et al., 1987.).

From July to September, many plant species that are sensitive to elevated ozone concentrations, show visible injuries on the upper surface of the leaf mass. In addition to the apparent symptoms, the leaves of plants damaged ozone is smaller, and the plant may

produce a smaller amount of healthy seed. Moreover, injuries may result in depletion of the sensitivity of plants to other damaging agents, such as harmful insects and fungi. In our climate, the best time to observe violations of ozone is from mid-July to mid-September. At higher altitudes, however, a violation of the ozone can be masked by staining the leaves in early fall.

Since the 1980s there are higher concentrations of tropospheric ozone, especially in the warmer half of the year, when the value of the ozone increase depending on weather conditions and increased anthropogenic activities. While at humans ozone irritates the mucous membranes and restricts lung capacity, in plants attacks and destroys the cell walls or individual cells in the leaves. Over the past 50 years, a large volume of literature has documented O3 impacts on forest trees (see reviews by Kickert and Krupa, 1990; Miller, 1993; Skelly et al., 1997; Chappelka and Samuelson, 1998; McLaughlin and Percy, 1999; Krupa et al., 2000; Bytnerowicz et al., 2003; Percy et al., 2003).

Depending on the sensitivity of plant species and the concentration of ozone, depends and the visibility of damage to leaves or needles. The harmful effects of ozone is difficult to prove, because there is no chemical residues that can be analyzed and measured. Visibility damage on the leaves or needles is the only effect that professionals can easily detect. Tropospheric ozone background concentrations have increased 36% since pre-industrial times (IPCC, 2001). Ozone is known to impact forest trees in many ways including inducing visible foliar symptoms (Chappelka et al., 1999a; Schaub et al., 2005).

The aim of this study was to investigate the long-term, cumulative ozone concentrations in relation to the occurrence and development of visible foliar injury to leaf mass. In addition, in order to assess the impact of environmental factors (abiotic and biotic) that modify the information on air quality in a given forest ecosystems is evaluated experimentally established symptoms in the field, in order to develop a regional risk assessment based on monitoring of ozone and data modeling. So, are evaluated visible ozone depletion in the selected area (Level II) and evaluated the effect of tropospheric ozone at locations where monitors ošte anja ozone, as well as risk assessment of ozone effects on forest ecosystems. Methodologies, including quality assurance, such as data harmonization, completeness and plausibility tests have been applied according to the ICP Forests Manual, Parts VIII - Assessment of Ozone Injury. Specific targets are set as follows: quantification of injuries ozone on the selected parcel level II in Europe; Detection of temporal trends in the selected plot level II in Europe (significant changes within 10 years with a 95% level of significance of individual plots).

Results from a Stage II will be documented in maps covering Europe, characterized by an area of increased risk of ozone to European forest ecosystems.

Material and methods

The locality on which is a measuring station for monitoring the meteorogical data, within the IPCC project, is located in 74a department, GJ "Samokovska river" in the national park "Kopaonik". The locality is placed directly below the road Kopaonik-Bruce, over place alias „Marin source".

Basic features of forest ecosystems on this site are as follows: elevation of 1700 m; exposure is northwestern; slope is a gently sloping to moderately steep; geological surface granite and granitmonconit, compact structure; soil type - brown podzolic soil deeply; dead cover medium-present unfavorable process of humification; ground vegetation is very dense, with rare shrubs present; the locality belongs to the type of spruce forest (*Picetum excelsae oxalidetosum*) on brown podzolic soil.

Stands of this type inhabit a large plateau, saddles and slopes. On the Kopaonik it is the most presented type of forest. The stands are well closed, dense (circuit 0.9-1.0), with poorly developed the shrub. Stands in which is the experimental station can be classified as uneven-

aged pure stands of spruce. The circuit is dense (0,8 - 0.9.) Spruce trees are right with developed treetop, what is logical where are they located.

The stands in terms of production may fall into more productive. The average population density is about 690 units/ha, the average volume is 460 m3/ha, increment is 8.30 m3/ha, mean stand diameter is 27 cm, and the mean stand height is 18.8 m.

The goal is to collect needles from trees representative of the experimental plot from which the sampling is performed again, twice during the growing season. Sampled needles should then be divided by categories, the one-year and two years.

Score of experimental samples for the presence of damage of ozone is carried out at certain chemical reactions, and the special equipment, by laboratory methodology. For sample preparation is necessary related equipment and a certain amount of dedicated substances. The analytical techniques are used because on the narrow vegetation or tree needles it is difficult to determine damage by ocular methode. In the tables damages are grouped according to the degree of damage and the manner in which recorded occurrence was shown (Tables 2 and 3). The main objective of assessing ozone visible injury on a selected number of Level II plots is to assess the effect of tropospheric ozone at the sites where ozone monitoring is performed, and to contribute to an ozone risk assessment for European forest ecosystems.

Results and discussion

Ozone visible injury on conifer species is expressed at the upper parts of the crown, in the upper side of branches and needles. A minimum of 3 branches per tree and 5 trees per plot are assessed. For off-Plot are measured variable, and they are shown in Table 1.

Tabele 1. Scoring and definition for the percentage of symptomatic leaves on a branch with approximately 30 leaves

Score	Frequency class (%)	Definition
0	No injury	None of the leaves are injured
1	1 - 5 %	1 – 5% of the leaves per branch show ozone symptoms
2	6 - 50 %	6 – 50% of the leaves per branch show ozone symptoms
3	51 - 100 %	51 – 100% of the leaves per branch show ozone symptoms

Samples were taken for laboratory analysis from 3 branches for all five trees on which were done evaluation of damage (trees numbered 9, 20, 54, 76 and 108). Also, samples were taken (three branches) from five trees from the edges of the stand. Needles are cut to length by 3 mm and placed in an Eppendorf cuvettes, in which are prepared solution (2.5% glutaraldehyde in Sorrensenovom buffer pH 7.0). Results are presented in Tables 2 and Table 3. In Table 2 are showen ozone injury of the trees within stands (trees numbered 9, 20, 54, 76 and 108).

Tabele 2. Assessment of damage from ozone on the assimilation organs of *Picea abies* L in the stand

No	9			20			54			76			108		
Sequence	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	+		+	+		+	+	+	+	+	+	+	+	+	+
1		+			+										
2															
3															

The results presented in Table 2 show that damages are different depends of possition of the tree in the stands, or from their exposure. Tree numbered 54, 76 and 108, were sheltered in

the strong part, and practically no damage, and tree numbered 9 and 20 have some slight damage of leaves, because they are on the open part of the stand. Table 3 shows the damage to the trees from the edges of the stand (trees I, II, III, IV and V).

Tabela 3. Assessment of damage from ozone on the assimilation organs *Picea abies* L from edges of the stand

No	I			II			III			IV			V		
Sequence	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1															
2															
3															

The trees on the edges of the stand (Table 3) haven't expressed the damage, although they are more exposed to the sun. The visible damage of the ozone in conifers are expressed in the top of the tree, the most exposed to the sun, at the top of needles.

The bole and other crown variables that are associated with growth and overall tree vigor can respond to elevated ozone exposures. Branch mortality in the lowest portion of the crown has been observed in southern California (Parmeter, 1968.) leading to a decrease in vertical crown length, as measured by percent live crown (Stark, 1968.). A reduction in the vertical and radial growth of stems has been documented for ozone-stressed trees in southern California and southern Sierras (McBride, 1975.).

Conclusion

In Europe, ambient ozone levels are high enough to cause visible injury in native species. Assessment of visible injury is a feasible way to detect the impacts of this pollutant in forest plants and to identify potential risk areas.

Chlorotic mottle caused by ozone injury were on the toop of the tree, in first part of the conifer.

Minimum 3 brances by tree and 5 trees by parceles are controled. Experiment were made on red fir in locality Kopaonik- Rtanj.

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NATURAL RESOURCE MANAGEMENT

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Abstract

A new wave of concern for the environment occurred during the 90s by launching claims that environmental problems are global in character. In fact, it is no longer enough that a country conducts proper environmental policy. Neither can polluted air be ordered not to cross the state border nor can an international river be informed not to flow in its bed through all the countries which it has been flowing for centuries. New findings about ozone depletion in the '90s were not announced to the world public for fear of the consequences for all of humanity, because nobody really knew how many centuries are needed for recovering waste. Even the problem of "acid rain" in Germany, "the greenhouse effect" in the United States and "waste impact" in Great Britain have not sufficiently sobered up environmental policy makers who cannot seem to understand that the market is not able to determine the price of resources such as water, air and clean environment..

Keywords: *economy of nature, environmental economics, environmental taxation, ecological equilibrium.*

The economy of nature

Theorists of Ecological economics offer two solutions for this: (1) it is necessary to know who the holder of a particular natural resource is, and (2) it is necessary to force producers and consumers to pay the actual costs in proportion to their share of environmental pollution. In the first case, the owner and the potential pollutant could negotiate, because if, for example, a private fishpond is in question, then the owner would take care to avoid over-fishing. In the other case, however, if it had been common, the producer's and the consumer's calculation would include in the price of gasoline and the cost of remediation of harmful effects of exhaust gases. In this context, the economists' task would be to determine the price of the environment, like the price of any other resource, so the economic policy would be reasonable in terms of official state policy towards current and potential pollutants on the principle of cost-benefit analysis. However, the governments are now acting quite the opposite; they encourage energy consumption by subsidizing prices. Agricultural subsidies encourage the use of pesticides and fertilizers. Permanently entrenched lobbies do not care why the U.S. subsidize the state industry, why Germany subsidizes coal mines, why Great Britain subsidizes the use of vehicles that are owned by companies, etc. And it is the sustainable development which does not exhaust the reserves so the respective reserves would remain for future generations to use. Therefore, it is a question of relation towards the present, as well as an ethical issue within the current environment policy. This is why, for most people today, the most important environmental issue in a market economy with a combination of private sector interests and government regulations is: "how to leave to posterity a world that is, if not better, at least the same as it was when the present generation inherited it". (Economic policy, 1992.)

For logistical entrepreneurs reliability is more important than speed. From an economic point of view, it is about goods to be in the right place at the right time; environmentally, this needs to be done with the least possible burden on the environment. (Economic policy, 1992) Criteria of "speed" is no longer of prime importance. The transition to a slower, but

environmentally favorable means of transport, is quite acceptable to so-called 'ecologistics'. The combination of ecology, economics and logistics in the structural projection of ecologistics prompts the modern society to solve the problem of mutual harmonization of road, rail, air and maritime traffic, so the traffic problem would not become a hindrance of economic growth. The structure of the mass transport must now choose the most environmentally advantageous mode of transport, particularly when it comes to the introduction of fees for heavy transport, increase of taxes on mineral fuels and the introduction of tax on carbon emissions. Ecologistics now pleads to significantly reduce costs through greater reliance on the maritime and railway transport, which provide environmentally friendly and better treatment of goods and more environmentally reliable transpor. (Lipietz, 1993.)

"Green" economy management

Goal of the II UN Conference on Environment and Development (Brazil, from 1 to 12 June, 1992) was the interaction between the economy and environment, and balancing economic and environmental objectives within economic decision-making and business management. These ideas are not new, because their intellectual foundation was formulated as early as 1971 in Switzerland, which served for the preparation of the so-called Stockholm conference. Then, however, it was dramatically emphasized that poverty is a major source of environmental pollution because a billion of the world population that lives in poverty, misery and deprivation, are forced, out of desperation, to assault their environment just to survive. The cumulative effects of the devastating onslaught of individuals on nature are big and dangerous, especially when destruction and poverty are combined. That is why the Brundtland commission rejected the so-called zero growth, since zero growth is a consequence of the development of destructive processes to the environment. To meet the needs of growth, the concept needed to include the so-called sustainable development, within the United Nations Conference (called ECO '92.). The concept of sustainable development implies change of climate, cross-border expansion of the air pollution, waste management, protection and management of land resources, conservation and biodiversity, protection of oceans and coastal areas and the quality of supply of freshwater resources. Global risks in the field of biological and genetic resources are forcing the accelerating transition onto balanced development, which must be done through incentives and regulatory measures. In market economy, this means that the cost of the environment is built into the prices of products that induce the growth of costs. This is the so-called "polluter pays" principle. The solution, through regulated action, involves the formation of environmental funds which gather resources intended strictly for the rehabilitation of the environment. The aim is clear: the environmental protection measures must integrate into economic growth and business management, and an economic basis for cooperative global alliance must be formulated, if there is a will for the EARTH to remain a safe home for humans and a common future.

In order to restore the healthy relations of the world trade flow, it is inevitable to incorporate environmentally-protective mechanisms in international trade. In this context, cheapening of agricultural products is not a central goal, if it happens at the expense of nature. Therefore, reduction of subsidies for "green products" does not necessarily mean the preferred policy of reduction of inherited environmental protectionism if the substance of ecology is not incorporated into the structure of market prices. The cost of production of organic food can can no longer be irrelevant, because they are already part of the structural reality. After all, market-competitive prices in international trade cannot protect natural resources of a country. Therefore, the environmental protection requires long-term financial and technological investments that would pay off most in the field of environmentally sound agricultural production.

The EU Commission has, after a process that lasted two years, proposed the introduction of a tax whose basis (subject to taxation) would be „the carbon content in fuel." The aim of the

new tax, according to the proposal, is that the emissions of carbon dioxide be stabilized l on their level in 1990, but also the encouragement of energy efficiency and stability of supply. Institutionally speaking, the European Union is not entitled to the introduce taxes, because it does not have fiscal sovereignty (in itself); therefore, the tax on energy can be introduced only by the member states in the form of a national tax, which would be included in fiscal policy harmonization. However, the fiscal (and economic) trend is such, that the new increase in tax burden is not an option. The solution is, therefore, found in reducing "other" taxes.

Ecology and economy

Green economists are already producing models for the valuation of environmental costs and benefits in national economies, so the national accounts would also show the changes in natural resources. Effects of consumption of natural resources should be empirically verified through the change of SNA (System of National Accounts and Methodology of UN), into the concept of national income, including those natural resources that are under the control of man. The goal is, therefore, for national income balance sheets to "turn green" in order to treat plants and animals in the same way ("increase in a country's livestock is included when it occurs, but the growth of commercial forests recorded when they are cut down)". (Economic policy, 1992) In the present calculation, the national income is often artificially increased by including the cost of preventing pollution. This, in turn, means that the pollution does not count as a loss of gross domestic product. Likewise, the decline in the value of natural resources is presented as an item that exaggerates the net national product. It is clear, in fact, that it is extremely difficult to say how much idyll costs. But deforestation, according to market criteria, is certainly the sum of loss of value of uncut trees and revenues from timber that could be achieved. But, this criterion does not include the value of forests as a wildlife habitat and a recreation area. Therefore, it is important that the development of the national balance sheet adapts to the needs of environmental protection. In the initial stage, it is important to build so-called balance satellites in the form of parallel balances (in addition to the official ones). These "new" balances would include the change in the quality of the environment (for example, increase of air pollution, extinction of certain species of plants and animals), and the evaluation of the damage to natural resources that are not commercially valued. For resources that do not have a market value, the controversial issue is what should be measured: (a) what is the cost of restoring the environment to its original state or (b) the amount of funds that consumers would be inclined to spend to improve environmental quality. All in all, the conventional models for the determination of wealth should be expanded and enriched in order to give adequate answers to the environmentalists who popularize the new calculations. Low prices in mining, grotesque economy of scale and national subsidies have negative implications for the ecology. Intended sale of state (public) land to mining companies for a pittance ($ 12 per hectare), public funding of mining research results and tax deductions, which reduce the real costs of mining in the United States have significantly contributed to the degradation of eco-balance. Japan offers a wide range of incentives (from loans and subsidies to tax incentives) for the exploration and exploitation of mineral reserves. It is the same in Canada and Australia. German and French governments guarantee assistance and direct financial investments, and they also subsidize foreign projects of domestic mining companies. (Economic policy, 1992)

Even the World Bank is financing the increase in mining production through the provision of loans under favorable conditions. Such a policy of exploitation of natural resources poses a serious environmental threat, because the real costs of world mining are hidden in the extensive producer subsidies as well as in unrecognized environmental damage. Low prices of ore today reflect the extraction-distribution economy, for which there are no costs of restoring denuded forests, eroded land, destroyed or polluted rivers. "The implementation of the stringent environmental laws suggests channeling part of the funds collected through taxation from industrialized countries into the mining countries of the third world. This

mechanism would be facilitated by the World Bank through commissions on loans, which would be conditioned by nature conservation. A higher degree of recycling raw materials and substituting them by less "malignant" materials, in the long term, are additive mechanisms in the reduction in demand that environmentally stumbles. Gradual replacement of copper communication cables by more efficient optical fiber made of glass, also represents the future, which should be supported by tax rewards (not just by basic subsidizing of mining). (Ristic, 2012) The establishment of new companies for waste sorting and companies for thermal processing and construction of devices for waste incineration plants and systems for the production of packaging for recycling are a new challenge to the Ministry for the Environment, which, through tax benefits, features instruments from the Ministry of Finance. Also, placing the green dots on new products should be funded from the state budget.

In the economic and ecological theory and practice, it is considered that most of the natural resources are of a regenerative nature: rational use can renew a resource, and efficient use can increase the total volume of the resource. Mineral resources or raw materials of mineral origin "excavated from certain deposits or ore body" cannot be regenerated, nor can other mineral concentrations be formed. In mineral materials, therefore, only what is created by nature in the unique manner can be used. Therefore, attention should be focused on economic measures in order to protect the environment in the philosophy of sustainable development. Economic instruments, in order to protect the environment, are used as an effective form of replacement of regulations and as a complement to legislation, since legislation cannot always influence the rational use of resources and effective protection against pollution. (Economic policy, 1992)

The "polluter pays" principle actually reflects the need to institutionalize environmental taxes (fees), as follows: (1) differentiated taxation of regular and lead-free gasoline, (2) differentiated sales tax and customs duty on import of cars and trucks with higher consumption compared to cars with lower fuel consumption and the use of unleaded gasoline, (3) differentiated tax on goods with packaging that can be recycled, (4) additional sales tax and customs duty on cigarettes, (5) sales tax and customs duty on import of fertilizers, detergents and pesticides, (6) selective taxation of goods (in order to establish such price ratio that will stimulate the consumption of products whose production and use is less polluting) (7) exemption from corporate income tax (for polluters and manufacturers who, by new technology, reduce emissions and the use of polluting materials), (8) the exemption from value added tax and the introduction of tax on the use of natural resources through the income tax with the abolition of tax on the sale of secondary raw materials (so as to encourage the collection and processing of waste materials), (9) the introduction of fees for pollution, as compensation for the costs of the waste material, (10) introduction of tax for manufacturers whose products pollute the environment during the production process or use, (11) the introduction of penalties for polluters so as to be forced to introduce new technologies, (12) the existence of subsidies to help invest in clean technology and (13) the introduction of pollution charges, for the use of landfills, for the use of natural resources and space (which would be applied for the discharge of pollutants into the air, water and soil, disposal of solid and hazardous waste at the landfills, and to cover the cost of rehabilitation of natural resources and space). (Ristic, 2014)

In general, almost all countries of the modern world are seeking out and finding instruments and mechanisms for the implementation of the so-called Bergen Declaration on Sustainable Development (1990), which insists on the economic respect for commitments based on taking from nature - so-called debt towards nature. In industrialized countries, the fees for so-called mineral wealth have already been introduced (fees for mineral resources and mining fees), which essentially reflects the allocation of the portion of assets (calculated per unit of product) as reimbursement for the renewal of the available natural resources, for goods taken from the available natural reserve funds and for the repayment of debt towards nature. However, sand and gravel are present in almost all regions of the world, whereas oil

and diamonds can be found only in "some" regions (because of uneven geographical dispersion of minerals). Therefore, the existence of so-called fees for mineral resources on selective basis, depending on the type of mineral resources, is economically justified.These allocations would be included in the cost of products, and would be used to repay debts to the nature. Debt for nature would incorporate a fee for use of mineral resources and compensation for damage caused to the environment. (Ristic, 2014)

Ecological strategy of global companies

For each transnational company (corporation), business success is becoming increasingly dependent on accurate predictions of future trends in the business environment of the company. Today, it is of great importance for the managers who are trying to create a picture of business environment for the twenty first century. Managerial structures in developed market economies are forced to respect the widespread opinion of the population which already refuses to accept a high degree of environmental degradation. And when environment is taken into consideration, companies are forced to respond more responsibly to public concern for the inevitable warming of the planet. Forthcoming financial years are future challenges for business dealings, because ecology is becoming a decisive factor in the future of business. The world's leading managers are already preparing to meet the strict requirements of environmental legislation and the demands of consumers, who increasingly insist on the organic components of the product quality. (Slijepcevic, Markovic, Ilic, 2013)

Businessmen feel their vital role in protecting the environment, as they have already realized that the business processes are the dominant source of pressure on the environment. The same as employment is the key prerequisite of social security, the protection of the environment has become a leading prerequisite for doing business. Environmentally sensitive public is giving a chance to profit-oriented managers to color their business planning "green" and to diversify approaches to business organization, accounting, balancing success, corporate finance, marketing, management and public relations, in order to obtain environmental reputation, which predominantly determines consumer decisions about buying (environmental quality) products. Environmentally enlightened consumers in civilized societies with market orientation are ready to use (in an organized way) their purchasing power on the market and put pressure on the industry. Manufacturers have already felt that the demand for environmentally friendly products has an upward trend in the developed markets of the modern world. At the international level, a dramatic shift in consumer preferences "swallows" additional environmental expense burden. And, lo and behold, it is considered a new chance for competitive success, pressuring the leading managers to recognize the need to formalize the new development strategies of the companies, which includes a new marketing view of the world. New business philosophy must take particular account of the relatively strong segment of the population that is willing to pay for products that meet environmental standards. However, managers must take into account the inevitable truth that certain products will become unacceptable to consumers of ecological quality. In the short-time sequences, multinational companies can achieve high profits by bypassing investments into ecological research of product quality. But in the long run, these companies acquire the image of environmentally insensitive companies, lose their place in the highly competitive market, run late in the restructuring of the production programs and endure future rigorous environmental standards more difficultly.

Conclusion

Environmental pressures of the public have forced the acceleration of the transformation of the evaluation of managerial success, which, in addition to the usual management performances based on the quantum of profit growth, incorporates long-term component of the ability to develop teams, who, business -wise and environmentally, introduce a company into the 21st century, focusing the company on environmental problems, with high

environmental awareness of employees and with developed production of so-called green products. The public opinion of modern Western civilization goes in the direction of the topic for the same reason as the companies are fully responsible for the impact of their products and technologies and pressure that their products put on the environment. Managers are, environmentally, burdened by public opinion, and companies are faced with environmental responsibility by law. In this sense, the companies, along with their managers, formulate internal environmental programs and thereby assume full responsibility for the pollutants emitted and recycling. Many companies are already looking for eco-perfection and the reduction of environmental risks that are inherent in the production processes and products. Future environmental monitoring will be tasked to observe the negative impacts on the environment and comply with environmental standards, with derived effects in terms in terms of raising the level of environmental awareness and savings of companies. Monitoring teams will have the opportunity to compare the environmental performances of production processes and products with environmental standards and to ensure their compliance, irrespective of the fact that ecological confrontation of costs and benefits creates problems in the company. But nevertheless, the future of the market will belong only to companies with strong ecological product development strategy whose industrial-production cycle envelops four stages in terms of (1) the extraction of raw materials, (2) the production of goods, (3) use of product, and (4) disposal of products after use (and recycling). It is now accompanied by the requirements for minimizing the environmental impact of products which expired, and for eliminating the perceived problem of waste disposal. In ecologically redefined business strategy, the companies are becoming fully responsible for the product life cycle, from the stage of production to the stage of waste and reuse. Production processes of the future, therefore, must be adjusted to recreating the roundabout and the inputs and outputs with a modular design, which combines relatively short technology cycles and long-term use of products by means of recycling .

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THE FIRST RECORD OF THE INVASIVE *Impatiens Glandulifera* Royle (HIMALAYAN BALSAM) IN THE REPUBLIC OF MACEDONIA

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Abstract

A population of *Impatiens glandulifera* Royle, an invasive plant species native to the Western Himalayas, was recorded in 2013 near the village Gorno Sedlarce in the north-western mountainous region of the Republic of Macedonia. *I. glandulifera* is a new alien species to the Macedonian flora. The surveys revealed an intensive growth and low to medium dense population of *I. glandulifera*. The population's density was not quantified, but several stands of different sizes were found. A rapid ecological risk assessment, mainly based on knowledge about invasion histories in North-Western and Central European countries, showed that this species which is on the EPPO List of Invasive Alien Plants is a serious threat to Macedonian biodiversity. Biological invasions of *I. glandulifera* affect biodiversity worldwide, and, consequently, the invaded ecosystems may suffer from significant losses in economic and cultural values. In accordance with nature conservation efforts, there is a clear need to develop a strategy for its control, which will deliver the greatest potential benefits to biodiversity, as a whole.

Key words: *Impatiens glandulifera, alien species, Republic of Macedonia, control, forecast*

Introduction

Impatiens glandulifera Royle (Balsaminaceae), known also as the Himalayan balsam, is a herbaceous summer-annual, widespread invasive plant species native to the Western Himalayas (Gupta 1989; Tanner 2007), which was established in North-Western and Central Europe (Beerling, 1993; Beerling & Perrins, 1993; Pyšek & Prach, 1995; Dawson & Holland, 1999; Weber, 2000; Peltre *et al.*, 2002), temperate North America (Toney *et al.*, 1998; Clements *et al.,* 2008) and New Zealand (Weber 2003). In Europe, *I. glandulifera* escaped from cultivation in the mid-19th century as a garden ornamental and nectar-producing plant (Pyšek & Prach, 1995) in the United Kingdom and is now a problematic invasive in many regions between the latitudes of 30 and 64°N (Beerling & Perrins, 1993; Wadsworth *et al.*, 2000; Lid & Lid, 1994, Prots & Klotz, 2004). It is identified as a significant invasive plant in at least 18 European countries (CABI, 2004; Sheppard *et al.*, 2006) and has been on the EPPO List of Invasive Alien Plants since 2004. In the countries of Central and Western Europe *I. glandulifera* is a problematic weed in moist and semi-open habitats (Kollmann *et al.*, 2007). Due to its large size (it is the tallest annual plant in Europe) (Perrins *et al.*, 1990; Stace, 1991; Pyšek & Prach, 1995; Willis & Hulme, 2004) rapid growth, high reproductive output and its ability to outcompete native species (Andrews *et al.*, 2005), *I. glandulifera* is able to quickly dominate local vegetation and diminish conservation value at some sites (Roblin, 1994). It is ranked in the top 20 invasive plants in the UK (Crawley, 1987), is on the Swiss 'black list' of harmful invasive species (Anonymous, 2002) and is one of the invasive species in Germany against which specific control measures are directed (Kowarik, 2003). In Poland it is regarded as one of the top 20 invasive alien plant species (Tokarska-Guzik, 2003). In Sweden Himalayan balsam has been classified as one of the five most aggressive

invasive plant species. It is found in all parts of Sweden except inner parts of Lappland. Its stands have been reported to persist for at least 70 years (Larsson & Martinsson, 1998). In Norway the species is rapidly expanding, and it is now found in natural and semi-natural habitats such as moist forests, moist meadows, flooded ground, in ditches and on seashores as well as along watercourses, in addition to various types of moist ruderal sites (Alm, 2002). Dominance of *I. glandulifera* along riverbanks has been reported to cause problems in stream management in the Czech Republic, Germany, Finland, Slovakia and the United Kingdom (Beerling, 1993; Pyšek & Prach 1995). In Lithuania (Gudžinskas & Sinkevi ien , 1995) and Latvia (Helmisaari, 2010) *I. glandulifera* has spread rapidly, since its introduction to invade riverbanks of major rivers and their tributaries. In Russia *I. glandulifera* is one of the widespread alien species and occurs from northern regions (Murmansk, Karelia) to Caucasus in the south. It occurs in floodplains, along river banks, wetlands and roads and in different human-made habitats (Markov *et al*., 1997).

First record in Republic of Macedonia

In this record, the authors of this paper are the first to document the presence of *Impatiens glandulifera* Royle in Republic of Macedonia. On 25 July 2013, a visit to maize field trials with herbicides near the village Gorno Sedlarce (41° 56' 12" N and 20° 56' 38" E) located in the North-Western mountainous part of the Republic of Macedonia, revealed an intensive growth of *Impatiens glandulifera* Royle (Himalayan balsam), a new alien species to the Macedonian flora (Fig. 1).

Figure 1. Map of the Republic of Macedonia showing where the invasive *Impatiens glandulifera* Royle (Himalayan balsam) was found. The green area is the area in the top left of the country is where the village Gorno Sedlarce is situated and where the plants were observed. The blue areas are lakes

The places where *I. glandulifera* was found are damp woodlands near streams which spring from the Sharr Mountains, the biggest mountains in the Republic of Macedonia. On the 9th of August 2013 and the 3rd of September 2013, the site was surveyed to estimate the extent of the invasion. These surveys revealed an intensive growth (flowering - development of fruit stages) and a low to medium dense population of *I. glandulifera*. The population's density was not quantified, but several stands of different sizes were found. The largest stands were approximately 10-12 metres at their widest point During the second survey, the authors extended the area of observation, and the plant was found mainly in human influenced and man-made habitats such as shrubbery, ditches, roadsides, hedges, alongside canals and nearby arable lands. Research by Gark je (2006) has shown that the biotopes that are most suitable for *I. glandulifera* are those that have been affected by humans. The studies of species dynamics in Latvia suggest that in the initial phases of invasion the species prefers human-affected, weedy sites and dump sites, while on later invasion stages it appears to be successful and a frequent invader in riparian habitats (Priede, 2008).

In habitats where *I. glandulifera* was detected, it most commonly grows together with nitrophilous plant species such as, *Urtica dioica* L.*, Calystegia sepium* (L.) R. Br.*, Tanacetum vulgare* L. and *Rubus caesius* L. Similar finding are reported by Kurtto (1992) and Kowarik (2003). Clements *et al.,* (2008) gave detailed list of species growing near *I. glandulifera* in

Canada: *Alnus rubra* Bong., *Athyrium filix-femina* (L.) Roth., *Barbarea orthoceras* Ledeb., *Cirsium vulgare* (Savi) Ten., *Convolvulus arvensis* L., *Corylus cornuta* var. *californica* (A.DC.) Sharp, *Epilobium angustifolium* L., *Hypochaeris radicata* L., *Leucanthemun vulgare* Lam., *Myrica gale* L., *Plantago lanceolata* L., *Prunella vulgaris* L., *Ranunculus repens* L., *Symphoricarpos albus* (L.) Blake, *Tanacetum vulgare* L., *Vicia cracca* L.,and *Impatiens noli-tangere* L. In other Canadian regions, *I. glandulifera* is likewise associated with plants of riparian areas, but because of the tendency of *I. glandulifera* to form monotypic stands the diversity of plants within these stands is probably fairly low. In Europe, *Impatiens glandulifera* is associated also with riparian communities (Wadsworth *et al.* 2000; Hejda & Pyšek, 2006; Hulme & Bremner, 2006). In river valleys *I. glandulifera* forms dense vegetation patches of its own community classified phytosociologically as association *Impatienti-Calystegium* (Moor 1958, Soó 1971)(cit. by Helmisaari, 2010).

In all study areas, the highest densities of plants, and the tallest ones, were recorded in the places close to the water streams with sufficiently high soil moisture. Out of these areas, several single plants could be observed as smaller forms, even in the edges of neighbouring maize crop fields.

Because of its preference for moist areas, rainfall might seem to be a key predictor of *I. glandulifera* distribution. In that context, the region where the village Gorno Sedlarce is situated is the most humid region in the Republic of Macedonia with annual precipitation of 795 mm (Kostov, 2003). However, Kollmann & Bañuelos (2004) noted that *I. glandulifera* occurred in European locations with moderate (e.g., Halle-Leipzig, Germany with 519 mm annual precipitation) to heavier precipitation (e.g., Zurich, Switzerland with 1137 mm annual precipitation). Thus, soil moisture is a more stringent requirement than the annual precipitation level (Beerling & Perrins, 1993).

Taking into consideration that, *I. glandulifera* was found in human influenced and man-made habitats, probably the introduced pathway may have been human activity. The starting point of the invasion was in the North-Western mountainous region of the Republic of Macedonia, where, because of very difficult economic situation, the majority of the population lives and works in western European countries (Belgium, Denmark, France, Germany, Switzerland, etc.). Thus, it is very likely that the occurrence there could be attributed to a person who illegally introduced *I. glandulifera* plant material from these countries in the Republic of Macedonia. It is well-known that small seed quantities of *I. glandulifera* are sufficient for establishing a new plant population in favourable environmental conditions. Hejda & Pyšek (2006) concluded that high rates of seed production, explosive dispersal from capsules and spread via water enable *I. glandulifera* to spread rapidly, particularly in riparian areas.

Ecological impacts

The discovery of a well-established population of *I. glandulifera*, as a new alien species in the Macedonian flora, is a significant concern. Biological invasions of *I. glandulifera* affect biodiversity worldwide, and, consequently, the invaded ecosystems may suffer from significant losses in economic and cultural values (Marton, 2011). The threat to biodiversity from *I. glandulifera* is particularly high in vulnerable habitats, including national parks, as the plant is able to successfully compete directly with native species for space, light and nutrients (Tanner, 2011). For example, in damp woodlands *I. glandulifera* forms dense monotypic stands which choke out all other plants (Perrins *et al.,* 1993; Prots & Klotz, 2004). Hulme & Bremner (2006) found that dense stands of *I. glandulifera* forms monocultures, and reduce species diversity by as much as 25% in sites in the United Kingdom whereas Hejda & Pyšek (2006) found only a negligible effect of *I. glandulifera* in the species diversity in the Czech Republic. The same authors suggested that invasion of *I. glandulifera* did not reduce species diversity so much as it changes the dominance hierarchy, with *I. glandulifera* reducing populations of other nitrophilous annual species. However, Maule *et al.,* (2000) showed that in the UK *I. glandulifera* could successfully compete with native plants, including tree

seedlings with the potential to inhibit the regeneration cycle of woodlands. This was not the case, in Germany, Ammer *et al.,* (2011), found no impact of *I. glandulifera* on established tree seedlings.

In a study of indirect competition, Chittka & Schürkens (2001) showed that *I. glandulifera* is capable of reducing the fitness of native plant species through reduced seed-set, by luring pollinators away from native species due to its higher rate of sugar nectar production. According to the same authors, in Central Europe the recorded rate of sugar production by *I. glandulifera* of 0.479±0.12 mg per flower per hour, was substantially higher than other common species visited by bumblebees. As a result of this, they recorded a 50% reduction in pollinator visits to the native species *Stachys palustris* L. when *I. glandulifera* plants were introduced to areas where native plants of *Stachys palustris* L. occurred. Prowse & Goodridge (2000) showed a similar preference for *I. glandulifera* by bees from the genus *Bombus* in a study of pollinator visitations to *I. glandulifera* and other plant species. Over time, such competition between plant species for pollinators could leave native species, which are unsuccessful at attracting pollinators genetically depauperate (Prowse & Goodridge, 2000). Apart from experimental evidence that *I. glandulifera* may compete successfully with native plants for pollinators (Chittka & Schürkens, 2001), observational studies indicate impacts may largely consist of a local change in cover and/or dominance of native species (Larsson & Martinsson, 1998; Maule *et al.,* 2000). At high densities, *I. glandulifera* can alter water flow, increase erosion, and cause flooding (King County, 2004). When thick patches of *I. glandulifera* die off in the fall, the stalks quickly rot exposing large areas of river banks and making them increasingly susceptible to erosion from high winter flows (Roblin, 1994; Graham 2003; Sheppard *et al.,* 2006; Martin & Pyšek, 2006). Even during the growing season, the plants offer little protection against soil erosion due to their extremely shallow root systems.

The success of *I. glandulifera* as an invasive annual species could be due to the intraindividual variation in seed mass that helps the utilization of heterogenous environments (Rees & Westoby, 1997). The ability of *I. glandulifera* to outcompete native flora and its predicted expansion along water courses indicates that it could become a more serious threat to nature conservation in the future (Prach, 1994; Pysek & Prach, 1995). *I. glandulifera* is known to prevent forests regeneration in moist and half shaded habitats (Lhotska & Kopecky, 1966). Since *I. glandulifera* seems to react positively to an increase in CO_2 and temperature it is potentially a still more aggressive invader in a changing climate (NeoFlora 2006)(cit. by Helmisaari, 2010).

Control management strategies

Because of the fact that *I. glandulifera* is a quite new alien species in the Republic of Macedonia, and there is still a lot of missing information regarding its invasion, there is a clear need to develop a strategy for identifying priority for its control. According to Dawson & Holland (1999), the first step after identifying a new invasive colony is to initiate an immediate control, because it is easier and cheapest to control invasions at an early stage of the process. Removal of invasive alien species should start as early as possible, before the species is too widespread. The prevention actions should be well organized. The success of actions needs to have public acceptance and hence the public needs to be informed about the negative effects of the plant and its effective spread along waterways (in particular beekeepers and growers of ornamental plants should be targeted with information on the species). Since *I. glandulifera* is an annual species, the best way to manage its dispersal is to prevent flowering and the formation and spread of its seeds. Care has to be taken to hinder spread of its seeds by transport of plant parts or soil containing viable seeds (Wadsworth *et al.*, 2000; Shaw, 2003).

In areas of a high conservation interest, mechanical eradication efforts are often used. This method consists of removing the whole plant, as this is quite easy due to the modest root system of *I. glandulifera*. However, the effect of using this method is rather questionable due

to the effective transportation of seeds through the river corridors. Cutting should sever the plant below the lowest node, preventing future seed set (Howell, 2002). According Prach, (1994) it must be carefully timed, in June, respectively. Since *I. glandulifera* is sensitive to grazing and grazing animals eat it, grazing is a good method to manage the species (Larsson and Martinsson, 1998). Sheep and cattle may also be used to graze the plant.

Chemical treatment is the most shared control method and it is very important that the plant is treated twice in a season, once before flowering and again later on (Wadsworth *et al.,* 2000). Glyphosate application is effective against *I. glandulifera* (Stensones & Garnett, 1994) but will also kill other plants in the near vicinity. Nevertheless, Wadsworth *et al.,* (2000) found that 99% control was almost as ineffective as no control at all due to prolific seed production. Control has also been achieved by spraying 2,4-D amine at rates of 6-9 L/ha early on in the season at the rosette stage (Environment Agency, 2003) and before flowering to prevent the development of seeds (Beerling & Perrins, 1993). But, the use of herbicides should be avoided and are often not permitted especially along waterways.

Biological control agents offer a sustainable, ecological and economically viable tool to support and sometimes to replace chemical and manual control methods. In 2006, a biocontrol programme was initiated, and it included three surveys conducted across the native range of *I. glandulifera* in Pakistan and India to collect and record its natural enemies (Shaw & Tanner, 2008). The studies have revealed the fact that in its native range, the plant is attacked by an array of invertebrate species and plant pathogens, which cause considerable damage for the plant. Beerling & Dawah (1993) recorded relatively few phytophagous insects on the foliage of *I. glandulifera* in Cardiff, United Kingdom. *Hymenoscyphus vitellinus* (Rehm) Kuntze was recorded as occurring on I. *glandulifera* in the United Kingdom (Dennis 1986). Glushakova & Chernov (2005) recorded that epiphytic yeasts occurred on *I. glandulifera*. In Germany, *Phyllosticta impatientis* (L. A. Kirchn.) Fautrey and *Ascochyta weissiana* Allesch. were found on the leaves of *I. glandulifera*. A rust tentatively identified as *Puccinia argentata* (C. F. Schulz) Wint. was found on *I. glandulifera* in its native Pakistan in 2006 (Tanner, 2007). Tanner (2007) evaluated this pathogen as having good potential for biocontrol use in Europe. The CABI scientists also identified leafspot damage in Pakistan due to three *Coelomycetes* species (*Phomopsis* sp., *Phoma* sp. and *Ascochyta* sp.), a downy mildew (*Peronosporaceae*) and a powdery mildew (*Erysiphaceae*) (Tanner, 2007).

Focusing management where *Impatiens* populations are most extensive may not only improve the effectiveness of control (Wadsworth *et al.,* 2000) but, also deliver the greatest potential benefits to biodiversity. Invasive alien species are a major problem for habitat management, because of the associated economic costs and concerns about losses in biodiversity. Invasive alien plants lead to devaluation of agricultural land, interfere with forest management, increase costs for maintenance of road margins, railways and waterways, and they can cause extinction of native species.

Conclusions for the Republic of Macedonia

Impatiens glandulifera Royle has been found in the Republic of Macedonia. However, in some areas, particularly in North-Western and Central Europe, it has spread fairly widely and is established and has become the target of large scale removal campaigns. Within 16 years of its introduction into the United Kingdom (1839-1855), it was able to spread from gardens and become established (Beerling & Perrins 1993). Now it is a widespread problem almost in the whole of Europe. The climate and topography of the many European regions are favourable for its growth and expansion. In other Macedonian locations with similar climates to the north-western part where *I. glandulifera* was found, it is important to detect where new plants of this species are present. *I. glandulifera* is able to outgrow its competitors as it reaches great heights in a short period of time and thereby shades other plants that are living in the close vicinity. The prolific seed production and explosive seed dehiscence contribute to its invasive potential. Spread is also facilitated by waterways and human transportation.

Although glyphosate can be used to control *I. glandulifera*, its use is limited as the plants are often near water ways where herbicide use is not recommended. The other control methods, however, are time consuming, and could be quite costly. The recent efforts to develop biological control in North-Western and Central Europe (Tanner, 2007) could eventually provide additional measures to be used against *I. glandulfera* in Republic of Macedonia, as well. It appears that curbing the spread of *I. glandulifera* in Republic of Macedonia will be extremely difficult. The authors expect that in the very close future, it will rapidly establish itself along waterways in many other Macedonian regions, following the pattern seen over the past two centuries in North-Western and Central Europe.

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ENVIRONMENTAL SUSTAINABILITY ANALYSIS OF SUB-NATIONAL AGRICULTURE IN PAKISTAN

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Abstract

This paper analyzes the environmental sustainability of sub-national agriculture in Pakistan based on indicators related to land use, crop production and protection practices. Quantitative information required to create environmental sustainability indices was collected from secondary sources, including, Economic Survey of Pakistan (2007-2012), Agricultural Census (2010), Agricultural Statistics of Pakistan (2009, 2011), Handbook of Pakistan Economy (2005) and Medium Term Development Framework (2005). The findings suggest that agriculture in Sindh and Punjab province lagged behind KPK and Balochistan in terms of environmental sustainability. The reasons for such trends in Punjab province were highly intense land use, the highest chemical use in terms of pesticides and chemical fertilizer. Contrary to this, Balochistan province performed better in the above indicators with an exception that it has the highest saline area in Pakistan. Sindh and KPK performed mix on selected indicators. Based on our findings, we recommend rational use of fertilizer and pesticides in Punjab and soil salinity control and crop zoning in Sindh. Whereas, we recommend cropping diversity in KPK and salinity control programs in some regions of Balochistan.

Keywords: *Environmental sustainability, Sustainable Agriculture, crop diversification, Pakistan.*

Introduction

Sustainability in agriculture sector is of utmost importance and can only be achieved through sustainable use of agricultural resources. The term 'sustainable' here means using the agricultural resources sensibly in such a way that they remain viable in present as well as in future (Fresco and Kroonenberg, 1992) so that future generations are not handicapped in their use because of over exploitation of the past. The notion of 'sustainability' has been the source of creating widespread consensus for its desirability as objective of agricultural development (Hansen, 1996).

With the advent of green revolution the crop productivity in Pakistan increased significantly mainly through using inorganic fertilizer and pesticides more intensively, the introduction of high yielding varieties and increased farm mechanization. The environmental problems caused by overuse of chemical inputs included land degradation and stalled agricultural productivity (Ahmed, 1994; Ali and Byerlee, 2002). Also the soil and water pollution has been caused by the excessive use of chemicals (Ahmed, 1994).

Materials and methods

The focus of this study was to assess the situation of environmental sustainability of agriculture at provincial level based on identified environmental indicators of success. The diversity in agriculture across all provinces lead us to conduct research at the provincial level (GOP, 2011). There are four provinces in Pakistan namely Punjab, Sindh, KPK (Khyber

Pakhtun Khwa) and Balochistan. The difference in agricultural infrastructure, environment, and diverse biophysical conditions have resulted in the development of whole different agricultural system in each province. The data for this paper related to environmental sustainability assessment was collected from secondary sources including government reports, Economic Survey of Pakistan (2007-2012), Agricultural Census (2010), Agricultural Statistics of Pakistan (2009, 2011), Handbook of Pakistan Economy (2005) and Medium Term Development Framework (2005).

Methods and Techniques

For the purpose of comparison the year 2005-06 was taken as base year similar to the standard adopted by the government of Pakistan (GOP, 2010). The data for all the indicators was analyzed from the year 2005-06 to 2010-11 or for the latest available data. This was because the last agricultural census in Pakistan, which provides comprehensive information on most of the agricultural variables, was carried out in 2010. The data analysis techniques were described in the following text.

Determination of Environmental Sustainability

The indicators can help in measurement and calibration of progress towards sustainable development goals (DiSano, 2001). There are multitude of indicators for the measurement of environmental sustainability depending on the availability of information and characteristics of the study area. However, the following indicators (table 1) were developed keeping in view the agricultural system in Pakistan, availability of the secondary data and regional level nature of the research (Rasul, 1999; DiSano, 2001; Rasul and Thapa, 2003; Zhen and Routray, 2003; Hatai and Sen, 2008; Hayati et al., 2011).

Table 1: Indicators of environmental sustainability

Indicators	Measurement
Agricultural land use intensity	Land use intensity = (Total cultivated area/ Total culturable area) * 100
Crop diversification	Crop diversification index
Extent of soil salinity	Percentage of total area under different soil salinity conditions
Use of fertilizers	Percentage of total farms using organic and inorganic fertilizers
Trend of inorganic fertilizer use	Fertilizer use (000 Nutrient tonnes)
Use of insecticides and pesticides	Percentage of total farms using insecticides and pesticides

The intensive use of chemical inputs has resulted in a lot of problems in Pakistan. A time series analysis of the use of chemical fertilizers and pesticides was done and conclusions were drawn based on the trends in chemical input uses. All the above indicators are self-explanatory except crop diversification index, which is explained below.

Crop Diversification Index

Crop diversification refers to a strategy to optimize the usage of agricultural land, water and other resources. Diversification may also be defined as the shift of agricultural production from low value crops to high value crops (Vyas, 1996 cited by (Bhattacharyya, 2008). There are various ways to measure the status of crop diversification. However, following method was used to calculate the crop diversification status in all four provinces of Pakistan. The Herfindahl Index (HFI) was calculated as following (Malik and Singh, 2002):

$$HFI = \sum_{i=1}^{n} Prop_i^2$$

HFI = Herfindahl Index, and $Prop_i = \frac{Area_i}{\sum_{i=1}^{n} Area_i}$

$Prop_i$ = Proportion of ith crop, $Area_i$ = i^{th} crop area (hectare), $\sum_{i=1}^{n} Area_i$ = Total cropped area (hectare), i = Number of crops (1,2,3,…n)

In order to calculate crop diversification an index was calculated directly from Herfindahl index and this is called Crop Diversification Index (CDI). $CDI = 1 - HFI$

The value of CDI varies from zero to one. The value of zero shows perfect specialization and as the value of CDI increases the level of crop diversification increases until it reaches one: which is perfect diversification. The CDI was calculated based on all crops including cereals, sugarcane, cotton, pulses, vegetables, fodder crops, and fruits.

Results and discussion

The environmental sustainability is an important component of agricultural sustainability. The very definition of sustainable agriculture requires the use of the resource base without environmental degradation (Firebaugh, 1990; Rasul and Thapa, 2003). It constitutes the use of natural resources for agricultural production without harming these resources and environment. The results are presented in the following discussion.

Agricultural Land Use Intensity

The appropriate use of land resources determines the sustainable use of it and land use intensity is a good measure for this. The higher land use intensity represents higher pressure on the farmland and thus lower environmental sustainability.
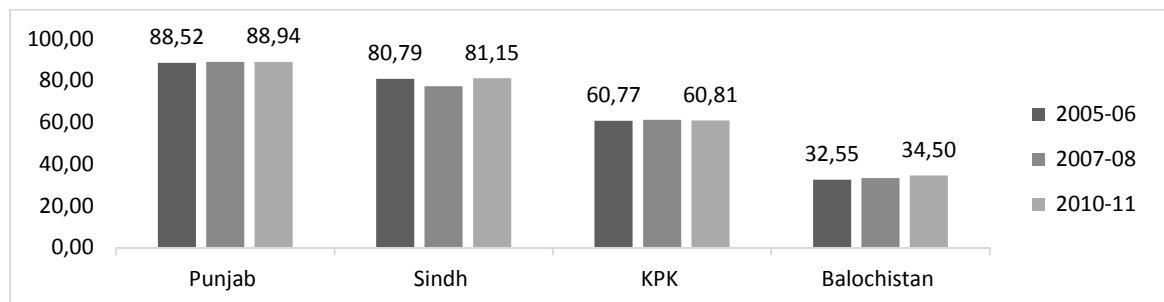
Figure 1: Land use intensity by province from 2005-06 to 2010-11

The land use intensity which measures the level of strain that its use puts on resources was highest in Punjab and lowest in Balochistan. The land use intensity was higher in Punjab and Sindh because of more favorable terrain and suitable growing conditions. The agriculture in these two provinces is mostly irrigated and presence of vast alluvial plains made it possible to use the land intensively (GOP, 2009). The presence of large irrigation network allows Punjab and Sindh to use more culturable land under cultivation. The KPK province was the third in the list because of difficult terrain due to hills and mountains. As expected, the Balochistan province had the least land use intensity due to a large area under deserts and limited irrigation infrastructure. The intense aridity and rugged topography only add up to pull down the agricultural land use in Balochistan (GOP, 2009).

Crop Diversification

A diversified farming system is more sustainable both for land and biodiversity. It also helps in maintaining the correct nutrient balance in soil.

Figure 2: Crop diversification index for year 2010-11

The crop diversification status of the four provinces was presented in Figure 2. The low level of crop diversification status in KPK can be explained by the type of crops grown in KPK, more than 70 percent of the agricultural cropped area was covered by only wheat and maize crops (GOP, 2011). There was a significant difference of crop diversification status among KPK and all other provinces. Sindh province has more diversity in soil conditions and thus farmers have to sort towards cultivation of different crops according to biophysical conditions rather than concentrating on few crops, like was done in Punjab. Similarly, in Balochistan there was great diversity of crops grown (GOP, 2011).

Extent of Soil Salinity

The good status of the land resources is an indication of its appropriate use. Thus, the extent of soil salinity was taken an indicator for measuring the environmental sustainability of the agriculture in each province.
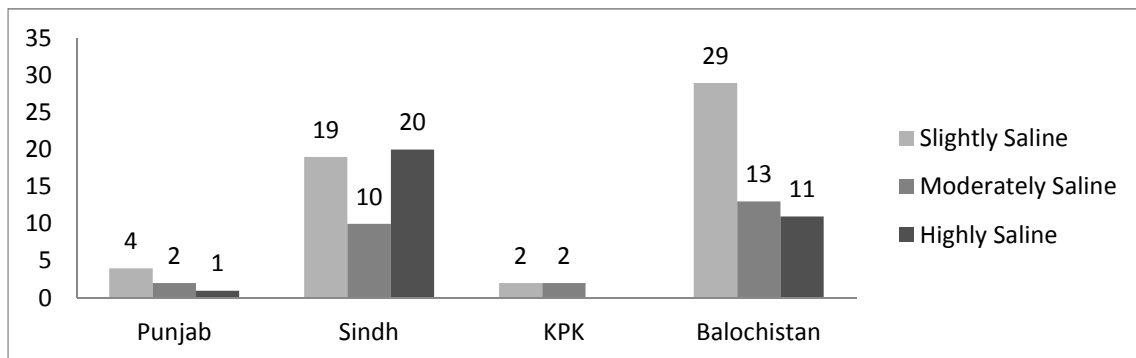
Figure 3: Surface salinity status by province for the period 2001-04

It can be deduced from the Figure 3 above that KPK was the least affected province from soil salinity problem. It was mostly because of different topographical conditions of KPK than that of other provinces. The crops grown in KPK and the lower irrigation water application along with soil nature combined together to result in lower soil salinity. The worst affected provinces were Sindh and Balochistan in terms of total percentage of agricultural area. In fact half of the soils affected by salinity were in Balochistan and Sindh province only (Khan et al., 2012).

Use of Fertilizer

In Pakistan the non-availability of organic fertilizers has forced farmers to use organic matter together with chemical fertilizers or in some cases organic matter alone. Thus, the use of organic matter was taken as an indicator for the willingness to use organic fertilizers.
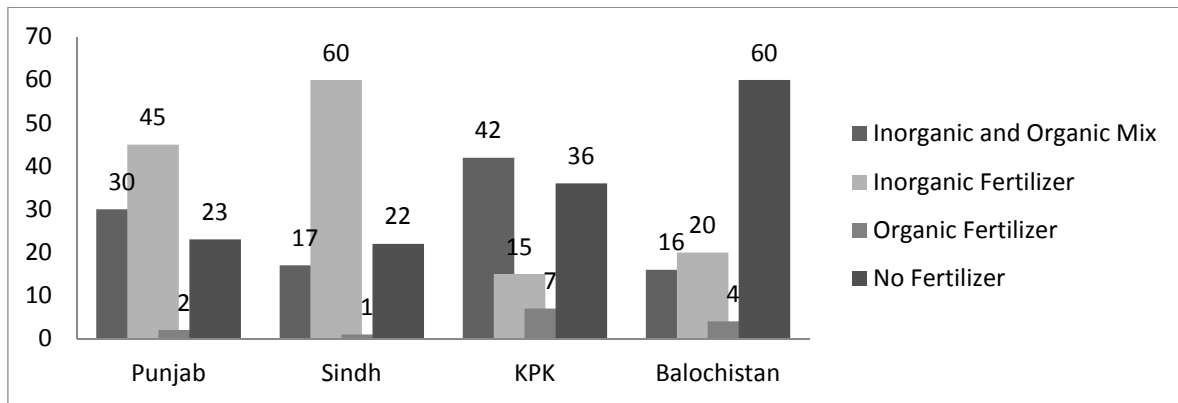
Figure 4: Percentage of total farms using fertilizers and manures in 2010

The use of organic manures was considered environmentally sustainable and KPK has the highest percentage of farms, 7 percent, using organic fertilizers only with no inorganic fertilizer use as shown in Figure 4. The low use of chemical fertilizer includes the non-availability and lack of proper know how about its usage (Khan, 2012). While, in Sindh and Punjab a majority of the farmers used inorganic fertilizers during the period under consideration. This was in-line with the high land use in these two provinces. In order to maintain such a high land use there was a need for an intensive use of chemical fertilizers.

Trend of Inorganic Fertilizer Use

The use of chemical fertilizers has proved to have many detrimental effects on environment. The trend of inorganic (chemical) fertilizer use gives an indication of the direction which agriculture is taking, whether towards or away from sustainability.
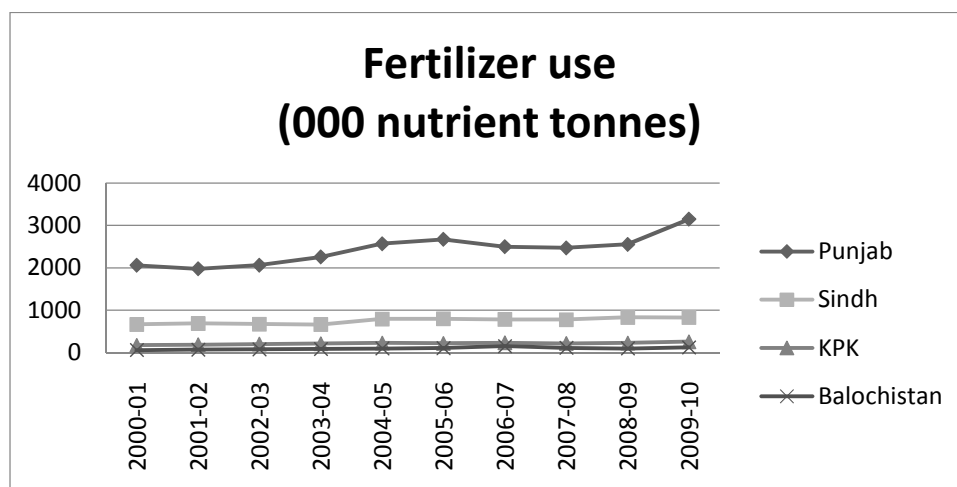
Figure 5: Trend of fertilizer consumption by province from 2000-01 to 2009-10

Although the cropped area in Punjab has not increased significantly during the period under consideration (GOP, 2011) the fertilizer use had shot up very quickly, indicating an upsurge in per hectare use of inorganic fertilizers. After Punjab, Sindh province had a smaller fertilizer use increase while KPK and Balochistan showed insignificant change in chemical fertilizer use. Thus, according to the trend in inorganic fertilizer use the order of environmental sustainability increases from Punjab to Sindh while KPK and Balochistan come in between these two provinces.

Use of Insecticides and Pesticides

The use of appropriate plant protection measures is necessary for good production. However, the nature of these measures determines the environmental sustainability of agriculture.
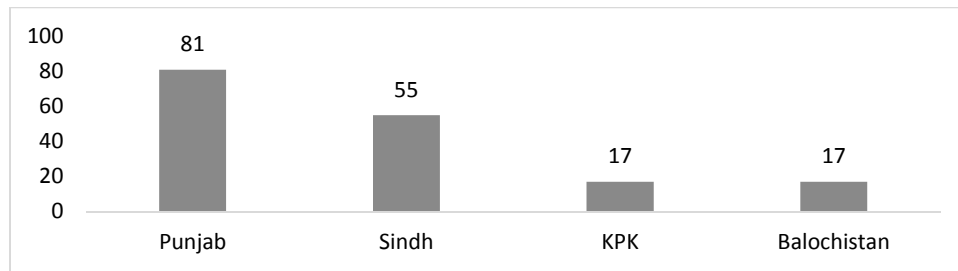
Figure 6: Percentage of total farms using insecticide, pesticide and herbicide in 2010

The use of chemicals as plant protection measures is harmful both for human health as well as to the environment (Carson, 1962; Jabbar and Mallick, 1994; Khan et al., 2011). Punjab province had the highest ratio of farms, 81% to be precise, under insecticide, pesticide and herbicide use as shown in Figure 6. Sindh province followed Punjab and had 55 percent of the farms using pesticides, insecticides and herbicides. This high level in both provinces was to maintain high level of land use as well as to control the high persistence of diseases. Thus, according to this criterion KPK and Balochistan rank highest on environmental sustainability, and also equally because these have same percentage farms, seventeen percent, under insecticide, pesticide and herbicide use. A study conducted in Balochistan also came with the same results about these chemicals; that the farmers in Balochistan use very low or no insecticides, pesticides and fungicides (Siddiqui et al., 2007).

Conclusion

The majority of farmers in all four provinces still use chemical fertilizers and pesticides indiscriminately, prefer the specialized cropping system, aspire to further intensify cropping and have large labor force in agriculture. The environmental sustainability of agriculture presented an altogether different picture across the four provinces. Punjab province had the highest land use intensity while Balochistan had exactly the opposite. Punjab province also had the highest chemical use in terms of total farms using insecticides, pesticides and herbicides as well as highest growth rate in chemical fertilizer use. These all four indicators had put the Punjab province as least sustainable in terms of environmental sustainability. Contrary to this, Balochistan had the lowest of all these four indicators along with lowest chemical fertilizer use placing it at the top of environmental sustainability among all four provinces. The other two provinces, Sindh and KPK, had mixed results in all indicators and came in between Punjab and Balochistan for environmental sustainability.

The contrasting results for environmental sustainability at the provincial level require province specific policies. In order to improve the environmental sustainability of agriculture in Punjab province there is need to diversify to more high value crops and encourage the use of organic fertilizers. For the improvement of environmental sustainability in Sindh province there is need to control soil salinity and over application of chemical fertilizer. The soil salinity control requires concerted efforts by the government to promote crops and varieties which are suitable to the arid biophysical condition of Sindh province. The biophysical conditions in KPK province are very suitable for fruits and vegetable cultivation and thus, there is need to promote their cultivation. In Balochistan and similar actions may be taken to control soil salinity as suggested for rain-fed agriculture in Sindh province. This study encourages the policy makers to embark on province specific policies for the achievement of sustainability based on diverse nature of biophysical conditions and agriculture across provinces.

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5. ANIMAL HUSBANDRY

BRUCELLOSIS IN REPUBLIC OF SRPSKA AND PREVENTIVE MEASURES

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Abstract

Brucellosis is a disease that endangers peoples health and causes enormous damage to livestock farming. This is primary animals' disease, but under certain conditions can be transmitted to humans. Researches have been done in the area of Republic of Srpska (RS) through the program of preventive health measures, 'milk chart' and animals' movement control. The paper aims at establishing the number of tainted animals in order to make proposal of measures to suppress the disease. Proposal of measures refers to veterinary and zootechnical measures in order to prevent brucellosis. The results of the study show the highest presence of brucellosis in the region of Manja a and Vlaši . Main conclusions of the work show the occurence of brucellosis in the area of Republic of Srpska and advise on measures for suppressing of this disease.

Key words: *brucellosis, Republic of Srpska, control measures.*

Introduction

Brucellosis is primary animals' disease, but under certain conditions can be transmitted to humans (Radovanovi , 1992). This disease is from the group of antropozoonose, caused by bacteria type Brucella (Lolin, 1991). Humans are infected through the contact with tainted animals or their products (Zaharija, 1978). Brucellosis is a disease that endangers peoples health and causes enormous damage to livestock farming (Tucikeši , 2008). From the wide range of zoonosis in our region, the most frequent ones are: Salmonelosis, Trichinellosis, Brucellosis and Echinococcosis. Brucellosis was not diagnosed with humans in the period between 1984-2004, whereas sporadic cases of detected disease, occurred with animals. Animals' brucellosis has increased since 2004, and along with increased number of tainted animals also occurred cases of infected humans. Epidemiological studies showed that the risk of transmitting brucellosis onto healthy animals and humans is connected to the local practise of breeding cattle, methods of milk processing, health awareness of population as well as climate conditions. Occurrence of brucellosis has great impact on livestock farming and whole industry of RS, because it causes severe damage. Agricultural production represents important branch of industry and basis for entering world market therefore establishing control over infectious diseases, brucellosis in the first place, is primary goal of administrative and professional service.

In order to put this into practise, it is necessary to identify number of tainted animals in this area and propose measures for prevention of this dangerous disease; which is the subject of this research.

Materials and methods

Resources used in this work were taken from Veterinary Institute of RS, "Dr Vaso Butozan". Analysis has been done according to Action Plan for Suppressing Brucellosis, created by the Ministry of Agriculture, Forestry and Water Management of RS. Samples for diagnosis of brucellosis are grouped in three categories:

- Program of preventive health measures;
- Milk record;

- Animals' movement control.

Within the categories of preventive health measures, there are animals' blood samples delivered from the areas where the disease was discovered, and where physical and chemical analysis were conducted to establish the number of tainted animals in the period from 2004 to 2007 for the territory of the Republic of Srpska by regions: region Manja a, region Vlaši , Grme -Potkozarje region, the region of Posavina, the region of Semberia, Drina region, the region of Srebrenica, Sarajevo Romanija region and the region of Eastern Herzegovina.

Diagnosis of brucellosis in relation to milk record issuing, refers to cattle (dairy cows), along with diagnosing tuberculosis, leucosis and mastitis where physical and chemical analysis were conducted to establish the number of tainted animals.

Samples of animals' movement control refer to animals that are transported from one municipality to the other accompanied with health certificate issued. Programme of movement control includes all herds whose owners are involved in nomadism.

Results and discussion

Results are classified in three categories: Programme of preventive health measures, check for milk record issuing and animals movement control.

Table 1. Number of animals checked within Programme of preventive health measures

Region	PROGRAMME OF MEASURES							
	SHEEP AND GOATS				CATTLE			
	Number of checked ones	%	Number of positive ones	%	Number of checked ones	%	Number of positive ones	%
Manja a	96678	54.01	4720	4.882	573	68.13	0	0
Vlaši	39691	22.17	1195	3.011	202	24.02	0	0
Potkozarje	2287	1.278	23	1.006	66	7.848	0	0
Posavina	27785	15.52	79	0.284	0	0	0	0
Podrinje	1075	0.601	0	0	0	0	0	0
Srebrenica	0	0	0	0	0	0	0	0
Sarajevsko-romanijska	1299	0.726	3	0.231	0	0	0	0
Eastern Hercegovina	10188	5.692	23	0.226	0	0	0	0
TOTAL	179003	100	6043	9.64	841	100	0	0

According to the data in table 1., in the area of the whole RS (Semberija region excluded) and within the programme of preventive health measures, the total of checked blood samples from sheep and goats was 179 003 and 841 for blood samples from cattle. The most blood samples from sheep and goats came from the area of Manja a (96 678 or 54.01%), and the smallest number of blood samples comes from the area of Podrinje (1 075 or 0.601%). Area of Srebrenica did not deliver blood samples form sheep and goats. The largest number of samples from cattle (573, i.e. 68.13%) came from the area of Manja a, and the smallest number of samples (66, i.e. 7.848%) came from the area of Potkozarje. Areas of Posavina, Podrinje, Srebrenica, Sarajevo-Romanija and Isto na Herzegovina (Eastern Herzegovina) did not deliver cattle blood samples. Within the programme of preventive health measures, 6043 positive blood samples from sheep and goats have been discovered whereas there were no positive samples from cattle. The largest number of positive blood samples (4720, i.e. 4,882% from total number of samples checked in that region) comes from Manja a, and the smallest number of positive blood samples comes from Sarajevo-Romanija region (3 samples, i.e. 0,231% from total number of samples checked in that region). There were no positive blood samples from sheep and goats in the region of Podrinje.

Table 2. Number of dairy cattle checked for brucellosis

MLK RECORD				
CATTLE				
Region	Number of checked ones	%	Number of positive ones	%
Manja a	3550	12.49	0	0
Vlaši	4205	14.8	10	0.238
Potkozarje	10370	36.49	3	0.029
Posavina	8697	30.6	0	0
Podrinje	103	0.362	0	0
Srebrenica	61	0.215	0	0
Sarajevsko-romanijska	11	0.039	0	0
East Hercegovina	1424	5.01	0	0
TOTAL	28421	100	13	0.267

According to the data in table 2., in the area of the whole RS (region of Semberija excluded) and within the check for milk record issuing, the total of checked blood samples from cattle was 28 421. The most blood samples came from the area of Potkozarje (10 370 or 36.49%), and the smallest number of blood samples comes from the area of Sarajevo-Romanija (11 or 0.039%). The largest number of positive samples (10, i.e. 0.238% from the total number of checked samples from that region) comes from the area of Vlaši , and the smallest number of checked blood samples comes from Potkozarje (3 samples, i.e. 0.029% from total number of samples checked in that region). There were no positive blood samples from cattle in the region of Manja a, Posavina, Podrinje, Srebrenica, Sarajevo-Romanija and Isto na Herzegovina (Eastern Herzegovina).

Table 3. Number of animals checked for brucellosis within the programme of movement control

MOVEMENT CONTROL								
Region	SHEEP AND GOATS				CATTLE			
	Number of checked ones	%	Number of positive ones	%	Number of checked ones	%	Number of positive ones	%
Manja a	6766	31.6	50	0.739	1186	17.34	15	1.265
Vlaši	1779	8.309	6	0.337	679	9.928	0	0
Potkozarje	2163	10.1	21	0.971	2746	40.15	1	0.036
Posavina	5380	25.13	11	0.204	1187	17.36	0	0
Podrinje	690	3.223	0	0	251	3.67	0	0
Srebrenica	3738	17.46	381	10.19	169	2.471	21	12.43
Sarajevsko-romanijska	199	0.929	0	0	21	0.307	0	0
Isto na Hercegovina	696	3.251	35	5.029	600	8.773	0	0
TOTAL	21411	100	504	17.47	6839	100	37	13.73

According to the data in table 3., in the area of the whole RS (region of Semberija excluded) and within the programme of animals' movement control, the total of checked blood samples from sheep and goats was 21 411 and 6 839 from blood samples of cattle. The most blood samples came from the area of Manja a (6 766 or 31.60%), and the smallest number of blood samples comes from the area of Sarajevo-Romanija (199 or 0,929%). The largest number of positive samples from cattle (2 746, i.e. 40.15%) comes from the area of Potkozarje, and the smallest number of checked blood samples comes from the area of Sarajevo-Romanija (21

samples, i.e. 0.307%). Within the programme of measures, 504 positive blood samples from sheep and goats have been discovered and 37 positive blood samples from cattle. The largest number of positive blood samples from sheep and goat (381, i.e. 10.19% from total number of samples checked in that region) comes from region of Srebrenica, and the smallest number of positive blood samples comes from Vlaši (6 samples, i.e. 0.337% from total number of samples checked in that region). There were no positive blood samples from sheep and goats in the Sarajevo-Romanija and Podrinje region. The largest number of positive blood samples from cattle (21, i.e. 12.43% from total number of samples checked in that region) comes from region of Srebrenica, and the smallest number of positive blood samples comes from Potkozarje (1 sample, i.e. 0.036% from total number of samples checked in that region). There were no positive blood samples from cattle in the region of Vlaši , Posavina, Podrinje, Sarajevo-Romanija and Isto na Herzegovina (Eastern Herzegovina).

On the basis of data analysis related to regions in the whole RS, the following can be discussed: the majority of blood samples, from sheep and goats, checked within the programme of preventive health measures, come from the regions of Manja a and Vlaši , where sheep farming is not main industry. Other regions delivered significantly small number of samples; the largest number of cattle blood samples checked, within the programme of preventive health measures, comes from the area of Manja a. There were no positive blood samples from cattle in the region of Posavina, Podrinje, Srebrenica, Sarajevo-Romanija and Isto na Herzegovina (Eastern Herzegovina); the majority of cattle blood samples checked for milk record issuing, come from the regions of Potkozarje. Other regions delivered significantly small number of samples; the largest number of checked blood samples from sheep and goats, within the programme of movement control, comes from the area of Manja a. Other regions delivered significantly small number of samples; the largest number of cattle blood samples checked, within the programme of movement control, comes from the region of Potkozarje.

Brucellosis preventive measures

This work proposes the following: Veterinary-sanitary measures and zootechnical measures for brucellosis prevention.

Veterinary-sanitary measures

In the following period it is necessary to conduct diagnosis with all available animals in the whole area of RS and to eliminate all detected disease sources. All newly discovered and current disease sources have to undergo diagnostic inspections until all positive reagents are eliminated and kept under control. It is necessary to establish diagnostic inspection with humans in cooperation with health service along with animals' diagnostic inspection. Special attention has to be paid to the high-risk category of population (cattle-breeders, veterinary staff and butchers). After detection of positive cases and new disease sources, it is necessary to conduct diagnostic inspection with animals in the wider area to establish disease spreading level. Animals' movement control is essential in general, and especially in the areas marked as high-risk (Manja a, Vlaši).

Zootechnical measures for brucellosis prevention

In the following period, it is necessary to work on supplying food and shelter for sheep in the winter along with buying up of excessive sheep. It would result in keeping the herds in the areas they start nomadic activities from and reducing their movement. When supplying food for winter is in question, bulky food should be provided first (hay) and then some alternative food should be provided in the future (silage). Buying of bulky food can be organized through producers association and help from municipalities. Wheat based food should be provided apart from bulky food.

Regardless the fact that 'Pramenka' is resistant type of sheep, it is necessary to provide them

with shelter for protection during winter and low temperatures. Areas of Vlaši and Manja a do not have enough shelters for sheep. It refers to the farmers who breed large sheep herds and who did not build bigger shelters due to the lack of financial means or habits and traditions. This deficiency must be corrected in the future period through building cheap shelters from woods in the first place.

Second issue that has to be addressed is market excess that occurs in certain periods. It is important to explore possibilities of state support to farmers for solving problems of excess of animals, especially in new, changed conditions for breeding sheep. If we set the issues in this manner and offer proper solutions, then we will be solving the position of all sheep breeders in the same manner, regardless the fact whether they have chosen stationary or nomadic way of keeping and breeding sheep.

Occurrence of brucellosis and its prevention imposes the need for change of current grazing system. One of the main measures for brucellosis prevention is eliminating possibility of mixing of herds at the same pasture. Areas where sheep are kept mainly at sheep breeders' land, sheep grazing and food preparation can be organized within personal resources. The breeders whose land capacities cannot provide enough grazing and food preparation, and number of sheep in the herd is not large, it is necessary to turn to agrotechnical measures. Aiming at increase of grass yield at pastures, some synthetic fertilizers should be applied or pasture botanical composition should be improved. For all sheep breeders who have larger number of sheep in their herds, but do not have their own capacities enough for animal feed and can not provide grazing at their own land, it is necessary to provide help through allotting areas for grazing. If it is not possible to allot the land for grazing, it is necessary to offer alternative profession in order to preserve rural areas and communities.

Areas that will need support from the state regarding change of habits of cattle breeders within new circumstances are: Sarajevo-Romanija, Isto na Herzegovina (Eastern Herzegovina), Vlaši and Manja a. Organisation of pasturing should not be a big issue in the areas of: Grme -Potkozarje, Posavina, Semberija, Podrinje and Srebrenica. Average herd size, according to the assessment at the above named areas, does not cross adequate numbers of sheep, where the proper pasturing would not be possible to apply. Larger number of sheep and stationary breeding is typical for the area of Sarajevo-Romanija. Local authorities of agriculture association should make a plan of pasturing at their area. Municipalities of Han Pijesak and Sokolac have enough space for pasturing sheep, therefore a good plan of herd movement can prevent mixing of herds. Area of Romanija, especially in the municipalities of Han Pijesak and Sokolac, where the size and number of herds are larger, can become a problem in the effort of providing proper pasturing, but with good plan of pasturing and cooperation of sheep breeders, this problem can be resolved. The most critical areas for introducing planned pasturing are areas of Vlaši, Manja a and Isto na Herzegovina (Eastern Herzegovina). Larger herds and larger number of sheep in the field cause problem of organizing pasturing, which is typical for the areas of Vlaši and Manja a. Solving of this problem must involve municipalities and agriculture associations as well as the state. Isto na Herzegovina (Eastern Herzegovina) is rich with pastures, which makes organizing pasturing easier, but it has specific climate conditions compared to the other parts of RS. At the end of spring and at the beginning of summer, when period of drought comes, and when pastures are poor, sheep breeders go to northern parts to mountain pastures. Solving problems of sheep pasturing in Isto na Herzegovina (Eastern Herzegovina) and making plans for the same should involve municipality bodies and agriculture producers' associations.

Conclusion

The whole area of RS has animals' brucellosis registered, where the frequency of this occurrence is very different around areas. Analysis of data showed that main areas where brucellosis is present are: Vlaši and Manja a, which is logical, because these are traditionally sheep breeding areas. Other areas suffer from smaller number of cases where

disease occurred, and in some regions it has not been discovered. Taking into consideration all the facts so far, it is clear that areas for further fight against brucellosis are Vlaši and Manja a, but other regions should not be neglected. In the future period, special attention should be paid to animals' movement control in order to put the danger of disease transmission under control. Methods for protection from brucellosis should be applied also, that were elaborated in this work.

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QUALITY OF PORK CARCASS ON THE SLAUGHTER LINE IN MINI SLAUGHTERHOUSES

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Abstract

The quality of slaughter pigs in terms of meat content is assessed by taking certain measures in one or both carcass, cutting of or measuring the finest particles, determining the content of certain tissues and quantitative relationships meat-fat. Research is carried out in mini slaughterhouse "Dim Dim" Trn, Laktaši. Total of 38 finishing pigs was taken from the municipality Laktaši, Republic of Serbian. Performed the basic measures of the quality of carcasses, live weight of pigs, hot carcass weight with head and warm carcass without the head mass, the weight of pork head, pork fat, weight of offal and mass of pig waste. The average mass of warm carcass with the head was 74.95 kg, while the average weight of hot carcass without the head was 69.54 kg. The share of the head of the pig relative to the total weight amounted to 5.41%, in relation to the weight of the head on the warm carcasses 7.2% The share of abdominal fat was 1.37% based on the total live weight, 1.83 % based on mass of warm carcasses with the head and 1.97% by weight of hot carcass without the head. From the data presented it can be concluded that in the Republic of Serbian mini slaughterhouses are not implemented EUROP standards on the quality of pig carcasses as regulated in the European Union where they pigs for slaughter have live scales of 125 kg, with an average mass of warm carcass of 93 kg.

Key words: *pig, mini slaughterhouse, hot carcass weight, slaughter indicators, EUROP standards*

Introduction

Production and quality of finishing pigs depends on many factors. The most important factors that influence the quantity and quality of fattening pigs are genetically and abiotic (race, fathers, breeding methods, age, weight throat, gender, neutering, feeding, slaughtering procedures during slaughter and after slaughter). Most important genetic factor is race, and the par genetic factor is nutrition and great role play a stress during transport and slaughter process. It is very important to reduce stress situations and to get the best quality meat, which is manifested by changing properties of meat designated as pale, soft and exudative (BMW) meat (Rudolf and Petrovich, 1997). Important role in the carcass quality have a selective method. The coefficient of heritability for fattening pig breeds is medium to high. They are for the same type vary between breeds, methods of evaluation, throat sex, group selection, feeding system. Carcass quality can be assessed using dissection (Walstra and Merkus, 1996). Radovanovic (2001) states that the for determination of carcass meat yield may use different electron-optical devices, such as FOM (Fat-O-Meter), HGP/S-4 (Hennessy Grasing Probe System), PCC (Pork Classification Center) and lately VIS 1000 (Pork Vision System), FOM AUTO (Automatic Fat-O-Meter) and others. In European countries with advanced breeding pigs for the first standards for evaluating the quality of carcass are defined in the late sixties of the last century (Petrovi et. al. 2009). In 1970 in Germany and Holland was introduced the first standard for carcasses quality, which included hot carcass weight, thickness of the adipose tissue of the back acts measured at two measuring points, as well as evaluating the type and conformation of the carcass (Petrovic et al. 2009). Improvement of the standard in

1985 was drafted legislation (Commision Regulation (EEC) NO. 2967/85) which was in force until 1989, when after that adopt Europe Standard (Jotanovi et al. 2011). The aim of this study is to show the quality parameters of fattening pigs at the slaughter that is recorded in the mini slaughterhouse, to get the review in which condition are the mini slaughterhouse. The obtained data point out mini slaughterhouse and compare them with other modern slaughterhouses.

Materials and methods

The research was carried out at the slaughterhouse "DIM-DIM" Klašnice, Trn, during June and July 2009. Total 38 fattening pigs was included of both sexes and body weight between 90-105 kg, with different genotype formed between breed of Landrace, Pietrain, Yorkshire and Hampshire hybrids. The pigs originating from farms from around Ljev a fields of municipalities Laktaši. After slaughter, evisceration and cutting carcasses on the slaughter line, the following parameters of quality are: live body weight, hot carcass weight with head mass, warm carcass without the head, the weight of pork head, pork fat, offal weight and mass of pig waste. To determine the live weight of porkers is used mechanical scales in the terminal (waiting boxes for pigs), to determine the mass of warm carcass and other parameters was used electronic scale on the slaughter line. During research, data and protocol from slaughterhouse "DIM-DIM" Klasnic, Laktaši was used. It was used official and internal records. The data on the value of the quality parameters are presented in tables.

Results and discussion

In most countries of the European Union (EU) meat quality by the end of the twenties is based on the measurement of backfat thickness. According to Pedersen (1988) basis for this method is the high correlation ($r = -0.75$) between backfat thickness and meat percentage in the carcass. An evaluation of carcass quality is assessed and the total work in the field of genetics, selection, nutrition, reproduction and health. Quantitative and qualitative characteristics of pigs depend on the selection method. Requirements for work on genetic improvement of the quality of pig's are knowledge of the variability of production traits of breeding animals. For this purpose, we used tests and recorded for all of the properties in respect of which the selection is carried out. All data collected on the farm should be explained with slaughterhouse data. In this case, can be obtained complete data on production characteristics and breeding stock selection effect will be much higher, which is the right way to improve pig production. Assess the quality of a pig on the slaughter line is necessary without which can not imagine progress in pig production (Radovi et al. 2003). As part of research into mini slaughterhouse was taken and analyzed 38 fattening pigs, originating from the municipality Laktaši. For slaughter redeem meaty pigs: Landrace, Pietrain, Yorkshire, Hampshire and hybrids formed between these breeds or animals in the type of some of these races. The main objective of the slaughterhouse is to find on the market very quality finishing pigs, with low fat.

Table 1. Slaughter data of porkers from mini slaughterhouse "DIM-DIM" Klašnice-Laktaši

Slaughter measures	Total (kg)	Average value (kg)	Participation in relation to the total mass (%)
Body weight	3784	99.58	100
Mass of warm carcass with head	2848	74.95	75.26
Mass of warm carcass without had	2643	69.54	69.84
Head	205	5.38	5.42
Abdominal fat	52	1.37	1.37

From the data of table 1 shows that the total live weight of fattening pigs (38) was 3784 kg average weight was 99.58 kg. The total mass of warm carcass with head was 2848 kg, with an average weight of 74.95 kg or 75.26 % participation of the total mass. The total mass of hot carcass without head is 2643 kg, the average weight was 69.54 kg and 69.84 % of the total weight. The total mass of pig head was 205 kg, an average of 5.38 kg and 52 kg was fat and an average of 1.37 kg. Pig's head in proportion to the total amount is 5.42 mass % relative to the weight of the head on the warm carcasses 7.2 %, while abdominal fat proportion was 1.37 % based on the total live weight, 1.83 % of hot carcass weight to the head, and 1.97 % by weight of hot carcass without the head.

Comparing these data with research Jotanovi et al. (2009) shows that the average mass of warm carcass with head lower by 3.35 kg (78.30:74.95). Comparisons are based on the monitoring data of pigs purchased from ex-intensive system (sub-contractors). The pigs from intensive system were from farm "Top Farm" Nova Topola, Gradiska hybrids imported from the Netherlands with an average body weight of 103.56 to 110.50 kg and an average hot carcass weight of 84.70 kg, the thickness of the dorsal bacon with 8.26 mm. The pigs from half-intensive that originate from two pig farms (Brcko District and Nova Topola) have average of hot carcass weight 85.02 kg and average backfat thickness 6.14 mm. From ex-intensive system were bought fattened pigs for small producers (with weak internal data) with an average hot carcass weight 78.30 kg and average of backfat thickness 30.23 mm. Research Stojanovski et al. (2011) suggest that the average weight of Landrace pigs before slaughter were 94.97, a mass of warm carcass with head 70.95. The values obtained are lower than our results. While research Prevolnik et al. (2012) are very different from our results, they have progeny pigs from Landrace $\times$ Large White $\times$ Landrace dams and Pietrain sires (free of the RYR1 gene). They have mass of warm carcass without had 82.20 kg while backfat thickness were 17.2 mm.

Table 2. Collective data of the internal organs from mini slaughterhouse "DIM-DIM", Klašnice-Laktaši

Intestines parameters	Total (kg)	Average value in relation to the number of livestock fattening pigs (kg)	Participation in a percentage relative to the total weight of the intestines (%)
Kidneys	8	0.21	4.8
Language	12	0.31	7.2
Heart	15	0.39	9.1
Liver	57	1.50	34.50
Lung	36	0.94	21.70
Esophagus	12	0.31	7.20
Stomach	20	0.52	12.10
Spleen	5.70	0.15	3.40
Total	165.70	4.36	100

Table 2 gives an overview of the total mass of the internal organs in individually, as well as their average weight. It is observed that the intestines of waste have average 4.36 kg, most of that is on the liver 1.5 kg and lowest in the spleen 0.94 kg.

Table 3. Collective date of slaughterhouse waste from slaughterhouse "DIM-DIM" Klašnice-Laktaši

Sample made at 38 porkers	Total (38)	Average value (kg)	Participation in percentages (%)
Blood, brain, spinal cord, hair, hoofs, intestinal with contents	718.30	19.90	19.03

For evaluation of fattening pigs are taken as a measure: hot carcass weight and fat thickness measured in two part. Based on these criteria using a table determines the amount of meat in the carcass. Fleshy pigs have summation of back fat thickness from 30 to 105 mm, a fatty pigs of 75 to 150 mm. American standards on classifications of pork carcasses provide the following categories: young pigs, sows, barrows and boars (Rudolf and Petrovi , 1997). For the meat of young pigs and sows provided five classes: 1, 2, 3, middle and poor. Each class is given a description of certain tissues (muscle, fat, bone), a description of the conformation of the carcasses and certain parts.

According to the latest EU regulations in pork carcasses shall be classified in the class by the percentage of meat. Carcasses of young pig slaughter weight from 50 to 120 kg are classified into the following classes:

E   » 55 %; U   50-55 %; R   45-50 %; O   40-45 %; P   « 40 %.

Appropriate to modern requirements in terms of quality, it is understandable that in practice countries, especially those with traditionally developed in livestock and meat production, there is a need to be in another production process as soon as possible, anticipate and determine the quality of carcass, or carcass. Results of these requirements, especially multidisciplinary approach to the issue, the modern methods and highly complex technical solutions with applications to the measurement of selected indicators of quality, process and record the data obtained accurately determine objectively differentiate the quality, value and class of carcass /carcasses in primary production (in-vivo), and on the slaughter line.

If you look closely the situation in agriculture of the Republic of Serbian (RS) at its branches, now you see that pig production in RS is not organized and is not integrated. In such circumstances, pig producers and manufacturing companies are independent and do not have a common interest. The meat industry is faced with poor carcasses quality and weakened quality of meat but do not participate in solving this problem. On the slaughter does not apply Europe Standard, in the years when the high demand and small supply pays a high price per 1 kg of live weight of non-performing pigs which discourages good producers.

The problem would be solved by adopting a definition of what it fattened pig with both desirable properties quantitatively (% lean meat) and qualitative (sensory and technological properties). The adoption of criteria and methods for classification pigs carcass in class, they could form a proper price carcasses of different quality.

Conclusion

Based on the presented results and discussions can be determined the following results:

1. The average value of the live weight of slaughtered fattening pigs was 99.58 kg;

2. The average value of warm carcass with the head was 74.95 kg and 69.54 kg without a head;

3. Average weight of abdominal fat was 1.37 kg;

4. The highest percentage of internal organs in relation to the total weight of the intestines was with liver and was 34.50% and the lowest in the spleen 3.4%;

5. Summary data slaughterhouse waste (blood, brain, spinal cord, hair, hooves, intestinal contents) was 19,03%.

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COURSE DELIVERY (PARTURITION) COWS ON THE BEEF FARM „GRCIC " IN THE EXTENSIVE FARMING

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Abstract

Duration of pregnancy is biologically determined at cows and its amount of nine months. On vary of gestation influences: maternal factors, fetal factors, genetic factors and environmental factors. Since pregnancy and partus are very complex physiological processes as opposed to the extensive in intensive applied their artificial control that can be taken only if they known the short and long term consequences for the mother and fetus, which may result from the applied treatments. In the extensive production on the farm "Grcic" is represented the natural course a cow giving birth, without control of the owner and veterinarian. On the contraction of miometrium acts oxytocin, all this resulting in the pressure of the fetus on the cervix and the vagina, causing a so-called Ferguson reflex further secretion of oxytocin and the contraction of the abdominal muscles. This created the conditions for the start of extrusion of the fetus. The course delivery can be divided into three more or less clearly separated stages: (1) a preparatory stage, (2) the stage of fetal desplacement, and (3) the stage of displacement fetal membranes and fluids.

Keywords: *cow, delivery, extensive production*

Introduction

The farm of beef cattle „Grcic"from Drnis (Republic of Croatia) produces beef cattle (Angus breed). Extensive production of this farm is based on protection of nature, animal welfare and leads to organic production. Grazing cattle, method of holding, reproduction, and location of residence of cattle in a natural environment on a small Promina. The farm has a total of 80 Angus beef cattle and three bulls to get their offspring. Act of breeding on the farm occurs in a nature without control measures. Course delivery (parturition) the cow's takes place in a completely natural way. The only protective measure to be applied during pregnancy, parturition and during the first days of life the youth, is protection against wolves attacks.

Literature review

Delivery

Physiological process by which, the gravid uterus pushing out fetus, fetal membrane, and fluids is called delivery (partus). Onset of delivery is preceded by the appearance of very specific physiological and behavioral changes of pregnant animals (Stancic et al., 2002). A few days before delivery vulva swell increases and become hyperemic, and from it is dripping mucous liquid (Peters et al., 1987). There is wetted (serous infiltration) arch ligaments of the pelvis (lig. scrospinosa ol. sacrotuberosa), as well as cartilaginous part of the symphysis pelvis. Relaxation mentioned ligaments, as well as consequences of their wetted, resulting in the appearance of dents pelvic arch with left and right side of the root tail. Shortly before delivery begins the activity of secretor epithelium of the mammary gland, which is in gestation subjected to the process of hypertrophy (Geoffrey, 1975). Before delivery can be observed changes in the behavior of pregnant animal. She became restless, exhibit in

appetence or completely refusing food, and often sounds like. These changes indicate an imminent start of delivery, and there is result of specific and complex neuron-hormonal and mechanical events (First, 1970).

Start of delivery

Start of delivery is regulated by the interaction of complex neuron-endocrine and mechanical factors on relation mother-fetus (Gordon, 1997). There are several theories about the mechanisms that cause start of delivery, but today the most acceptable one that says that the initial stimulus for initiation of the mechanism of labor is derived from fetuses (Bazer and First, 1983). Hippocrates claimed that the fetus at a certain point, corrects its legs and pressure uterus, how to cause birth contractions (Geoffrey, 1979). Embryonic mortality increases after the fertilization, but it is proportional to the highest between 15th and 18th days of gestation, whereas the post implant period until the normal calving is 5 to 8% (Sreenan et al., 1986).

Course delivery

Course delivery can be divided into three stages: the preparatory stage, stage of fetal extrusion of fruit and stage of fetal extrusion membranes and fluids (Hafez, 1974). Duration of individual stages differs in certain domestic animals, but the stage of extrusion of the fetus, under normal circumstances, in all species is the shortest.

The preparatory stage

During this stage there are some changes, which are representing necessary preparation for extrusion the fetus. Uterus, who is up to this moment rested, begins the accumulation of large amounts of energy substances, and greatly increases the amount of actomiozon, proteins of the contractile smooth muscle fibers miometriuma. In this way, the uterus provides the necessary sources of energy and proteins for extrusion of fetus (Hafez, 1974). This stage is called the stage of opening, because in this period of time by expanding of soft tissues and bone basic of the birth canal. Stars and coordinated contractions of uterus, which resulting in fetal membranes injecting the liquid into the cervical canal, which performs its spreading and opening. During this stage of the contraction of the uterus only manifested, and the distance between them is longer than the distance between the individual stages of the uterine contractions during the extrusion of the fetus. Uterine contractions cause some pain, which called labor (Dolores praeparantes). Contraction of the abdominal muscles (so-called abdominal presa) is not observed during the preparatory stage. At the end of this stage the cervix has fully expanded, and the uterus, cervix and vulva comprises a unique channel. Fetus membranes are embedded in the lap of birth canal, which burst, and fetal fluid stresses through vulva in the outer environment.

Stage of extrusion of fetus

This stage occurs shortly after preparatory. Then the head and the part of front and hind limbs, wrapped in the amnion, impact in the birth canal. During this stage the contractions of the uterus are the most common and the most powerful. This stage lasts at least in relation to the first and the last stage of labor.

Stage extrusion of the placenta

At this stage of contraction of the abdominal muscles gradually calm, as well as contraction of the uterus, but the later still sufficiently strong and frequent, to could throw out the remaining parts of placenta and amniotic fluid. Peristaltic contractions of the uterine horns,

which start from the tips of horns, pushing out the placenta in the inverted position. As the inner side of the placenta, which is now outside and sits on the walls of the birth canal, smooth and slimy, this allows it's easier to extrusion.

Puerperium

Puerperium is the period between the end of the extrusion of the placenta and the moment when the mother's body, in histological, morphological, psychological, and psychological terms, reaches the state it was in prior to establishing a pregnancy (Hafez, 1974). The most important changes that occur during the puerperium are regeneration of ondometriuma, uterine involution, and re-establishment of the estrous cycle. The first ovulation and estrus at cows occurs in 15 to 16 days after calving (Petrovic, 1976).

Conclusion

On the farm „Grcic"parturition of cows takes place without complications, in a natural way. Insemination of cows performed three bulls with good genetic characteristics, health status, individual characteristics, well kept and well fed, and the farm has a healthy offspring. Losses occur due to wolf attacks, and major complications during parturition were not observed (Grcic, 2013).

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MONITORING QUALITY OF HAY ON FARMS FOR MILK PRODUCTION IN NORTHERN BOSNIA AND HERZEGOVINA

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Abstract

The goal of the research was to monitor the quality of hay on farms in the period from 2008. to 2012. year, and to compare the quality of hay by years of research. The analyzed samples of hay from 41 farms are from low to medium quality (low protein content, high cellulose content, low content of mineral matter), probably mowed in later stages of development of lawn maturity than recommended for the production of high quality hay to feed dairy cows. The medium value of crude protein by years of research is in 2008 – 15.62 %, 2010 – 9.39 % and in 2012th was 11.57 %. The low level of protein indicates a bad choice of grass and clover-grass mixture for sowing and preparation at a later stage of grass and mixture growth. Minimum content of crude protein is 4.54 %, maximum is 18.56 %. The medium value of crude cellulose by years of research is in 2008th 41.49 %, 2010 – 43.82 % and in 2012 – 43.13 %. The high content of cellulose is an indicator of preparation of hay in later stage of grass and mixture growth. Minimum content of crude cellulose is 25.24 %, maximum is 66.07 %. Moisture content, the medium value by years of the research is in 2008 – 85.58 %, 2010 – 86.40 % and in the 2012 – 86.58 %. The medium value of mineral matter by years of research is in 2008th 2.7 %, 2010 – 2.11 and in 2012 – 2.07 %.

Key words: *hay, protein, cellulose, moisture, mineral matter*

Introduction

High milk production can only be achieved with quality livestock forage because the type and quality of forage affect the quantity and composition of milk (Caput, 1996).

Hay is characterized by low concentrations of digestible nutrients and a large amount of ballast that make indigestible organic matter (Kalivoda, 1990).

Hay can be visually evaluated taking in account the stage of maturity at the time of mowing, the purity of color and scent. Chemical parameters associated with the consumption and quality of hay are energy value of feed (Bll et al., 2002), fiber content, protein and dry matter (Cherney and Martens, 1998).

There are many factors that determine the quality of hay (species and varieties of grasses and / or legumes, soil fertility, climate, season, relation of stems and leaves, thickness of stems, weeds, weather conditions at harvest, storage technologies and storage), but the most important factor is the stage of maturity of grass / legume at the time of mowing. Delaying the harvest time from the vegetative stages of development of grasses and legumes to reproductive (seed formation) is increasing cellulose content and reducing protein content, digestibility and forage intake.

According to Hoveland et al. (1997) delaying of lawn mowing for four weeks, in the hay is reduced the protein content for 4 to 6%, and digestibility of organic matter in the dry matter for 13%.

The forage quality decline by delaying of mowing time has been connected with an increased proportion of lignin and structural parts of wall of the cell, or reduction in content of protein and digestible parts of the plant cell, such as starch (Aman and Lindgren, 1983)

In the vegetative stage of plant development, leaf share is larger than the stem share, while the aging of turf reduces the share of leaf, and relatively increases proportion of stems, ie. the amount of crude protein decreases and the amount of crude fiber is increasing (Di Marco et al., 2002).

The average cow can eat easily (if fed only with hay):

- About 12 kg of low quality hay from which, with surviving needs, she gets 2.2 liter of milk;
- About 15 kg of high quality hay from which, with surviving needs, she gets 15.3 liters of milk.

Increasing of cellulose amounts affects digestibility of feed, energy content and potential consumption decreases, which directly affects the production of milk. In parallel with the quality decrease, digestibility of feed and drinking at will reduces, so it is necessary to provide nutrition with other fodder in order to meet the nutritional needs of highly productive animals.

Hay production prevails in the preparation of forage feed from the lawn. Production of alfalfa hay is conditioned by the impossibility of alfalfa production on acid soils that dominate in this area. As a possible solution it is found the production of red clover, which tolerates better acid soils than alfalfa.

One of the problems is applied agro-technique measurements on artificial meadows and pastures. When establishing meadows and pastures most farmers performs spring sowing, without plowing of fertilizer, and also the usage of manure is reduced. All these factors are leading to low yields of green mass and hay as well as the poor quality of the produced animal feed.

The introduction of new forage crops such as field peas, beans and other legumes goes very difficult. Lolium (ryegrass) is predominant grass.

Production of clover-grass mixtures happens on small surfaces. Main reason for low production of clover-grass mixtures is lack of production technology. Most farmers highlight problems of maturing grass and clover in a different period, which creates a dilemma about mowing time. Regardless such opinion of farmers, preparation of hay is done in the later growth stages for reasons of higher yields, because farmers from BiH have prevailing opinion that more important is forage yield, not quality. Number of cuts is two to three per year, which is, as compared to some neighboring countries, very low number. In order to improve this aspect of forage production, a number of experiments have been done for production of red clover and the clover-grass mixtures.

Materials and Methods

The survey included hay samples from 30 farms. The surveyed farms have more than 10 dairy cows. Samples were analyzed by the Agricultural Institute of Una-Sana Canton.

The chemical quality of the hay samples was determined by following methods:

-        Protein (nitrogen) - (sample preparation, digestion, distillation, titration), apparatus by Kjeldhal procedure;
-        Cellulose- manufacturer's method (VELP) – cellulose extractor;
-        Humidity (dry matter) - automatic moisture device (Ohaus);
-        Minerals- method of burning and annealing (burner and furnace annealing).

Based on the results of analysis, consultants from the Republika of Srpska Extension Services Agency, Agricultural Institute of Una-Sana Canton and Agricultural Institute of Tuzla Canton, developed recommendations on the hey feeding procedure for dairy cows.

Data were analyzed using SPSS 12 statistical program.

Results and Discussion

Table 1. The crude protein content (%)

	2008	2010	2012
min	11,62	5,52	4,54
max	18,43	15,83	18,56
Average	15,624	9,389	11,57

Table 2. F – test of crude protein content

DEVIATION			d.f.	Variation	Analysis			
					F		d.f.	
Source of Variation	Amount	%			Calc.	Tab.	More	Less
Between mean treatments	560,5658	42,82	2	280,2829	30,32361	3,15	2	81
Residual or sample errors	748,69	57,18	81	9,24306				
Total	1.309,25	100	83					

Statistically there is a significant difference in the content of crude protein by years of research, and as a major factor in the differences of crude protein are agro climatic conditions of production. Results show a high average content of crude protein in tested of hay samples from 4.54 % to 18.56 %.

Table 3. Crude cellulose content (%)

	2008	2010	2012
min	38,54	25,24	29,17
max	45,87	66,07	64,96
Average	41,49	43,82	43,13

Table 4. F – test of crude cellulose content

DEVIATION			d.f.	Variation	Analysis			
					F		d.f.	
Source of Variation	Amount	%			Calc.	Tab.	More	Less
Between mean treatments	80,1434	1,65	2	40,0717	0,681837	3,15	2	81
Residual or sample errors	4.763,53	98,35	81	58,80898				
Total	4.843,67	100	83					

Results show a high average content of cellulose in tested of hay samples from 25.24 % to 66.07 %. The cause of the high content of cellulose of the prepared silage is agro-climatic conditions of production. Statistically, there is a significant difference in terms of cellulose content by years of research.

Table 5. The moisture content

	2008	2010	2012
min	13,02	9,6	8,26
max	16,45	25,85	17,89
Average	14,42	13,6	13,42

Table 6. F – test of moisture content

					Analysis			
DEVIATION			d.f.	Variation	F		d.f.	
Source of Variation	Amount	%			Calc.	Tab.	More	Less
Between mean treatments	15,91695	3,62	2	7,958475	1,522266	3,15	2	81
Residual or sample errors	423,4718	96,38	81	5,228046				
Total	439,3887	100	83					

The fortified average moisture content ranged from 8.26% to 25.85 %. It is not noticed a statistically significant difference in moisture content.

Table 7. The mineral matter content

	2008	2010	2012
min	1,83	0,93	1,27
max	3,87	3,56	3,87
Average *Prosjek*	2,7	2,11	2,07

Table 8. F – test of mineral matter content

					Analysis			
DEVIATION			d.f.	Variation	F		d.f.	
Source of Variation	Amount	%			Calc.	Tab.	More	Less
Between mean treatments	6,965193	21,59	2	3,482596	11,14933	3,15	2	81
Residual or sample errors	25,3011	78,41	81	0,312359				
Total	32,26629	100	83					

The determined average mineral matter content from 0.93% to 3.87% .

Conclusion

The analyzed samples of hay from 41 farms are from low to medium quality (low protein content, high cellulose content, low content of mineral matter), probably mowed in later stages of development of lawn maturity than recommended for the production of high quality hay to feed dairy cows.
Statistically we determined significant differences in the quality of the hay.
To ensure the quality of the hay it is necessary to do the following:
-   Chemical analysis of soil every 4-5 years,

- Ameliorative fertilization + calcification every 4 or 5 years, based on the chemical analysis of soil. Soil fertility at least 16 - 18 mg of phosphorus and potassium in the soil + sufficient amount of calcium,
- Processing and preparation of land for sowing + fertilization of current production, - pre-sowing fertilization; plowing of 2/3 NPK fertilizer to get to the bottom of the furrow, and disking of 1/3 NPK
- Mineral fertilizer for top dressing - NPK 10:20:30 2/3 in autumn + 1/3 at the end of February and early March and KAN for feeding before the start of the vegetation season and after each grass swath
- Timely sowing and purchase of grass or alfalfa seeds
- Mowing the green mass in the earlier stages of maturity and transportation to the barn.

Recommendation is: mowing and preparing of mown mass for haylage or hay, 4-6 swaths. Hay no more than 10%, while lawn should be used for preparation of haylage or silage in silos.

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QUALITY OF CHICKEN MEAT FROM CONVENTIONAL AND ORGANIC PRODUCTION

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Abstract

Poultry meat production in the world exceeded 92 million tons in 2009 and constituted one third of global meat production. Commercial poultry production, especially intensive broiler production, has shown a rapid increase and has dominated the Bosnia and Herzegovina agricultural sector over the past decade. Organic rearing of poultry in accordance with the guidelines of European Economic Community Regulation 1804/1999 (European Economic Community, 1999) is perceived as being more respectful of animal welfare compared with intensive rearing because these regulations provide specifications for housing conditions, nutrition, breeding and animal care, disease prevention, and veterinary treatment. Studies on consumer perception of chicken meat and different rearing systems revealed that consumers believe that the meat of free range chickens is healthier and tastier than birds reared in intensive production systems, making their overall perception positive towards free range production systems. The aim of this study is to compare conventional and organic poultry production in terms of quality analysis. Indicators were quantified using scientific literature and national data sets. Changing from a conventional to an organic broiler production system, therefore, not only affects animal welfare, but also affects economic, ecological and other social aspects.

Key words: *broilers, meat, organic system production.*

Introduction

Poultry meat production in the world exceeded 92 million tons in 2009 and constituted one third of global meat production (Evans, 2008). Commercial broiler hybrids reach market weight within 40 days, with excellent feed conversion efficiencies and high yields of edible cuts. Organic broiler production should comply with the overall goals of organic farming, as expressed by the International Federation of Organic Agriculture Movements (IFOAM) (IOFAM, 2000). Some of the principle aims are to encourage and enhance biological cycles within farming systems, to use as much as possible renewable resources in locally organized production systems, to create a harmonious balance between crop production and animal husbandry. Organic and sustainable agriculture plays an important role in offering solutions to meet these challenges (Ellis, 2012). The organic meat sector is currently one of the fastest growing segments of the organic food industry, and poultry accounts for nearly two-thirds of this sector (Cobanoglu et al., 2014). Consumers believe that quality of foods from organic production is superior to foods from conventional production (Lampkin, 1990). Consumption of fresh meat and meat products are mainly driven by quality but also influenced by meat prices and per capita income (Zhao & Schroeder, 2010). Modern consumers are health conscious and are shifting towards more naturally produced products such as free range chicken. The aim of this study is to compare conventional and organic poultry production in terms of quality analysis.

Production and Poultry Meat Consumption

Production of broiler practically presents the most intensive branch of the animal husbandry. According to a 2006 worldwide survey, more than 30 million hectares of land is farmed organically on 700,000 farms. Countries with the greatest organic acreage at the end of 2006 were Australia, China, Argentina, and the United States. International sales of organic foods reached more than $38 billion in 2006, with Europe and the United States being the largest consumers, and demand has outgrown supply of many organic foods since 2005 (Willer et al., 2008).

The production in the poultry meat sector is organized within a production chain. The poultry meat sector consists of production on farm level and processing industry of broiler, turkey, duck and goose ready for consumption. Table 1 gives an overview of the production of poultry meat in the EU–25 countries. There is a wide variation in production volume between the countries. The main poultry meat producing countries are, in this order: France, UK, Spain, Germany, Italy, Poland and the Netherlands. The total poultry meat production includes broilers, turkeys, ducks and 'spent hens'. In all EU countries, broiler meat is the most important type of meat within poultry meat.

Table 1. Total production of poultry meat (in 1000 tonnes) in EU countries (ZMP, 2007).

In 1.000 Ton	2001	2002	2003	2004	2005	2006
Belgium/Luxemburg	291	321	304	310	297	269
Denmark	218	219	205	213	205	190
Germany	986	1.026	1.077	1.166	1.196	1.190
Greece	163	164	169	166	165	133
Spain	1.305	1.331	1.336	1.310	1.302	1.309
France	2.269	2.145	2.015	1.975	1.920	1.801
Ireland	121	121	120	122	122	111
Italy	1.134	1.169	1.097	1.128	1.092	1.041
Netherlands	717	705	485	555	565	557
Austria	108	110	112	114	118	109
Portugal	317	311	270	281	286	287
Finland	76	83	84	87	86	84
Sweden	106	111	106	105	104	99
United Kingdom	1.572	1.544	1.574	1.574	1.606	1.605
EU–15	**9.381**	**9.360**	**8.954**	**9.106**	**9.064**	**8.785**
Czech. Republic	234	238	227	228	235	230
Estonia	9	11	14	15	9	10
Cyprus	36	37	37	37	37	37
Latvia	9	11	12	14	15	15
Lithuania	30	33	39	42	45	45
Hungary	472	515	492	490	490	480
Malta	6	7	8	8	8	8
Poland	695	794	860	915	1.020	1.040
Slovenia	64	69	70	74	74	74
Slovakia	72	77	76	80	80	80
EU–25	**11.008**	**11.152**	**10.789**	**11.009**	**11.077**	**10.804**

Total poultry meat production in the EU-25 in 2005 was 11 million tonnes. In 2006, the production decreased (-2.9%) as a consequence of the lower demand due to the Avian Influenza (AI) scare. The short term disruption due to AI is not expected to alter the medium outlook for poultry production (EU, 2007). Poultry meat is relatively cheap compared to

other meats and the consumer preference in food preparations are also in favor of poultry meat.

Figure 1 gives an overview of the EU production and consumption over the period 1991 to 2005 and the prospects towards 2015.
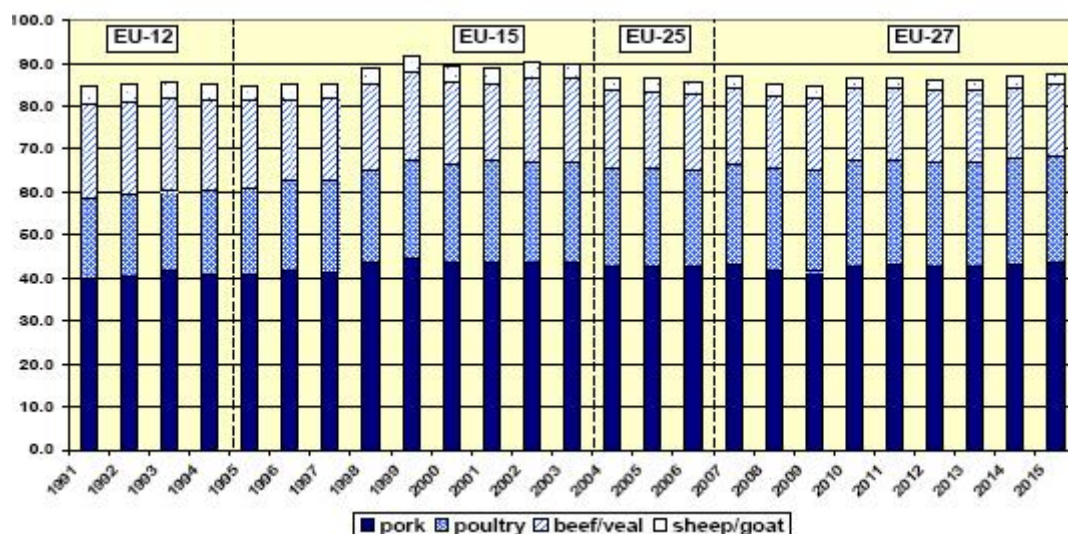
In spite of the significant increase in poultry meat consumption per capita during the last decade, Bosna and Herzegovina poultry meat consumption per capita is still lower than EU average and developed countries average.

Table 2. Poultry Meat Consumption per capita in B&H and World in 2006

Region	Consumption per capita (kg/year)
World	11.7
USA	46.2
Russia	16.7
EU	15.8
Bosna and Herzegovina	< 5

Source: USDA–FAS

Quality of chicken meat from conventional and organic production

Chicken meat is a low fat protein source and provides essential vitamins and minerals such as niacin, vitamin A, vitamin E and magnesium. It also has a favourable ratio of polyunsaturated fatty acids to saturated fatty acids making it beneficial to consumers within a cholesterol lowering diet and thereby helping to reduce the risk of cardiovascular diseases (Charlton et al., 2008). Consumers frequently see chicken meat as a "healthier" option when compared to other meat or protein products on the market (Verbeke & Viane 1999; du Toit & Crafford, 2003). Studies on consumer perception of chicken meat and different rearing systems revealed that consumers believe that the meat of organic production is healthier and tastier than birds reared in intensive production systems, making their overall perception positive towards organic production systems (Harper & Makatouni 2002; Fanatico et al., 2007; Castellini et al., 2008; Branciari et al., 2009). An increasing number of studies has compared meat quality from organic, free–range and conventional broiler production systems (Grashorn, 2005; Husak et al., 2008; Ponte et al., 2008). However, relatively few studies have reported on the meat quality features of slow-growing broiler genotypes grown without outdoor access (Fanatico et al., 2007).

Küçükyılmaz et al. (2012) reported that there chemical composition of breast and thigh meat from broilers reared under conventional or organic systems (tab. 2).

Table 2. Chemical composition of breast and thigh meat from broilers reared under conventional or organic systems (Küçükyılmaz et al. 2012)

Rearing systems	Conventional fast–growing	Conventional slow–growing	Organic growing
Thigh meat (%)			
Moisture	73.4	73.9	73.8
Ash	0.94	0.91	0.89
Fat	6.54[b]	8.29[a]	8.11[a]
Protein	18.6[a]	17.4[b]	17.3[b]
Breast meat (%)			
Moisture	74.1[a]	72.7[b]	72.9[b]
Ash	1.15[ab]	1.10[b]	1.20[a]
Fat	2.41	2.81	2.66
Protein	22.4	22.7	22.6

[a, b]Means within rows the different superscript are significantly different ($P < 0.05$)

The rearing system influenced some of the traits concerning the chemical composition of the breast and thigh meat. Factors such as production system, genotype, age, stocking density, lighting regime, temperature and diet have an effect on the overall quality of chicken meat. Castellini et al. (2002) studied the effect of rearing system on the chemical composition of broiler meat in conventional broilers (8 birds/m^2) and organic broilers (8 birds/m^2 +4 m^2 free range/bird) and observed minimum differences in protein content and substantial differences in fat content in different muscle groups. Organically produced chickens show a difference in the composition of the carcass and the chemical content of breast and thigh meat. Organic production system, among many other improved conditions and standards in rearing, provides free range area for greater physical activity and that seems to be an important contributing factor for the production of higher quality meat in chickens and livestock (Angood et al., 2008). According to Castellini et al. (2007) more natural rearing conditions and increased activity of the birds contribute to the lower lipid content in broiler meat and pasture intake generates their meat with a greater degree of consumer acceptability (Ponte et al. 2008). Husak et al. (2008) reported, that both the breast and thigh meat from conventional broilers were more tender than the breasts and thighs from free-range birds. Likewise, Farmer et al. (1997) showed that free-range access made the meat of free-range chickens tougher than the meat of birds raised under the standard production system. The effect of rearing system on protein and fat content of breast and leg muscles was also reported by Bogosavljevi -Boškovi et al. (2008). The results obtained were attributed to the fact that extensive indoor and free range production systems, with the latter involving access to natural environment (fresh air and sunlight), resulted in differences in terms of the structural manifestations of tissues and organs, as well as in terms of the biochemical processes involved in the metabolism.

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EXAMINATION OF CERTAIN PARAMETERS AFFECTING DAIRY COWS WELFARE IN BOSNIA AND HERZEGOVINA

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Abstract

Dairy cattle housing quality can significantly affect the whole structure of the factors that determine the profitability of this production. The aim of this research is to examine the housing quality of dairy cows on a number of farms in the Republic of Srpska (RS) and Bosnia and Herzegovina (BiH). The study included 80 dairy cattle farms. The capacity of these farms was diverse and ranged from 4 to 107 dairy cows. Investigated farms are located at different altitudes, and 40 farms were over 600 meters above sea level and 40 below 300 meters above sea level. Research in the field started on December 5, 2013 and ended on March 15, 2014. The next parameters being measured were, or data were recorded: number of different categories of animals, housing and feeding system, space allowance per animal and barn measures, microclimatic conditions (temperature, humidity, air velocity), light and cleanliness of animals and stalls. The dairy farms in the mountain regions are small and the mean herd size of these farms was 11.75, and in lowland farms the average number of cows was 22.9. The air temperatures inside at visited farms in the barn were higher in the "lowland farms" than in the "mountainous farms" for 2.7^0C, and were in average 8.38^0C in mountain farms, and 11.11^0C in lowland farms. There is a clear evidence that farm building do not reach modern standards, especially if we considered light intensity inside the barns, but also air velocity was quite low. For further development of dairy farming in BiH will be urgent modernization in housing systems, both by reconstruction of existing or building new barns for dairy cows.

Keywords: *dairy cattle, housing, altitude, microclimatic conditions.*

Introduction

Issues of dairy cattle housing conditions are every day more and more important, especially in recent years, due to the consequences of global warming, and the increase in prices of primary fuels and electricity which more stronger influence on agricultural production. The practice, which began in the sixties, and that includes the construction of the lower-cost facilities in order to increase competitiveness is slowly losing priority. In buildings that are insufficiently protected from external climatic factors, increasing the needs for introducing a variety of accessories, such as fans, sprinklers, leads to big losses in animal health, and increased consumption of electricity and other energy that used on the farm (Erbez, 2008; 2010).

Dairy cattle housing quality can significantly affect the whole structure of the factors that determine the profitability of this production. There are various factors that can determine the efficiency of production, not taking into account the characteristics of the breed and genetic predispositions of individual animals. There are microclimatic factors, such as temperature, relative humidity, light inside the building, the presence of gases, then the architectural solution of the object for livestock and farming systems, cleanliness stall and animals, target

production and more. Given the complexity and dependence of all the above parameters among themselves, the question arises how to evaluate, understand and present the results to the farmers. It is necessary to compare the obtained data with defined standards, if they exist, or with the similar research.

The European agency for food safety for the needs of dairy cattle breeders, researchers, students and other interested drafted: „Scientific Opinion on the overall effects of farming systems on dairy cow welfare and disease", which are defined norms by parameters which determines the housing quality of dairy cows and adopted a certain conclusions. Their goal is to formulate certain standards when it comes to the housing of dairy cows. The recommendations are based on a comprehensive survey conducted on a large number of farms in several countries of the European Union (EFSA, 2009). Ruud et al. (2011) examined the cleanliness of free stalls (cubicles) on 232 farms in Norway and concluded on what kind of design that provided the maximum hygiene and cleanliness of cows. As an important factor in determining the housing quality and the potential impact of extreme climatic factors on the productivity of animals, Erbez et al. (2010) reported an architectural solution of barns with open sides and differences in climatic conditions inside and outside the barn. The air temperature and humidity were measured during 12 months using 4 data loggers, out of which three were located inside the barn, and one outside the barn. Falta et al. (2009) examined the influence of microclimatic values on milk production of Holstein cows in second lactation and found associations between the temperature in loose housing barns and milk production.

The specified experiences of the researchers were the basis for defining the list of parameters used in the project „Evaluation of cattle welfare and housing in Bosnia and Herzegovina". It should be noted that significant research of dairy cows welfare in BiH according to the available data are not yet carried out.

The aim of this research is to examine the housing quality of dairy cows on a number of farms in the RS and BiH and to present these results for dairy farmers.

Material and methods

The work is based on an extensive secondary data review and primary data collected from 80 dairy cattle farms. The capacity of these farms was diverse and ranged from 4 to 107 dairy cows. Investigated farms are located at different altitudes, and 40 farms were over 600 meters above sea level and 40 below 300 meters above sea level. Field research started on December 5, 2013 and ended on March 15, 2014. For defining the research area and the number of farms the Ministry of Agriculture, Forestry and Water Management of RS was contacted, which supplied a list of potential 147 farms. From documents of Ministry were chosen 80 farms in 18 municipalities all over the country, with Bile a as the most Southern municipality and Novi Grad which is situated at northwestern part of the country. This research was carried out during the winter period, in order to determine possible increasing of relative air humidity and cleanliness of the farms and animals, but also to achieve presence of animals inside the barns when observations were provided.

For field research was developed data sheet and purchased equipment (mobile laboratory). Data sheet was filled out for each farm separately, and for each farm it was also possible to distinguishing between housing system (tied, loose housing and free stalls) and housing related animal behaviour.

The next parameters being measured were, or data were taken: number of different categories of animals, housing and feeding system, space allowance per animal and barn measures, temperature, humidity, air velocity, light and cleanliness of animals and stalls. Estimation of microclimatic conditions was done based on data obtained by measuring air temperature and relative humidity by Thermo Anemometer PCE-423, temperature and air velocity measured by Anemometer PCE-AM82 and light intensity measured by Lux-meter PCE-MLM1. Light was always measured when artificial light was switch off. These parameters were measured

on three parts of a barn (in north, south and in the middle part of a barn), then calculated averages. For assessment of space allowances dimension of barns were measured by Laser distance meter PCE-LDM50. Hygienic conditions estimation was made on the basis of visual assessment of the cleanliness of animals, beds and water trough′s cleanliness. For the aim of cleanliness assessment was developed model, according to level of cleanliness of cows. The cleanliness of cows and stalls was assessed from 1-clean to 4-very dirty.

Results and discussion

In total 84-89 different parameters were recorded on each farm, or a total of about 7.000 single observations.

Mean values for investigated parameters are presented in Table 1. It′s evident from results, that the dairy farms in lowland regions are bigger than "mountainous farms". The dairy farms in the mountain regions are small and the mean herd size of these farms was 11.75, and in lowland farms the average number of cows was 22.9.

Table 1. Average values for investigated parameters

Parameters	„Mountainous farms"	„Lowland farms"
Mean herd size	11.75	22.9
% of tie-stall farms	100	80
% of farms summer grazing	95	47.5
Area per animal	9.55	8.98
Mean stall temperature, °C	8.38	11.11
Mean humidity, %RH	44.73	49.52
Air velocity, m/s	0.26	0.12
Light	24.78	17.02
Mean cow cleanliness	1.9	2
Mean stall cleanliness	1.9	2.1

*Source: Authors' elaboration based on survey results

According to German research the optimal size of breeding herd in dairy production with tied housing is 40 dairy cows (Stipi et al., 2000). According these studies, the breeding herd at visited farm is much lower to ensure profitability of this production.

In all farms in the hilly-mountainous regions the cows are kept in tied housing systems, but during the summer period farmers let their cows out to pasture on 95% (38 farms) of visited farms. In the lowland regions farms were different in breeding systems (loose, tied housing), but also majority of farms (80% or 32 farms) keep cows tied. In lowland farms, just 47.5 cows have access to the pastures in summer period. According to EFSA research (2009), if dairy cows are not kept on pasture for parts of the year, i.e. they are permanently on a zero-grazing system, there is an increased risk of lameness, hoof problems, teat tramp, mastitis, metritis, dystocia, ketosis, retained placenta and some bacterial infections.

The optimal temperatures in dairy farms are between 0 and 20^0C (Stipi et al., 2000.) The air temperatures inside at visited farms in the barn were higher in the "lowland farms" than in the "mountainous farms" for 2.7^0C, and were in average 8.38^0C in mountain farms, and 11.11^0C in lowland farms.

The average relative humidity in the "mountainous farms" was 44.73 % and in the "lowland farms", the average humidity was 49.52 %. Stipi , et al. (2000.) suggested that optimum values of humidity for dairy cows are between 60 and 80.

Bouška et al. (2006) suggested that dairy cows during the 16 hours a day should have light intensity of 200 lx. There is substantial evidence that a longer light duration (16L: 8D, intensity at least 150–200 lux) promotes milk production (European Food Safety Agency,

2009). At visited farms, there was found higher light intensity in mountain farms, and it was 24,78 lx., whereas in lowland farms, the average light intensity was 17.02 lx.

Air velocity in normal temperature conditions in the barn should have maximum of 0.3 m/s (Chloupek and Suchy, 2008). Results of this research showed air speed 0.26 m/s in mountain and 0,12 m/s in lowland farms.

The results showed that farms in both regions have the optimal area pre animal. The mean cow cleanliness in farms in the mountain regions was estimated with 1,9 (low dirty) and 2 (some dirt) in the farms in the plain regions. The cleanliness of stalls in the mountainous regions were 1.9 (low dirty) and stalls in the plain regions were 2.1 (some dirt).

Conclusions

So far conducted research indicate on more intensive breeding system in the plain than in the mountainous regions. In the mountain regions of BiH the dairy farms are small. In all visited farms in mountain regions the cows are kept tethered, and during part of the spring, summer and part of autumn, the cows graze during the day, considering that a large part of the territory in this region disposes with pastures. In the plain regions the dairy farms are bigger, and the cows are more frequently being kept in loose housing systems. There is an clear evidence that farm building do not reach modern standards, especially if we considered light intensity inside the barns, but also air velocity was quite low. Positive finding were in percentage of farmers providing to cows grazing during summer, and that was almost 75% of all farms. That cows were more clean in mountain areas, could be related to time spend on pastures during the year.

Based on preliminary data, and data gathered through direct interviews with farmers the awareness of farmers on issues of quality of dairy cattle housing and its impact on production and animal health, seems low.

For further development of dairy farming in BH will be urgent modernization in housing systems, both by reconstruction of existing or building new barns for dairy cows.

Acknowledgements

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EFFECTS OF PROBIOTICS AND PREBIOTICS ON THE PRODUCTION PERFORMANCE OF FATTENING CHICKENS

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Abstract

The goal of this research was to investigate the influence of probiotics and prebiotics added into the diet of fattening chickens, as an alternative to antibiotics. Probiotic BioPlus2B (Bacillus licheniformis and Bacillus subtillus) and a prebiotic TechnoMos (Sacharomyces cerevisiae) have been added at the level of 0.1%. The experiment lasted 42 days, whereby two mixtures have been used, starter until 21 days and finishing mixture from 21 to 42 days of life, all the same in regard to protein and energy content, differing only in the presence of probiotic and prebiotic. Chickens were divided into three groups, where the first group consumed mixture free of probiotic or prebiotic and served as a control group. During the trial body weight, daily weight gain, feed consumption and conversion were recorded. Body weight in the control group was 2080.60 grams, while the experimental groups of chickens achieved higher body weight for 7.04% with added probiotic and 2.63% with an addition of prebiotic. Daily weight gain in the control group was 48.52 g. Daily weight gain was higher for 7.19% with an addition of probiotic and 2.72% with an addition of prebiotic. Feed consumption of the control, probiotc and prebiotic group amounted 111.57 g, 111.37 g and 116.06 g respectively. Feed conversion ratio in the control group was 2.30 kg, probiotic group 2.14 and in the prebiotic group of chickens 2.33 kg.
Prebiotics in diets for fattening chickens had positive effect on body weight, daily weight gain and feed conversion without statistically justified confirmation (P>0.05). The result of probiotic incorporation into chickens diet resulted in statistically significant ((P<0.05) higher values of body weights and daily weight gains, as well as better feed conversion.

Key words: *fattening chickens, probiotic, prebiotic, production parameters*

Introduction

An intensive production of healthy and high value food of animal origin, sets the high recommendation for animal husbandry and industry of animal food. The ban of European Union for use of antibiotics, as growth promoters, from the 1st January, 2006, onwards, provoked many investigations to find alternatives without antibiotic's sides' effects, such as resistance, genotoxic effects, and presence of residua in food of animal origin. The most used so called "alternatives to antibiotics", at last decade, became probiotics and prebiotics.
The quality and proportion of microorganism in the gut are relatively constant and typical for the particular periods of life and part of the intestine (Jensen, 1998), depending on animal species, environment, consumed feeds (Pluske et al., 2007) or feed additives. Probiotics, as "live, microbial cell preparation or microbial cell components with positive effect on health and performance of microorganism, by improving its intestinal balance" (Fuller, 2004), take their role trough sanitary and nutritional effects (Fuller, 1999). Prebiotics can be classified as Prebiotics are defined as non-digestible food ingredients that affect the host beneficially by the modification of bacterial composition in the colon, where oligosacharides and

polysacharades were mostly investigated in different animal specie (Baurhoo et al., 2007; Bigs et al., 2007; Canibe et al., 2007; Liu et al., 2007).

Numerous investigations towards estimation of possible influence on production abilities of poultry showed effectiveness of probiotics and prebiotics (Kabir et al., 2004) especially in regard to higher body weight, daily weight gains, better feed conversion (Apate, 2008; Awad et al., 2009; Novak et al., 2010; Midilli et al., 2008; Panda et al., 2005; Racevichiute-Stupeliene et al., 2007; Khaksefidi and Ghoorchi-a, 2006; Tokic et al., 2007).

Having in mind potentially positive effects of probiotics and prebiotics, the aim of this research was to examine the effects of the probiotic preparation BioPlus2B and prebiotic Techno Mos on the production abilities of fattening chickens.

Material and methods

Te experiment covered 156 one day old Cobb hybrid chickens divided into three groups with 52 animals. The first group, without an additive, was the control for other two groups whose diet contained 0.1% of the probiotic BioPlus 2B and the prebiotic TehnoMos. Diet content of energy and proteins was the same for all groups and differnce was only regarding to the presence or absence of used additives.

Chikens diets contained optimal content of proteins in two feeding periods 21% (1-21. day) and 19% (21-42. day). During the experiment all neccesary housing conditions were provided and were identicall for all animals. Chicken weight was measured every seven days during the trial together with group feed consumption.

Obtained results were analysed by using Anova and differences treated with Tukey HSD test marking the differnce of 0.5% significant.

Results and discussion

Average values of chicken body weights are presented in table 1.

Table 1. Average values of chicken body weights (g)

Grupa	Period tova							
	1. day	Index	21. day	Index	35. day	Index	42. day	Index
Control	42.75	100.00	670.78	100.00	1517.30	100.00	2080.60	100.00
Probiotic	42.90	100.36	612.10	91.25	1526.02	100.57	2227.04[*]	107.04
Prebiotic	42.25	98.85	677.55	101.01	1570.00	103.47	2135.29	102.63

* Statistically significant difference P<0.05

At the beginning of the trial chickens were uniform regarding the body weight in all experimental groups (P<0.05). At the end of the experiment it is obvious that experimental groups of chickens achieved higher body weight for 7.04% with added probiotic and 2.63% with an addition of prebiotic. Difference between control and probiotic group is statistically significant (P<0.05). Similar results of probiotic and prebiotic dietary influence on body weight of chickens have been reported by other authors (Khaksefidi and Ghoorchi, 2006; Zhou et al., 2010; Novak et al., 2010).

Table 2 contains achieved average values of daily weight gains, consumption and feed conversion per feeding periods, as well as for the total experiment.

Table 3. Average values of daily weight gain (g) feed consumption (g) and feed conversion (kg)

Group	Daily weight gain (g)					
	1 -21 day	Index	21-42 day	Index	1-42 day	Index
Control	29.91	100.00	66.87	100.00	48.52	100.00
Probiotic	27.10	90.63	76.66[*]	114.63	52.00[*]	107.19

Prebiotic	30.25	101.16	69.42	103.81	49.83	102.72
Daily feed consumption (g)						
Control	62.01	100.00	161.12	100.00	111.57	100.00
Probiotic	62.57	100.89	160.17	99.41	111.37	99.82
Prebiotic	68.38	110.27	163.76	101.64	116.07	104.04
Feed conversion (kg)						
Control	2.07	100.00	2.41	100.00	2.30	100.00
Probiotic	2.31	111.35	2.09	86.71	2.14	93.14
Prebiotic	2.26	109.03	2.36	97.90	2.33	101.30

The results presented in table 2 show that control group achieved 48.52 grams of weight gain per day, while the prebiotic group achieved 49.83 grams, higher 2.72% in comparision with the control group. That diference was not statistically significant (P>0.05). The best results regarding the daily weight gain were achieved in the probiotic group of chickens, 52 grams, 7.19% higher comparing it with the results of the control group. Analysis of variance showed that this difference was statistically significant (P>0.05).

Feed consumption of the control, probiotic and prebiotic group amounted 111.57 g, 111.37 g and 116.06 g respectively. Feed conversion ratio in the control group was 2.30 kg, probiotic group 2.14 and in the prebiotic group of chickens 2.33 kg. As for other parameters, so for the parameters of feed utilization, best regards were accomplished in the group of chickens fed with diet containing 0.1% of probiotic. Our results are in accordance with the results of other authors (Apate, 2008; Awad et al., 2009; Zigic, 2006; Novak et al., 2010; Midilli et al., 2008; Panda et al., 2005; Racevichiute-Stupeliene et al., 2007; Tokic et al., 2007), but still remains to adapt the dose and methods of application of additives such as probiotics and prebiotics, to a specific farm and conditions at the farm.

Conclusions

The examination of probiotic and prebiotc inclusion into the diets of fattening chickens and their effects on the production abilities following conclussions can be made:
- Both, probiotic and prebiotic positive effect was expressed
- Probiotic BioPlus 2B significantly increased body weight and daily weight gain during the trial (P<0.05),
- Prebiotic TechoMos increased body weight and daily weight gain during the trial but without statistical siginifance (P<0.05),
- Both, probiotic and prebiotic improved feed utilization.

The research showed positive effect of probiotic and prebiotic on the production results of fattening chickens and can be considered for application as an alternative to antibiotics, especially during the stress periods.

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MACROELEMENTS IN RED CLOVER (*Trifolium Pratense* L.) RELATIVE TO COW REQUIREMENTS

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Abstract

Mineral contents of forages are very important for animal feeding. A number of inorganic elements are essential for normal growth and reproduction of animals. Therefore, it is important that rich forages in terms of mineral content are used in animal feeding. Among the forage plants, red clover is one of the best forage to meet the mineral demands of livestock. Mineral contents of forage species may show significant variations in aspecies. The aim of this study was to choose a superior cultivar in terms of macro-minerals contents for animal feeding among tetraploid and diploid cultivar of red clover. A field experiment was conducted in 2012 at Institute for forage crops in Kruševac (Serbia). The experiment was designed as a randomized complete design with three replications. The plants were harvested in the three stages of development during the spring. Higher content of N, P and K were found in the tetraploid cultivar of red clover (K-32) than in diploid cultivar (K-39), and decreased with growth and development. The content of Ca increased with plant development from 17.64 to 22.30 g kg^{-1} of DM in tetraploid cultivar of red clover, and from 19.50 to 28.0 g kg^{-1} of DM in diploid cultivar of red clover.

Keywords: *macro-minerals, plant-development, red clover*

Introduction

Red clover (*Trifolium pratense* L.) is commonly grown throughout the world. It is an important perennial forage legume because it is used in hay or as pasture in crop rotation (Famham and George, 1993) and have high productivity and protein content (Murray et al., 2007). It is especially, suitable for cattle breeding, because red clover has quality and nutritive hay (Acikgoz, 2001).

Mineral contents of forages are very important for animal feeding. A number of inorganic elements are essential for normal growth and reproduction of animals (NRC, 2001). Therefore, it is important that rich forages in terms of mineral content are used in animal feeding. Among the forage plants, red clover is one of the best forage plants to meet the mineral demands of livestock. Stage of forage maturity affects the content of a number of minerals in forages. A rapid uptake of minerals by plants usually occurs during the early stages of growth. With advancing maturity, the dry matter content of the plant generally increases more rapidly than mineral uptake causing concentrations of many minerals to decrease (Ammerman et al., 1982).

Mineral contents of forage species may show significant variations in a species. A large number of studies have shown important differences in term of mineral contents in a species (Jones et al., 1995; Lema et al., 2000; Yolcu et al., 2008; Sengul and Haliloglu, 2008). The aim of this study, was to choose a superior cultivar in terms of mineral contents for animal feeding among tetraploide and diploide cultivar of red clover in field conditions in the spring growth.

Material and methods

The experiment was designed as randomized block design in three replicates. Three stages of growth of red clover (*Trifolium pratense* L.) *cv* K-32 (4n) and *cv* K-39 (2n) were examined in the first cut. Soil type was with an organic matter content of approximately 3,5 % and a pH of 6,5. Samples were hand cut with scissors at 5 cm height. The first stage was cut after 62 days of vegetation, at the mid bud stage, another one after 76 days of vegetation (around 10-15% flowering), and a third one (around 50% flowering) after 84 days of vegetation. Dry matter was determined by drying out samples at 65ºC and grinding and sieving them to 1 mm particle size.

Forage was cut and a sample of the whole plants was collected. The concentrations of K, Ca and Mg were measured by atomic absorbance spectrophotometry. Samples for Ca and Mg analysis were prepared with $1gL^{-1}$ lanthanum. Phosphorus was measured colorimetrically, according to the ISO 6491 method. The amount of total nitrogen was measured by the Kjeldahl method on the TECATOR KJELTEC AUTO ANALYZER 1030.

The data were processed by the analysis of variance in a randomized block design. The significance of differences between arithmethic means was tested by Fisher test ($p < 0.01$).

Result and discussion

The development stage of plants and the form of red clover differentiated the concentration of mineral components in green forage (Table 1).

The results of this investigation showed that stage of harvest is an indicator of forage quality. With growth and development the nitrogen content decreased from 29.50 to 23.80 g kg^{-1} (4n) ($p < 0.01$), and from 25.60 to 21.60 g kg^{-1} DM (2n). The higher nitrogen content in dry matter of the tetraploid *cv* of red clover might be explained by higher leaf:stem ratio, because leaf tissue is almost always the highest quality part of the forage, and tetraploid cultivar usually have higher leaf:stem ratio.

The concentration of phosphorus ranged between 2.36 and 1.88 g kg^{-1} DM, with more phosphorus found in DM of cv K 32 (4n). The significant difference between the cultivars of red clover were determined only in the first stage of development. These results are in agreement with Bieniaszewski and Fordonski (1996) who found out that tetraploid forms contained more phosphorus and potassium than diploid ones. It was reported that forages for cattle and sheep should contain P between 1.7 and 3.9 g kg^{-1} DM (NRC, 2001).

In our experiment, the content of potassium decreased with growth and development from 21.70 to 14.40 g kg^{-1} DM in cv K 32, and from 19.10 to 10.90 g kg^{-1} DM in cv K 39.

Table 1. Concentration of macro-minerals in red clover, g kg^{-1} DM

		b_1	b_2	b_3	$\overline{X}_A$
	a_1	29.50[A,a]	26.40[NS,b]	23.80[NS,c]	26.60[a]
N	a_2	25.60[B,a]	24.10[NS,a]	21.60[NS,b]	23.80[b]
	$\overline{X}_B$	27.55[a]	25.25[b]	22.70[c]	
	a_1	2.52[A,a]	2.12[NS,b]	1.94[NS,b]	2.19[a]
P	a_2	2.19[B,a]	1.99[NS,ab]	1.82[NS,b]	2.00[b]
	$\overline{X}_B$	2.36[a]	2.06[b]	1.88[c]	
	a_1	21.70[A,a]	15.70[NS,b]	14.40[A,b]	17.30[a]
K	a_2	19.10[B,a]	15.20[NS,b]	10.90[B,c]	15.10[b]

	$\overline{X}_B$	20.40[a]	15.50[b]	12.70[c]	
	a_1	**17.60[B,b]**	**18.90[A,b]**	**22.30[B,a]**	19.60[b]
Ca	a_2	**19.50[A,b]**	**16.80[B,c]**	**28.00[A,a]**	21.40[a]
	$\overline{X}_B$	18.60[b]	17.90[c]	25.20[a]	
	a_1	**18.00[A,a]**	**14.90[B,c]**	**16.30[NS,b]**	16.40[b]
Mg	a_2	**16.20[B,ns]**	**16.20[A,ns]**	**17.30[NS,ns]**	16.60[a]
	$\overline{X}_B$	17.10[ns]	15.60[ns]	16.80[ns]	

Different letters (A, B) denote significant differences ($p < 0.01$) between red clover cultivars, and different letters (a, b, c) denote significant differences between different stages of development ($p < 0.01$); NS, ns – non significance

When analyzing the concentration of Ca in three stages of development of tetraploid and diploid cv of red clover, it was demonstrated that K 32 (4n) contained more amount of Ca only at the beginning of flowering ($p < 0.01$). Considering the nutritional usability of forages, the concentration of Ca in red clover was twice as high as required by animals (Plaza et al., 2009). Although, forages are generally high in Ca, the availability of calcium may be low because of the presence of calcium oxalate.

The concentrations of magnesium were not shaped analogously, and the tetraploid cv of red clover contained more of this element only at the first stage of plant development. In this cultivar, concentration of Mg decreased from bud stage to beginning of flowering, and after that increased to 50% of flowering ($p < 0.01$). This, however, does not undermine the finding that the content of magnesium fully covered the nutritional demands of animals, especially dairy cows, which according to the INRA (1988) – demand 1.5 to 2.0 g Mg kg^{-1} of DM.

Mineral imbalances, deficiencies or excess and low bioavailability of essential minerals result in negative economic impacts when animal performance and health are compromised (Van Soest, 1983). The results of this study affect the existence of variation among the populations regarding their Ca:P and K:(Ca+Mg) ratios. Calcium is associated with phosphorus metabolism in animals (Onal Asci, 2012). In this current study the Ca:P ratio was between 6.98 and 11,50 in dry matter of tetraploide cultivar and between 8.90 and 15.40 in dry matter of a diploid cultivar of red clover. These results are in agreement with Onal Asci (2012) (Ca:P ratio of red clover was between 4.53 and 11.45). Although the generally recommended ratio of Ca:P is 2:1, ranges in dietary 1:1 and 7:1 resulted in similar performance of ruminant livestock (Buxton and Fales, 1994) without unfavourable effects if adequate vitamin D is available (Barnes et al., 1990). Legumes used sources of calcium, but not phosphorus (Schroeder, 2004). Low P and high Ca content resulted in this wide Ca:P ratios (Basaran et al., 2011).

Graf. 1. Ca:P   Graf. 2. K:(Ca+Mg)
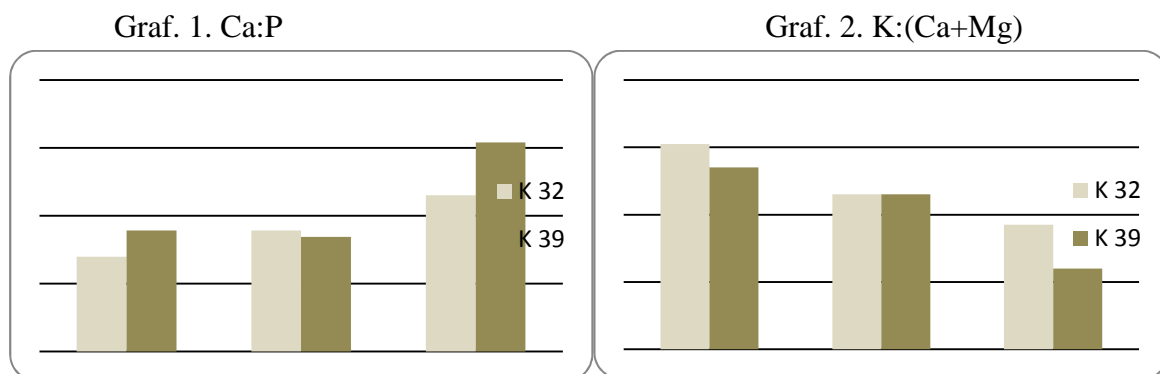
The ratios of Ca:P and K:(Ca+Mg) in di- and tetraploid red clover cultivars

Magnesium concentrations are important, but must be considered in relation to K and Ca in herbage. The ratio tended to decline as the growing season progressed. It is recommended that K:(Ca+Mg) ratio should be below 2.20 (Kidambi et al., 1989). K:(Ca+Mg) ratio of both cultivar of red clover were lower than the critical value. As Saba et al. (2000) claim, high content of potassium, due to the antagonostic metabolic effect of this element on magnesium, may constitute an additional factor which depresses the bioavailability of magnesium.

Conclusions

The concentration of nitrogen, phosphorus and potassium was higher in the tetraploid cultivar of red clover (K 32), unlike the content of Ca, which was lower except at the beginning of flowering, and Mg which was also lower, except at the mid bud stage. The Ca:P ratios were a product of greater concentrations of Ca combined with lesser amounts of P in the tissue. These cultivars can be successfully used to meet a part of mineral requirement of livestock and to improve new quality red clover cultivars for animal feeding.

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EVALUATION OF METABOLIC STATUS IN DAIRY COWS DURING TRANSITION PERIOD

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Abstract

The objective of this study was to evaluate organic and inorganic blood parameters, i.e. indicators of metabolic status in dairy cows (n=30) during the transition period. The cows were divided into two groups. The first group (n=15) comprised clinically healthy prepartal cows, and the second one included clinically health postpartal cows (n=15). Blood samples were taken from all the examined dairy cows. Blood glucose levels were statistically significantly lower ($p<0.05$) in the postpartum cows, which suggested an increased glucose uptake by the mammary gland and decreased gluconeogenesis in the liver. The significantly lower ($p<0.05$) blood triglyceride levels as well as the low total blood cholesterol levels ($p>0.05$) in the postpartum cows indicated their accumulation in liver cells. Significantly lower ($p<0.05$) blood levels of total protein, albumin and urea were recorded in the postpartum cows, which suggested the reduced synthetic capacity of liver cells. Blood bilirubin levels in the postpartum cows were significantly higher ($p<0,01$), which clearly indicated the reduced excretory capacity of the liver. Blood calcium, phosphorus and magnesium levels in the postpartum cows were lower, but they were not statistically significant ($p>0.05$), which most likely resulted from the increased uptake of these blood macroelements by the mammary gland. Biochemical evaluation suggested that early lactation cows had metabolic disturbances associated with some degree of hepatic lesions, probably due to fat infiltration.

Key words: *cows, metabolic status, blood metabolites*

Introduction

During the transition period, from immediately before to after parturition, and with the establishment of lactation, the organism in high-yielding dairy cows is pushed to its physiological limits, reaching maximum until day 120 of lactation, resulting in a substantial load on the organism, specifically on the digestive organs, liver, udder and the reproductive organs. Major health disorders in high-yielding cows occur around parturition. They include sudden changes in energy metabolism that are likely to induce severe uncontrolled disorders of organic matter metabolism (Grummer, 1995; Overton and Waldron, 2004). Metabolic conditions of negative energy balance (fasting, parturition and lactation) lead to an increased uncontrolled rate of mobilization of body fat and its increased accumulation in liver cells, resulting in disturbance of the physiological and morphology integrity of the liver (Veenhuizen et al., 1991; Reist et al., 2002; Bobe, 2004; Djokovi et al., 2007, 2011). Moderate fatty infiltration of liver cells in dairy cows during transition and maximum lactation is considered to be almost physiological. The fat content of liver can range from 10-60%, as dependent on the degree of pathology (Gaal, 1993). Increased metabolic load on the dairy cows' organism and fat accumulation in liver cells resulting in decreased blood levels of

individual liver-synthetized indicators of liver function (glucose, total protein, albumin, globulin, cholesterol, triglyceride, urea). Furthermore, the excretory function of hepatocytes is reduced and, accordingly, the levels of certain metabolic products in the blood (bilirubin, ammonia, bile acids) are generally increased (Herdt et al., 1983; Holtenius, 1989; Veenhuizen et al., 1991; Vazguez-anon et al., 1994; Reynolds et al., 2003; Sevinc et al., 2003; Bobe, 2004; Lubojacka et al., 2005; Djokovi et al., 2007, 2011). The blood levels of calcium, inorganic phosphorus and magnesium in cows during peripartal period, reflect the intake of intake if these macroelements through diet and their utilization by the mammary gland. Any reduction in these blood parameterss as compared to the physiological values in cows in the beginning of lactation, or their deficiency, a well as an abnormal relationship between them most commonly lead to to subclinical and clinical manifestations which adversely affect cow health and fertility (Ivanov et al., 1993; Sevinc et al., 1997; Kupczynski et al., 2002).

The objective of this study was to evaluate organic and inorganic blood parameters, i.e. indicators of metabolic status in dairy cows during the transitional period.

Materials and methods

This experiment was conducted in a dairy Simmental herd diagnosed with a number of metabolic and reproductive disorders. The cows were mid-yielding with a preceding lactation of about 6.500 l. Two groups of clinically healthy cows were chosen from the herd: Group 1, consisting of late pregnant cows (n = 15) at 25 to 1 (13 ± 9) days to partus, and Group 2, including early post-partum cows (n = 15) in the first month of lactation (16 ± 9 days). Body condition scores (BCS) were recorded by the same observer using the 1~5 scale according to Ferguson et al. (1994), with 1 being too thin and 5 too fat. Late pregnant and early lactation cows had BSC 3.80 ± 0.33 and 3.42 ± 0.55, respectively. The experimental cows were kept in tie-stall barns. The diet and the housing facilities were adapted to research purposes. The diet suited the energy requirements for cows in late pregnancy and early lactation. The cows in late pregnancy were fed a diet consisting of 6 kg lucerne hay, 15 kg maize silage (30% DM) and 3 kg concentrate (18% crude proteins, CP). The cows in early lactation received a diet consisting of 7 kg lucerne hay, 20 kg maize silage (30% DM) and 5 kg concentrate (18% CP). Dietary nutrient contents for dairy cows in late pregnancy and early lactation are given in Table 1.

Table 1. Nutrient contents in daily ration for dairy cows in late pregnancy and early lactation.

	Late pregnancy	Early lactation
Dry Matter (DM) (kg)	11.94	16.05
Net energy of lactation (NEL) (MJ)	65.25	87.15
Crude protein (CP) (% of DM)	12.55	13.58
Rumen undegradable protein (RUP) (% of CP)	30.86	35.91
Fat (% of DM)	3.27	3.15
Fiber (% of DM)	25.28	23.26

Blood samples were collected at 10:00 h or 4 to 6 hours after milking and feeding, by puncture of the jugular vein into sterile disposable test tubes. After clotting for 3 hours at 4°C and centrifugation (1500g, 10 minutes, 4°C), sera were carefully harvested and stored at -20 °C until analysis. Blood samples collected on fluoride were immediately centrifuged according to the same modalities and plasmas were assessed for glucose concentrations. The following blood biochemical components were measured at the Biochemical laboratory by different colorimetric techniques using spectrophotometers (Cobas Mira and Gilford Stasar): glucose, total cholesterol, total bilirubin, magnesium and inorganic phosphorus using kits from Human (Germany), albumin, urea and calcium using kits from Biosystem (Spain), total protein and triglyceride using kits from Elitech (France). Data were subjected to statistical

analysis using the GLM model and t-test for difference of means between two independent groups (late pregnancy group vs. early lactation group) (software: Statgraphic Centurion, Statpoint Technologies Inc. Warrenton, Va, Virginia, USA). Differences were considered significant at p values below 0.05.

Results and discussion

Blood metabolic organic and inorganic parameters in late pregnant and early lactation cows were compared in this study. Table 1 shows the research results on the blood levels of glucose, triglyceride, total cholesterol, total protein, albumin, urea and total bilirubin as well as blood levels calcium, magnesium and inorganic phosphorus in dairy cows during peripartal period.

Table 2. Metabolic parameters in the late pregnant cows and in the early lactation cows and significant difference

Gruop	Late pregnancy	Early lactation
n	15	15
Glucose (mmol/l)	3.36 ± 0.30^a	2.29 ± 0.48^b
Triglyceride (mmol/l)	0.29 ± 0.07^a	0.12 ± 0.02^b
Total cholesterol (mmol/l)	3.48 ± 1.07^a	3.24 ± 0.81^a
Total protein (g/l)	78.89 ± 4.92^a	75.27 ± 4.49^b
Albumin (g/l)	42.57 ± 7.53^a	34.61 ± 3.56^b
Urea (mmol/l)	5.29 ± 1.32^a	3.60 ± 1.07^b
Bilirubin (µmol/l)	3.91 ± 1.85^a	5.22 ± 1.05^b
Calcium(mmol/l)	2.25 ± 0.26^a	2.16 ± 0.29^a
Magnesium (mmol/l)	0.91 ± 0.16^a	0.85 ± 0.19^a
Inorganic phosphorus (mmol/l)	1.59 ± 0.31^a	1.46 ± 0.18^a

Legends: Mean values within a row with no common superscript differ significantly (P<0.05).

Glucose is a blood parameter defining the energy metabolism in late pregnancy and early lactating cows. Blood glucose values in late pregnant cows were within the physiological range of 2.5 - 4.2 mmol/l (Radostits et al., 2000), whereas hypoglycemia was detected in early lactation cows. The postparturient cows showed statistically significantly lower (p<0.05) blood glucose values as compared to the preparturient cows. The above results are in agreement with the literature data (Veenhuizen et al., 1991; Grummer, 1995; Reist et al., 2002; Djokovi et al., 2007, 2011) indicating that physiological glycemia in early lactation cows is at the lower physiological limit due to the sudden activity of the mammary gland and increased lactose synthesis. Furthermore, the negative energy balance, lipomobilization and increased fat accumulation in hepatocytes induce a considerable reduction in glucose synthesis by gluconeogenesis in the liver. Lipid metabolism parameters include the blood levels of triglyceride and total cholesterol. Significantly lower (p<0.05) blood triglyceride levels were determined in the postparturient cows, the total cholesterol values being lower, but statistically insignificant (p>0.05) as compared to those in the other group of cows. The results suggested an increased accumulation of triglyceride and total cholesterol in liver cells in the early lactation cows. The data are in agreement with the results obtained by other authors (Pechova et al., 1997; Veenhuizen et al., 1991; Vazquez-Anon et al., 1994; Sevinc et al., 2003; Djokovi et al., 2007, 2011) showing that the triglyceride and cholesterol transport from the liver into blood by the very low-density lipoproteins was reduced due to lipomobilization, the development of fatty infiltration and hepatocyte degeneration in early lactation. Nitrogen metabolism parameters include determination of the blood levels of liver-synthesized total protein, albumin and urea, the values there of decreasing in cases of liver

cell damage (Lubojacka et al., 2005). Albumin is an indicator of the synthetic capacity of the liver, its decrease in the blood to values as low as 20% being induced by chronic liver diseases (Sevinc et al., 2003). The values of the above blood parameters were within the physiological limits (total protein 60-80 g/l; albumin 30-40 g/l; urea 1.66-6.66 mmol/l; Radostits et al., 2000) in all examined groups of cows. They were statistically significantly lower (p<0.05) in the early lactation cows than in the other group of cows, suggesting the reduced synthetic capacity of the liver cells in the early lactation cows. The reduced synthesis of total protein, albumin and urea at the beginning of lactation in dairy cows is induced by the development of fatty infiltration and degeneration of liver cells (Pechova et al., 1997; Sevinc et al., 2003; Overtron and Waltron, 2004; Lubojacka et al., 2005; Djokovi et al., 2011). Blood bilirubin value is a highly sensitive indicator of the functional capacity of liver cells. Reynolds et al. (2003) reported positive correlation between the blood bilirubin values and the liver fat content. The blood bilirubin values recorded in the present study were within physiological limits (0.85- 5.60 µmol/l; Radostits et al., 2000) in all examined groups of cows. Significantly higher (p<0.05) values were determined in the early lactation cows suggesting the disturbance in the excretory capacity of the liver cells due to fat accumulation in the hepatocytes. Similar results were obtained by other authors (Herdt et al., 1983; Holtenius, 1989; Bobe, 2004).

In this study, blood levels of calcium, magnesium and inorganic phosphorus were lower, but no statistical significance (p>0.05) in postparturient cows than in preparturient cows. The obtained results on the blood level of macroelements showed that the calcium and inorganic phosphorus values (Ca: 2.0-3.0 mmol/l; P:1.6-2.3 mmol/l; Radostits et al., 2000) in the blood serum were under or at the lower physiological limit in both groups of cows, which resulted from the sudden activity of the mammary gland and its utilization of these macroelements. The obtained results suggested the possible development of subclinical puerperal paresis in early lactation cows.. Similar results were obtained by other authors (Ivanov et al.1993, Sevinc et al.1997). Magnesium homeostatsis depends on an optimum supply from alimentary sources and, hence, magnesium levels depend on ruminal resorption. Magnesium resorption is insufficient in diets rich in potassium and proteins, but lacking cellulose. Magnesium values in the early lactation cows were low within physiological range (0.7-1.2 mmol/l; Radostits et al., 2000) and in accordance with results of other authors (Ivanov et al.,1993; Sevinc et al., 1997; Kupczynski et al., 2002) suggesting a reduced supply from alimentary sources and/or increased utilization by mammary gland at the beginning of lactation.

Conclusion

Significantly lower (p<0,05) blood levels of glucose, total protein, albumin and urea were found in the postparturient cows, which suggested the decreased synthetic capacity of liver cells.Significantly lower (p<0.05) blood triglycerides values and low values of total cholesterol (p>0.05) in the postparturient cows suggest their being accumulated in the liver cells, as opposed to the preparturient cows. Blood bilirubin levels were significantly higher (p<0.05) in the cows at the beginning of lactation than in the preparturient cows, which clearly indicated the decreased excretory capacity of the liver. The analysis of the blood parameters as indicators of the functional capacity of liver cells suggested that early lactation cows had metabolic disturbances associated with some degree of hepatic lesions, probably due to fat infiltration, as opposed to the cows before parturition, in which the morphological and functional capacity of hepatocytes was preserved. Blood calcium, phosphorus and magnesium levels in the postpartum cows were lower, but they were not statistically significant (p>0.05), which most likely resulted from the increased uptake of these blood macroelements by the mammary gland.

Acknowledgment

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THE EFFECT OF GENOTYPE AND THE NUMBER OF FARROWING ON SOW FERTILITY TRAITS

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Abstract

The goal of this paper was to investigate the effect of genotype and the number of farrowing on the number of piglets and variability of the fertility traits of the pigs from the farm "PKB Vizelj" in Padinska Skela (Belgrade), in the period 2007-2012. The paper investigated the following pig genotypes: Swedish Landrace (SL), Large White (LW), Duroc (D) and crosses SL x LW and (SL x LW) x D. The paper shows the variability in the total number of piglets, the number of live born and weaned piglets, determined on the sample of 3,909 litters. The results show that the SL sows averaged 10.81 piglets per litter (n=1,532), while the LW sows averaged 10.04 piglets per litter (n=379). The SL sows farrowed 0.78 more piglets per litter than the crosses of F1 generation (SL x LW). On average, 11.51 more piglets per litter (n=859) were produced by three-breed crossing of the sows of F1 generation (SL x LW) with Duroc boars than by pure breeding and two-breed crossing. The authors came to conclusion that genotype and the number of farrowing had a significant effect on fertility traits, and no significant effect on the number of stillborn piglets.

Key words: *Pigs, genotype, number of farrowing, fertility traits*

Introduction

Litter size is one of the most important factors of pig fertility and it is one of the main breeding and production goals. Production costs can be reduced by increasing the number of piglets per farrowed sow per year, and good fertility is therefore one of the basic conditions for successful pig production. In the prenatal stage, litter size mostly depends on the number of ovulated egg cells, the survival capability of the embryo and the uterine capacity, while in the postnatal stage, litter size is mostly presented as the total number of born piglets, and the number of live born, stillborn and weaned piglets per litter.

Kosovac et al. (2005) recorded the average number of live born, stillborn and weaned piglets ranged 8.50-10.37, 0.30-0.79, and 6.75-8.44, respectively. In the research of *Radojkovi et al.* (2007), the average number of live born piglets, born piglets, stillborn and weaned piglets in the first three farrowings of purebred sows was 9.19, 9.78, 0.51 and 8.42, respectively. Litter size can be increased by crossing of pig breeds and lines, and manifesting the heterosis effect in the crosses of F1 generation. The number of farrowing and the age of sows can affect the litter size. It is common that the number of live born piglets increases to the fifth farrowing, and then decreases. Most important reason for this decrease in litter size that comes along with the aging of sows is high embryonic mortality. Primiparous sows have smaller litters than multiparous sows, which can be explained by fewer ovulated eggs in gilts. *Vin ek* (2005) concluded in his research that the size of Large White litters increased to the third farrowing, while other genotypes had a tendency to increase to the fifth farrowing.

Materials and methods

This research on fertility traits comprised 3.909 litters produced in eight farrowings by five sow genotypes: Swedish Landrace (SL), Large White (LW), Duroc (D), and two groups of

crosses (SL x LW and (SL x LW) x D). The authors recorded data on live born and stillborn piglets, total number of piglets born and data on 21-day-old weaned piglets. The data were processed and analysed with a method of mono-factorial analysis of variance for unequal sample size. The authors observed isolated effects of genotype and the number of farrowing on the number of live born, stillborn and 21-day-old weaned piglets. Multiple comparisons of the sample pairs were conducted using the Tukey-Kramer method. Other measures of variation observed in this paper comprised the analysis of the standard variation and coefficients of variation.

Results and discussion

The results (Table 1) show that the average number of live born piglets of the Swedish Landrace was 10.49, which is 0.21 more than *Kosovac et al.* (2005) obtained in their research. At the same time, the number of stillborn piglets was lower by 0.11, when compared to the results of the aforementioned authors. In the research of *Lukovi and Škorput* (2012) on the sample of 2,035 litters, Swedish Landrace sows averaged 11.19 piglets, 10.27 of which were live born piglets, i.e. 8.45 weaned piglets. In our research, the sows of the Swedish Landrace in the first farrowing (n=193) had on average 9.25 live born piglets, and 0.39 stillborn piglets per litter (Table 2). These values are higher than those recorded by *Radojkovi et al.* (2007). Examining the phenotypic variability of fertility of Swedish Landrace sows from a herd in Serbia those authors determined that in the first farrowing the average number of live born and stillborn piglets was 8.31 and 0.56; while the total number of born piglets was 8.87.

Most studies show that Large White sows have good maternal traits and give high milk yields, farrowing on average 10-14 live born piglets. In this research, the sows of the Large White breed farrowed on average 1.07 live born, 1.39 stillborn, and 1.59 weaned piglets less than in the research of *Vidovi et al.* (2012), where Large White sows farrowed on average 10.6 live born, 1.9 stillborn, and 10.2 weaned piglets. Within this breed, there are some hyper fertile lines, comprising a small percentage of animals with fertility far above average for this breed.

Table 1. Number of piglets per litter, by genotype

Genotype	Live born	Stillborn	Total	21-day-old weaned
SL	10.49	0.32	10.81	8.81
LW	9.53	0.51	10.04	8.61
D	8.91	0.34	9.25	8.27
SL x LW	9.70	0.32	10.03	8.73
(SL x LW) x D	11.22	0.29	11.51	8.94

The average number of born purebred piglets (SL and LW) is higher than the average number of crosses (SL x LW). It can be explained by the fact that sows and boars from nucleus herds are used for the production of purebreds, and sows from production herds (that are less fertile) are used for the production of F1 crosses. This is also supported by the results of *Uremovi et al.* (2003), who determined that the average number of live born piglets of F1 generation (SL x LW) kept in an outdoor system was 9.8, while the average number of weaned piglets was 8.03.

When it comes to the Duroc, it is a breed of good maternal traits, but of slightly more variable fertility. Duroc sows farrow on average 8-12 piglets per litter. This breed has pronounced fattening and slaughter traits, so "PKB Vizelj" uses it for pure breeding (nucleus herd) as well as for three-breed crossing, where Duroc boars are used as a terminal breed. Sire-boars of the

Duroc breed (D) caused an increase in the number of piglets per litter in three-breed crossing. In all farrowings, some significant differences were recorded in the number of live born piglets of two- and three-breed crossing. The highest number of live born piglets (12.35) was recorded in the fifth farrowing of the sows mated with Duroc boars, about 2.49 piglets more than in the case of SL x LW crosses produced in the same farrowing. The lowest number of live born piglets (7.44) in the first farrowing was recorded for the Duroc sows. The results show that the number of live born piglets of F1 generation (SL x LW) was 9.70, which is lower than recorded by *Kosovac et al.* (2005), where the highest number of live born piglets (10.87) was obtained in third and lowest (9.21) in the first farrowing. It is in line with our results, where the highest number of live born piglets (11.49) was also recorded in third and lowest (7.44) in the first farrowing.

The best fertility traits were expressed in the three-breed crosses ((SW x LW) x D), with 11.22 live born piglets, and the total number of 11.51 born piglets, which was a result of the heterosis effect of both the dam and the sire-boar. *Petrovi et al.* (2002) recorded that on farms in Vojvodina the number of live born and stillborn piglets was 9.51 and 0.72, and the total number of piglets born was 10.23; on farms in Serbia, the number of live born piglets and stillborn piglets was 9.41 and 0.58, while the total number of piglets born was 9.99.

Table 2. Number of live born piglets, by genotype and farrowing

Number of farrowing	Swedish Landrace			Large White			Duroc			SL x LW			(SL x LW) x D		
	$\bar{x}$	SD	CV	$\bar{x}$	SD	CV	$\bar{x}$	SD	CV	$\bar{x}$	SD	CV	$\bar{x}$	SD	CV
1	9.25	2.95	31.84	8.91	2.66	29.86	7.44	2.83	38.09	7.44	2.72	36.55	9.74	3.10	31.88
2	9.99	3.44	34.47	9.16	4.02	43.89	8.60	3.12	36.34	9.33	3.24	34.71	10.68	3.02	28.30
3	9.22	2.91	31.62	9.54	3.49	36.59	9.11	3.11	34.21	11.49	2.91	25.35	11.59	3.07	26.46
4	9.83	3.15	32.05	10.06	3.40	33.82	9.55	2.89	30.23	10.25	3.23	31.49	11.83	2.77	23.42
5	11.32	2.65	23.42	10.11	3.19	31.50	9.54	3.57	37.40	9.41	3.24	34.41	12.35	3.07	24.88
6	10.64	3.24	30.43	9.92	3.96	39.94	10.27	2.67	26.03	10.54	2.87	27.25	11.35	3.53	31.07
7	9.98	3.43	34.39	9.82	3.01	30.61	9.77	2.73	27.92	10.35	2.98	28.77	10.62	3.96	37.28
8	9.94	3.06	30.76	8.91	3.14	35.30	8.47	3.56	41.97	9.48	3.54	37.30	10.70	4.01	37.49

When observed by genotype, the average number of farrowing is shown in Chart 1. The highest number of farrowing was recorded for the Swedish Landrace sows and the lowest for the Duroc and Large White sows.
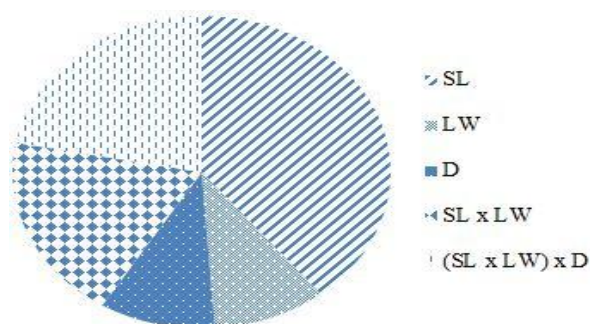
Chart 1. Average number of farrowing, by genotype

The average number of stillborn piglets did not exceed 5% of the total number of piglets born. The number of stillborn piglets per litter is shown in Chart 2.
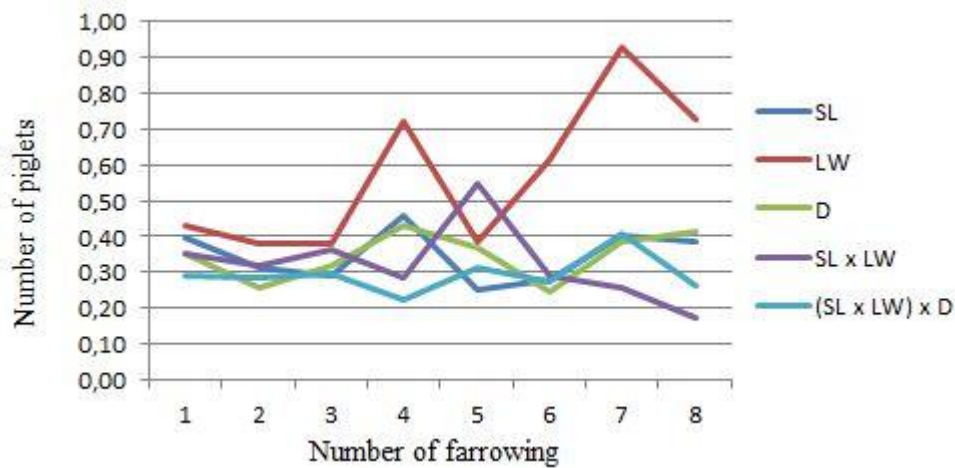
Chart 2. Number of stillborn piglets per litter, by genotype and farrowing

Table 3. Number of weaned piglets per litter, by genotype and farrowing

Number of farrowing	Swedish Landrace			Large White			Duroc			SL x LW			(SL x LW) x D		
	$\bar{x}$	SD	CV	$\bar{x}$	SD	CV	$\bar{x}$	SD	CV	$\bar{x}$	SD	CV	$\bar{x}$	SD	CV
1	8.50	2.29	26.97	8.86	1.00	11.25	7.77	2.23	28.70	7.77	1.97	25.40	8.46	2.30	27.20
2	8.90	2.30	25.90	8.74	2.74	31.31	8.49	2.28	26.83	8.78	2.22	25.29	8.93	2.25	25.19
3	8.07	2.49	30.80	8.75	2.61	29.76	8.51	2.35	27.66	8.79	2.38	27.10	9.02	2.03	22.49
4	8.69	2.61	30.08	8.83	2.28	25.81	8.35	2.64	31.57	9.21	2.83	30.72	8.94	2.25	25.20
5	9.37	1.93	20.59	8.55	2.65	30.96	8.26	2.72	32.92	8.86	2.46	27.70	9.62	1.14	11.86
6	8.72	2.75	31.59	8.62	2.75	31.91	8.84	1.85	20.92	9.22	2.39	25.93	8.92	2.57	28.82
7	8.52	2.84	33.32	6.89	4.18	60.70	7.87	2.99	37.94	9.00	3.31	36.73	8.75	2.72	31.11
8	8.55	2.63	30.73	8.91	3.02	33.84	8.35	3.30	39.47	9.00	1.33	14.81	8.39	3.40	40.53

The results shown in Table 4 make the authors conclude that genotype significantly affects the variability of live born, stillborn and weaned piglets. The number of farrowing significantly affects the number of live born and weaned piglets, but not the number of stillborn piglets per litter. Some statistically highly significant differences were determined in the dynamics of the number of live born and weaned piglets, when observing each following farrowing. At the same time, no statistical significance was detected for the effect of the number of farrowing on the average number of stillborn piglets. When observing the effect of genotype on the number of live born piglets, there were highly significant differences in all the genotypes, with the exception of Large White and Duroc, and Large White and the crosses of F1 generation (SL x LW) where no statistical significance was recorded. Highly significant difference in the number of stillborn piglets was recorded only for the Large White, since its mortality rate was higher than the mortality rate of the other breeds. Significant and highly significant differences in the average number of weaned piglets were recorded after comparing the sows of the Duroc and the Large White breed, and Duroc and SL x LW crosses, i.e. (SL x LW) x D.

Table 4. Effect of genotype and farrowing on the variability
in the number of 21-day-old weaned piglets

Factor	Number of live born piglets	Number of stillborn piglets	Number of 21-day-old weaned piglets
Genotype	48.59**	5.48**	5.88**
Number of farrowing	29.74**	0.98[NS]	4.99**

**P<0.01; *P<0.05; [NS]P>0.05

Conclusions

The results show that genotype and the number of farrowing significantly affect fertility traits, except for the number of stillborn piglets, where no clear consistency was determined. A significant difference in the litter size of the purebred sows was determined. On average, the highest number of piglets was farrowed by the Swedish Landrace sows and the lowest by the Duroc sows. Two-breed crossing did not show a consistent effect on the increase in the average number of live born piglets. This increase was a result of three-breed crossing (SL x LW) x D in all eight farrowings. The authors can conclude that the average number of live born piglets of all genotypes increases from first to the fifth farrowing, and then decreases, showing significant differences between the farrowings. With the exception of the first farrowing, the sows of the three-breed crosses show better results to the fifth farrowing, after which they achieve poorer results than two-breed crosses and purebreds. Observed by genotype, no consistencies in the variations of the number of 21-day-old weaned piglets can be found.

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QUALITY OF MILK AND WHEY OBTAINED DURING THE PRODUCTION OF SJENICA CHEESE AND A TYPE OF SJENICA CHEESE

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Abstract

Sjenica cheese is one of the most famous types of cheese made in the Republic of Serbia , from the group of white cheese in brine . It is produced by indigenous technology on individual households on the Sjenica- Pester plateau. Sjenica cheese is made from fresh, whole sheep milk and a type of Sjenica cheese is made from whole cow milk. Procedure of making cheese is done immediately after milking without any thermal treatment. The quality and overall value of cheese depend on the chemical composition and quality of milk, and the chemical composition of whey depends on the degree of the utilization of milk components, and chemical composition of whey is an indicator of the correctness of keeping the technological process of making cheese. Because of these reasons it is necessary to determine chemical composition. The dry matter content in sheep milk had an average value of 20.45 % and 12.31 % in cow milk, milk fat 9.25 % in sheep milk and 3.68 % in cow milk, protein 5.96 % in sheep milk and 3.06% in cow milk. The chemical composition of whey was good which indicates good technological process of making cheese and a good utilization of milk components, and small losses through whey. Sheep whey had the following average chemical composition: dry matter 7.02 %, milk fat 0.60 %, protein 1.42%, total nitrogen 0.23%. The average chemical composition of cow whey had the following values : dry matter 5.62 %, milk fat 0.22%, protein 0.80 %, total nitrogen 0.11 %.

Key words: *Sjenica cheese, milk, whey.*

Introduction

Chemical composition and quality of milk depend on the type of animal and animal breed. Differences exist in the same race, depending on the each individual animal. Sheep milk is about 50% richer with dry matter than cow milk. Because of the higher content of dry matter, especially because of the wealth of fats and proteins, sheep milk is very suitable for the production of cheese because it provides nearly twice utilization rate than cow milk. In to these factors, on chemical composition and quality of milk, affects the period of lactation addition, a physiological state of the mammary gland and nutrition. (Djordjevic, 1987). The quality and value of the cheese depends primarily on the quality of milk. The quality of milk, which is processed into cheese, depends on its chemical composition, physical, technological and microbiological properties. Technological properties of milk depend on the chemical composition, of the health status of the mammary gland and primary processing of milk. (Dozet et al., 1979).

The quality of milk depends of the content of dry matter which has the most significant importance, then dry matter without fat, percentage of fat and proteins. Of all the components of milk, in the process of production, the greatest significance belongs to the casein. The technological process of cheese production is based on the specific properties of casein, in which the most important are the ability of coagulation and gel formation of milk, the ability of forming gel to syneresis, and propensity to proteolysis under the influence of proteolytic enzymes which are present in the cheese. (Pudja, 2009).

In the course of coagulation, milk fat fits in formed gel and thus is retained in the cheese. The primary function of milk fat is reflected in its contribution to the sensory properties of the cheese. Therefore cheese with high fat content is characterized by a full flavor and aroma. In the production of cheese, the small part of lactose retained in the cheese while most of it goes with the whey. Thanks to the presence of lactose in milk, fermentation is carried out. Mineral composition of cheese is closely related to the course of fermentation of lactose. By a control of fermentation course, we regulate mineral composition of cheese**. (Pudja, 2009).

Materials and methods

During 2008-2009, the researches which are included in this paper were carried out over a wide area of Sjenica-Pester plateau, where on the typical production sites were selected experimental households that produce cheese by indigenous technology in a traditional way. The experiments were conducted in 12 households. In 6 households cheese was produced from whole sheep milk, and it is original Sjenica cheese, and in 6 households cheese was made from whole cow milk, known as the type of Sjenica cheese. Because the quality and overall value of cheese depend on the quality of milk, the chemical composition and quality of milk were determined before cheese production. After making cheese, samples of whey were taken from cow and sheep milk, in which the analysis showed chemical composition and quality. Analyses of milk and whey were made in the chemical laboratory of the Special Veterinary Institute of Kraljevo, and have included :
- percentage of dry matter by method of drying at 102 0C
- percent of fat by acidobutirometrical method
- percentage of total nitrogen by Kjeldahl method and
- percentage of total proteins
Analyses of milk and whey were performed by standard methods (Pejic and Djordjevic., 1963).

Results and Discussion

In the production of cheese quality and technological properties of milk, the most influence have the content of dry matter, fat, proteins and fat ratio - casein. Table 1. gives the chemical composition of sheep milk from the experiment.

Table 1.Average of chemical composition of sheep milk

Indicators per %	Calculated indicators				
	min	max	$\overline{X}_{n=6}$	Sd	Cv
Milk fat	8.40	10.60	9.25	0.86	9.29
Solids	19.69	21.51	20.45	0.78	3.81
Proteins	5.88	6.04	5.96	0.07	1.17
Nitrogen	0.91	0.94	0.92	0.01	1.08
Casein	5.11	5.25	5.18	0.06	1.19

Based on the results of the chemical composition of sheep milk (Table 1.), it can be concluded that it was of very good quality, typical for the breed. This especially applies to the high content of dry matter, fat and proteins. Because of the higher content of dry matter and especially because of the richness of fats and proteins, sheep milk is very suitable for the production of cheese, because it provides almost twice utilization rate than cow milk. Sheep milk is original and irreplaceable raw material in the production of cheese. The richness of the chemical composition of sheep milk, production provides original, high-quality cheese of high biological value. (Mio inovic, 1994) points out that the high content of individual components of sheep milk,contributes to better quality and higher utilization rate in the

production of cheese from the milk**.** (Adzic et.al, 1984) have identified the following chemical composition of sheep milk, which is used in production of Njegusi cheese : milk fat 6.80 % , dry matter 17.52 % , dry matter without fat 10.72 % . During the survey of sheep milk for production of Pljevlja cheese, (Dozet et.al, 1996) determined its chemical composition: dry matter 19.20 % , milk fat 7.60 % , total protein 5.75 % and casein 3.90 % .During the production of Sjenica cheese in industrial conditions, (Savic, 2014), used sheep milk of following chemical composition: dry matter 18.14%, milk fat 6.80%, protein 5.97%, casein 5.20%. Describing indigenous technology of Polimsko-Vasojevic cheese, (Konatar, 2006) determined chemical composition of sheep milk: dry matter 18.14%, milk fat 6.90%, protein 6.05%. Results from the experiment, are consistent with the data quoted by these authors. Table 2.gives the average chemical composition of cow milk, in the production of the type of Sjenica cheese.

Table 2.Average of chemical composition of cow milk

Indicators per %	Calculated indicators				
	min	max	$\overline{X}$ n=6	Sd	Cv
Milk fat	3.20	4.00	3.68	0.28	7.87
Solids	11.70	12.66	12.31	0.33	2.69
Proteins	2.88	3.26	3.06	0.07	2.31
Nitrogen	0.44	0.50	0.47	0.02	4.25
Casein	2.50	2.83	2.66	0.05	2.12

Based on the results of the chemical composition of cow milk (Table 2.) we can see that cow milk was of good quality and of characteristic chemical composition typical for the breed. It is important to emphasize that the content of the fat and proteins, and especially of casein was good, which affected on the quality of finished product. The ratio of casein and fat was narrow, so milk fat was well blended by casein, resulting by minimal losses of milk fat through the whey. The ratio of protein and fat is an important indicator for defining the required fat content in dry matter of cheese. For the cheese which is produced in a traditional way, ratio between casein and milk fat is important, as the casein represents the only protein which is involved in the construction of the proteins net of the cheese, and serum proteins mostly depart with the whey. Examining chemical composition of cow milk intended for manufacture of Polimsko-Vasojevic cheese, (Dozet et.al,1996) determined following chemical composition: dry matter 13.92%, milk fat 4.40%, total protein 4.18% and casein 3.57%. Macej- (1989), gives the following chemical composition of cow milk intended for making white soft cheese: milk fat 3.72%, dry matter 12.23%, total protein 3.02%, dry matter without fat 8.53%. It can be seen that the results of experiments are in the agreement with it and there is no any significant deviation.

Table 3. Average of chemical composition of sheep whey

Indicators per %	Calculated indicators				
	Min	Max	Average	Sd	Cv
Milk fat	0.49	0.80	0.60	0.12	18.82
Solids	6.80	7.19	7.02	0.12	1.56
Proteins	1.32	1.51	1.42	0.06	4.15
Nitrogen	0.20	0.25	0.23	0.007	4.08

Table 4. Average of chemical composition of cow whey

Indicators per %	Calculated indicators					
	Min	Max	Average	Sd	Cv	
Milk fat	0.16	0.20	0.21	0.05	14.36	
Solids	5.46	6.00	5.62	0.17	3.38	
Proteins	0.76	0.83	0.80	0.03	3.23	
Nitrogen	0.10	0.12	0.11	0.05	3.75	

On the basis of data on the chemical composition of whey, it can be seen that the percentage of milk fat in cow and sheep whey was low, suggesting that the technological process of making cheese was properly guided.

The whey from cow milk in average contained 0.21% of milk fat, and sheep whey contained 0.60% of milk fat. Analysis showsthat these differences were statistically significant. Properly guided technological process of making cheese, allowed a good utilization of milk fat and total milk nitrogen compounds, which is directly reflected in a better utilization of milk dry matter. The dry matter content in cow whey was 5.62%, and in sheep whey it was 7.02%. Analysis show statistically high significant difference.

Conclusion

Based on the above it can be concluded that:

-The milk quality in production of Sjenica cheese and the type of Sjenica cheese was very good. On milk quality, among other things, also contributes the feeding of dairy cattle on pastures of high grass quality , located on an altitude of over 1,000m.

-because of the richness of chemical composition, sheep milk is original and irreplaceable raw material in the production of Sjenica cheese

-traditional technology of making Sjenica cheese is characterized by variability and often uneven quality of cheese which can be considered as a   lack, and can be served as a recommendation for modern and standard technology for production of Sjenica cheese

-with standard technology and high quality, Sjenica cheese is an important product not only for the local market but also for the wider market, and it is important for the recognition of the area

-Sjenica cheese is famous and recognizable product, and with the protection of the name and geographical origin, it   will become a initiator and support for economic development of Sjenica-Pester plateau.

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THE MECHANIZATION PROPERTIES OF CATTLE FARMS IN DİYARBAKIR PROVINCE, TURKEY

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Abstract

This study was conducted to determine the mechanization features of cattle farms in Diyarbakir province through survey applied in 427 farms selected randomly. We observed that 196 of farms have their own tractor while 231 of them have no tractor. The average number of tractors per farm was 0,46. In contrast, the number of machinery and equipment was 1,23 per farm and this number was quite low.

The numbers of feed dispensers, corn silage, grass silage, and pick-up ballers machines per tractor were recorded as 0,15, 0,10, 0,10 and 0,09 respectively. Besides, we found that the number of machinery-equipment has not proved to meet the farm's requirements. The milk cooling tanks required for dairy farms were found insufficient less as well. However, dairy farms using milking machines are expressed to obtain higher yield of milk.

Key Words: *Cattle farms, mechanization properties, field survey, Diyarbakır*

Introduction

The sufficient and high quality nutrients of mankind required are meet by animal products as much as crop production. For example, dairy cattle are the most important source of meat for milk production in Turkey. Approximately 92 % of the total milk production was obtained from dairy cattle's in Turkey according to data of 2012 (Anonymous, 2012a). This value was calculated as 98% for EU countries and 85% for the worldwide. This situation in meeting the requirements of animal protein reveals the importance of cattle in Turkey. Cattle is not only important for milk production, but also for meat production. According to the statistical data of the end of 2009 approximately 79 % of Turkey red meat production from cattle reported (Anonymous, 2009). Approximately, 78% of this rate in the world and 88% in European Union (EU) countries was found.

Therefore, the need for quality number of animals' demands increase each year as parallel growing population and increasing the demand for food in the world. Products of animal origin for human nutrition as well as national, regional land rural development, ensuring national industrial raw materials plays a very important role in increasing employment. The desired improvement in animal husbandry, productivity and profitability can be achieved; quality breeders, suitable environmental conditions, veterinary health services, evaluation and marketing of products as well as other important factors, together with the mechanization largely depends on the efficient use of tools and applications. It is well know that the, according to crop production, animal production activities are more time-consuming tasks and the need for labor is more as well.

In modern livestock farming, in order to obtain for age the mechanization equipment is used intensively in all stage from production to harvest in forage cultivation. This is due to fact that animal production, both internally and externally, requires daily activities. In extensive animal husbandry, both concentrate and forage are supplied while in intensive animal husbandry, production of concentrate and forage, transportation, preparation,

distribution of feed to animals, shelter, cleaning, milking, disposal of manure on the field activities need tractors and proper equipment (Sessiz et al 2006, Esgici et al 2007).

Whereas energy and manpower saving are ensured by using mechanization, while on the other hand, facilitating amount of daily work, increase the production, maintain quality and reduce the cost of production. Otherwise, the competitiveness of farms will not be expected to performance profitable agricultural production. So, nowadays cattle farms operating in the modern sense of mechanization in the use of tools has become necessary and obligatory.

There are significant differences between the regions of Turkey in cattle farming. Production are performed in modern conditions and intensively in Marmara and Aegean regions where the agriculture developed and using of mechanization at high level largely while the cattle farming are performed in more extensive conditions and as family farms in Eastern and Southeastern Anatolia regions where underdeveloped using of agricultural technologies (Sessiz et al., 2006). In these regions, using and investment of technology is insufficient. This reflected in the amount of production and costs. That is why the production efficiency is low. Production costs are high.

This study was conducted to determine the effects of mechanization on the production process and the mechanization features of the cattle farms having over 25 head cattle in Diyarbakır province where the crop production and animal production has high potential.

Material and method

This study encompassed 427 dairy cow farms which have more than 25 head of cows in 17 central districts of Diyarbakir province during the autumn session (from September to December) of 2013 year. Face to face interviews were conducted with dairy farmers and all answers were recorded.

During the visits to the farms, answer of cattle holding owners for the questions relating to survey were recorded and also made some more observations about the details of farms was noted. Totally 15 questions on business and labor level of mechanization of farms were asked to farm owners. The data obtained from the study was analyzed using Microsoft Excel-XP package.

Results

Tractors on farms

The tractor presence in cattle farms are given in Table 1. We found that 196 (46%) out of total farms (427) have own tractor while other farm (231 or 54%) have no tractors. The average number of tractors per farm was recorded as 0.46. A similar result has been found in the case for machinery-equipment. The numbers of feed dispensers, corn silage, grass silage, and pick-up balers machines per tractor were recorded as 0.15, 0.10, 0.10 and 0.09 respectively.

Table 1. Tractor presence in cattle farms

	Number	Percentage (%)
Farms have own tractors	196	46
Farms have not own tractors	231	54
Average tractor number per farms	0.46	-
Total farms number	**427**	100

Cattle farms not having tractors use rental or neighboring assistance when they need. We determined that the daily works has been done by people on the basis of manual labor in difficult conditions in the farms not having tractors and equipment. Therefore, the daily works such as; cleaning of shelter, feeding, milking and hygiene were performed under unsuitable conditions. Milk production farms were maintained towards mainly small local

markets. It was stated that the farm owners not have enough budget to buy the machine and therefore they expressed performance non-profitable production.

Agricultural machinery and equipment on farms

One of the most important indicators to determine the level of mechanization of the farms is owned agricultural machinery and equipment. Table 2 presents farms that have only machinery and equipment used for animal production, out of total number of farms (427).

Table 2. Agricultural machinery purchased for livestock on studied farms

Machinery	The number of farm	Machinery-Equipment/Farm (%)
Feed dispensers	31	7.25
Solid+ liquid manure spreaders	4	0.23
Trailer + straw carrier	219	51.28
Corn silage machines	20	4.68
Grass silage machines	19	4.45
Mowers	26	6.08
Rakes	49	11.47
Pick-up ballers	17	3.98
Mills and crushers	73	17.09
Solid manure removing	32	7.49
Fixed milking facilities	18	4.21
Mobile milking machines	27	6.32
Milk cooler tanks	29	6.79
Total number of farms	427	---

Source: Authors' elaboration based on questionnaire results

The number and percent of the grass and corn silage machine, balers and rakes, roughage, milking machines, fixed milking facilities, feed crushing and dispersing machines were given in Table 2. Results showed presence of 528 machinery and equipment units used for livestock activities. The total number of machinery and equipment per farm was 1,23. As shown in table 2, agricultural trailers and straw trailers are owned by 219 farms due to intensive use in field crop production as well as in animal production. The average number of trailers was 0,5 units per farm. In addition, the average number of machinery was 0,7 per farm except trailer. According to these data obtained from our study, the level of mechanization is far what is required. Agriculture activities are more oriented to field crop production and animal husbandry lag behind.

Situation of using machinery-equipment grant aid of farms

Turkish Ministry of Food, Agriculture and Livestock has started grant program in 2007 years called the "Rural Development Machinery and Equipment Support" to improve rural development. For this aim, many new generation machines provided to farmers for increasing the crop and animal production each year. The Number of farms have been provided the machine by using government grant support (50 % discount for each machine) are shown in Figure 1. Within the context of grant, rakes, feed dispenser, corn silage, balers,

milk cooling tanks and milking machines were purchased. Totally, 44 farms that surveyed have benefited from the government grant. This constitutes about 10 % of total surveyed ratio and 90% of enterprises have not benefited from the support of this grant. The reason of very limited number grant using was expressed as to be more bureaucratic procedures in the recruitment process and can result from long assumed.

Figure 1. The Number of Farms taken machine by using grant
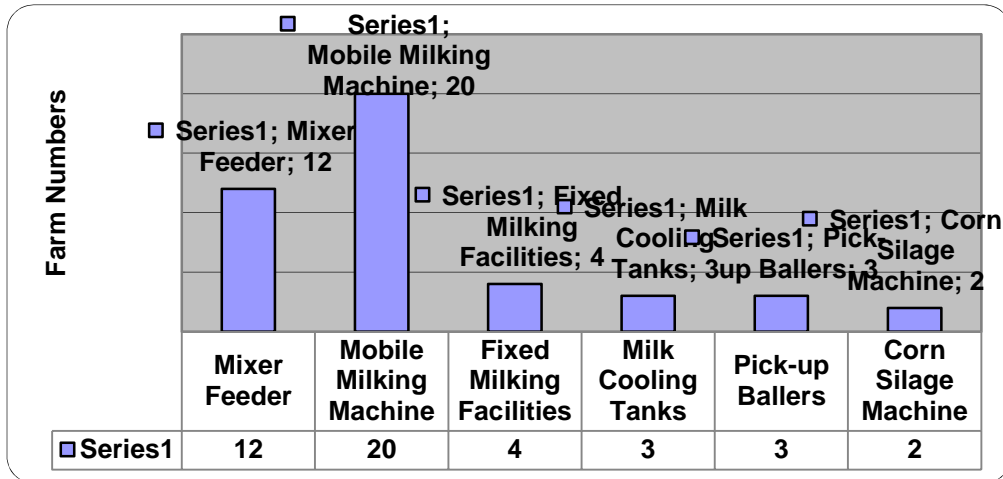
The milking is often done manually due to high numbers of family members but also due to lack of habits to use milking machine. The milking machine systems are important in dairy cattle farms. 46,5 % of farms in researched region has received different milking machine by using government grant program. Whereas, we obtained that 53,5 % of farms no benefited this grant program of the government. In particular, feed and machines for stability are insufficient. Sessiz et al., (2009) reported that there were a few machine used directly in animal production. The same authors reported that the number of some machines such as; rakes, mixer feeder, corn silage, balers which are necessary for animal production are increasing in new farms in this region. Furthermore, the number of mobile milking machine was recorded as 27 (Figure 2 and Figure 3).

Figure 2. A Viewing from fixed milking facilities

Figure 3. A Viewing of Mobile Milking Machine

Low level of knowledge and education for workers in farms was recorded. We obtained that people works in farms don't have enough technical knowledge for solving machine problems occurred. The farms such as cooperatives and farms body located in organized zone should be encouraged. Therefore, these kind of farms can be executed their daily activities by means of the use of tractors and machinery in common.

In conclusion, results from this study showed that dairy farmers had insufficient machines on the preparation feeds, milking and animal feeding practices.

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THE EFFECTS OF TRITICALE REPLACEMENT IN MAIZE BASED BROILER DIETS WITHOUT ENZYMES SUPPLEMENTATION ON GROWTH PERFORMANCE AND CARCASS TRAITS

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Abstract

The effects of different levels of triticale replacement with maize based diets without any enzymes supplementation on growth performance and carcass traits of broiler chickens were studied. A 42-day feeding trial involving sexed 960 day old Ross-308 broilers with 48 group four replicates for 3 feed treatments in 4 rooms was carried out in a completely randomized design. Starter (23% CP and 3000 kcal ME/kg of feed), grower (21% CP and 3175kcal ME/kg of feed), and finisher diets (20 CP and 3225 kcal ME/kg of feed) were provided from 0 to 11, from 12 to 28, from 29-42 days of age as the dietary phase respectively. Diets containing either maize (M) as a control group; triticale (T) as a sole grain source and Maize+Triticale (MT) mixture were used. Triticale was provided % 50, 55 and %58 in starter, grower and finisher M and T groups' diets in total and MT group percentages were 25%, 27.5, and 29% in the feeding periods respectively. No enzyme added to diets phytase included. Live body weihgt (BW), feed consumption (FC) were recorded weekly up to the 42d of age. At 42 d, 6 bird (3 male and 3 female) per pen in total 288 birds were used for evaluation of carcass traits. Overall, the triticale-fed birds had lower final body weight (BW) and higher feed conversion ratio (FCR). Eviscerated carcass, thigh, drum and breast as a percentage of carcass weight were lower in T and MT groups 36 and 6% than M (control group) respectively as BW and FC. Final BW, carcass weight and slaughter traits of broilers fed triticale were affected negatively within similar percentage by increasing inclusion of triticale to diets without any enzyme.

Keywords: *broilers, maize, triticale, enzyme, growth and carcass performance*

Introduction

Maize is the most important inputs in feed mixtures for broilers and uses extensively as an energy source for poultry but its content in diets should be reduced for economic reasons (Korver et al., 2004; Józefiak et al., 2007; Zarghi and Golian, 2009). Studies on the possibility of using triticale in broiler chicken diets were carried out in the 1980s and 1990s (Proudfoot and Hulan, 1988; Klocek and Adamczyk, 1994), but they generally concentrated on the estimation of rearing performance and showed decreased live weight gain and increased feed conversion ratio. Triticale is a grain that competes with other species in terms of lower soil requirements and high yielding potential and nutritive value. Triticale, however, was not a popular component of mixtures for broiler chickens because it has the most changeable chemical composition of all grains and contains anti-nutritional factors (Pourreza et al., 2007). Triticale is a hybrid of wheat and rye and its nutritive value vary between its parents. It is established that the main antinutritional factor of these grains is soluble arabinoxylane that can inhibits digestion and absorption of nutrients in digestive tract and decrease the performance of broiler chickens (Bedford and Schulze, 1998). Soluble indigestible polysaccharides may also affect the water consumption in broilers (Van der Klis et al., 1993). Nowadays above mentioned problems are seems solved by supplementation of specific feed enzymes to the diets. Some negative effects can be eliminated that way of addition of enzymes such as ß-glucanase, arabinase and xylanase to grain-based feed mixture have been reported (McNab, 1999; Malthlouthi et al. 2002; Toker and Ergene, 2004). On the other hand, different effects on broilers have been reported that using enzymes with triticale in broiler feed mixture. Azman et al., (1997) reported that have no any positive impact on the broiler performance using xylanase and protease enzyme complex containing 1g/kg dose in triticale. Karaalp and Ozsoy, (2001), also reported that more than 30% triticale in broiler diets has been reduced yield performance and efficiency and hasn't improved in that situation

even adding enzyme to triticale. However, broilers lack enzymes that digest fibrous components or cell wall fractions of diets such as those that contain cereal grains. In broilers, different enzymes play an imperative role in the utilization of different nutrients i.e. amylase can digest starch, protease can digest protein and lipase can digest fats. Although the role of enzymes in improving feed utilization, growth, meat quality and economics has been well reported, their quality, consistency and reproducibility have been questioned by many researchers (Anjum and Chaudhry, 2010). There are some uncertainty about the enzymes usage with triticale in poultry nutrition and also particularly conflicting about the positive or negative effects of enzyme supplementation to triticale in poultry feed. Recent findings (Korver et al., 2004; Józefiak et al., 2007; Santos et al., 2008) were not so clear and in most cases showed no effect of grain on slaughter traits and quality of poultry meat. Therefore the objective of this study was to determine the effect of triticale without any enzyme supplementation as a partial or complete maize substitute in feed mixtures on some yield performance and carcass traits of broiler chickens.

Materials and Methods

A 42-day, 3 feed resources feeding trial involving sexed 960 day old Ross-308 broilers was carried out in a completely randomized design. There were 320 chicks per treatment within 48 sub-groups each and 4 replication having 20 chicks in separated 4 rooms. The initial live weights of the day old chicks were about 38g. New wood shavings at a depth of approximately 10 cm were used as bedding material over the concrete floor. The house temperature was maintained at 32 ℃ during the first week of age, and a reduction of 3℃/wk was practiced until the house attained a temperature of 25℃. Feed (crumbled) and water were provided ad libitum and 24-h 23L 1D lighting was provided throughout of the study. The dietary treatments groups were M (100% maize + 0% triticale) T (100%triticale + 0% maize) and MT (50% maize+50% triticale). Triticale was provided % 50, 55 and %58 in starter, grower and finisher M and T groups' diets in totally and MT group percentage was 25%, 27.5, and 29% in the feeding periods respectively (Table 1). No enzyme added to diets phytase included. The basal starter and grower diets were formulated in izocaloric and izonitrogenic according to the Ross requirements guideline. Any enzymes or antibiotics, coccidiostat and other external agents were not added to feed or drinking water. The birds were not vaccinated any disease. Live BW, feed consumption (FC) and FCR were recorded weekly up to the 42d of age. FCR for a whole period was calculated dividing the total feed consumed by the cumulative BW attained the period.

Table 1: Feed Ingredients of maize-based diet used in broiler starter, grower and finisher periods of experiment replacing by different levels of triticale

Ingredients (%)	Starter (1 to 11 d)			Grower (12 to 28 d)			Finisher (29 to 42 d)		
	M	T	MT	M	T	MT	M	T	MT
Maize grain	50.00	---	25.00	55.00	---	27.50	58.0	---	29.00
Triticale grain	---	50.00	25.00	---	55.00	27.50	---	58.00	29.00
Soybean meal	32.18	25.50	28.18	31.30	26.00	27.00	30.00	18.70	24.80
Sunflower meal	8.00	12.30	10.94	4.00	6.50	7.00	2.40	11.00	6.30
Vegetable oil	3.52	6.00	4.63	5.10	7.50	6.50	5.20	7..9	6.50
Meat and bone meal	4.00	3.80	4.00	1.80	2.10	1.70	1.70	1.70	1.70
Limestone	0.80	0.80	0.74	0.90	1.00	0.90	0.90	0.90	0.90
Premix (Vit,Min)[*]	0.20	0.30	0.20	0.25	0.25	0.25	0.20	0.20	0.20
DCP	0.84	1.00	0.87	1.20	1.20	1.20	1.20	1.20	1.20
DL-methionine	0.04	0.06	0.04	0.08	0.08	0.08	0.04	0.02	0.04
L-Lysine	0.08	0.05	0.06	0.05	0.06	0.07	0.03	0.03	0.03
Salt(NaCl)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Calculated analysis									
ME (Kcal/Kg)	3000	3010	3000	3167	3174	3179	3211	3210	3209
CP (%)	22.9	23.0	23.1	20.9	21.0	20.9	19.8	19.9	19.9
CF (%)	4.13	5.19	4.72	3.64	4.64	4.26	3.41	4.90	4.10
Calcium (%)	1.00	1.04	1.00	0.88	0.95	0.88	0.86	0.88	0.87
Available P (%)	0.50	0.51	0.50	0.45	0.46	0.44	0.44	0.43	0.44
Lysine (%)	1.40	1.39	1.40	1.27	1.31	1.26	1.13	1.16	1.15
Methionine (%)	0.55	0.54	0.55	0.53	0.51	0.53	0.40	0.44	0.43
Meth.+Sistin (%)	0.88	0.96	0.92	0.81	0.86	0.85	0.73	0.81	0.78

Carcass Yield Evaluation
At the 42 d of age, 6 bird/pen (3 male and 3 female) in total 288 birds were randomly selected which representing an average pen weight for slaughter and carcass traits. The birds were weighed, after overnight fasting of feed but not without water, slaughtered by severing the jugular vein and allowed to bleed thoroughly. Birds were scalded at 75°C in a water bath for about 30 seconds before defeathering and then the birds were eviscerated. Abdominal fat (surrounding the gizzard, cloaca and adjacent abdominal muscles) was removed and weighted for calculations. Hot carcass weights were recorded and dressing percentages calculated as a percent of live weight. The wings were removed by cutting anteriorly severing at the humeo-scapular joint; the cuts were made through the rib head to the shoulder girdle. Thighs and drumstick were dissected from each carcass and weighed separately.
Analyze the carcass characteristics such as live weight, carcass weight, carcass yields and the weights of breast, thigh, drumstick, wings, neck, giblets (gizzard, heart, liver) and abdominal fat data were collected and recorded by ex-pressed as kg a measuring scale. Carcass dressing percentage was calculated as total weights of the whole carcass + giblets, percentages of live body weight.

Statistical Analysis
All statistical analyses were done from pen means. Treatment effects were evaluated by ANOVA using the General Linear models (GLM) procedure of SAS software (SAS Institute, 1999). Duncan Test was used to estimate significant differences among treatment means.

Results and Discussion

Performance
BW, FC and FCR mean values of the study are summarized from 7.d to 42.d of age in Table 2. and Figure 1. Inclusion of different levels triticale to broiler diets caused a significant (P<0,01) differences in BW, total FC and FCR. Birds fed triticale were significantly (P<0,01) lower BW, when compared with the control-M and MT groups. The FC were also significantly decreased with inclusion of triticale in the broiler diet with 100% Triticale in overall periods when compared with the M, and MT (Figure 1.).
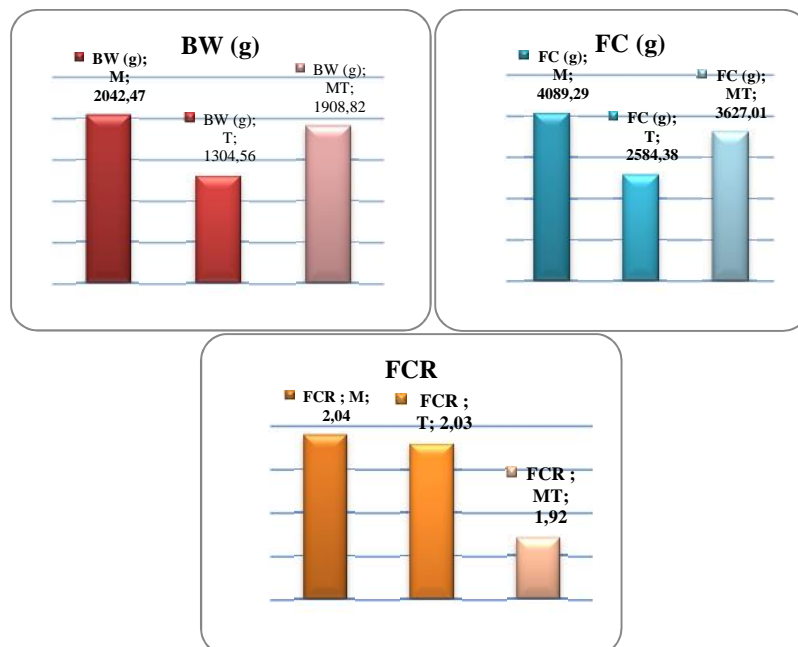
Figure 1. Performance Characteristics of broilers fed different level triticale replacement without any enzyme.
In this study, FCR was showed same pattern in M and T groups, but MT group's different that's FCR 6% was lower than in the control M group (P<0.01) (Table 1.). This may give an indication that inclusion of triticale without any enzyme did have a negative effect on performance characteristics.

Table 2. Performance Characteristics of broilers fed different level triticale replacement without any enzyme (Mean+SE)

Traits	Feed	7. d	14. d	21. d	28. d	35. d	42. d
BW	M	138.57 ± 2.21 a	326.58 ± 6.06 a	688.72 ± 13.00 a	1138.41 ± 18.20 a	1602.48 ± 18.80 a	2042.47 ± 21.00 a
	T	120.92 ± 2.60 b	214.79 ± 5.73 c	342.70 ± 10.20 c	506.34 ± 19.60 c	913.28 ± 30.60 c	1304.56 ± 33.80 c
	MT	114.75 ± 1.02 c	260.14 ± 3.70 b	584.85 ± 08.22 b	1022.23 ± 11.20 b	1485.37 ± 14.70 b	1908.82 ± 25.00 b
	P	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
FC	M	130.12 ± 2.17 a	429.00 ± 07.16 a	1056.67 ± 21.30 a	2075.85 ± 29.80 a	3020.83 ± 35.70 a	4089.29 ± 43.60 a
	T	112.60 ± 2.84 b	308.14 ± 09.31 b	657.31 ± 18.00 c	1053.98 ± 28.90 c	1716.63 ± 47.10 c	2584.38 ± 57.50 c
	MT	108.30 ± 1.83 b	312.96 ± 14.40 b	869.43 ± 24.90 b	1654.05 ± 18.90 b	2579.83 ± 27.90 b	3627.01 ± 36.80 b
	P	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
YDK	M	1.31 ± 0.010 b	1.50 ± 0.016 b	1.63 ± 0.016 b	1.89 ± 0.016 b	1.94 ± 0.017 a	2.04 ± 0.016 a
	T	1.38 ± 0.022 a	1.76 ± 0.025 a	2.18 ± 0.056 a	2.29 ± 0.072 a	1.98 ± 0.042 a	2.03 ± 0.025 a
	MT	1.43 ± 0.020 a	1.42 ± 0.069 b	1.59 ± 0.041 b	1.68 ± 0.014 c	1.78 ± 0.010 b	1.92 ± 0.009 b
	P	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01

a, b, c, :Means in rows with no common superscript differ significantly (P<0.01). Initial weights of treatment groups were not significant, then they not given on the table.

The poorer FCR of the triticale-fed birds may be due to lower nutrient amounts, limited nutrient availability, or antinutritional factors not found to the same extent in maize. However, other researchers have observed poorer FCR with triticale-based diets in broilers (Gerry, 1975; Proudfoot and Hulan, 1988; Vieira et al.(1995) Smith et al. (1989) reported 4 to 5% reduction in average FCR for broilers fed triticale compared with a maize control diet from 0 to 2 wk and from 2 wk to 3 wk of age.

Variable results in triticale feeding experiments are reported in the scientific literature. Azman et al., (1997) reported that 35% triticale (Tatlıcak) may be substituted to broiler diets. Karaalp and Ozsoy, (2001) reported that the rate of 30% triticale can be used without performance-enhancing feed additives for broiler chicks feed mixtures but the usage of a high rate triticale in feed mixtures cause decreasing of performance, so triticale cannot be used as a sole sources instead of maize for broiler chickens. Elsewhere, poultry feeding studies shows that diets containing up to 30% triticale have had no negative effect on performance with enzyme and result in significant saving of feed cost. Hermes and Johnson (2004) reported that feeding broiler chicks triticale up to 15% with maize did not affect their performance. Ba er and Yeti ir (2007), reported that triticale rate should not exceed 20% for broilers, 30% for laying hens, and 40% for quail and partridge feed mixtures. Negative effects regarding the decrease in birds' body weight by feeding triticale were observed by Korver et al., 2004) and others (Gerry, 1975; Ruiz et al., 1987; Smith et al., 1989) which agreed with our findings. However, other researchers disagreed with our results by reporting non-detrimental effect of triticale in poultry feeding trials. Vieira et al. (1995) found that the graded inclusion of triticale up to 40% (substituted for maize) had no negative effect on weight gain or final weight of broilers. In those studies, the limited replacement of the main cereal grain might have hidden any negative effect of triticale. Antinutritional factors in triticale include soluble pentosans (Pettersson and Aman, 1988, Rundgren, 1988) trypsin inhibitor, alkyl resorcinols, and pectins (Smith et al., 1989).

It was found that there were significantly differences between M,T, and MT groups for broilers BW, BWG, FC, and FCR at the end of trail. BW of birds fed M were %36 and %6 heavier than that fed T and MT groups respectively (P<0.01). The FC and FCR M, T and MT groups were (4089.29 ; 2.24); (2584.38 ; 2.20); (3627.0 ; 1.89) respectively at the end of the trail (P<0.01). Livability was not affected by M, T and MT groups treatments. Supplementation of triticale by 50-58% for broilers diets within the first 4 weeks without any kind of enzyme including phytase causes a very significant growth retardation. To obtain optimum efficiency broiler chicks should not feed triticale alone as a sole source without any kind of enzyme including phytase prior to 4 weeks. Instead of triticale alone as a sole source, a 50% corn and triticale mixing by half in the case generally compensated possible growth retardation.

Carcass characteristics

Carcass characteristics as a mean values of the broiler chicks fed triticale with different levels without any enzyme at 42 d of age has shown Table 3.

Table 3. Carcass and Organs Characteristics of Birds (0-42d) fed different level triticale replacement without any enzyme. Mean+SE)

Parameters	M (Maize)	T (Triticale)	MT (Maize+Triticale	P
Live Weight (kg)	2049,44±12,70 a	1312,77±14,90 c	1925,43±16,60 b	<0,01
Eviscerated Percentage (%)	76,21±0,168 a	71,11±0,187 c	74,05±0,162 b	<0,01
Eviscerated Weight (kg)	1561,60±09,80 a	934,06±11,30 c	1426,24±13,10 b	<0,01
Edible Giblets or Internal Organs (% EW) (g)				
Liver	32,19±0,62 a	22,48±0,39 c	29,79±0,51 b	<0,01
Heart	9,91±0,19 a	6,76±0,01 c	8,39±8,39 b	<0,01
Gizzard	41,57±0,79 a	33,99±0,54 c	38,60±0,72 b	<0,01
Cut up parts (% EW) (g)				
Breast weight	413,19±4,36 a	203,73±3,68 c	359,22±4,49 b	<0,01
Thigh weight	121,07±1,25 a	76,24±0,87 c	113,92±1,49 b	<0,01
Durumstick weight	97,52±1,00 a	62,27±0,99 c	90,83±1,08 b	<0,01
Wing	83,34±0,94 a	52,42±0,53 c	74,41±0,87 b	<0,01
Neck	64,14±1,18 b	46,70±0,77 c	66,68±1,30 a	<0,01
Abdominal fat	33,03±0,65 a	20,37±0,45 c	29,93±0,45 b	<0,01

[a,b,c]means in rows with no common superscript differ significantly (P<0.01)

All the parameters measured among the treatment groups differences showed as a similar percentages. Live weight value of birds in the control group was significantly higher than those of MT and T groups (P>0.01). Carcass weight was decreased significantly (P<0.01) when 100% triticale was replaced to maize diet. Birds with 100% triticale had the least live and eviscerated weight. MT group was only lower 6% than M group but T group was lower 36%. The Eviscerated percentage were 76, 71 and 74% respectively M, T and MT groups. Breast meat weight of T group chicks was decreased significantly (P<0.01) compared with the chicks the control (M) and MT. Big reduction was seen about breast weight as 51%. This is important because broiler chicken breast is more valuable than other carcass parts. Breast, thight, drumstick weights relative to eviscerated weight for T diet with 100% triticale were significantly (P<0.01) lower than those of diets groups with M and MT. The thight and drumstick weight was found to be significantly (P<0.01) lower in chicks from the T group compared with other groups. Dietary triticale was also decreased the gizzard, heart and liver weights relative to eviscerated weight (P<0.01). Wing weights decreased when dietary triticale level was increased to 100%. The highest neck weight was obtained from MT, while the least was T group. There were significant differences between all groups in term of abdominal fat weight. However, the abdominal fat weight were higher for chicks fed maize compared with other groups. Abdominal fat weight, as percentage of eviscerated weight, was decreased with replacement of triticale when compared with those maize based diet (P<0.01).

The analysis of slaughter and carcass characteristics were different. Control birds (M group) with higher body weight compared to the other groups (P<0,01), their eviscerated weight were also different, which shows that the introduction of triticale into the feed mixtures had effect on this parameter. Korver et al. (2004) reported that feeding triticale to broiler had a negative effect on eviscerated carcass weight and many portion weights, which agreed with our findings. On the other hand, Charalambous et al. (1986) observed that carcass yield carcass plus edible giblets yield, and dressing percentage were higher in birds fed maize or maize–triticale diets than in broilers fed a diet with triticale as the only cereal grain. These findings support our results which conclude that feeding higher triticale as decreases eviscerated carcass weight and many portion weights and the deposition of abdominal fat in broiler when compared with using maize. Therefore, high inclusion of cereal grains may result in poor growth, less efficient digestive organs, poor feed conversion ratio and carcass downgrades of broiler birds. Such negative effects are usually associated with the presence of high levels of non-starch polysaccharides (NPS) in cereal grains such as wheat and corn or their by-products. Enzymes may overcome these problems by increasing the digestibility and reducing the amount of excreta in broilers. Digestive enzymes typically hydrolyse the dietary components and so are classified as hydrolases (Taylor-Pickard, 2008). Although numerous research articles and reviews have been published on various aspects of enzyme use in the poultry industry (Bedford, 1996; Choct, 2006; Kamyab and Houshmand, 2006; Aksu 2007; Brzoska and Steck, 2007), it is still unclear how these enzymes could remain effective in improving feed utilisation in the foreseeable future. We conclude that eviscerated carcass, thigh, drum and breast as a percentage of carcass weight were lower in T and MT groups 36 and 6% than M (control group) respectively. Abdominal fat yield in T and MT

groups were also lower 9 and 38% than those of M group. Final BW, carcass weight and slaughter traits of broilers fed triticale were affected negatively within similar percentage by increasing inclusion of triticale to diets without any enzyme (phytase included).

Conclusion

The replacement of triticale in broiler chicken starter and grower diets resulted in lower live weight of T and MT groups as compared to control diets M. The general trend observed as triticale increases up to 100% it tended towards decreased live BW gain. 100% maize group had the highest FC and also the highest live BW gain. MT group's FCR was 6% lower than others that maize consumption may be compensated triticale's negative effect. Slaughter and carcass characteristics were also affected birds fed triticale and caused a significant decrease on breast, thigh, drumstick and other carcass part . From the technical point of view, %100 triticale substitution was not successful, but the 50% triticale replacement even without any enzyme (25% grower and 30% for finisher diets but not starter diets) is better than %100 triticale. Therefore, %100 triticale replacement is not advisable that triticale and it shouldn't be used without any enzyme within first starter period for broiler chicken under commercial conditions. However, we can conclude that birds in the MT group may be compensated triticale's negative effect with maize consumption even not use any enzyme (phytase) include with triticale relation of yield performance and carcass characteristics of broiler chicken. Further research is needed to study the effect of using enzymes especially starter period to overcome the negative effect of the antinutritional factors in triticale which may reduce nutrient utilization by broiler chicks.

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THE LIVESTOCK SITUATION OF TURKEY

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Abstract

In this review, it was intended to present general information about the products status, breeding systems and to propose recommendation for improvement of the potentials about livestock. Based on the agricultural statistics by Food and Agriculture Organization of the United Nations (FAO) and Turkish Statistical Institute (TSI), there is an important potential in terms of livestock farming, the number of animals and the production value. According to 2013 figures, the number of cattle has increased 3.6% compared to the previous year, while the number of small ruminants has increased 6.8 %. By the end of year 2013 the number of cattle is 14.415.257, sheep 29.284.247 and goat 9.225.548 of head. Total milk production increased by 4.7 % compared to the previous year, 18 million tons.That 91.39 % of the cow's milk, 6.04 % of sheep milk, 2.28 % of goat's milk and 0.29 % of has created the buffalo milk. In the same period, the wool, hair and lint production increased, while honey, beeswax and in the production of silk cocoons has seen a decrease. During this period,the total number of poultry increased by 4.9 %. By the end of 2013 the number of broilers and laying hens 5.0% to 177.5 million units, an increase of 4.8% from the number of 89 million units, while the number of turkeys increased by 6.0% and reached 2.9 million units. In the same period, the increase in the number of ducks and geese, while the increase of 3.1 % percent in the duck, goose stood at 11.7 %

Key words: *Turkey, Livestock, Cattle, Small Ruminant, Poultry*

Introduction

Livestock in the whole world as it is adequate and balanced nutrition for the growing population in Turkey and used as raw materials in many areas of industry occupies an important place. However, unlike other sectors of the livestock sector in the country due to host many sectors of the economy that brings solutions to the social problems of the country.
The livestock sector in Turkey has considerable potential and is an important part of the agricultural sector and economy. Livestock contribute to the economic development of rural households. The Livestock products such as; meat, milk, eggs, honey, wool, and hides play a significant role in the Turkish economy.
The livestock sub-sector in Turkey, consisting mainly of cattle, dairy, buffalo, poultry, sheep and goats, includes traditional and commercial activities.
Animal husbandry has a great potential and is well placed in Turkish national economy and agricultural sector. Turkey in terms of geographical features and a suitable environment for the production of all animal products has a significant potential.
The Turkish livestock sector is characterized by small-scale farms and domestic breeds, which are better able to adapt to the harsh climate of eastern Turkey but are less productive. More than half of the nations' herds are in eastern Turkey, despite less suitable topographical and climatic conditions (Gifford and Sertta , 2010).
Turkey maintains a very restrictive livestock product import policy, allowing only imports of dairy and and beef breeding stock.
Although demand for meat products is increasing, the Turkish livestock suffer from low yields, extreme price fluctuation, and an unpredictable government support system.

The recent high meat prices have attracted investments in the sector. Large companies have tried to establish commercial farms in the western parts of the country, primarily for dairy production, along with some feedlots. In the west part of Turkey former textile factory owners are also investing in the livestock sector. These investments have increased demand for quality live cattle and livestock genetics in recent years

Animal husbandry sector plays an important role in nutrition, and has so many economic functions such as increasing national income and level of welfare, providing raw material for food, textile, leather, cosmetic and medicine sectors. At the same time, the sector has many other effective social functions such as decreasing and preventing migration, and decreasing registered and unregistered employment. In addition, the human being benefits from all the materials of the animals from their skin to their nails (Selli et all, 2010).

Products meat, milk, eggs, fibre and hides from the livestock subsector in Turkey contribute 30 percent of total agricultural gross domestic product (GDP). Some 96 percent of the country's 4 million agricultural enterprises are mixed crop–livestock farms. The average number of animals per farm is low (Gursoy, 2006).

The contribution of livestock production is 26,5% in the agricultural production value (of 89.782 million TL). And the greatest contribution to livestock production value comes from cow milk as much as 42 % of it.

Livestock value decreased by 9.2% respect to previous year and reached to 57.7 billion TL in 2013. Value of bovine animals decreased by 15.1% and became 36.7 billion TL whereas value of sheep and goats increased by 3.3% and reached to 17.3 billion TL. Value of poultry became 3.5 billion TL with 3.2% increase.

The value of animal products reached to 40.5 billion TL with 2.1% increase in 2013. Total production values of milk 18.3 billion TL, honey reached to 1.9 billion TL, hen eggs production value reached to 3.9 billion TL and red meat production value became 16.0 billion TL.

Graphic 1. Value of Animal Production, 2012 - 2013
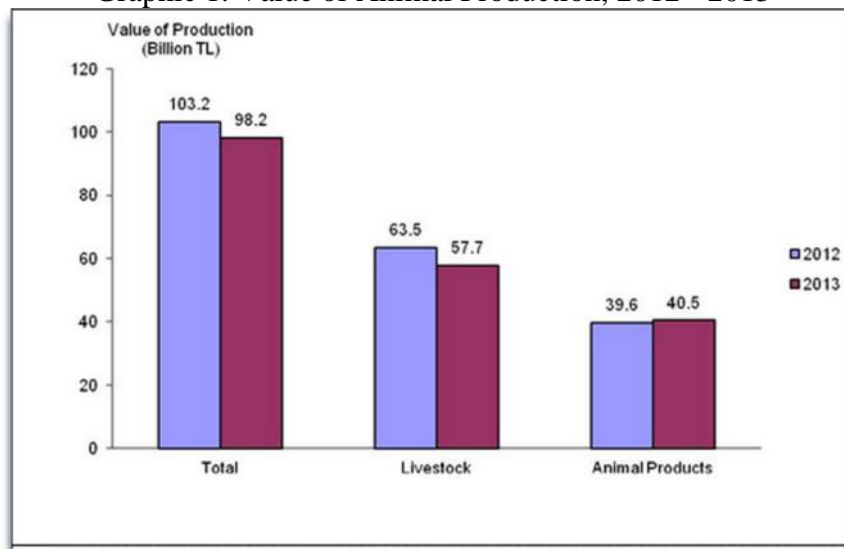
Source: TSI (2013)

Livestock Sector in Turkey

The livestock sector is still traditional and important sector in Turkey. The Turkish livestock sector is characterized by small-scale farms and domestic breeds, which are better able to adapt to the harsh climate of eastern Turkey but are less productive. In Turkey, the family owned farm is the basic unit of agricultural production, and family members provide most of the farm labor.

Livestock products are an important source of household income for many farmers and households in rural areas. For small farmers, livestock products such as cattle, sheep and goat generate income and ensure food security for these households because an important amount of their incomes comes from the sales of animal and milk (Akbay and Boz, 2005).

Livestock Population in Turkey
Regarding the number of animals and level of yields per animal, it should be clearly stated that yields were rather low as compared to the developed countries.
Turkey take place in the first place in terms of the bees, chickens and goats presence of among EU (28) countries, while presence of cattle, buffalo and sheep ranks second.

Table 1. Trends in livestock numbers in Turkey (2000-2013)

Years	Cattle	Buffalo	Sheep	Goat	Poultry	Beehives
2000	10.761.000	146.000	28.492.000	7.201.000	258.168.320	4.267.123
2005	10.526.440	104.965	25.304.325	6.517.464	317.497.114	4.590.013
2010	11.369.800	84.726	23.089.691	6.293.233	234.918.385	5.602.669
2013	14.415.257	117.591	29.284.247	9.225.548	266.153.454	6.641.348
Change (%)	33.96	-19.45	2,78	28,11	3,09	55,64

Source: TSI (2013)

Livestock Products in Turkey
Table 2. Trends in Livestock products in Turkey (tonnes)

Product	2000	2005	2010	2013	Change, %
Red Meat					
Beef	354636	321681	618584	869292	142,3
Buffalo*	4 047	1 577	3 387	1.736*	-57.1
Lamb/Mutton	111 139	73 743	135 687	102 943	-7,3
Goat	21395	12390	23060	23554	-55,6
White Meat					
Poultry	643 457	936 697	1 444 059	1 758 363	171,2
Total Meat	662 731	979 406	1 476 025	1 797 990	134,8
Hen Eggs	13 508 586	12 052 455	11 840 396	16 496 751	22.0
Honey	61091	82336	81115	94694	54,8
Milk					
Cow	8732041	10026202	12418544	16655009	91.0
Sheep	774 380	789 878	816 832	1 101 013	42,1
Goat	220211	253759	272811	415743	88,7
Buffalo	67 330	38 058	35 487	51 947	-22,8
Total Milk	9793962	11107897	13543674	18223712	86.0

Source: TSI (2013)   * TSI, 2012 Stst.

Livestock products between the years 2000 and 2013 was shown in Table 2. According to the data, buffalo, lamb/mutton and goat meat quantity decreased by -57.1%, -7,3 and -55,6 respectively while beef meat increase by 142,3% with respect to previous 2000 year.
Additionally, the white meat (poultry) inreased by 171,2 % between the mentioned years. Total meat quantity increased by 134,8 and reached to 2.793.000 tonnes approximetly. Hen eggs imroved by 22% and honey 54,8 % as well. The milk quantity except buffalo milk increased by 86% totally.

Comparing of the Turkey's Livestock Production with EU (28) Countries

Table 3. Livestock production and changes of EU28 and Turkey (2000 production=100)

Livestock Products	2000 1000 t	2005	2010	2013	2013 1000 t
		*EU 28			
Cattle meat	8.516.634	95,5	98,4	93,6	7.970.638
Buffalo meat	1.767	365,5	380,2	1367,2	24.158
Chicken Meat	8.144.929	108,2	122,6	129,7	10.567.149
Total Milk	156.155.395	99,2	98,2	99,8	155.919.234
Hen Eggs	6.711.057	100,2	101,7	99,7	6.689.713
Goat Meat	94.158	105,0	102,4	92,9	87.495
Goat Milk	1.982.607	104,7	100,4	97,2	1.927.712
Honey	168.899	118,6	121,0	113,2	191.119
Lamb /Mutton Meat	1.202.214	88,1	74,2	73,2	880.379
Swine Meat	21.723.966	100,3	105,7	105,1	22.842.351
Sheep Milk	2.705.480	101,8	107,8	103,3	2.795.315
Turkey Meat	1.961.525	93,7	88,8	90,0	1.765.151
Wool	197.143	94,9	95,9	97,6	192.483
		**TURKEY			
Cattle Meat	354.636	90,7	174,4	245,1	869.292
Buffalo Meat***	4.047	39,0	83,7	8,3	1.736*
Chicken Meat	643.457	145,6	224,4	273,3	1.758.363
Total Milk	9.793.962	113,4	138,3	186,1	18.223.712
Hen Eggs	13.508.586	89,2	87,7	122,1	16.496.751
Goat Meat	21.395	57,9	107,8	110,1	23.554
Goat Milk	220.211	115,2	123,9	188,8	415.743
Honey	61.091	134,8	132,8	155,0	94.694
Lamb/Mutton Meat	111.139	66,4	122,1	92,6	102.943
Sheep Milk	774.380	102,0	105,5	142,2	1.101.013
Turkey Meat	19.274	221,6	165,8	205,6	39.627
Wool	43.140	107,0	99,3	127,0	54.784

Source : *AB (28) FAO Statistics (2012), ** TURKEY, TSI (2013)   *** (TSI, 2012)

EU(28) and Turkey's main animal products in terms of value of production value was given in Table 3. As can be seen in mentioned table; beef, goat meat, sheep and lamb, turkey meat and wool production, with the exception of any product or group of products for the EU production quantity is not below in terms of 2000 values. However, in Turkey the situation is quite different. In by the year 2013, many production values are above the production in 2000, while 92% in buffalo meat has seen a decrease.

The major livestock products in Turkey consist of cow milk, broiler meat, eggs, beef and veal, lamb, mutton and goat meat. Based on religious and cultural preferences the demand of pig meat is negligible in Turkey.

Under the baseline, Turkish beef, sheep meat and eggs are significantly above the respective EU prices due to the high levels of tariff and non-tariff protection provided to Turkish livestock farmers. In contrast, Turkish broiler prices are projected to remain below the EU prices for the projection period (Leeuwen et all, 2011).

Conclusıon

In spite of Turkey is in the first place in terms of the the animal presence among EU (28) countries, productivity per animal is low. It is well known that Turkey's shortcomings in animal production can be improve by using the country's potential already exist. Turkey need to improve its own animal production for both better nutrition of the people living in country and the country wealth and prosperity (Tatar, 2013).

EU-related studies at least have the ability to agree on what can be done. However, those proposed by the EU to Turkey as the only real orders and not to regard it should be an understanding .

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THE STRUCTURAL SITUATION AND FEEDING PRACTICES IN CATTLE FARMS IN DIYARBAKIR PROVINCE IN TURKEY

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Abstract

The objective of the study was to determine the structure of farms, feeding practices and the use of feed resources in cattle farms in Diyarbakir Province. This research has been conducted in 17 districts of Diyarbakir. Totally, 465 cattle farms which have more than 25 cows were investigated. Interviews were conducted face-to-face with farm owners during the autumn season in 2013. Results show that cattle farms in the region are consisted of family based small scaled enterprises (83%), cooperative (12%) and private big farms (5%). Current cattle breeds in farms were 11% of local breeds, 31% of cross breeds and 58% of pure breeds. The average milk production per cow was 5.25 liters for local breeds, 7.25 for cross breeds and 10.65 liters for pure breeds, respectively. In addition, the 26% of cattle farms experienced problems in obtaining feeds. We observed that 70 and 88 of % of farms purchasing forage and concentrate feeds respectively. In addition, forage crops are grown in only 10% of studied farms. As a roughage source hay, poor quality hay, silage and other roughage at the rate of 69, 18, 12 and 1% were used in farms respectively. Results from this study showed that farmers had insufficient knowledge on the feed preparation and animal feeding practices.

Key Words: *Cattle farm, Structural Situation, Feeding, Diyarbakir Province*

Introduction

Adequate and quality food production is still expected to be the greatest power in determining the future of the countries that swept the globalization policies. It is obvious that the countries can produce their own food in sufficient level will have more say in determining the future of countries of the world. Dairy farming is the most important livestock production in Turkey. Approximately 91.4% of the milk production has been obtained from cattle in Turkey according to TurkStat (TUIK, 2013). This value is 98% for the European Union (EU) and 85% for world-wide. Cattle breeding have an important factor for the meat production. The similar situation is in Turkey according to the statistical data of the end of 2013 where approximately 87.2% of the red meat has been obtained from cattle. Number of ruminant livestock animals for Turkey and researched zones are given in Table 1. Turkey's ruminant livestock resources in 2013 consisted of 14.415.257 head of cattle, 29.284.247 head of sheep, and 9.225.548 goat heads. The proportions of local, cross-breed, and pure breeds are 16.3% (local), 42,4% (cross) and 41.3% (pure), respectively at the end of 2013 in Turkey. There are significant differences between the regions regarding cattle farming in Turkey. In Marmara and Aegean regions cattle breeding are often intensive in modern conditions. Whereas, in Eastern and Southeastern Anatolia regions conditions are more extensive and cattle raising is made largely at the small family farms.

Table 1. Number of local, cross-bred and pure cattle, sheep and goats by agricultural zones in 2013 (TÜ K, 2013)

Species	Turkey	Southeastern Region	Diyarbakir
Total cattle	14.415.257	963.540	334.876
Local	2.348.487	320.712	143.001
Cross bred	6.112.437	346.036	112.229
Pure	5.954.333	296.792	79.646
Buffalo	117.591	11.130	9.950
Sheep	29.284.247	4.844.744	741.312
Goat	9.225.548	2.066.310	231.415

Diyarbakir is one of the largest cities in Southeastern Region in Turkey. Situated on the banks of the River Tigris, it is the administrative capital of the Diyarbakir Province and with a population of over /about 1 million. The province of Diyarbakir extends over an area of 15.355 km^2. This region is one of the most heavily grazed parts of Turkey. The climate is semi-arid and the pastures dry out very quickly at the end of June. There is some nomadic type of grazing in the region. Since there is short spring and summer grazing, some of the livestock are moved to Eastern Anatolian pastures or to high mountain pastures of the South Eastern Taurus Mountains in the west. About 6% of the pasture area of Turkey is situated in this region (Karagöz, 2006).

Generally, crop production and livestock are performed together by the farmers in Diyarbakir province. All types of livestock operations can be performed in this zone due to the suitability of the climate and geographical features. In this province cattle and sheep breeding is the most common types of animal production. High proportion of cattle is raised under traditional systems. Most cattle farms are still under traditional management relying mainly on extensive grazing, and receiving poor quality feed. However, this indicates a structural change in the livestock sector through a move to more intensive systems.

The main goal of this study was to determine the structure of dairy farms and the practices of animal feeding and the use of feed resources in dairy cow farms in Diyarbakir Province, Turkey.

Material and Methods

This research has been conducted in 17 districts of Diyarbakir. Totally, 465 cattle farms which have more than 25 cows were investigated. Interviews were conducted face-to-face with farm owners during the autumn season in 2013. The farms selected randomly. Interviews were conducted face-to-face with dairy farmers. The questionnaires with 25 questions were asked and the answers given to farmers were recorded. The data obtained at the study were analyzed by using SPSS 15.0 for windows.

Results and Discussion

An extensive cattle farming is common in the Diyarbakir region. The most of cattle farms has been found as the family based enterprises. Cattle farms in the region consisted of family based small scaled enterprises (83%), cooperative (12%) and big farms (5%). The number of cattle in each of the regions of the Turkey fell year on year. The number of cattle in Southeastern region and Diyarbakir province has increased between 2009 and 2012. While the number of local breeds decrease, the number of pure and cross- breeds increased by the

years. About 58% of pure breed with high yielded, 31% of cross-breds and 11% of local breeds constitute the cattle population of Diyarbakir province.

Livestock kept or produced in smallholder farming systems are an important component of the agricultural economy in the developing world. The role of livestock on smallholder farms varies widely, providing draught power for crop production or as a production activity for subsistence needs or market sale under systems ranging from extensive pastoralist to intensive, peri-urban feeder and dairy systems (Mcdermott et al., 1999). Number of cattle farms in the Diyarbakir respect to their capacity of the existing situation and rate is given in Figure 1.

Figure 1. Number of cattle farms in the Diyarbakir respect to their capacity of the existing situation and rate
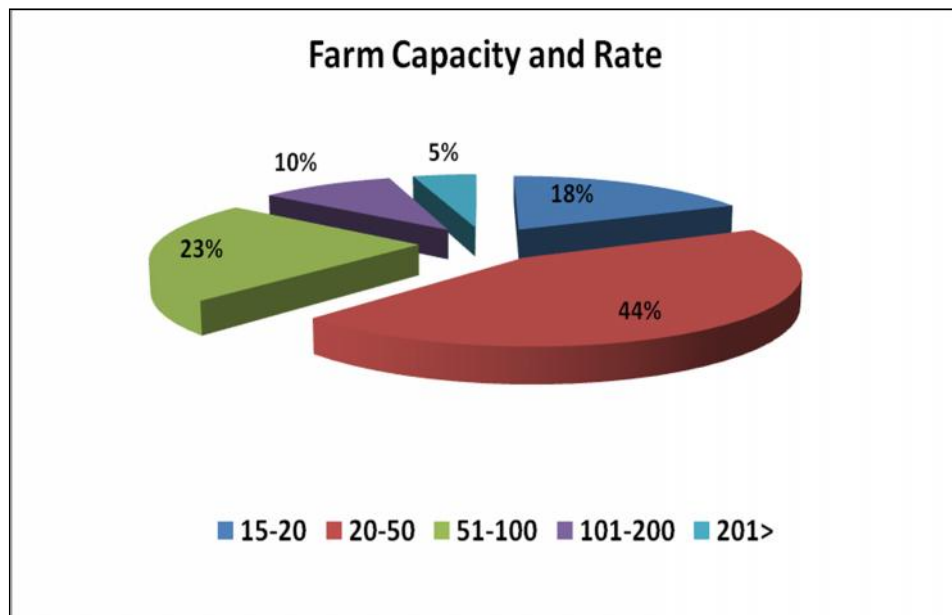
According to the results obtained, the distribution of cattle enterprises are as follows; 204 cattle holdings (44%) having 25-50 of cattle, 108 holdings (23%), having 51-100 head of cattle,, 85 cattle holdings (18%), having 15-20 head of cattle, 46 cattle holdings (10%) having 101-200 head of cattle and 22 cattle holdings (5%) having more than 201 head of cattle. The farms having between 15 to 20 and 25 to 50 head of cattle were small ancient farms performing under primitive indoor barns in villages. Farms having more than 51 head of cattle were new established partly modern and modern ones.

Average of daily milk yield per cow during the lactation period was given in Figure 2. The average milk production per cow was 5.25 liters for local breeds,, 7.25 for cross breeds and 10.65 liters for pure breeds, respectively. Results shows that pure breeds have the highest milk yield.

Figure 2. Average of daily milk yield per cow per by lactation period
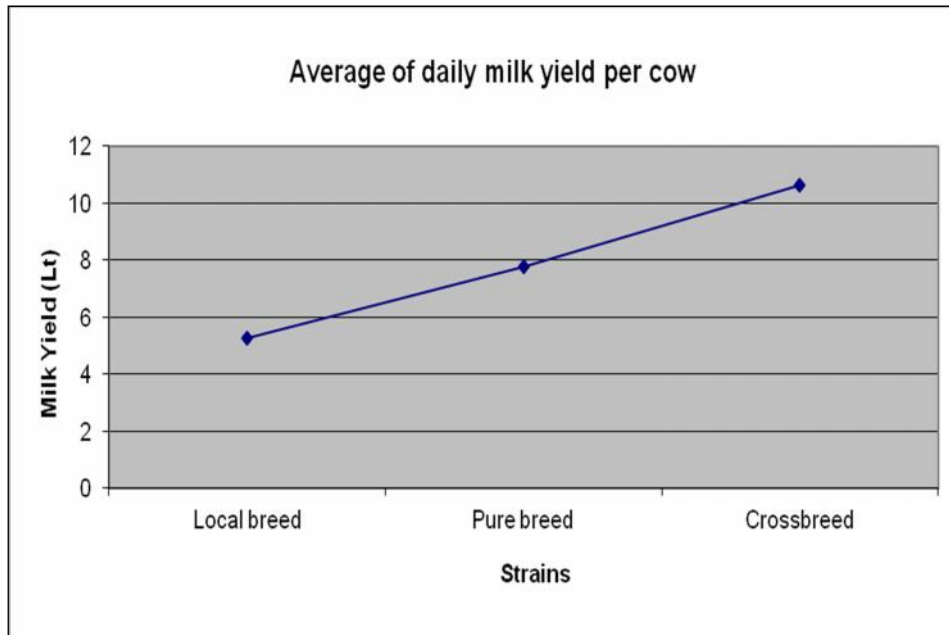
The major factor for improvement in production is to optimize the efficiency of utilization of the available feed resource. Feeding is the most important and probably the most confusing part of raising cattle. This is because there are a wide variety of feedstuffs, ration types and alternatives, and methods of feeding cattle. Feed cost representing approximately 60 to 70 percent of the cost of producing milk. We observed that 70 and 88 of % of farms purchasing forage and concentrate feeds respectively.. In addition, 26 % of dairy farms experienced problems in obtaining feeds and forage crops are grown in only 10% of farms. We determined that Hay, poor quality hay, silage and other roughage at the rate of 69, 18, 12 and 1 % were used in farms respectively. We observed that only 15% of farmers have knowledge about ration formulation, remaining of farmers have not any knowledge on ration formulation techniques.

Conclusion

As a result, cattle farmers in had insufficient knowledge on the preparation feeds, animal feeding practices Diyarbakir province. At the same time serious errors in animal nutrition and feeding practices causes severe yield losses and productivity in farms.

Acknowledgments

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CAMEL WRESTLING ECONOMY IN MODERN TURKEY

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Abstract

Aim of this paper to review traditional camel wrestling and its place in Turkish economy. In Turkish history, camels were always important in their life. In the past camels were used as transport, pack, ride, war, food and sport animal by Turks. After industrialization and modernization since 20th century, camel lost their importance and nowadays they are only a sport and tourism material in Turkey. Hence the camel population in Turkey decreased in number of about 1.000 recently. The camel population is mostly used for camel wrestling events in West Anatolia. The camel wrestling events are organized about in 60-70 places annually during winter season. Wrestling events are on Sundays and followed by not only men spectators but also women and children. Because of this side, camel wrestling events is a family sport. Although camel wrestling equipments, accessories, ornaments, wages of take carers, transport for wrestling from city to city, accommodation, catering are quite expensive, camel owners are not so rich people, but low or middle income people. Hence, those organizations and camel owners should be supported by the state more in order to survive this traditional event.

Key Words: *Camelus dromedary*, *Camelus bactrianus*, genetic resource, native breed, sport.

Introduction

Because of geographical position Turkey is like a bridge between ages, nations, cultures and civilisations besides continental of Europe and Asia (Yilmaz et al., 2011). In Turkey there are reared some native domesticated animals including bee, camel, cat, cattle, dog, donkey, duck, goat, goose, guinea fowl, hen, horse, mule, partridge, pheasant, pig, pigeon, rabbit, sheep, silkworm, turkey, and water buffalo (Wilson and Yilmaz 2013[a,b]; Wilson et al., 2011, Yilmaz and Wilson 2012; Yilmaz and Wilson 2013; Yilmaz et al., 2011; Yilmaz et al., 2012 [a,b,c,d,e,f], Yilmaz et al., 2013[a,b]).

Table 1. Camel numbers and camel meat production in Turkey 1999-2012 (Yarkin 1965; Aydin, 2003; Anon, 2014[a]).

Item	Year											Change 1960-2012 (%)
	1928	1937	1950	1960	1970	1980	1990	2000	2003	2010	2012	
Number	74.437	118.211	110.000	65.390	39.000	12.000	2.000	1.350	808	1041	1315	-98,0
Animals slaughtered	N/A*	N/A	N/A	1.600	3.140	400	320	29	N/A	N/A	55	-96,6
Tonnes meat	N/A	232	160	208	531	60	75	8	24	N/A	18	-91,3

*N/A: Not available)

The origin of the word camel likely is derived from the Greek word 'Kremal' or from the Sanskrit word 'Kreluk' which means 'throw away legs' (Khan et al., 2003). The genus of

Camelus was likely among one of the last domesticated animal species. It is believed that camels were domesticated in Saudi Arabia peninsula around 1.500 B.C. and spread to Anatolia (Asian part of Turkey) around 300 B.C. (Wilson, 1998). Camel is not widely reared recently and the numbers critically decreased in 20th century continuously (Table 1). Nowadays camels are used in small numbers as pack animal in provinces of Antalya, Mersin and Mugla (Figure 1). The majority of camel population is used for camel wrestling in 21st century in Turkey (Yilmaz et al., 2011). The camel is also used as a sacrificial animal for slaughtering (Cetin et al., 2011).

The aim of this review is to report camel wrestling from history to present with all aspects.

Figure 1. Nomadic Yoruk Turks migrating from plain to highland (Photo by M. Karakoyun)

Camel

All wrestling camels are illegally imported when they are 8-9 years old age from Iran, Afghanistan and Turkmenistan to Turkey. They illegally pass the border between county of Maku (Iran) and county of Dogubeyazit (Turkey) (Anon 2011; Bagcil, 2013). A wrestler camel is called as 'tulu' which is crossbred of a single-hump Arabian female camel (*Camelus dromedary*) and double-hump Asian male camel (*Camelus bactrianus*) (Kilickiran 1987).

Although other large ruminants have horns, camel does not any horn which is good for camel wrestling (Gulsoken, 2010). Temporary teeth fall around 7 years old age and permanent teeth come out around 8 years old age. Between 5-8 years old age, the camel is begun to wrestle but he should not be mauled until 10 years old age. After 12 years old age, a wrestler camel is accepted as adult (Bagcil, 2013). They wrestle effectively from the age around 10 to 20 (Anon 2011; Anon, 2014[c]). Although some of them can live up to 40 years old age, after 25-30 years old age, they can have front leg disorders which cause walking difficultly and limping (Bagcil, 2013).

Weight of wrestling camels is normally 400-500 kg, but under good feeding and care this amount increase up to 1000-1200 kg around fall season (Anon, 2012). In fall season camel should be exercised and must lose weight up to around 900 kg (Bagcil, 2013). In this season they started to rut and 'havut' (camel packsaddle) is put on the camel (Culha, 2008). Havut is put on the camel on the day of Republic Day, 29 October which is called as 'Havut Giydirme

Toreni' (Kilickiran, 1987). All wrestling camels put on packsaddles are adorned and taken for a walk in that settlement (Caliskan, 2009). After putting havut, camel begins to be exercised (Caliskan, 2010[b]). Also havut helps to exercise, so lose weight to around 900 kg. Heat signs can obviously be seen. For example a kind of oily liquid called as 'mislik' is secreted from his neck. (Bagcil, 2013).

Camel wrestling fans agree that, a champion is born and not made (Kilickiran, 1987). According to Muhsin, a saddler from Burhaniye, a perfect camel is lower in front part, but higher in rear part of body. The camel has long neck, small head, symmetric hump, thin tail, balanced testicles, and bigger penis (Gulsoken, 2010). Wrestling camels can be trained, but no amount of training can make up for a weak or overly peaceful character (Kinzer, 2000). A wrestler camel morphologically should have in shorter front legs, but longer rear legs. Hump of wrestling camel should be in almond shape and it is so called as 'badem horguc' (almond hump) (Kilickiran, 1987).

Normally camels do not attack to human. If somebody hit or kick to the camel, the camel never forget the attacker and want to hurt him and attack to him. Camels can know people by smelling, hearing or seeing. (Bagcil, 2013).

When camels are brought to wrestling arena, camels generally open their back legs and wave their tail, or cock their head back and moan (Figure 2). This is the kind of posing "I am looking for my opponent". Organizers arrange a female camel just outside the fighting ring to provoke the male wrestlers (Parkinson, 2011). When the camel is brought to the arena, he should erect his ears. If he droops his ears, this means the camel does not want to wrestle. If a camel is crushed and screamed by his adversary, that camel does not want to wrestle again at least 2-3 weeks. During wrestle a camel sometimes droops his ears, erect his tail and look for the gate which means he will flee (Bagcil, 2013). On the other hand the camel owners tries to find a good spot in the fields outside, where their camels can size each other up for the contests (Aydin, 2011).

Figure 2. Legs opened and waving tail. The 'pes' is also seen on 'havut'

Preparations
Wrestling organizing committee (WOC) which consist from several persons invites camel owners and negotiates about cost of truckage. The cost of truckage is not fixed and it depends on according to the camel's reputation. The WOC should pay a fair price for truckage of camels. If they agreed about the truckage, they prepare a contract and sign it for each side. The contract includes a fine against to the possibility of camel's absence. If owner of camel does not bring his camel, he must pay the fine which mentioned into the contract (Anon, 2012). The fine is about 3.000 TL[1] (1.500 USD) (Bagcil, 2013). WOC also promise to pay about 300-500 TL (about 150-200 USD) to the owners to provide their attendance (Kinzer, 2000). WOC also should find accommodation for camel, owner and 'savran' (caretaker of camel). If there is any cost for accommodation, WOC should pay the cost (Bagcil, 2013).
The day before wrestling, WOC assign a board of referees which consist of about three to five people. The one of them board of referees is field referee who manages the matches. And then they decide two 'urganci' groups. The urganci attendants carry a piece of rope to split up the locked and still camels. Each group consist of 10 to 20 attendants. Thirdly WOC determine 2-4 of 'agiz bagci' (muzzle guy) who fitted the camels with tight halters to prevent them biting each (Christie-Miller 2011). Besides them WOC also determine 2 of 'agiz bagi kontrolcusu' (controller of muzzle) who check muzzle whether it is securely muzzled or not. The camel has to securely muzzled before the match (Anon, 2010). WOC also assign a 'cazgir' (announcer) (Anon 2012). Cazgir is a very important because he is not only announce the camels, but also he give some details about camels, tells mania poems and makes jokes. The most colourful person of wrestling is the cazgir. WOC finally chooses enough ticket sellers and security personnel. Those attendants are announced by WOC the day before wrestling (Culha, 2008). WOC also organize 'Hali gecesi' (Carpet night) and a carpet is sold by auction to supply to pay some expenses (Kilickiran, 1987).
The wrestling day the board of referees is gathered in early morning and prepares a list to wrestle for a pair of camel (Anon, 2012). While deciding the pairs of camels, age of camel is ignored, but wrestling style and applying certain tricks are definitely considered. A weight difference of 150-200 kg can be tolerated (Bagcil, 2013). This list cannot be changed except by the board of referees (Anon 2012). Sometimes the board of referees is gathered the day before wrestling to prepare the list to (Culha, 2008). All attendants should carry armbands in order to be known (Anon, 2012).

Economy
Camel wrestling events contribute to economy via camel raising, feeding, equipments, accessories, ornaments, clothes and finery, eating, drinking, wages etc. A camel consumes approximately five tons of feed in a year. Depending on the feed type, the annual feeding costs of camels vary between 2,000 and 5,000 TL. Savrans receive a salary varying between 500 and 1,000 TL. Hence only the caring cost of a camel varies between 8,000 and 17,000 TL yearly excluding its accessories (Caliskan 2009). These rich elements and relationships create an almost special wrestling economy and cultural fabric that supports each other's existence. Some camel wrestling organizations or association use income of wrestling events for establishing for school, bridge, village hall or holy places. In additional, beyond being traditional events, camel wrestling events are a rich attraction for international tourism. Tourism economy in Turkey, the policy of combining festivals and tourism began to become evident after 1980s (Caliskan, 2010[a]).
The quality of wrestling has increased recently with the contribution of very well-bred camels. This has meant an increase in the cost of buying and caring for these camels (Aydin, 2011). Camel wrestling is no longer a sport for low income people. The beginning price for a wrestling camel is between 20,000 and 50,000 TL (10.000 and 25.000 USD) (Parkinson,

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[1] TL – Turkish Lira is Turkish currency.

2011). Superstars like 19 years old Cilgin Hasan, in Burhaniye county of Balikesir province, can fetch up to 300,000 TL (150.000 USD). On the other hand, if a camel is badly injured or retired because of age, he is generally sent to be slaughtered (Caliskan, 2010[b]). Carcass yield is about 50% (Bagcil, 2013).

Conclusions

In an organization, cost of transport the camels, accommodation and catering of owners and savrans, arranging a 'Hali Gecesi' (Carpet Night) Party, embellishing of camels, wages of 'hakem heyeti' (board of referees), 'urganci's, 'agiz bagci's, 'agiz bagi contolcusu's and 'cazgir' are important expenses factors. Even though all cost are expensive about wrestling camels, the most of the camel owners are low or middle income people. Another problem is import of the camels from Iran, Afghanistan etc., because those camels are not native domestic animals of Turkey. The imported camels which are mostly 7-8 years old are very expensive, in additional owners have to spend too much money, until they reach to wrestling age of 12-13 years old. In some provinces, the governorship usurped 40-50% of ticket income gained by camel wrestling organizations or association.

In the past, communication was a horrible problem for camel owners, but nowadays mobile phones and internet solved this problem. Another benefit is about following weather forecasts easily, because wrestles were cancelled in cases of unfavourable weather conditions in the past. In spite of economic, social and cultural advantages of camel wrestling events, there have been no institutions or organizations, which are interested in and plan camel wrestles at regional or national scale in Turkey. All events are organized by local instrument excluding Selcuk events. The most common problem is to overcome the financial problems of the continuing these wrestling events. At the present situation local municipalities help those events but it is not enough but in fact that many settlements are organized wrestles with financial difficulties. The state should support those events.

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ENVIRONMENTAL POLLUTIONS CAUSED BY ANIMAL WASTE AND POTENTIAL SOLUTIONS

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Abstract

Modernization in the rapidly developing animal husbandry and intensive management business, has brought a number of issues. At the same time a significant number of animals with the economic potential of the waste are major problems for the environment. Although there is poor water, water constraint is considered among the countries of our country's existing water resources, such as manure is contaminated by materials of high economic value. Obtained from an animal shelter is not stored in a proper manner fertilizer nutrients and microorganisms in the surface and ground water may cause pollution. The wastes in livestock operations would not create adverse environmental conditions necessary legal and technical measures are required. In this review, environmental pollutions caused by animal waste and potential solutions was investigated.

Key words: *Animal manure, envoirmental pollution, cattle, small ruminant, poultry*

Introduction

With the increasing population, to meet the proteins of animal origin required has made an intensive animal production necessary excluding of traditional methods. However, this situation brought about a number of environmental pollution (Mutlu, 1999). Indeed, Improperly stored or used of animal waste in animal enterprises pollute underground drinking water supplies primarily (Özek, 1994). Animal production waste to cause environmental problems but also is an important source of economic income as well. Many of these wastes is possible to use as fertilizer and fodder production therefore, as a result of animal waste management, environmental pollution may be reduced or even can be regarded as an economic gain for the enterprises (Karaman, 2006). However, disposal of animal waste unconsciously to the fields, pastures, open fields and streams reduces productivity and quality of water and soil biological structure is disrupted (Yetilmezsoy, 2010).

Solid and by diluting stored animal wastes generally cause the air and water pollution, environmental odor and flies resources due to absence of animal waste recycling methods and techniques and high cost. Due to the ease of use and more economical of the increasingly widespread use of artificial fertilizers instead of animal manure in wineyards, gardens and fields has led to further growth of the problem (Sahin and Altunal, 2008).

If the proper precautions are not taken for the animal manures may result unintended consequences. The fact that a material which can provide benefits of animal waste will be caused to become harmful (Waskom, 1999). Putrefaction will began when the manure and other wastes released into the external environment after a while and start to smell bad for the environment and will emit harmful gases and dusts to atmosphere. As a result of distortion as well as chemical pollution, visual pollution and bad odors occur. Therefore, uncontrolled use and relasing of manure to the external envoirment should be avoided. The

use of animal-based fertilizers in agricultural land or other storage steps should be performed under conditions that prevent contamination consciously (Jacobson et al., 1999).

Animal Wastes

Wet and Solid Animal Manures

Manure and urine is the way of throwing the metabolic wastes or some indigestable nutrients. Excreted amount of manure and urine vary in terms of an animal's age, physiological condition and physical properties of feed. Body weight and manure excretion amount of some Livestock was given in Table 1. (Ergül, 1989).

Table 1. Body weight and manure excretion amount of some Livestock

Livestock	Live Weight (kg)	Manure and Urine Rate (%)	Amount of Daily Manure (kg)
Cattle	600	9	54.0
Buffalo	500	8	40.0
Small Ruminants	50	5	2.5

Environmental pollution occurring as a result of livestock farming consists of two wastes basically. These fluids (urine) and solid (manure) wastes. These wastes varies according to effect of various factors such as the animal's age, physiological condition and physical properties of feed consumed.

The manure are not cleaned and stored properly create environmental pollution considerably in both inside and outside environment . For this purpose, in shelters emerged fertilizer shelter air emitted into the scent the air with harmful effects of substances very well known and their animals and do not harm people to be tolerated is necessary (Alagöz et al., 1996).

Using of manure and urine in certaint extent is not a waste, but is a commercial substance for increasing crop production contrary. Proper using of animal waste materials prevent soil decomposition in terms of organic materials and leads to increase soil fertility.

When certain levels of used manure and urine exceed in an effort to increase crop production quantity and soil amelioration, the quantity of crop production, product quality, soil structure, underground and surface waters were affected adversely. In addition, it spread to the soil, plants, water, animals and people by the disease-causing agent, a heavy odor emitted to the environment. The odor spreading to the environment will be easier due to contamination of animals to manure in shelter (Ergül, 1989; Alagöz et al., 1996).

It is important to reach of all kinds of waste (food waste, barn wash water, etc..) and dirty water caused by manure and urine seeping into groundwater through the permeable soil layer in Livestock enterprises . This spreading can be possible for surface water in sloping terrain and in wet weather. The contaminated groundwaters enriched by nitrate especially. The surface waters in terms of phosphorus and nitrogen content begins to enreach the highest value. Phosphorus contamination occured on surface waters depending on animal manure causes less dangerous in terms of nitrogene. The effect of nitrogen is heavier, indicating the presence in the conversion of urea to ammonia.

The Gases, Odors and Dust Emitted by Animal

Gas can be spread from animals with respiratory and intestinal tract, such as manure and urine excreted can arise as well. Gases in the manure, in bedding, in silos and as a results of the aerobic or anaerobic microorganisms activity on rooting feed may occur. While the water steam, carbon dioxide and ammonia are always seen, the hydrogen sulfide, carbon monoxide, hydrogen gas is detected occasionally in animal barns.

Dissemination and distribution of gas may be different according to the power density and diffusion (Ergül, 1989). There is also a heavy odor in the form of gases emission impact on the environment occured in animal shelters. The smell of manure spreading rate are closely related to manure operating and mismanagement applications. Odor can be spread from animals especially, manure and urine gases and may also be caused by decayeing feed.

The odor from these sources can be transported by the effect of wind to remote locations. The bad odor can be released more intense during the removal and storage of manure in open-air manure storage and spreading of compost to the field. Odors realesed in barns is important for the health of the workers and animals. It is also uncomfortable sitiuation for people living close residential areas. Especially hydrogen sulphide and ammonia gas has a greater influence in this respect. (Ya ano lu, 1987; Ergül, 1989; Alagöz et al., 1996).

When the animal waste and animal manure stored without taking measure in near settlements , by spreading bad odor to the environment causes air pollution as well, primarily flies to various pest proliferation of facilitating environmental health deterioration and spread of infectious diseases (Gur, 1993).

Stored manure without taking measures spread a weak smell once, then with the effect of high heat and humidity causes microorganizmical fragmentation. As a result, uric acid was quickly converted to the ammonium salt and increased ammonia output causes irritating odor emission to the atmosphere.

The animal wastes' 50-75% include organic materials that can be decomposed by bacteria. These organic substances for an energy source for microorganisms are proteins, fats and carbohydrates. The odors occur as a result of separation organic substances depending on ambient oxygen. In shelters where the oxygen is abundant and sufficient, animal waste decomposes quickly and carbon dioxide, water and some odorless compounds spread to environment The nitrogen and inorganic compounds of sulfur occurs in the rapid decomposition of animal waste under aerobic conditions while decomposition is slow insufficient oxygen and anaerobic conditions. As a result of animal waste decomposition, 60 different compound spreading various odorous was determined (Ya cıo lu, 1981; Ya ano lu, 1987). Some chemical substances emerged from decomposition of manure was given in Table 2 (Anonymous, 2003).

Table 2. Compounds Emerged from Anaerobic Decomposition of Animal Manure

Volatile fatty acids	Sulfites
Acetic acids	Hydrogen sulfide
Propionic acids	Dimethylsulfide
Butyric acid	Diethylsulfide
Isobutyric acid	Disulfides
Alcohols	Ammonia and amines
Aldehydes	Ammonia
Esters	Methylamine
Phenols and Cresols	Ethylamine
Mercaptans	Dimethylamine
Methylmercaptan	Diethylamine
Ethyl mercaptan	Nitrogenous heterocycles
Propyl mercaptan	Indole
	Skatole
	Odorless gases
	Carbon dioxide
	Methane

Result and Discussion

As a result of the review, the measurment to be taken are as follows;

- Manure storage must be designed according to the planning principles that can be stored in a storage tanks in a certain period of time and spreading of animal manure to the environment, (Karaman, 2006).
- Liquid waste to be removed from the environment must be prevented seeping into underground sources of drinking water , It should be drained and collected in underground tank. (Harner et al., 1997).
- The capacity of manure storage must be constructed to prevent contamination of water. (Öztürk, 2003).
- In order to reduction of air pollution, animal waste must be stored in a controlled environment . The storage and disposal channels to be prevent surface runoff should be made in open-air manure storage (Mature and Parker, 2005).
- Animal shelters should be constructed separately from the buildings, it should not be built the bottom and side walls of the houses in a common way.
- Recommended values taken into consideration in calculating the distance between manure storage and settlement, lakes and other water resources,
- In order to prevent grounwater contamination, the ground of manure storage should be checked frequently by eliminating cracks and leaks.
- Manure storage should be designed in accordance with construction techniques. It must construct storage capacity sufficient to store all manure produced by the operation over a period of at least 3 months.
- Biogas is one of the renewable energy source. Using of biogas in reducing methane and ammonia, increasing carbon dioxide emissions in atmosphere, reducing of the greenhouse gas emission that cause global warming can be achived and hygienic living spaces are created.

Conclusion

Animal waste causing environmental problems in Livestock enterprises has also an important economic potential. Most of the animal origin waste for use in areas such as fertilizer and feed production is possible. Therefore, management of animal waste will tend to reduce on environmental pressures and idle economic resources will be assessed.

Unless properly stored manures may cause environmental pollution. Storing of manure outside will reduce quality of animal based fertilizer to be used in crop production, odours and visual pollution create. Animal manures produced in shelters must be stored an environmentally responsible manner. The manure storage should be constructed with livestock buildings together. Energy supply is quite expensive nowadays, Processing of the animal wastes by the way of anaerobic fermentation and obtaining fermented manure as well as providing production and use of renewable energy, reduction of environmentally harmful wasten and will also be reduced waste management costs.

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6. RURAL DEVELOPMENT AND AGROECONOMY

AGRICULTURE AROUND PROTECTED AREAS IN ALBANIA ‑ CHANGING POLICY

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Abstract

There are several protected areas in Albanian surrounded by agricultural lands. It is beyond argument that the issue of safeguarding the biodiversity and the landscape of such areas is inseparable from farming as the performance of this latter is primarily dependent on the status of natural resources and at the same time affects the surrounding environment, the diversity and stability of natural ecosystems. On the other hand, rural people in theseregions have to make their living principally from agriculture in the future, too. The research presented here is based on an analysis of the agricultural development of the last twenty years of a protected area and assessed the trend in the use of mechanization, fertilizer, pesticides as well as changes in the structure of crops and livestock. The analysis has enabled us to properly evaluate the environmental performance of agriculture in this particular region. The study offers many recommendations on the right policies and appropriate economic incentives to improve its future agricultural outputs while making the sector economically efficient, socially acceptable and environmental friendly. The main strategic directions for increasing farm revenues in the rural areas surrounding the Lake, taking into account the tradition and the development trends of private farms, should focus on adapting the agricultural production to the development of agro-tourism, in order to exploit the opportunities offered by the nature of the region; increasing the number of associations of rural areas production and services in order to strengthen cooperation among producers and encourage better marketing.

Keywords: *nature conservation, agricultural policy, agri-environment indicators*

Introduction

The present study is focused on the the ecosystems of Ohrid Lake, Prespa Lake and Shebenik which includes areas bordering the above lakes and Shebenik mountain on their Western side.Administratively, the Region under study includes 1 municipality, 10 communes and 75 villages with a total of 40178 inhabitants living in the city (32.3%) and 77155 in the villages (65.8%). In general, this Region is distinguished for its diverse and dynamic natural and human resources. It is a border Region with the Republic of Macedonia (FYROM) and Greece. The north-western part of this Region is dominated by forests.

The outstanding environment and nature of this most interesting region and significance for Europe's biodiversity is known since long and has been pointed out in recent publications (Gjiknuri, et al. 1997, Crivelli and Catsadorakis, 1997, Fremuth et al., 1999). The Ohrid and Prespa region belongs to the Balkan sub-division of the Sub-Mediterranean vegetation zone (Meusel et al. 1965) with three phytoclimatic zones (for details see Mersinllari, 1997, Pavlides, 1997, Rizovski et al., 1997).

In total, the Region has very suitable geographic position, which is very important for the economic development. The main land uses include park land and protected areas, forest, pastures, irrigated land, scattered small industries, fish farming and coastal tourism. Pogradec city comprises the most built-up area, with its industrial zone. Land use in Ohrid watershed is mixed and comprises mainly agricultural and urban uses. About 40% is water, 9% arable

land, 5% pastures, 37% forests, 5% enterprises and about 2% buildings. The high demographic movement during transition has radically changed land use in this Region. Parts of the watershed are quite developed whereas others are virtually undisturbed.

Most of the land in this Region is devoted to agricultural activities. Therefore, the following analysis will concentrate mostly on agriculture (including livestock), food processing industry and other industries as a source of pollution for the ecosystems trying to assess the current status and future trends and how the latest could affect these ecosystems.

Material and Methods

Although there have been a large number of projects on the ecosystems of Ohrid and Prespa Lakes as well as that of Shebenik Natural Park, during our literature review we did not found any analyses of the impact of agriculture and related industries on these ecosystems, except for Sulce et al., 2011 for Prespa Lake. Although the objective of conserving the Lake and developing agriculture are inherently incongruous, the paper was written without taking sides.

Phase 1 of the research was used to review all existing data, reports, studies on the Region under study as well as relevant international experience. Phase 2 was designed as a data collection through an institutional survey and supplemented by in-depth face-to-face interviews with various stakeholders in the Region under study. The survey ran from October to December 2013 and achieved a relatively high response rate of 90%. Tables with total rows may not sum exactly to 100% due to rounding. The goal of the survey was to gain a deeper insight into the crop structures and changes in the last decade due to competitiveness, levels of intensification, use of good practices, etc. There are three comparative periods, data immediately before 1990 (1985 – 1988) and current data (2010 – 2011) showing the current status of development of agriculture and related industries in order to possibly quantify their impact on the environment, particularly the Lake. Compared to the period before 1990 it serves to demonstrate the level of intensification, especially in terms of fertilizers and pesticide usage. Compared to 1998 shows the trend in crop pattern and the future prospect of development in agriculture and related industries. It is also useful for drawing conclusions and recommendations about the policies. Wherever data is collected through the survey and is not a routine statistic report periodically it is referred as "survey data".In Phase 3, based on theoretical reviews and assessment of the context we have compiled a list of findings and recommendations which could apply to the Region's economy, stakeholder dynamics as well as agricultural and environmental policy context.

Results and Discussions

The main agronomical problems in this Region are related to land degradation due to uncontrolled deforestation, livestock grazing, and illegal construction and rapid urbanization. Moreover, national and local governments and local residents in both countries see tourism as the main engine for economic development of the Lakes' area, and national spatial and sectorial strategies identify it as a priority special interest area to develop nature, culture, and recreation-based tourism, which depends heavily on environmental quality. Increased number of tourists, includingrapid population growthwill increase the demand for agricultural products and therefore land exploitation.

Land abandonment and the withdrawal of historic management have become a threat to large areas of farmland in Albania (Kullaj, 2005). An extrapolation of current farming trends in the Region under study would indicate that without intervention, a further concentration of agricultural production on the best soils and in the most productive herds is likely to occur, leading to an irreversible loss of high nature value farming systems. The rich natural heritage of this Region can only be preserved if the present traditional, or low-input, farming systems are maintained or adapted in a sustainable way (Kullaj, 2007). The high nature value systems that remain in this Region are at risk if the same transformation of

agriculture which has occurred in Western Europe is allowed to take place, so it is important this is avoided and lessons can be learnt from past experience. The EU is currently spending considerable amounts of money within Member States on reviving nature that has previously been sacrificed for short-term agricultural interests (OECD 1998b). In order to avoid this, it is important that measures to minimise the potential impact of agriculture policies on wildlife are put in place to ensure the valuable natural capital of this Region is conserved.

Agricultural mechanisation
Nowadays, development of agricultural mechanisation plays a key role in its development in terms of productivity, effectiveness, quantity and development. Figure 1 shows the changes in the possession of tractors between the two comparing periods. Communes of Ohrid and Prespa ecosystems are more agriculturally-oriented and the use of tractors has increased. On the contrary, being more isolated, communes of Shebenik ecosystem have reduced the level of mechanisation compared to 1990.
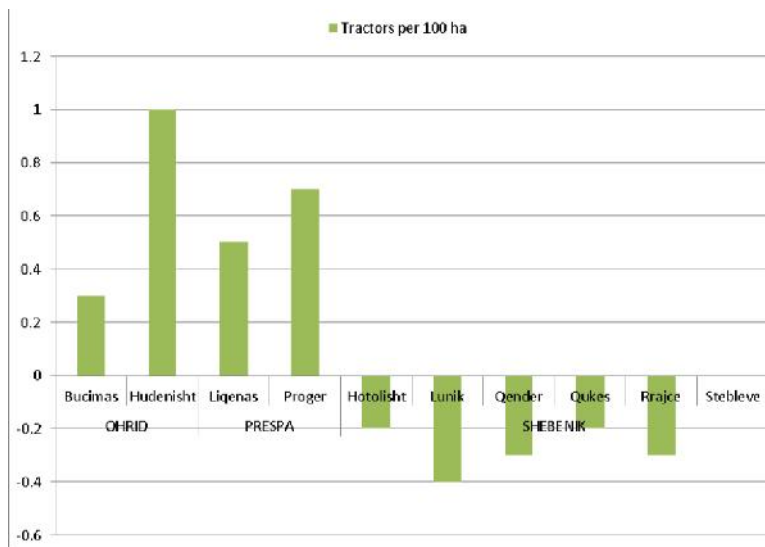
Figure 1. Developments in agricultural mechanization in the Region in the last 20 years
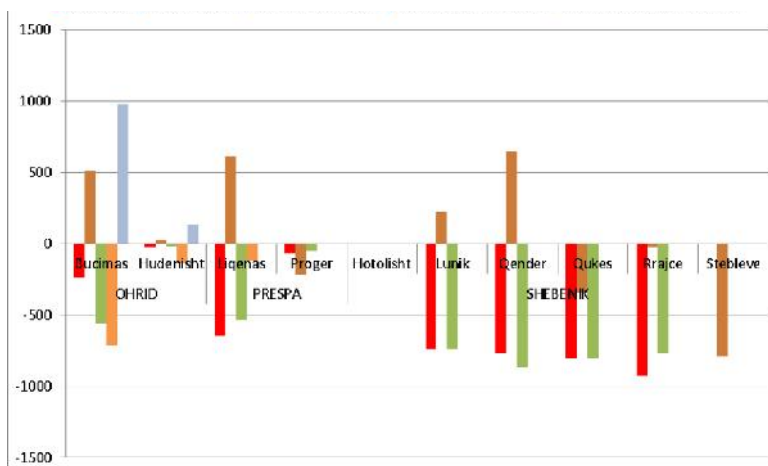
Figure 2. Developments in the use of irrigation in the Region (1990 – 2011)

Irrigation and Drainage
At the current stage, the irrigation potential capability in the entire Region is 62% while before 1990 was 74% considering also that the cultivated surface was about 650 ha higher. Progress or regress in terms of irrigation coverage is shown in Figure 2. More than 84% of the surface was irrigated through a network of canals and only about 700 ha were irrigated with sprinkler irrigation. In 2011, the irrigated surface has been reduced by 10% compared to the cultivated land in 2011 but it should be taken into consideration the reduction of the latest by about 650 ha. No investments have been made in sprinkler/drip irrigation.

Surface irrigation, especially furrow irrigation as the dominating method in the Region under study has low efficiency in distribution and application as well as higher environmental impact. This traditional methods (flooding) should be replaced by irrigation techniques like sprinkler or use of pressurized tubes, despite the investment

and maintenance costs. The irrigation should meet but not exceed crop needs. Governmental

subsidies should be in place in order to save on environmental costs, i.e. save on the amount of water, improve the quality of the water, reduce erosion, leaching, pollution of underground waters, etc.

Fertilizers and Pesticides
Data on the use of fertilizers and pesticides are shown in Figure 3 and 4. To summarize, the Region under study receives a total of 1581 tons of nitrogenous fertilizers and 2221 tons of phosphorous fertilizers. If we further analyse the data we can see that the amount of chemical, especially nitroge-nous fertilizers has decreased. On the contrary, organic fertilizers has increased. This means that more and more farms are applying fertilizers but at almost the same rate as in the previous years. Such phenomena can be explained with the recent developments in agriculture where a large surface of land has been cultivated only recently and with more and more farmers having the

Figure 3. Developments in the use of chemical fertilizers in the Region (1990 – 2011)

financial conditions and market access to justify the use of chemical fertilizers. Use of soil tests should be enforced by law in order that N rates are based on these tests and reasonable yield potential. Variable rates should be applied also depending on each zone and specific technology.

The use of organic fertilizers in agriculture in the Region under study is diminishing due to the problems in implementing the manipula-tion technology and its use. The tradition of the farmers in the Region is somehow deficient and there is a lack of experience to make composting in complete parameters according to the technological requirements. Most of the organic fertilizers are used in greenhouses and vineyards.

Cultivation of field vegetables requires a larger use of pesticides and herbicides to protect these crops from diseases, pests and weeds. Moreover, fruit tree and grapevine are high value crops which require a large number of treatments. Data show clearly a reduction trend in 2011 in the use of pesticides compared to 1990 levels except for Buçimas of Ohrid Ecosystem, with a reduction of total quantities for the Region from 17 to 10 tons from 1990 to 2011.

Figure 4. Developments in the use of pesticides in the Region s (1990 and 2011)

Crops

The cultivated surface has been reduced to about 160 ha with a slope of more than 15%, mainly found in Progër; those with a slope less than 15% found in Progër and Liqenas have also been reduced. The surface planted with wheat in 2011 is smaller compared to 1990. Moreover, maize surface has also been reduced in 2011. The surface with fruit trees has not changed compared to 1990, but there are changes to the structure of species. Forages has increased to about 650 ha compared to 1990.
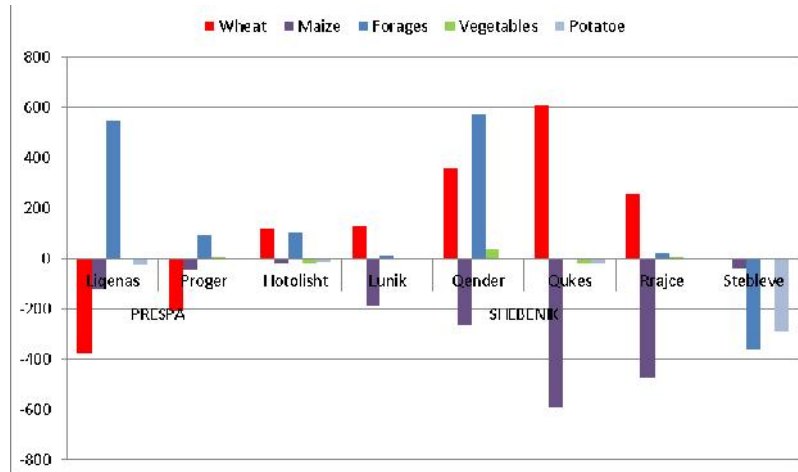
Figure 6. Developments in planting various arable crops in the Region (1990 – 2011)

Fruit growing is not important from the land use viewpoint, remaining almost constant through the entire 20 years period of comparison. The arable land, except for Qendër commune, has been drastically reduced in the other five communes. Surfaces planted with forages have increased but the yield is low as a good part of them is left as a meadow for hay with a lower cost and income.

Although the area has been oriented toward the field vegetable production, intensification by installation of greenhouses will happen. This should not be stimulated because of the high levels of intensification in terms of the use of agricultural inputs. As for arable crops, the same goes for improvements in the technology. Arable crops need to be diversified to include deep rooted annual crops as well as consider legumes.

Livestock production

In the Region under study and broader at country level, it is mainly based on the household economy with 90 % of the farms developing their activities based solely on the family labour,

a typical feature of Albanian farms. According to survey data, about 80 % of the farms breed farm animals but farms are mixed, i.e. they cultivate various crops too. The general trend is to raise cattle and small ruminants whilst the pigs and poultry number has decreased because these animals are more attractive for the livestock business rather than farm breeding.
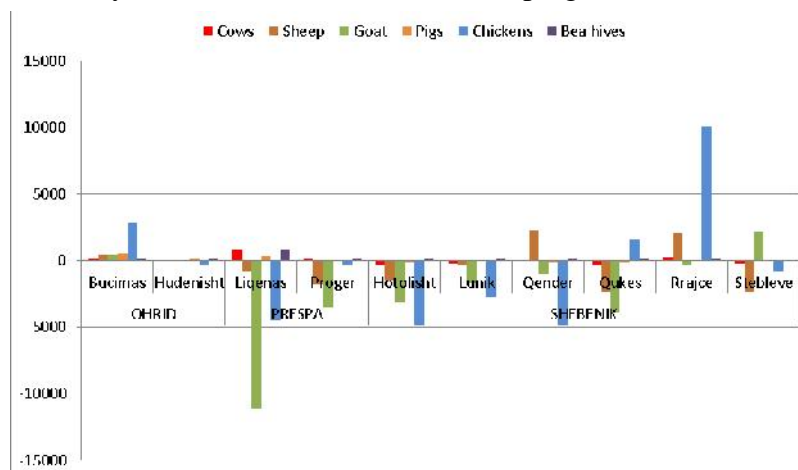
Figure 7. Change in the number of livestock in the Region

Government policies should be in place to change the livestock composition (numbers, proportion of different breeds and species in their total population) depending on the restrictions on access to

feed/fodder resources and, quantitative and qualitative change in the types and availability of fodder. These policies should strongly strengthen the crop – livestock integrated mixed farming system, with a positive impact on the environment.

Conclusions

The Region under study is an important agricultural area of Albania. Trends and projections show an increasing growth in farm production.The agricultural landscape surrounding the ecosystems of Ohrid and Prespa Lake as well as Shebenik Park is particularly valuable as it incorporates sizeable areas of less disturbed semi-natural habitat and high nature value farming systems, usually associated with more traditional, less intensive forms of production. The systems of farming which are adopted, and the ways in which land is managed, are therefore of particular concern for nature conservation.

A soil conservation policy should be in place for highly erodible lands which will require to farmers to implement conservation plans to protect the soil. Practices like re-cropping land rather than fallow and reduced tillage should be recommended. Payments for no tillage or reduced tillage practices should be in place especially for those areas of the Region which experience high rates of natural erosion due to climate and topography. The Regional Development of Agriculture, Centre for Agricultural Technology Transfer, communes and other institutions should strengthen their role in raising the farmer's awareness on practices which minimise soil erosion.

To protect the biodiversity of the Ohrid, Prespa and Shebenik, subsidies or other incentives should be in place to substitute chemical fertilizers with biological fertilizers, used mainly for the stimulation of plant growth, rapid transition between phonological phases, and activation of soil microorganisms, which affect the rapid decomposition of fertilizers used on them. N should be credited from all other sources such as manure and previous legume crops.

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REFORMING THE PENSION SCHEME OF SELF‑EMPLOYED IN AGRICULTURE

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Abstract

This paper has analysed the pension scheme of self-employed in agricultural sector taking into consideration the forthcoming reform. Key problems facing rural pension scheme in Albania were identified with an overview of the scheme. With the disintegration of agricultural cooperatives and enterprises accompanied by land distribution to rural inhabitants constituting 65% of the population, considered as self-employed in agriculture by law. Therefore, the number of contributors to the social insurance drastically dropped raising the dependency coefficient ratio. After ten years, in 2002 this coefficient improved due to the increase of contributors. However, the replacement coefficient is still low. Later this ratio has increased much more than the same ratio for urban people. Further analysis shows that the so-called obligatory social insurance contribution has been very low, about one USD per month to gain 1 year of contribution. The analyses shows that if such a scheme was relatively stable in the beginning, with the increasing number of pensioners from rural areas, the social insurance fund could not cope and therefore it has to be afforded by the state contribution, raising the fiscal burden and deforming the scheme. The paper draws some conclusions and makes recommendations for changing the pension policy.

Keywords: *self – employment in agriculture, pension scheme, replacement coefficient*

Introduction

In 2012 Albania spent 5.2 percent of GDP on pensions, much less than the EU countries or the average for Eastern Europe. Relative to the average wage, minimum pensions are higher in Albania than in most other countries, which makes it difficult to differentiate benefits by earning or contribution level without sending costs even higher. Spending on pension programs increased very little over 2005–12, from 4.9 percent of GDP in 2005 to 5.2 percent in 2012.

In rural areas, disincentives to contribute are even more obstinate because those earning minimum pensions receive additional allowances that raise their total incomes higher than those of pensioners who previously earned more. Disintegration of agricultural cooperatives and enterprises in 1990 was accompanied by land distribution to rural inhabitants constituting 65% of the population. Although very weak at the beginning, these households gradually produced surplus to sell in the market. It was therefore considered fair to include them in the social protection scheme. They were considered as "self-employed in agriculture" by law in 1993. This category, as the others, is protected by the obligatory insurance. Besides employees of the agricultural state cooperatives and enterprises, it also includes other workers in the state service which got agricultural land according to law 7051 dated 19.07.1991 "On land distribution". Initially the burden of insurance was with the head of the family, despite the organization of the private activity, but later was an individual obligation.

They would have paid only part of the contributions paid by other self-employed individuals, while the difference was paid by the state budget. This political choice was conditioned by the fact that although the population of the village has received the plots of land they were unable to make a profit. Agriculture constituted the main economic activity for the country and needed support. In that period, only 35% of the population was living in urban areas. While the pensioners in urban areas occupied about 10% of the population, the specific weight of pensioners in rural areas constituted only 3% of the population. Moreover, there were differences in the insurance scheme in relation to the level of profit that was higher for the state employees compared to ex-cooperative employees. These arguments were forming the rationale for policies taken by the government to alleviate rural inhabitants from state obligations to pay taxes and contributions.

This research aimed at analyzing the current pension scheme and using the income equalization technique to adjust the pension accordingly. This should lead to some recommendation on the policy changes.

Material and Methods

The analysis used in this document assessed the adequacy of retirement incomes for rural pensioners by comparing the rates for simulated individuals. This allows the assessment of policy changes that will have impacts several decades in the future. Primary data related to the total amount of contributions, number of contributors, etc. were collected from the Social Insurance Institute and were used to calculate various indicators, like dependency coefficient ratio (the ratio of beneficiaries to contributors in the social insurance scheme). Secondary data were obtained from official publications (World Bank Albania 2006a, b, 2013; Ministry of Finance 2013a, b, c; ILO 2007, 2009; OECD 2011, ISSH 2014), official gazette, national dailies and internet sources. The technique used is the income equalization (Courchene, 1998), which recognizes these economies of scale, and adjusts the pension accordingly. Assumptions about inflation, earnings growth and the labour market are consistent with medium and long-term assumptions.

Results and Discussions

Calculation of the dependency coefficient ratio shows an increase for the period 1994 – 1999 for rural areas. After ten years, in 2002, this coefficient was improved due to the increase of contributors (the ratio of the average pension to the average salary) but remains low. Later this ratio has increased much more than the same ratio for urban people. Such increase was due to the higher rate of increase of the average pension for the villages relative to the minimum contributory salary. In 2009, "self–employed" in rural areas paid an annual contribution of about 100 EUR for plain areas and 63 EUR for mountainous areas, thus about 26% of the contribution and the remaining 74% was paid by the state. While for 2011, the monthly contribution of "self–employed in agriculture" in plain areas has been 13 EUR and in mountainous areas 8.4 EUR, the contribution of self–employed in urban areas has been 37.6 EUR. Thus, the contribution of "self–employed in agriculture" for 2011 has been 1/3 of the monthly contribution of self–employed in urban areas.

More than 500 000 people "self–employed" in agriculture entered into an "obligatory" payment contribution scheme which *de facto* where not obligatory. The average monthly contribution fee was less than 1 EUR. A villager, at a working age, to ensure one year of seniority for pension purposes, should have paid a little more than 1 EUR per year. This logic continued although the contribution fee increased. The latest has progressed in the opposite direction with the requirements for the pension fund. If in the first instance, the payment effect of such a low contribution fee was not so sensible towards the misbalance contribution – pension fund, gradually, the number of pensioners form the "self – employed in agriculture" category was increasing, i.e. those paying 1 EUR a month to get the pension.

Under such conditions, an individual has paid very little and they were getting a pension at least fifty times more than the amount of contribution. Thus, the self-employed in rural areas were paying much less contributions compared to the minimum contributions of self-employed in urban areas. The difference was covered by the state budget as a contribution and not as a state subsidy. However, referring to the data, it should be stressed that the contributors in rural areas contribute by about 15% of the necessary contribution and they get full rights in the pension system. In other words, 85% of the contributors in the rural sector "does not pay" the contributions. If we will expel this 85% of rural contributors, the poverty ratio of the system would increase to 1.36 meaning that each contributor should support 1.36 pensioners.

Table 1. Amounts of contributions (in EUR) by self – employed individuals living in urban or rural areas and the share (%) of subsidy paid by the state budged

Insurances	RURAL		URBAN		SUBSIDY		
	yearly	month	yearly	monthly	yearly	monthly	share
Plains							
Social insurance	214.3	17.9	375.1	31.3	160.8	13.4	43%
Health insurance	24.5	2.0	110.9	9.3	86.4	7.2	78%
Total insurance	*238.8*	*19.9*	*485.0*	*40.6*	*247.2*	*20.6*	*51%*
Mountains							
Social insurance	164.3	13.7	375.1	31.3	210.8	17.6	56%
Health insurance	24.5	2.0	110.9	9.3	86.4	7.2	78%
Total insurance	*188.8*	*15.7*	*485.0*	*40.6*	*296.2*	*24.8*	61%

Results of such policy were a deepening of the fiscal burden of pensioners on state budget but also a deformation of the entire scheme. Therefore, although a ceiling was applied for pensions, it is still unclear what is the minimum benefit of a pensioner that fulfills the specific requirements of seniority and wage. The lack of a minimum pension limit is a typical feature of pension categories in villages. Under such conditions, indicators related to the minimum living conditions at poverty level of an unemployed, were unfairly hided by the pension scheme.

As the village pensions constitute a central part of the pension scheme in Albania, they will be gradually replaced with the so – called state pensions. Even according to the new reform approved, a new methodology was applied for calculating a pension for self – employed in agriculture. This method is similar to the pension of the urban area and is made up of two parts: a basic pension (village), defined by the Council of Ministers and a supplement of 1 per cent of the minimum salary for every year of contribution to the social insurance scheme. Based on the our methodology, a person who has been working in the ex – agricultural cooperatives and has regularly contributed to the social insurance scheme since 1994 and onwards as a self – employed in agriculture, in 2004 would have benefited a basic village pension of 18.5 EUR/month and a supplement of 7.4 EUR/month, totaling about 26 EUR/month. This pension would have represented about 54 per cent of the minimum city pension. In 2006 this supplement would have reached 10 EUR/month for 12 years of insurance added to the basic pension of 29.4 EUR/month, totaling a village pension of 39.4 EUR/month and representing 49.8% of the minimum city pension. In 2009 this pension has reached the value of 45.3 EUR/month equal to 61,7% of the minimum city pension (73.4 EUR/month).
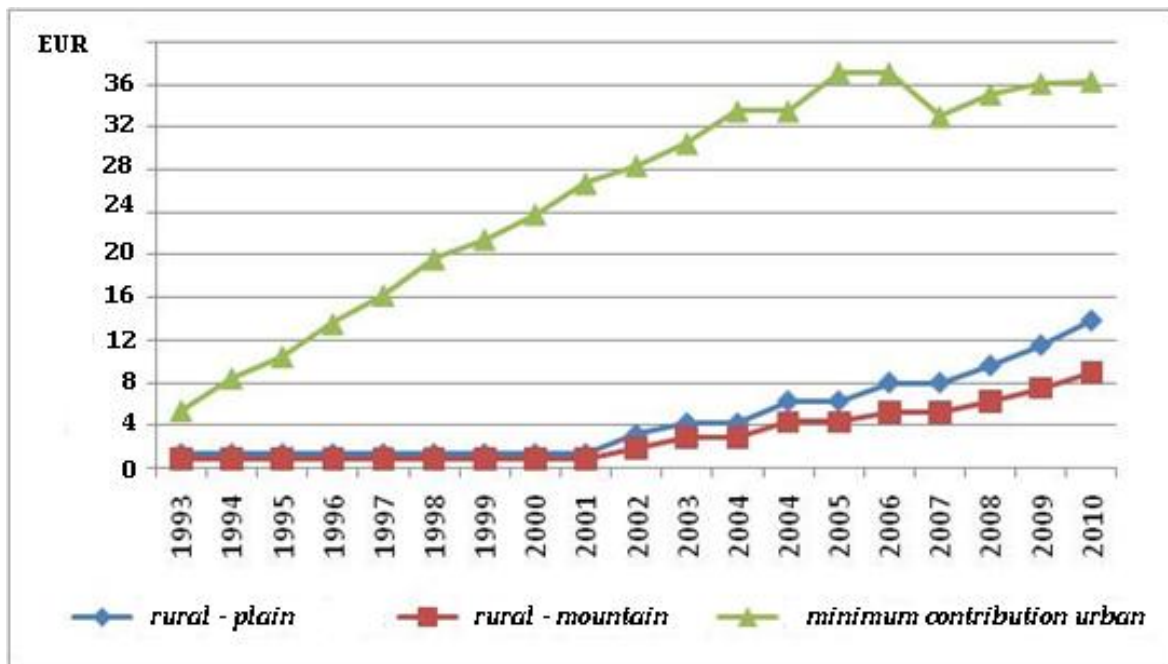
Figure 1. Comparison of the amounts of contributions between urban and rural areas and between mountainous and plain areas
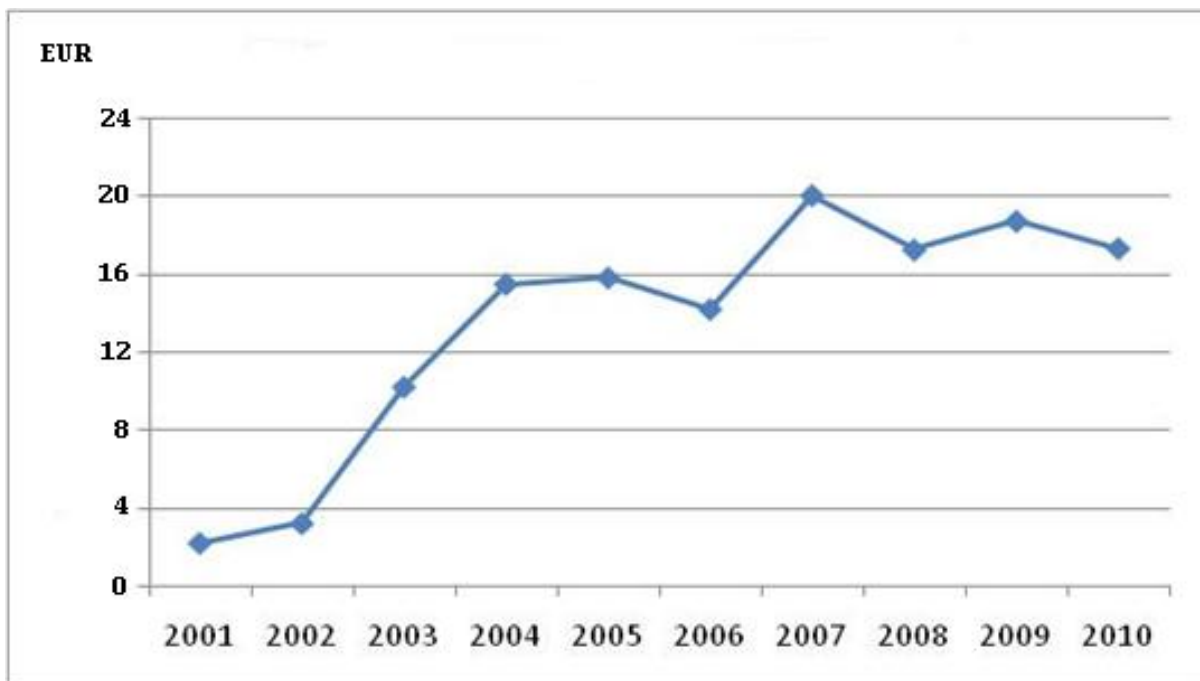
Figure 2. Incomes of self-employed individuals

In 2010, the monthly village (rural) pension reached about 50 EUR/month equal to 65,3% of the minimum city pension and in 2011 the monthly rural pension was 53.4 EUR/month equal to 67% of the minimum urban pension (79.4 EUR/month). In 2012, the minimum pension in the village was 56 EUR/month equal to 67.8% of the minimum city pension (82.6 EUR/month). Using this logic of calculations for the yearly indexation of the basic village pension, based on a minimum wage which increases every year, it is assumed the rural and urban pensions will be equaled by 2014.
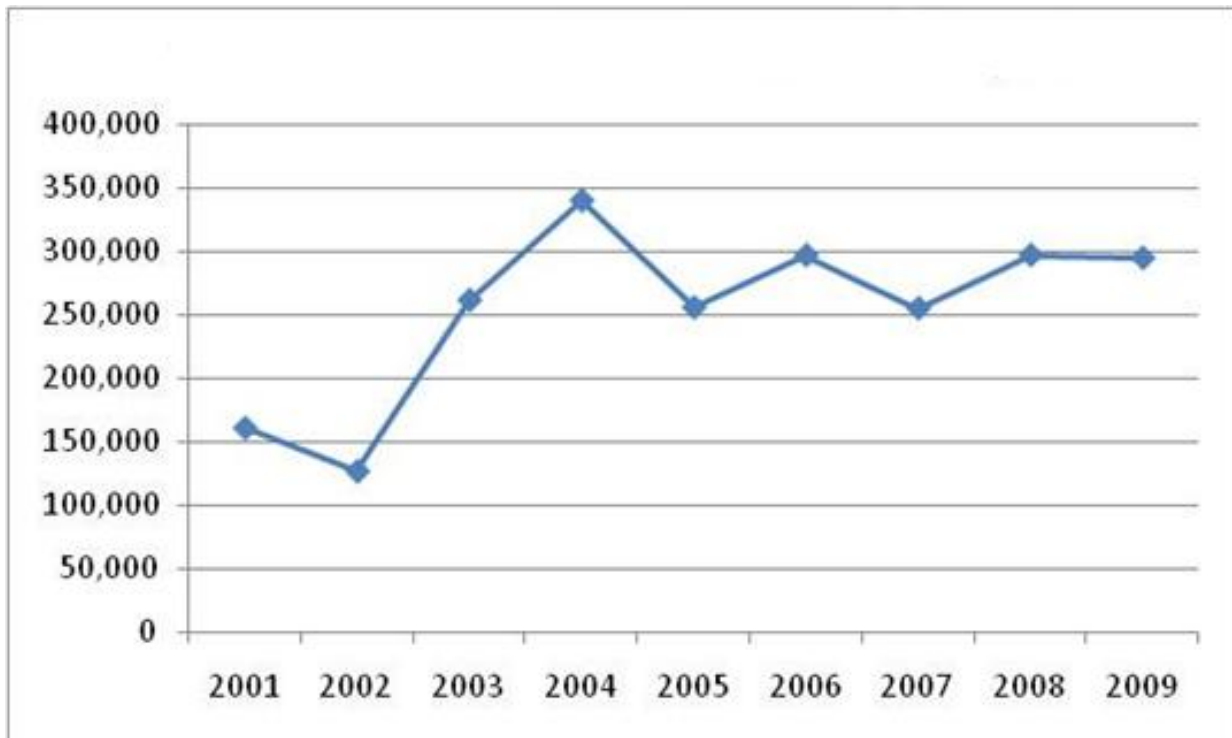
Figure 3. Dynamic of self – employed in agriculture

For 2013, the number of self – employed in agriculture for plain areas has been 47.824 persons whilst for mountainous areas 16.450 persons, totalling 64.274 persons. Compared to 2012, there is a reduction in the number of self – employed. In 2012, a total of 66.620 people were self – employed and 7.748 were at the age of 16 – 30 years old.

It is calculated that the financial effects for the budged by 2020 would be 10 milion EUR compared to 2.7 million EUR in 2000.

Conclusions

The government was endeavoring to provide better benefits to pensioners and improve their income security, but the changes were made without a comprehensive approach to all the challenges in the system. As a result, a pension system that is overly redistributive and fiscally unsustainable. In urban areas, there is significant redistribution from high- and middle-income earners to low-income earners. As a result, average and minimum pensions are now virtually equivalent. The benefit structure appears to be flat, although to be eligible for a pension when they retire, people must have paid in amounts indexed to their incomes, which naturally differ. As a result, the urban scheme has significant disincentives to contribute for longer periods and to declare full earnings. The scheme for rural residents requires transfers from the budget both to supplement contributions and to finance the pension system deficit. Consequently, rural pensions have become a de facto social assistance scheme, although one administered as if it were contributory. Lower contribution rates and sizable increases in pensions have affected system fiscal sustainability. Although the government has to finance an increasing pension system deficit, the extensive informality in the labor market means that a significant share of the elderly will not have access to a pension benefit in future.

There is political pressure to raise the current rural pension, which is *de facto* social assistance, to the level of the urban minimum pension despite minimal rural contributions; instead it should be replaced with a social pension for non-contributors that would also cover those in urban areas who do not work or contribute. The advantage for workers is that their contributions directly support worker benefits and are no longer channeled to the social

assistance component. From the government's perspective, the political pressure to equalize rural with urban pensions should disappear and the government should be able to provide benefits more affordably.

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ASSESSMENT OF SEDENTARY AND MOBILE PASTORALISM DYNAMICS IN THE REGION OF DIFFA (NIGER)

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Abstract

This paper builds on the article entitled "Pastoral dynamics in the Region of Diffa: descriptive analysis of livestock capital" (Laouali and *al*., 2013). In view of its agro ecological characteristics, Diffa is a largely pastoral region in Niger. Livestock practiced by more than 95% of the population, is the dominant economic activity of local communities. It contributes around 55% of the annual GDP of the Region. To assess and understand the pastoral dynamics in the Region, a survey involving 300 households (150 households with sedentary herds and 150 households with mobile herds) was conducted during the first half of 2012. The paper attempts to capture, from the responses of households surveyed, livestock trends in the Region of Diffa over a period of six years (2007 to 2012). Analysis of results, at least regarding households who provided comprehensive responses, shows reduced livestock over the relevant period with variances according to species. Data cross analysis highlights the occurrence of recurrent fodder deficits, attributable to a series of annual rainfall deficits as well as animal diseases as the main cause of reduced sizes of the herds of households surveyed.

Keywords: *Pastoral System, Diffa, Niger, Dynamics*

Introduction

Livestock, with more than 37 million heads of animal, is practiced throughout Niger according to agro climatic parameters. This activity significantly contributes to the budgets of Nigerien households (around 25%) and significantly meets their food needs (Republic of Niger, 2003; *Save The Children*, 2009, Republic of Niger, 2013). Livestock sector is the second most important source of export earnings (21% of export revenues) of the country after uranium. It represents 62% of agricultural export products and contributes some 11% to the GDP of Niger (Republic of Niger, 2013).

However, various natural (rainfall, silting of rangelands, etc.) and man-made constraints severely hamper pastoral production systems nationwide, including in the Region of Diffa. In this largely pastoral Region, 95% of communities practice livestock as their main economic activity or secondary activity after agriculture. The Region has more than 3 million heads of animal (i.e., 10% of the national livestock) composed of bovines, sheep, goats, camels, donkeys, horses (Republic of Niger, 2008a).

To understand pastoral dynamics in the Region of Diffa, in the face of such constraints which has increasingly become structural over the years, 300 households were surveyed during the first half of 2012. After a reminder of the environmental framework and methodology used, paper will first made an overall analysis of recorded livestock trends and then livestock trends according to species, on the one hand, and compare general trends to highlight variances and identify key determinants, on the other hand.

Natural framework
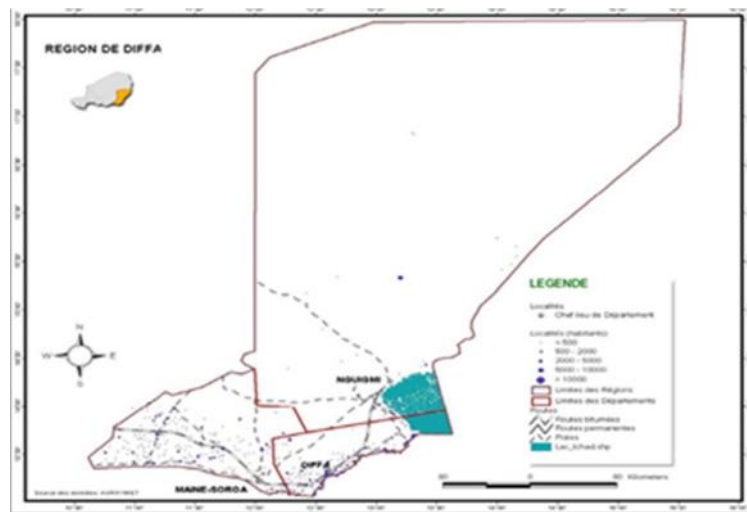
Figure 1: Region of Diffa (source: Republic of Niger, 2008b).

Located in the extreme East of the Republic of Niger, between longitude 10° 30' and 15°35'E , latitude 13°04' and 18°00'N, the Region of Diffa covers a surface area of 156,906 Km2 (figure 1). This Region straddles a Saharan Sahelian zone in the North and a Sahelian zone in the South.
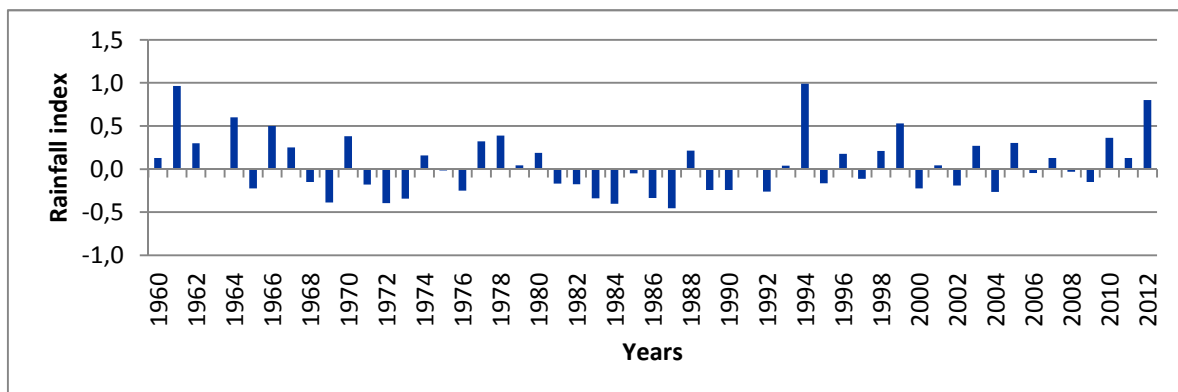
Figure 2. Rainfall variation in the Region of Diffa from 1960 to 2012 Source: NSI data (2010, 2013).

The Region of Diffa is subjected to high climate variability, characterized by an increasingly constant succession of dry spells (figure 2). Such climate variability engenders recurrent shocks characterized by major fodder deficits for an extensive livestock system. On average, 2 out of 3 years recorded deficits between 2005 and 2013 (figure 3).
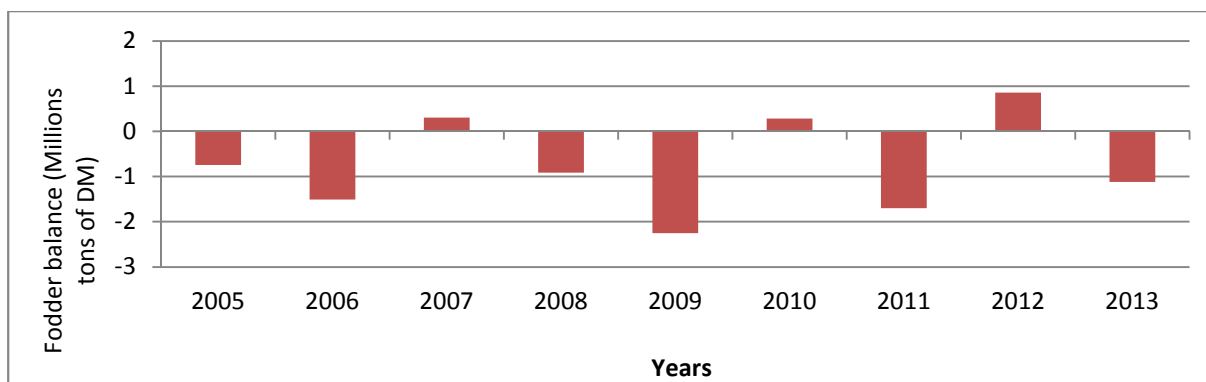
Figure 3. Changes in fodder balances in the Region of Diffa, from 2005 to 2013
Source: DREIA Data

Materials and method

The study area was divided into three survey zones (pastoral depressions zone, Lake Chad zone and Komadougou zone) based on agro-ecological parameters.

- The pastoral bowls zone: this is a largely pastoral zone is located between 50 to 250 mm/year isohyets (Saharan Sahelian region).
- The Komodougou zone: It is located in the South of the Region of Diffa and receives 250 to 300 mm of rainfall per year. This is an agro pastoral zone.
- The Lake Chad zone: It is located in the extreme East of the Region of Diffa in Lake Chad basin and receives 250 to 300 mm of rainfall per year. This is an agro pastoral zone and a retreat area for pastoralists during the dry season.

Sampling and conduct of the survey

The sample included 300 households (150 households with sedentary herds and 150 households with mobile herds) selected in a reasoned way based on 100 households per survey area. The survey was conducted from 10 February to 5 April 2012, i.e., over a period of some 45 days (Cf. Abdoulkadri et al., 2013). The data subject of this paper focus on the retrospective statements made by households surveyed on the numbers and species composition of their herds over the 2007 to 2012 period. However, this exercise was quite difficult, as very few households could provide useable responses in this regard.

Results and discussion

The results of the survey show that out of the 299 herds surveyed, only 50 households could trace changes in their cattle herds over the relevant period; 55 households for sheep herds; 49 households for goats and 13 households for camels. The reduced size of the sample does not allow analysis per agro ecological zone. Thus, this overall analysis will be limited the livestock of households interviewed according to livestock system (sedentary and mobile), on the one hand, and according to species, on the other hand.

Trends in livestock surveyed

Figures 4 trace changes in the herds of respondent households, between 2007 and 2012. Figure 4a shows that the numbers of livestock are constantly decreasing for all species. From a total number of 6,418 heads of cattle (around 2,421 Tropical Livestock Units) in 2007, livestock decreased to 2,965 heads (around 1,287 TLUs) in 2012, i.e., a decrease of about 53.8% over the period under consideration. This decrease was more pronounced between

2009 and 2010 when livestock recorded a decrease of about 39.6%. However, it should be noted that between 2008 and 2009, despite its decreased numbers, livestock recorded a slight increase in terms of TLUs. This could be attributable to an increase in the numbers of large ruminants while the number of small ruminants decreased.
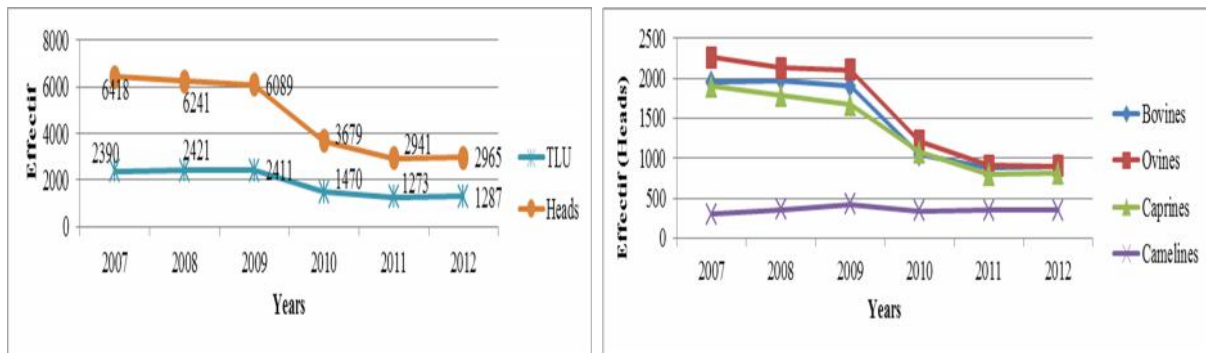
Figure 4. Livestock trends between 2007 and 2012 (Heads)

Figure 4b trace herds' evolution according to species between 2007 and 2012 to better assess the situation. This figure shows the level of loss according to species. Thus, the number of camels increased from 301 heads (or 301 TLUs) in 2007 to 421 heads (or 421 TLUs in 2009, i.e., an increase of about 40%. At the same time, the number of small ruminants reduced by around 10%. The number of cattle decreased by some 2.7%.

On the contrary, between 2009 and 2010, all species recorded losses. Cattle (45%) and sheep (42%) were the most severely affected by drought experienced in the area during the 2009-2010 pastoral seasons. This season recorded an important fodder deficit (Cf. figure 3). Goats (35%) and camels (18%) were relatively less affected.

Sedentary herds'evolution

Analysis of both sedentary and mobile herds' evolution makes it possible to compare and better understand the phenomenon. For sedentary herds, in view of the low number of camels per household (less than 1 dromedary per household, on average), the exercise only focused on cattle, sheep and goats. The number of households who gave full responses on the period under consideration was 23 households for cattle and 18 households for small ruminants.

Figure 5 indicates a drastic and sustained reduction (of about 56.4%) of sedentary herds surveyed, regardless of species. Cattle recorded the highest levels of loss (59.6%) probably because of their high sensitivity to the impacts of drought attributable to their diet. They were followed by goats (56.7%) and finally by sheep (53.8%). Though goats are more resistant to drought and fodder deficits, given their capacity to use aerial pastures under such circumstances, they were the first to be sold during food and/or feed crisis periods to meet household needs.
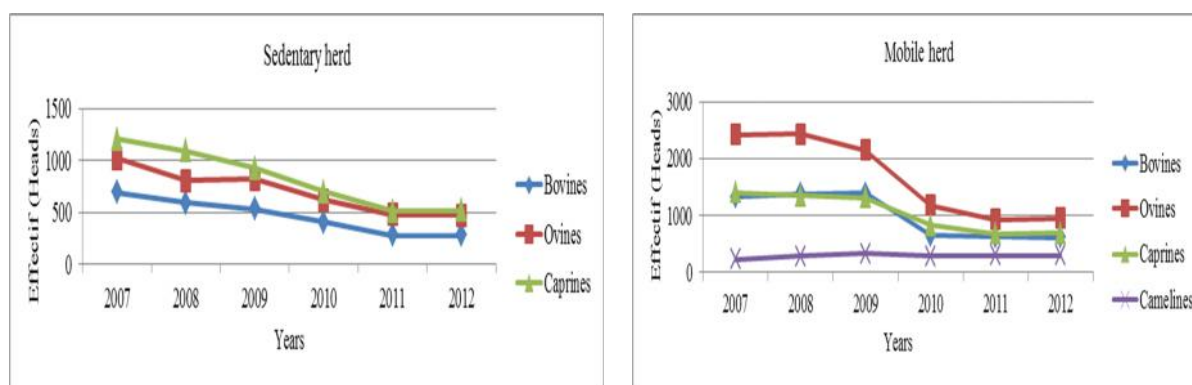
Figure 5. Changes in the numbers of sedentary and mobile herds between 2007 and 2012.

Mobile herds' evolution

For mobile livestock, the number of respondents per relevant species is : 27 for cattle ; 37 for sheep ; 31 for goats and 13 for camels. Figure 33 shows a reduction in livestock of about 52% between 2007 et 2012. Sheep are the most affected species (60.8% loss), as opposed to sedentary herds, followed by cattle (53.6%) and goats (50.5%). Camels, with 27.8% loss, are the least affected animals, probably given their drought resistance capacity and their diet (figure 5). According to pastoralists interviewed, animals were subjected to lengthy walks and at sustained pace to find pastures and best safeguard herds (especially cattle and camels). Animals were thus exhausted, weakened and vulnerable to diseases. Sheep, enable to sustain such a rhythm, thus recorded the highest mortality rates during this feed crisis.

Determinant factors

To account for the increase or reduction of herds, respondents were asked a multiple choice questions and by order of priority questions, as the case may be. Frequencies of key reasons given by respondents are reported in table 1.

Analysis of results per species shows that droughts (or fodder deficits) and animal diseases are the main causes of herd reductions. Indeed, 83% of relevant households estimate that drought ranks among the causes of bovine mortality in their herds. At the same time, 76.6% of such households reported animal disease related mortality as one of the other causes of reduced bovine herds, while 34% report sales as one of the main causes of the reduced number of their cattle.

Table 1. Main reasons put forward to account for reduced herds, according to species

Item	Number of relevant households	Disease-related mortality		Drought-related mortality		Sales to meet household needs	
		Number of responses	%	Number of responses	%	Number of responses	%
Bovines	47	36	76.6	39	83,0	16	34.0
Ovines	35	30	85.7	31	88.6	13	37.1
Caprines	36	31	86.1	30	83.3	14	38.9
Came**line**s	14	10	71,4	11	78.6	8	57.1

Similarly, droughts and animal diseases were respectively reported by 71.4% and 78.6% of responding households as the main causes of reduced number of camel herds. In addition, 57.1% of households also reported sales as one of the reasons why the number of the dromedaries decreased over the period under consideration. For sheep, 88.6% of household affirm that drought is one of the factors which led to sheep mortality within their herds. In the same vein, 85.7% of households estimate that animal diseases are also involved. Contribution

of sales to reduced number of sheep was reported by only 37.1% of respondent households. For goats, response frequencies are, by order of importance: 86.1% for animal diseases; 83.3% drought-related mortality and 38.9% for sales.

Animal disease and/or drought-related mortality was put forward in 95.8% of cases as the basis for reduced number of cattle; 94.7% of cases for goats and 88.6% of cases for sheep. All households sampled and interviewed in the Region (pastoral depressions, Komadougou and Lake Chad) estimate that drought, which generates chronic fodder deficit; remains the main cause of livestock mortality in the Region and that diseases are in fact the impacts of weal underfed livestock.

Discussion

An evaluation study on the 2009-2010 pastoral crisis revealed loss of about 24% of the livestock of Niger during this crisis (Republic of Niger, 2011). The main causes of animal mortality include: fodder deficit (38%) and diseases (35%). On this basis, it may be said that against our results, the Region of Diffa has been relatively more affected than the national average, on the one hand, and on the other hand, confirmed the occurrence of animal diseases and fodder deficits in the evolution of livestock in the Region.

Thus, between 2010 and 2012, the Regional Directorate of Livestock and anima industries (DREIA, 2010 ; 2011 ; 2012) of Diffa recorded 296 reports of suspected outbreaks of legally contagious diseases with a predominance of suspected piroplasmosis (36 % of reported outbreaks); of sheep pox (31%) and pasteurellosis (20%).

Conclusion

In summary, it seems that livestock in the region of Diffa was affected between 2007 and 2012. Camels and goats, given their diets (capacity to use aerial pastures) were less affected. Droughts, which generate fodder deficits, are the main causes of reduced livestock, both in large and small ruminants. Fodder deficit translates into under-feeding of animals which become very vulnerable to diseases..

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SOCIO-ECONOMIC CHARACTERISTICS OF FULANI'S HOUSEHOLDS IN NORTHEASTERN BENIN

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Abstract

Fulani belong to a socio-cultural group predominantly met in western Africa and usually raises cattle. Known as a nomadic group, Fulani have become increasingly more settled and combine crop farming with livestock husbandry. In Benin Fulani are predominant in the two eastern departments of the north. This community plays a key role in meat and milk supply in the country. But deep information on their household characteristics is scarce so that specific development actions concerning their activities are scarce. This study was carried out to characterize their household and highlight their livelihood strategies in the three agro-ecological conditions of the study area. 150 Fulani livestock keepers randomly selected were interviewed in 2013. The results show that the average household size is 18 people of which 22% are directly involved in cattle farming. The land is mostly inherited and the average size for a household is about 10.5 ha. Half of the land size is devoted to crops farming mainly 80% for home consumption and 17% to cotton production. Their livestock includes cattle, sheep, goats and poultry (chickens and Guinea fowl). Cattle represent 50% of the household livestock size. Cattle provide daily milk consumed at 51%; the rest is sold. Fulani also sell in average one cattle per month. In less favorable ecological conditions, they derive their income mainly from livestock. While in the regions where it rains more, they diversify their incomes by investing in food crops and cash crop (cotton mainly) farming.

Keywords: *Fulani, Cattle farming, household economy, Benin.*

Introduction

Fulani populations are scattered over the vast West African savannah belt of wooded grasslands, from Senegambia in the west to French Equatorial Africa in the east (Stenning, 1959). In these countries and especially in Benin, the name of Fulani is synonym of cattle ownership. Traditionally, they have been known as nomadic people moving from one area to another with all their family looking for a better grazing land. But facing some problems related to their mobility like land tenure, drought and the household size which will not allow them to exchange cattle with cereals, more settle down. So in addition to cattle breeding, they are involved in farming, primarily for home consumption. According to Iro (1994), they are usually concentrated in the savannahs and semi-arid zone of countries to escape humid zone infested by tsetse fly. In Benin, Fulani population is concentrated in the North. Livestock production in this part of the country represents 85% of the national cattle herd. *Borgou* and *Alibori* departments concentrated 63% of this national herd (FAO, 2013). Nearly 95 % of national cattle herd is hold by Fulani (Dehoux & Hounsou-Vè, 1993) who represent an important group practicing livestock husbandry (Alkoiret et al., 2009; IIED & SOS Sahel, 2010). More, people in the country and especially in rural areas of the north depend mostly on Fulani for meat, milk, cheese, butter, skin and manure so that they are key actors in the country for protein supply. Most of the literature dealing with Benin Fulani (Bierschenk & Foster, 2004; Schareika, 1998; Bierschenk & Le Meur, 1997; Boesen et al., 1998) is written

by anthropologists, historians and sociologists. These authors have tried to describe Fulani society, complexity and relations with the neighbor socio-cultural groups. Recent works on Fulani focus on their cattle farming systems (Alkoiret et al., 2009; Alkoiret et al., 2010; Youssao et al., 2013) and also their impact on environment (Djenontin, 2010). Most of these studies focus on Fulani as cattle owners forgetting that most are settled. In addition to livestock farming, Fulani households share cropping activities common to the others socio-cultural groups. So, the present study tries to characterize Fulani's household and highlight their livelihood strategies in the three agro-ecological conditions of *Alibori* and *Borgou* departments in Republic of Benin.

Materials and methods

The study was carried out in *Alibori* and *Borgou* departments located in northeastern Benin, within sudano-sahelian and sudanian climate. The area is lying between 02° 04' and 03° 33' of longitude east and 09 ° 24' and 12 ° 08' of latitude north. The average annual rainfall varies between 1200 mm in the south and 900 mm in the north of the departments. The dry season lasts from November to April while the wet season starts from May and ends in October. *Alibori* and *Borgou* departments are divided in three agro-ecological zones corresponding to the climatic zones of the area. Data were collected in *Kalalé*, *Banikoara* and *Malanville* districts selected in the three agro-ecological zones of the study area. *Malanville* belongs to the first agro-ecological zone characterize by a sudano-sahelian climate. This district is located in the northern part of the departments with an annual rainfall between 700 and 900 mm. Land use system is mainly based on millet, sorghum, cowpea and peanut. Despite the limited rainfall, there is a great potential for agricultural development linked to the existence of fertile and irrigated land along the Niger River. *Banikoara* district is situated in the second zone with a sudanian climate. Rainfall varies between 800 and 1200 mm a year. Cotton, sorghum, maize, cowpea and peanut are the main crops in the land use system. *Kalalé* is located in the third agro-ecological zone also characterized by a sudanian climate with rainfall ranging between 900 and 1300 mm. Land use system is based on sorghum and yam, with a high concentration of maize and cotton. Fifty household heads were selected by district. This give a total of 150 Fulani heads of household for the study. District of each agro-ecological zone and the three villages inside each district have been selected according to the importance of Fulani population and the size of cattle herd. In each village, respondents randomly selected were interviewed. Detailed information about household composition, information on livestock (species, number) and other assets such as land (size and crop produced) were also collected. Main sources of income for the household members were recorded: livestock income and crop income. Data were recorded from May to June 2013. Descriptive statistics design was run to show household socio-economic characteristics. To determine to what extend livelihood strategies of the households are local specific, Chi square test and ANOVA have been used to compare data between the three districts.

Results and discussion

The results show that all the heads of households are married and predominantly (63%) polygamous. Table 1 shows that they are 46 years old in average. The median age (47 years) as well as the modal value (40 years) support the fact that cattle farming attract more young than older people. The educational status is found to be very low. Predominantly (78%), had received non-formal education and only 19% had koranic education. But 27% of them have been alphabetized in *Fulfulde*. Nevertheless, 46% of the households enroll their junior sons to school when 37% of the households do it for their junior daughters. In 15% of the second group's households, only girls benefit this enrollment to school (Table 1). It derives from this table that schooling decision for children follows the same statistic trend and provides an equal chance to male and female. The median household size is 15 people whereas the average value is 18 people of which 22% are directly involved in cattle farming.

The modal value of 10 people which also represents only 25% of the households size distribution shows that majority of Fulani have a big household size. Table 1 also reveals that people involved in cattle farming is independent of household size. Four people can be indicated as the optimum size needed for cattle farming. Polygamy and sons married who stayed inside the household of their parents can explain the high size of the household. The average household size is higher than that recorded by Olorunnisomo et al., (2010), Oladeji (2009), Adisa and Badmos (2009) in Nigeria which is around 9 people. Data are also recorded among Fulani agro pastoralists living in cattle farming areas. Households are mainly polygamous but the high difference in household size can be the nonexistence of sub-household phenomenon compared to Benin Fulani's households.

Table 1. Socio-economic profile of Fulani's households

Characteristics	Mode	Percentiles			Mean
		25	**50**	**75**	
Age of household head (years)	40	35	47	55	46
Household size	10	10	15	23	18
People involved in cattle farming	4	3	4	5	4
Boys' schooling	1	1	1	2	1.6
Girls' schooling	1	1	1	2	1.8
Family pattern Monogamy (%) Polygamy (%)	37 63				
Level of education (%) Non-formal education Primary Secondary Koranic	78.0 2.7 0.7 18.7				
Alphabetization (%)	27				

The results also reveal that land is mostly inherited and the average size owned by a household is about 10.5 ha. The modal value (7 ha) and median land size (9 ha) show that majority of the households have enough land. It is one of the factors that indicate their settlement degree. Half of the land size is devoted to crops farming mainly for home consumption (80%) and 17% to cotton production. The main crops produced are sorghum, maize, yam, soybean and peanut. The land size for farming (6.9 ha) corroborates the finding of Alkoiret et al., (2009) of 6.7 ha for cattle farmers who are predominantly Fulani in Gogounou district (north eastern of Benin).

The livestock in a Fulani household includes cattle, sheep, goats and poultry (chickens and Guinea fowl). Cattle is dominant and represents 50% of the household livestock size as shown in table 2. Cattle represents an important part of Fulani cultural identity and it constitutes one of the properties they leave to their children. The cattle size dominance is in agreement with the finding of Oladeji (2009) and Iyayi et al. (2003). These authors revealed that cattle is dominant and the most important livestock among Fulani agro pastoralists in south-west Nigeria. The average cattle herd size (66 heads) found for all the study area is more than that revealed by Akpa et al. (2012) for Fulani household in Zaria which is about 42 cattle. But the herd size distribution shows that only 32% have more than 66 heads and reveals that most of the households have a relatively medium cattle herd size.

Table 2. Livestock pattern (number of heads) among Fulani's households

Livestock	Mode	Percentile			Mean	Minimum	Maximum
		25	50	75			
Cattle herd	30	30	48	78	66	20	748
Sheep herd	15	8	15	20	19	0	120
Goat herd	10	5	10	18	15	0	350
Chicken herd	10	10	15	25	19	0	100
Guinea fowl herd	0	0	7	11	9	0	69

Cattle production is composed of meat (which is sold as live animals), milk, manure and draught. The household consume most (51%) of the milk daily recorded. The rest is mainly sold as fresh milk. Milk consumption is higher than that found by Somda et al. (2004) by revealing that milk consumed in smallholders' dairy households represent 35% of daily milk recorded. But in western province of Zambia, nearly 75% of milk is consumed by the household or exchanged in the community (Moll et al., 2007). Sixty-two percent of Fulani households sell cattle to solve money problem. The median size of cattle sold is one cattle per two months when in average one is sold per month in the household. The distribution of cattle sold shows that majority (67%) of households sell from one to four cattle in half a year. So, Fulani are not contemplative of their cattle herd and the number of cattle sold is in agreement with their wish to leave something to their children and to bring a well-being to the household's members.

Results in table 3 show Fulani's households' strategies according to their agro-ecological conditions. In high rainfall region (third agro-ecological zone), more households produce cotton with cotton area representing the double of the one in the two others agro-ecological zones. Moreover, all the households in this zone sell 36% of the crops produced. Milk sold and income derived from cattle selling is the least of the three regions. In less favorable ecological conditions (first agro-ecological zone), Fulani households derive their income mainly from livestock (milk and cattle selling). Crops harvested are mainly for home consumption. Households located in the second agro-ecological zone have their incomes mostly from livestock but less than in the first zone. In addition, majority (80%) of them sells their crop, a bit less than in the third zone with regard to the part sold (26%).

This could be explained by the fact that when conditions are hard, Fulani dedicate more time to their traditional pastoral activities, compared to favorable conditions. Given the high fluctuation of food crop market price in Benin within a year, Fulani develop risk avoidance strategy by producing crops to maintain their household's food security. In favorable conditions, Fulani have access to the market with milk and meat in addition to food crop. It is a kind of survival strategy developed according to the agro-ecological context which made Fulani people more resilient.

Moreover, Fulani household economy is diversified according to the conditions of their environment. It is a kind of specialization of agricultural producers that should be experimented to organize all the other producers in the country. This will help Benin to improve its regions' productivity and have a better agricultural production. Agricultural population could therefore earn more money and improve its livelihood conditions.

Table 3. Fulani's household strategies according to the three agro-ecological condition of the study area

			Kalalé	*Banikoara*	*Malanville*
Half-yearly income derived from cattle selling (F CFA[1])	Mean		418,927[a]	691,176[a]	6,141,666[b]
	Mode		80,000[2]	200,000[b]	2,600,000
	Percentile	25	110,000	270,000	2,075,000
		50	240,000	537,500	2,650,000

	75	430,000	845,000	4,575,000
Households harvesting cotton (%)	58[a]	56[a]	20[b]	
Cotton farming (ha)	4.8[a]	1.8[a]	2.6[a]	
Households selling crop (%)	100[a]	80[b]	30[c]	
Part of crop sold (%)	36[a]	26[a,b]	23[b]	
Households selling milk (%)	52[a]	94[b]	80[c]	
Part of milk sold (%) [3]	45[a]	56[b]	60[b]	

[1]: 1 € 656 F CFA; [2]: Multiple modes exist. The smallest value is shown; [3]: part of daily milk recorded in the household. Values followed by different letters are significantly different ($p<0.05$).

Conclusion

Results from the study reveal that Fulani households are not only contributing to livestock production but are also involve in food crop and in cash crop production. Their high household size is also contributing to supply enough labor force for farming activities. This proves that Fulani households are enough settled but cattle is still very important for them. From less favorable agro-ecological zone to favorable, Fulani households diversify their income sources mainly from livestock by adding staple and cash crop farming. It is therefore the proof that Fulani are crop producers as well as cattle herders. Climate decides to what extent they specialize. More attention should be given to Fulani people by agricultural policies of the country in order to improve agricultural production, accumulate enough food for export and help the country's economy to reach a better level.

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BUDGETARY SUPPORT TO AGRICULTURE IN BOSNIA AND HERZEGOVINA, AND EURO - AND WTO INTEGRATION PROCESSESS

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Abstract

Bosnia and Herzegovina (BiH) and its agriculture are facing big challenges - from gradual approximation to full adoption of the EU Common Agricultural Policy (CAP), and full membership in the World Trade Organization (WTO). The budgetary support to agriculture in BiH is still far from the above integration processes both in qualitative (types of measures, criteria for support, ways of implementation) and in quantitative terms (budgetary transfer amounts both in total and per unit). Although these integration processes are a strategic determination for BiH, they can also contribute to the continuation of numerous negative trends in a larger number of agricultural subsectors in BiH. In order to avoid possible negative consequences and in order for BiH to best prepare for needed integrations, it is necessary to initiate certain reforms of budgetary support to agriculture in BiH. The comparative analysis of agricultural policy of BiH and EU CAP indicate a still large gap between them and a significant difference both in the range and structure of measures. In both BiH entities, direct payments based on output make a larger part of direct support to producers; whereas, they almost do not exist in the EU countries. Regarding the WTO integration, the support policy in BiH is mostly based on the measures that are subject to limits in WTO (Amber Box measures) and as well that several key agricultural products considerably exceed the *de minimis* threshold of 5%. This can be a big problem, particularly from the angle of continuation of implementing some agricultural support measures after the BiH membership in WTO.

Key words: *agricultural policy, Bosnia and Herzegovina, budgetary support, CAP, EU, WTO*

Introduction

Agricultural policy in BiH is carried out at several distinct levels because of the political system complexity. Without a single national ministry that would cover the field of agriculture, agricultural policy management is partly handled by the Division for Agriculture, Food and Rural Development within the Ministry of Foreign Trade and Economic Affairs. The entity level of creating and implementing agricultural policies is composed of separate ministries of agriculture, water management and forestry in Federation of BiH (FBiH) and the Republika Srpska (RS) and they, along with the Division for Agriculture within the Government of District Brcko (DB), are the most important institutions competent for agricultural policy in BiH. In addition to the entity level, FBiH has also the cantonal level (10 cantonal ministries) where the management of agricultural policy considerably determines the overall position of agricultural producers and the sector as a whole. The budgetary transfer amounts, agricultural policy measures, rural development policy and criteria to support producers are only part of the policy that is under the exclusive competency of the entity/cantonal ministries of agriculture, i.e., the Division for Agriculture within the Government of DB. In fact, agricultural policy in BiH does not exist; it is rather an aggregation of policies by entities and cantons without much coordination among them. Such

policy is unstable, very often depends on political orientation and more determined to serve to a "higher interest" than strategic goals. Incomparability of the policy is not a problem for itself but a fact that testifies about the populism and lack of strategy and vision in the politics (Bajramovi et al., 2010a).

Based on previous experiences of EU integrations some conclusions useful for BiH can be made. There a lot of critics on CAP (Atkin, 1993, Ritson and Harvey, 1997, Tracy, 1997, Sapir et al., 2003) in the literature, but BIH, if wants EU membership, should incorporate itself into CAP mechanism (Erjavec, 2004, Harrop, 2000). The countries with clear aspirations toward the EU integration have to take over the concepts, mechanisms and implementation systems of CAP at the very beginning. (Erjavec et al., 2010, Bajramovic et al., 2010b). CAP is a complex system of legal regulations, budgetary support and public regulatory interventions that considerably affect the situation in agriculture and rural areas in the EU. Gradual adaptation to CAP measures and instruments in the pre-accession period aims to prepare the country for effective integration into a complex institutional and legislative EU CAP system. An additional value of this process derives from the fact that this is the way for agricultural producers in a (potential) candidate country for the EU membership to prepare timely for a significantly different approach such as the CAP planning and implementing. Significant differences in the range and way of implementing agricultural policy measures make the EU accession a challenge for every candidate country, particularly for less-developed countries such as BiH. Because of continuous changes, it is often said that CAP is a "moving target" for all EU candidate countries (Erjavec et al., 2010, Salputra and Erjavec, 2012).

Membership in the WTO, as second targeted integration for BiH requires different, but no less reforms that are primarily related to the mechanisms and types of supports to agriculture and rural development. Actually this is a limitation of the total budgetary support (base AMS – Aggregate Measurement of Support) and the limitations related to certain measures that can be used in support. One of the important obligation that BiH will have after joining this organization (has not been in focus until recently) is the harmonization and coordination of agricultural policies at all levels of government. This includes the same criteria for creating, implementation and control of agricultural policies.

The aim of this paper is to determine the current budgetary support to the agricultural sector in BiH and the achieved level of the EU CAP convergence. Furthermore, the paper will present structure of the support according to the WTO classification of measures aiming to find out to what extent the domestic budgetary support complies with the provisions of the Agreement on Agriculture (AoA) of WTO agreement. Based on the results obtained recommendations are offered on how to improve the integration processes.

Material and methods

For the analysis and the comparison of agricultural policy of Bosnia and Herzegovina as country preparing for the EU accession with the CAP it was used a methodological tool called the APM (Agri-Policy Measures), developed by Rednak and Volk (2010). A uniform classification of agricultural budgetary support was created using the current EU concept based on the policy pillars as a basic starting point, combined with the OECD PSE classification. The EU program aspect (pillars, axes) has been applied at higher levels of aggregation, whilst setting forth the OECD PSE criteria for the formation of groups or subgroups under individual pillars and particularly for defining the lowest level of classification (basic headings). Thus, the APM allows for a rough analysis of budgetary transfers to agriculture also according to the OECD PSE classification and *vica-verse* (Volk et al., 2012). For determination of achieved WTO integration processes we used WTO AMS methodology[1] that categorizes incentive measures into three groups, i.e. in three boxes:

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[1] Source: Ministarstvo vanjske trgovine i ekonomskih odnosa (2002)

Amber Box, Blue Box and finally the Green Box. According to this classification, measures which are classified in the Amber Box are directly related to production of, either individual products or all agricultural products in general and as such they have the greatest impact on trade. The amount of these measures is determined by appropriate AMS methodology into single AMS indicator. AMS calculated from the base period is the subject of observed decrease in percentage and time interval. Blue Box measures are measures within the framework of the so-called limiting production program, while Green Box measures may not have or may have only a minimal distortion effect on the trade (Gorter and Ingco, 2002).

Source of data for all figures regarding agricultural policy in the paper was own calculations based on available public data and internal documents of entity's (DB) ministries of agriculture and cantonal ministries (departments) of agriculture of FBIH compiled in APM database created through the FAO-SWG project (2014).

Results and discussion

Budgetary support to agricultural sector of BiH
The total agricultural budget in BiH in the observed period 2002–2012 continuously increased, with some minor fluctuations in the years of the global economic crisis and its consequences on BiH.
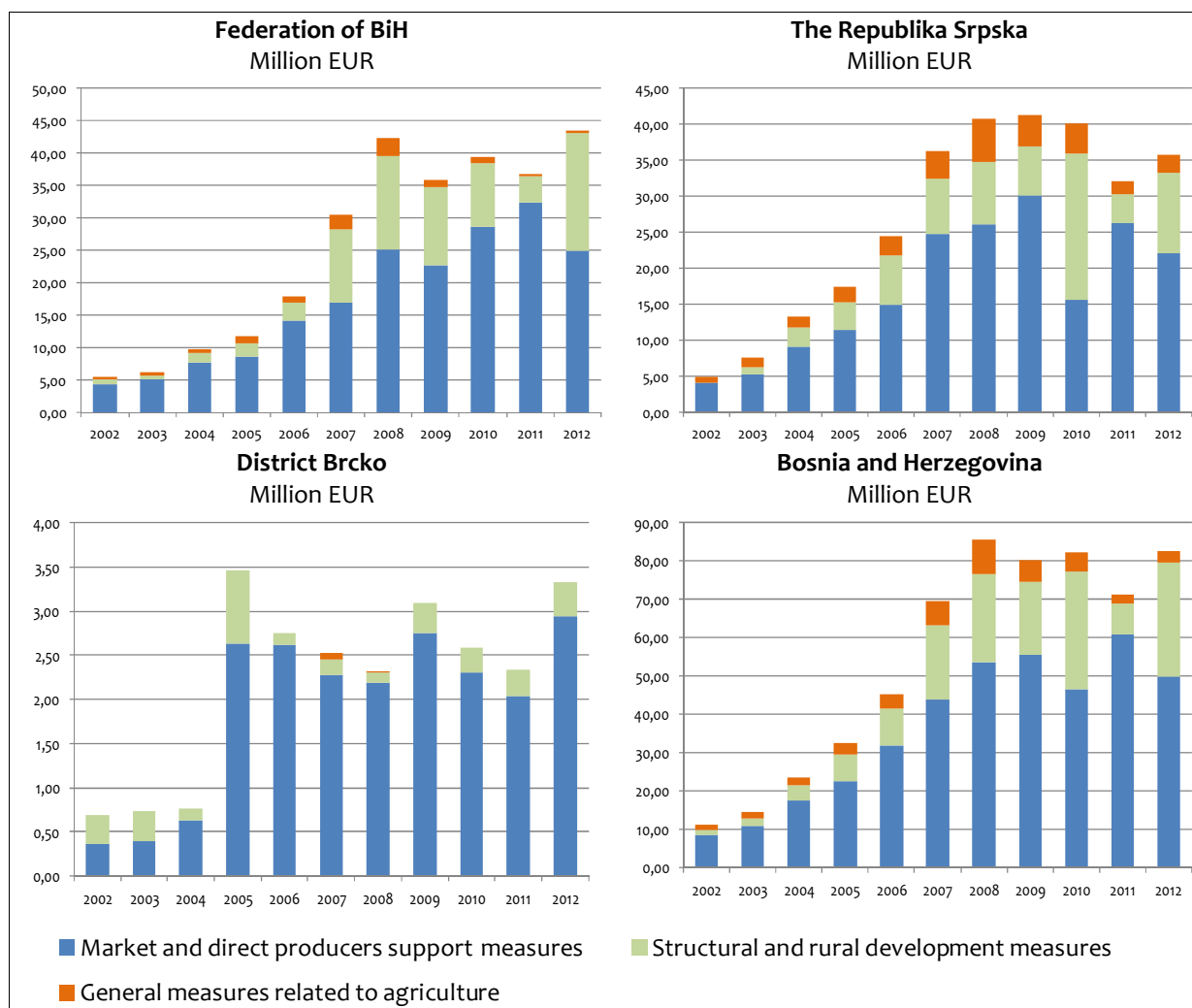
Figure 1: Budgetary support to agriculture according to group of measures in BiH (total and per entities and District Brcko) for period 2002-2012

In 2002, the total budgetary transfers to agri-food sector at the country level amounted to EUR 11.12 mil., and increased almost eight times in 2012, reaching EUR 82.73 mil. The main characteristic of the observed period is the fact that support funds for agricultural sector

have been considerably increasing since 2007 as a result of increased budgetary revenues and introduced value added tax.

Agricultural policy of BiH and its entities (including the district) is composed of three pillars, i.e., groups of measures, as follows: Pillar I – Market and direct producer support measures, Pillar II – Structural and rural development measures and Pillar III – General measures related to agriculture. In FBiH Pillar I policy measures (market and direct producer support measures) dominate in the structure of budgetary transfers and account for average 70% of the total agri-food budget in the observed 11-year period, making up even nine-tenth of the entire support in some years, as was the case in 2011. The second group of measures by importance are structural and rural development measures, while Pillar III and its general measures related to agriculture form the smallest part of the total sector support, and that is one of the reasons for the farmers' poor knowledge of science, a low level of sector promotion and marketing, and generally insufficient institutional capacity building in the sector (Bajramovi et al., 2014). Similar positive tendencies of increase in agricultural budget were also present in RS. Except in 2010, the sector support mainly covered Pillar I market and direct producer support measures, the share of which was 62%–82%. Structural and rural development measures came second in the total agricultural policy in this BiH entity, and unlike FBiH, RS paid much more attention to Pillar III policy and general sector support, which had regularly accounted for more than 10% of the total budgetary support until 2011. This is probably one of the reasons why this BiH entity has better institutional capacities in this sector, including a very important field of knowledge transfer and the role of agricultural advising in it.

When we talk about direct producer support measures (figure 2), the structure of share differs, depending on the entity. So, in FBiH direct support to producers mostly pertained to direct payments and was the most popular support measure. Unlike FBiH, support to variable inputs in RS has a significant share in direct support to producers, in addition to direct payments. This was particularly evident during 2009–2012 with the exception of 2010, when the share was one-third (2009) to one-half (2011) of the total funds allocated for Pillar I policy in this BiH entity. Figure 2 evidently shows that direct payments based on output dominate over the payments based on current area/animal in the structure of direct payments to producers at the BiH level over the entire observed period. In this, there is a clearly different entity approach to this group of policy measures. Direct payments based on output in RS had been the only direct payment to producers until 2005, when the payments based on current area/animal were introduced. The latter payments had a considerable share in this group of policy measures including the year 2008, but during 2009–2012 direct payments based on output became topical again, accounting for average 85% of all direct payments. Bulk of these payments were intended for milk producers who were mostly paid on the basis of produced amounts or amounts bought from them, and among other production types, support to the producers of arable crops, fruit and vegetables should be mentioned. Although payments based on output still have a large share in FBiH, it is encouraging that the payments based on current area/animal increase its share because it is a measure toward the harmonization with EU CAP and WTO integration processes. The support based on current area/animal is practically the first step in the transition of support policy toward EU CAP arrangements.
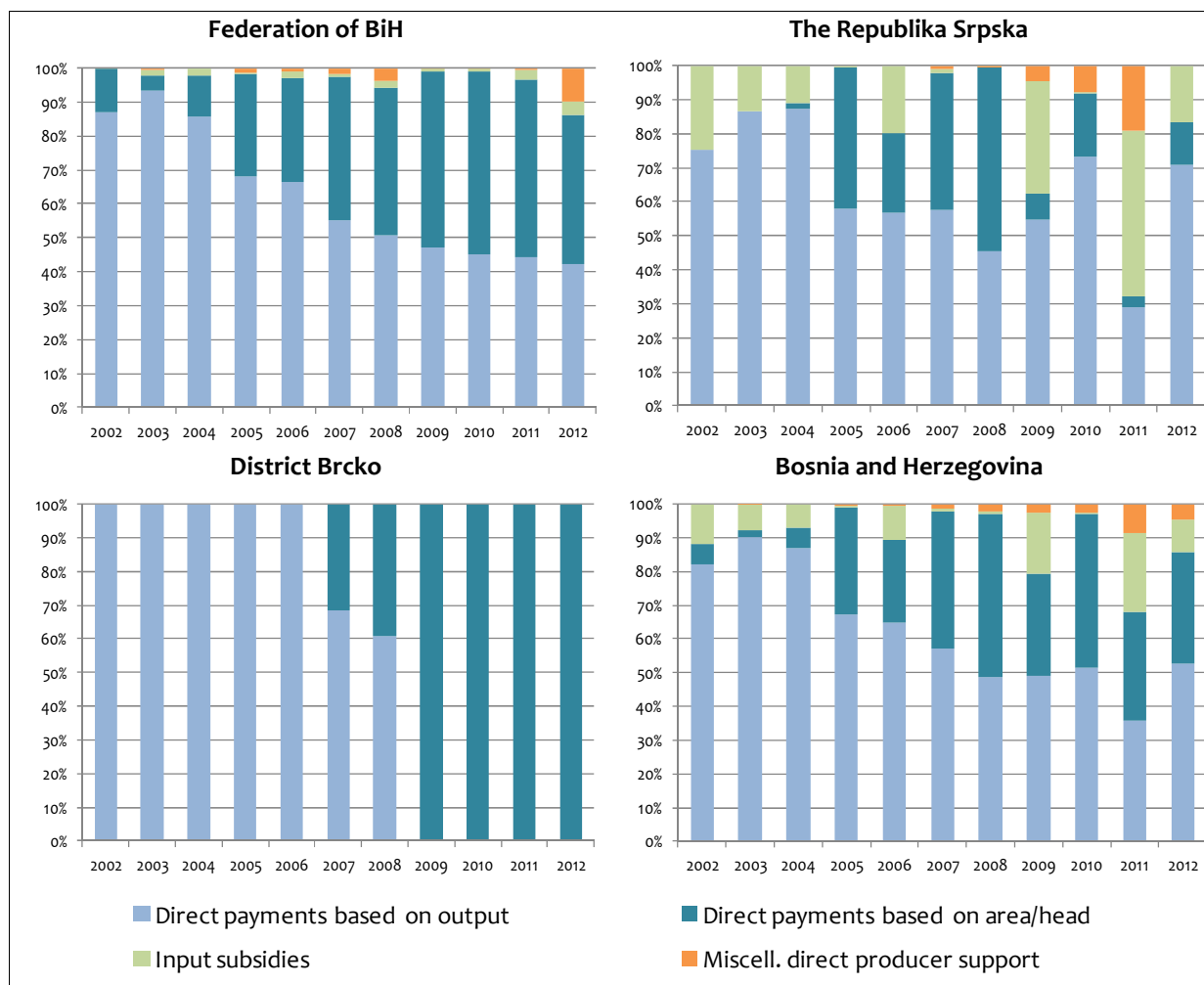
Figure 2: The structure of direct producer support measures in Bosnia and Herzegovina (total and per entities and District Brcko) for period 2002-2012

The comparison of budgetary support to agricultural sector in BiH and EU

Comparison with EU countries and achieved level of CAP convergence is particularly important if we take into account the expressed aspiration of Bosnia and Herzegovina firstly to become the candidate and then a full member of this community. As previously mentioned, the total budgetary allocation for the agricultural sector in Bosnia and Herzegovina, that is to its entities are quite modest. According to FAO SWG project data (2014), in the year of 2012, the total budgetary support to the agricultural sector in BiH per capita is EUR 19, per ha of agricultural land EUR 38 and per employee in agriculture sector EUR 495. This is significantly lower than in the EU-27 countries where in the same year the budget support for the sector per capita was EUR 157, per ha of UAA (utilized *agricultural area*) EUR 450 and per employee in the agricultural sector EUR 7,344. Significant differences are observed too, when the market structure and direct producer support measures structure are compared (Figure 3).

Unlike the EU-27 countries, direct payments based on output are dominant in BiH, especially in the Republika Srpska. When talking about the structure of the first pillar of agricultural policy measures, evident is the significant difference between BiH entities. In the Federation of BiH direct payment share per ha/head are significant, while support in variable inputs is almost symbolic. In the Republika Srpska variable inputs support is an important measure of the first pillar referring to subsidizing fertilizers, fuel and seed material purchase.
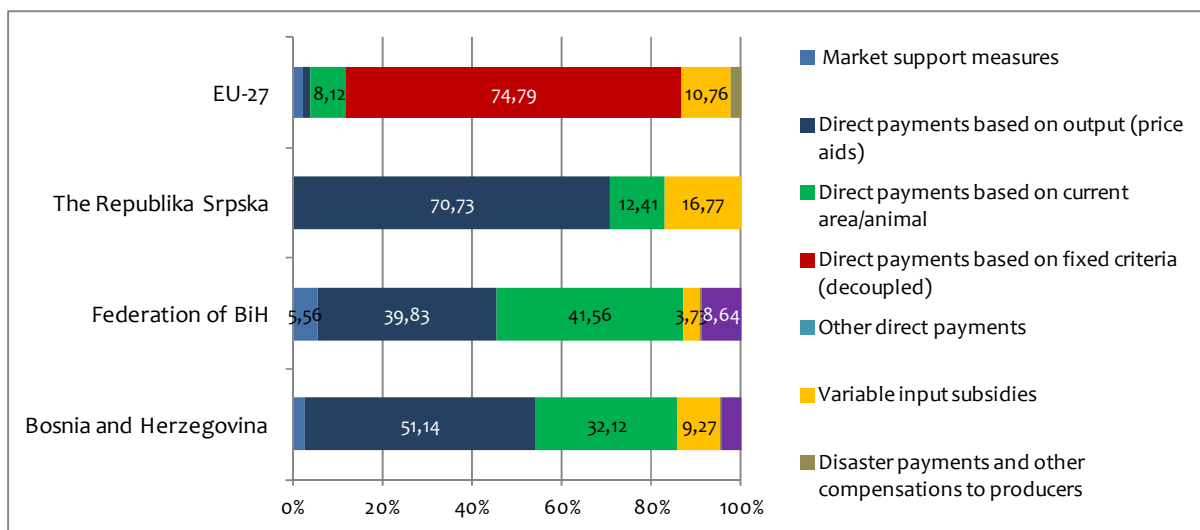
Figure 3: The comparison of the structure of market and direct producer support measures in Bosnia and Herzegovina (state, entity and District Brcko level) with EU-27 in 2012

The previous analysis clearly indicates that BiH will have to increase support to agriculture on its road to EU and adapt its support model to the EU mechanisms. The new model of measures in the EU indicates that BiH and its entities will have to orient toward direct payments based on current area/animal (leave out support per output) in the creation of the future agricultural policy and give more importance to various payments in the rural development policy.

WTO integration processes
The structure of the support to the agriculture sector according to the WTO classification has been made aiming to find out to which extent BiH budgetary support is consistent with the provisions of the AoA/WTO agreement.
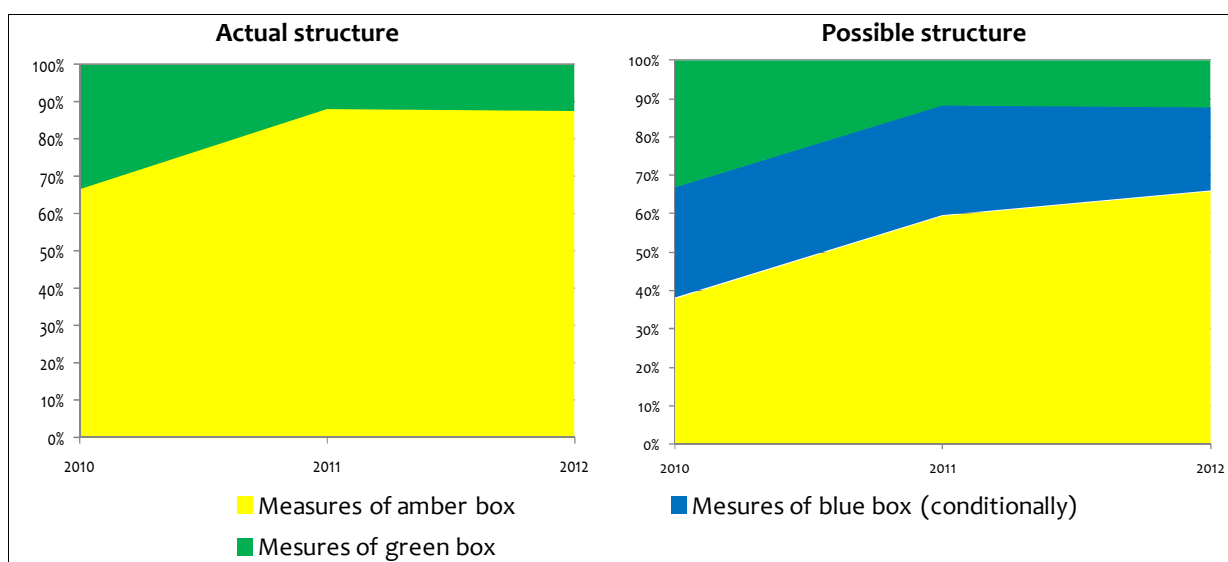
Figure 4: The actual and possible structure of budgetary support to agriculture in Bosnia and Herzegovina according to WTO classification for period 2010-2012

Figure 4 gives an overview of the structure of agricultural support measures according to WTO/AMS classification in a way that left graph provides a structure taking into account the strict adherence to the provisions of the AoA, while the right graph presents data on possible

support structure since the direct payments measures per head/hectare could theoretically be classified as measures of Blue Box. After reviewing the given graphs, it is evident that budgetary support to BiH farmers in general has the characteristics of so-called Amber Box. In the case that a portion of direct support (payments per ha/head) is adjusted to WTO rules, which requires specific, but not too much efforts, budgetary support could play a much smaller part in the Amber Box. Established structure and relationship between "boxes" support the fact that BiH is far from the kind of support system existing in developed countries, that is, agricultural support is still strongly linked to production. By signing the agreements and accession to the WTO such a structure of support can be a big problem because the measures in the Amber Box are included in AMS and are subject to reduction.

As the most developed countries in the world dictate negotiation directions in the WTO and since their support systems are mostly separated from production, it is clear in which direction negotiations are expected to continue under the WTO. In this regard, this paper models BiH budgetary support according to the WTO / AoA criteria.

AMS calculation for BiH was made under the assumption that BiH is developed country with all aspects arising from that status. The reference period is 2010-2012[1]; *de minimis* threshold is 5%, while the stipulated AMS reduction degree was 20%. In this case, so-called transitional period for the reduction was six years[2]. AMS for Bosnia and Herzegovina, with reduction in the specified period amounts to EUR 51.7 mil. in 2010, EUR 31.7 mil. in 2011 and EUR 30.9 mil. in 2012, or in average EUR 38.1 mil. Compared to countries in the region, BiH AMS is lower than in Croatia, but higher than in Montenegro and Macedonia. On the base AMS calculated in this way is then applied a reduction of 20% in the next sixth year, so that at the end of the transitional period we get the final amount of the AMS for the country. Thus, Bosnia and Herzegovina would have support averaged about EUR 30.5 mil. at its disposal from measures having the features of Amber Box which is the AMS after reduction. This amount is the upper limit that should not be "broken". To calculate the AMS of EUR 30.5 mil. can be an important limiting factor for the development of agriculture in BiH, considering the need for higher investment in the agricultural sector and increasing its competitiveness.

Despite the relatively low amount of AMS for support, there are two other significant problems. The first one is the unfavourable structure of the AMS, where more than half of the included incentives are for only one product (milk). Another problem is the internal (entity) distribution of AMS reduction. When we talk about subsidies for milk, they participate in AMS with about 60% in average, which is very high. A problem that can occur due to such unfavourable structure of AMS is that any reduction must reflect on the milk producers as the most important agricultural product. This problem may be even greater if provisions of the Doha Proposals come into force. Another problem is the internal distribution of the obligation to reduce the AMS. Farmers in Bosnia and Herzegovina, as already pointed out, are supported from several different levels that have their own models of support and mutually differ not only in the type of measures but in the amounts and criteria for implementation. Given that the rate of reduction of the base AMS implies the whole country, problem will be how to harmonize and distribute obligations for AMS reduction at lower levels of government.

Conclusion

The above analysis of agricultural policy 2002–2012 in BiH and its entities and the comparison with the EU clearly indicates that both formal and essential implementation of

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[1] The reference period is the period of three years which, in principle, a country chooses on its own, but it has to be as close as possible to the current year.
[2] It should be noted that the obligations regarding domestic incentives for developing countries are somewhat milder (the de minimis threshold of 10% reduction of 13%, a transitional period of 10 years)

accession process and adaptation of agricultural policy to CAP is still at a low and unsatisfactory level. Agricultural policy in both BiH entities considerably differs from that both in the range and structure of measures, and so the policy implementation is far from the EU model. In both BiH entities, direct payments per output make a larger part of direct support to producers, whereas they almost do not exist in the EU countries.

Accession to the WTO as the second targeted integration for BiH, although less challenging, still carries certain changes that may adversely affect the agricultural sector in BiH. This primarily relates to the support restriction through the Amber box measures, or through measures that are directly related to production. Research results show that from the WTO standpoint, support in BiH is generally restrictive in its nature. An additional concern is very bad AMS structure where milk has a dominant position. This "poor" structure prevents manoeuvring in AMS reduction obligations. The existence of multiple model support within entities is also a problem in terms of fulfilling obligations of AMS reduction - the problem of distribution of obligations within the country.

In order for BiH to face the challenges of the Euro and WTO integrations as easily as possible and have as few negative consequences as possible internal harmonization of agricultural policy is necessary at the entity and DB level including its legislative and institutional aspects. Without this condition it is not possible to make any progress towards adjustment to the obligations that will follow. Reform of support to producers in the context of suspension of certain measures and their replacement with acceptable solutions is also one of the steps that are necessary to do. Reducing the list of supported products and restructuring forms of support (reducing output support in favour of support per ha/head) is something that must be done in the near future. Finally, it is necessary to further strengthen the transparency of expenditures as well as establishment of the missing mechanisms of implementation such as monitoring and evaluation of agricultural policy.

The future EU membership is a basis for political and economic stabilization and development, and as well for necessary modernization of government administration. As for BiH, agri-food sector potentials provide realistic market opportunities that, unfortunately, have not been used for many reasons. This is why BiH needs to engage its intellectual and political capacities, and as well various programs and projects toward the harmonization of value systems, legislation, policies and institutions. We could expect that the current standstill in BiH relating to European integration processes will not mean elimination from the group of ex-Yugoslav republics on the road to EU, which would result in a huge political, economic and social damage.

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POSSIBILITIES FOR DEVELOPMENT OF RURAL TOURISM AS AN ELEMENT OF RURAL DEVELOPMENT ON MOUNTAIN BJELAŠNICA

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Abstract

Bjelašnica is an Olympic mountain, situated about 30km away from the capital of Bosnia and Herzegovina, Sarajevo. For the last 30 years there has been an initiative to proclaim this area as a part of national park, due to rich biodiversity and cultural heritage. Local population of Bjelašnica is faced with high level of poverty and increased migrations. As a strategy for livelihood diversification, this paper proposes development of rural tourism; having in mind that rural tourism is being used as a force to revitalize rural areas in many countries.

The aim of the study was examining the attitudes of local population towards possible development of rural tourism in the area. As a theoretical method to guide the study, the sustainable livelihood approach was chosen; having in mind that this approach provides comprehensive insight of people's strengths (assets or capital endowments) and how they endeavor to convert these into positive livelihood outcomes. For data gathering, the study utilized method of household face-to-face survey; by which we identified the main livelihood activities of local people, as well as household livelihood assets. Findings have shown that local population is to a large degree interested in cooperation of rural tourism development, in which they see opportunities for income improvement and community development.

The analysis presented in the paper shows that different demographic and socioeconomic conditions influence positive attitudes towards rural tourism development, and further explains them.

Key words: *rural development, rural tourism, livelihood*

Introduction

Bjelašnica is an Olympic mountain, situated about 30km away from the capital of Bosnia and Herzegovina, Sarajevo. It is famous for its winter tourism; but also for rich biodiversity and cultural heritage; which is why for the last 30 years there has been initiative to proclaim this area as a part of national park. Cultural and historical heritage of Bjelašnica are among most unique and fascinating of all European mountain culture; but today local communities are faced with high level of poverty and increased migrations.

Rural areas around the world are going through considerable economic and social changes due to the decline in employment opportunities. It has been shown that average living standard, as expressed as Gross Domestic Product (GDP) per head, is generally lower in rural than in urban areas (EC, 2008). The rural development policy became increasingly important segment of economic policy in the Central and Eastern European countries, but in the Western Balkan countries as well. In recent years, rural development received priority status in policies in these countries, and this could be illustrated by the fact that some of the countries have adopted particular strategies as well as rural development programmes, which include special emphasize on support of small rural enterprises, rural tourism, creation of non-farm employment, development of the food stuff sector on the farms as well as the rural infrastructure (ejvanovi , 2011).Literature on this topic shows that in order to overcome poor living conditions in rural areas, livelihood diversification needs to be done. In

order to fight against economic decline, rising unemployment rates, and the increased migration of younger population, many countries use the development of tourism as a force to revitalize these regions. Good planning and development of tourism product in the rural areas could be an avenue through which the livelihoods of the rural community can be improved (Obonyo, 2012). According to Sharpley and Tefler (2002), a variety of reasons may be suggested for the popularity of tourism as development option. These include the facts that development of tourism may lead to infrastructural improvements and the provision of the facilities that are of benefit to local community as well as tourists; that tourism often provides the justification for environmental protection, for example the designation of national parks and that tourism may encourage the revitalization of traditional cultural crafts and practices.

Since Federation of Bosnia and Herzegovina (FBiH), in its Strategy of Development, for the period 2010-2020 (EI, 2010), defined development of rural tourism as one of its strategic goals; it is certain that the rural areas can and should find their place, taking into account the natural beauty, tradition in tourism and the various possibilities for the development of different forms of tourism.

Materials and methods

The study was first of the kind in analyzed area that addressed these issues; and its exploratory nature could be seen from the fact that it seeks to contextualize and gain holistic understanding of the livelihood system of the rural communities in Bjelašnica.

In order to gain an understanding of the significance of the tourism to livelihood for the local communities on Bjelašnica, the study employed Sustainable Livelihoods Framework (SLF) as a conceptual framework developed by the Department for International Development (DFID,1999), through which we gained insight of the main factors that affect people's livelihoods, and typical relationships between these; by analyzing five types of capitals/assets: natural, physical, social, human and financial. Different types of capitals were recognized as variables affecting people's willingness to engage in rural tourism development.

Table 1. Set of variables/capitals

Type of capital	Variable
Human	- Gender - Age - Level of education - Number of household members - Employment - Foreign language skills
Natural	- Forest ownership - Forest property size
Physical	- Building facilities - Transport facilities - Agricultural plants - Livestock - Infrastructure - Antiquities
Financial	- Level of monthly income
Social	- Cooperation with neighbors - Involvement in organization

Approach of the study was both quantitative and qualitative and in great part it relied on the production of primary data collected on the basis of structured questionnaires.

The study covered two local communities on Bjelašnica mountain: Šabi i and Dej i i, in the period between 10th and 30th of June 2012. Unit of analysis was household, and out of the population size of 351 household in the communities, with confidence level of 95% and confidence interval 10, it was determined that sample size needed was 76 households. From simple proportion x:100=y:76; where 76 is sample size; „x" number of households per village; we calculated „y" which represents required number of households we were going to interview per village.

During the data collection, the principle of anonymity of respondents was respected; as well as impartiality of the researcher. Average time needed per one interview varied between 30 to 40 minutes. The head of the household, who are major decision makers and have influence in the daily livelihood of the household, were asked questions. Pre-testing of the questionnaire was done with limited number of Bjelasnica residents, in order to see if the questions are understood. The household face-to-face survey contained four groups of questions: 1. general characteristics of the respondents (gender, marital status, their age groups, education level and type of employment); 2. life within the household; 3. attitudes towards life in the village; 4. attitudes towards rural tourism development. The survey questionnaire included a mixture of open, fixed-response and multiple response questions.

The study used quantitative analytic tools to organize, summarize and present research findings in relation to the study objectives. The statistics programme SPSS (Statistical Package for Social Sciences PASW Statistics 18) was used. In order to bring structure to the data collected for this research, several independent variables were analyzed in relation to dependent variable - readiness for engagement in rural tourism. For analysis of correlation between the variables, we applied a nonparametric method of rank correlation with Spearman's rank coefficient.

Results and discussion

Based on a survey carried out in 76 households, the study identified that due to specific sampling method most of the respondents were men; out of the total of 76 respondents covered by the study, 61.6% were men and 38.4% were women. Most of the respondents were elderly and old population, 38.4% are people between the ages of 50 and 64; and 43.8% were residents older than 65.

The study tried to investigate what are the specific problems that affect livelihoods of the people on Bjelašnica. Out of group of problems, respondents were asked to choose those directly affecting them and their household. According to these findings (Graph 1.), respondents pointed out as the major problems: harsh climate, no adequate labor market, dissatisfaction with health services, etc.

Graph 1.: Problems in the community (Q13: Which are the problems you are facing in the village?)
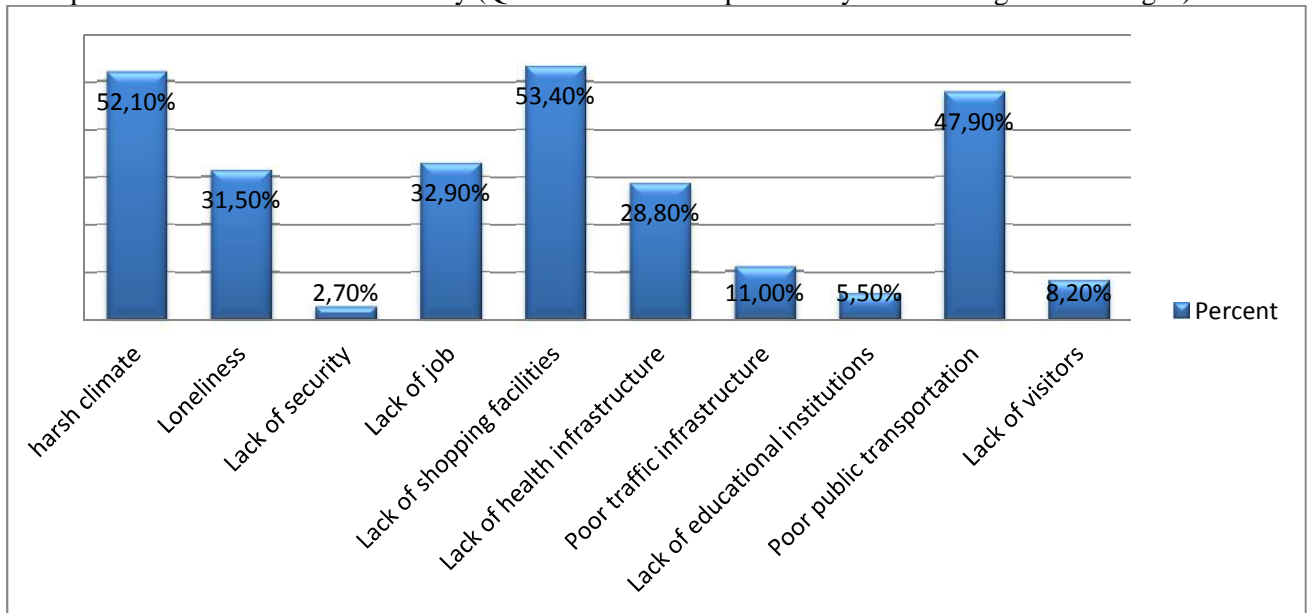
When asked if they are ready to participate and collaborate with local community regarding rural tourism development (Graph 2.), 61.6% of the respondents said they would likely be ready for involvement in such kind of development, which indicates high level of interest. Such findings are indicating that people in rural areas, with special reference on Bjelašnica locality; are aware of possible positive outcomes that this type of tourism can bring; and that they are ready to engage themselves in such kind of development.

Graph 2. Readiness to participate in rural tourism development of local population on Bjelašnica (Q22:How likely would you be to participate and collaborate with local community regarding rural tourism development?)
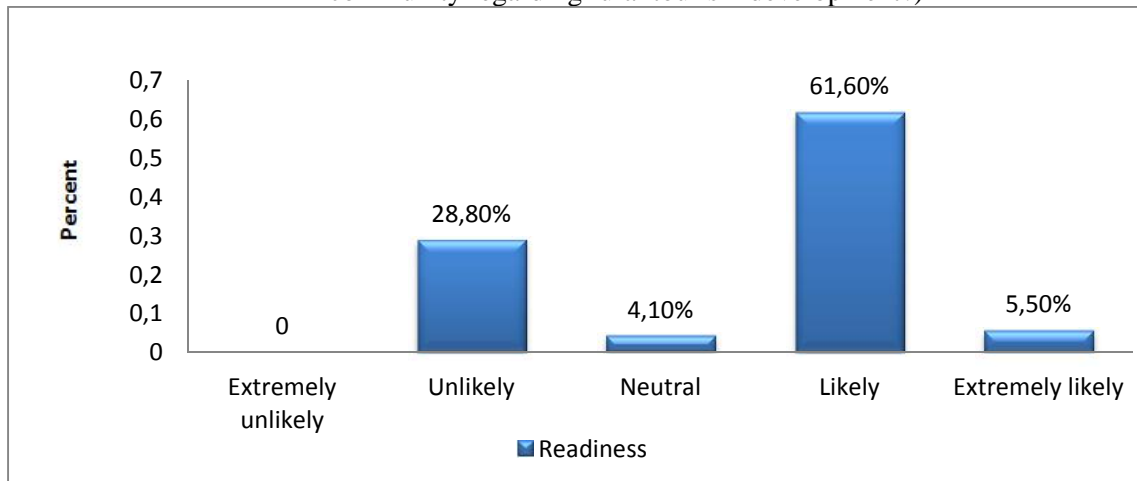
In order to determine which demographic and socio-economic variables influence readiness to get included in rural tourism on Bjelašnica, the nonparametric test of rank correlation was applied together with the Spearman rank correlation coefficient.

The Spearman rank correlation coefficient between the gender of respondents and readiness for rural tourism was -.329** (df=76, $p < 0.1$), which indicates that women showed less interest for engaging in rural tourism development; and that men showed higher interest; 77.8% of men said they are ready, while only 50% of women said the same.

It was determined that age influences readiness for involvement in rural tourism. The correlation between the age of respondents and readiness for rural tourism was -.319** (df=76, p < 0.1), showing us that young people showed more positive attitude towards rural tourism development.

Graph 3. Readiness for rural tourism-age distribution

	15-19	20-34	35-49	50-64	>64
■ Ready	0	83,30%	71,40%	75%	56,30%
■ Not ready	0	16,70%	14,30%	17,90%	43,80%
■ Neutral	0	0	14,30%	7,10%	
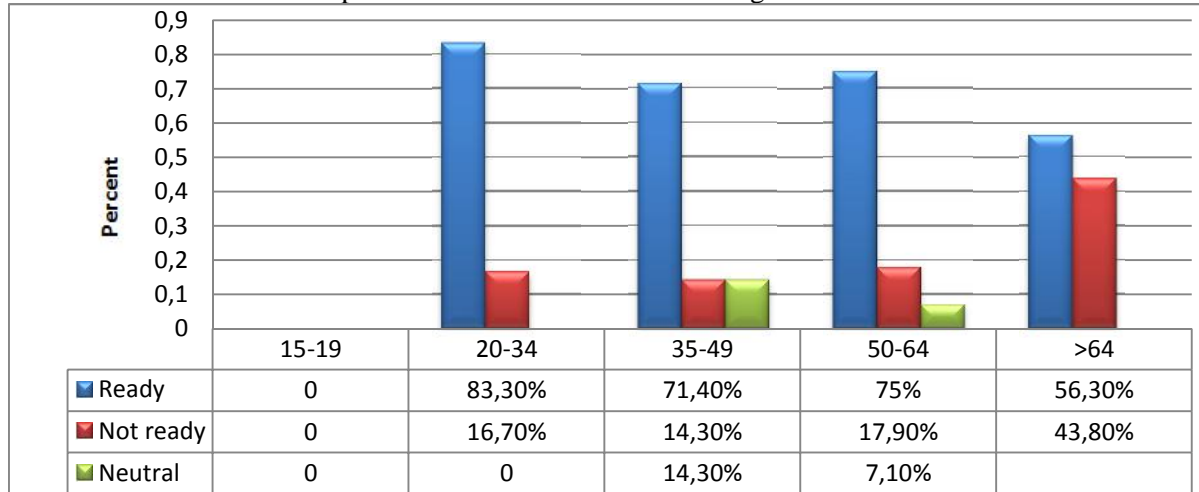
The variables education and readiness for rural tourism correlated with -.319** (df=76, p < 0.1), clearly showing that education has a significant influence on a positive attitude towards rural tourism development. A negative correlation means that the correlation is in the opposite direction of the set values of variables, which in a concrete situation means that more educated people have more positive attitudes towards rural tourism.

Graph 4. Readiness for rural tourism-education distribution

	No formal education	Elementary school	High school	University education
■ Ready	56,70%	61,10%	81,80%	100%
■ Not ready	43,30%	27,80%	13,60%	0
■ Neutral	0	11,10%	4,50%	0
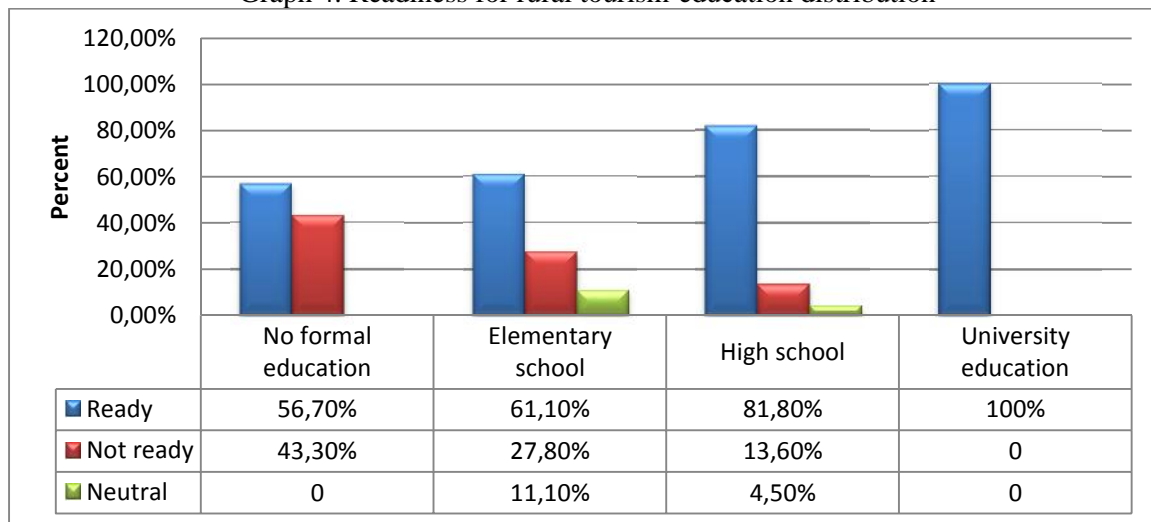
The following variable influencing attitude toward rural tourism development was number of household members. The number of household members and readiness for rural tourism correlated with .379** (df=76, p < 0.1), indicating that large families, with more household members showed greater interest and a positive attitude towards rural tourism development.
The correlation between variable that represents livestock breeding and attitude toward rural tourism development showed negative correlation: -.231* (df=76, p < 0.5), which in a concrete situation means that people who take care of livestock breeding showed more negative attitude. The reason could be found in the fact that some of the respondents who said

not to have livestock, explained it with lack of finances; and the opportunity for improving their financial status, they perhaps see in rural tourism.

In order to see how financial capital influences readiness for involvement in rural tourism, we compared it with income level households regularly receive. These two variables showed following correlation: .307* (df=76, p < 0.5), which means that respondents with higher income showed more positive attitudes towards rural tourism development.

Besides the factors that influence readiness in rural tourism involvement, study was also interested in motives. Therefore, respondents who answered they would be ready to involve themselves in rural tourism were asked to state their motives and 86.3% said they would do it basically for earning more money and improving their financial status; while 13.7% said they were not so much interested in just money but in community development, which would as a later consequence bring more improvement in every way for everyone in the community (Graph 5.).

Graph 5. Motives for engagement in rural tourism
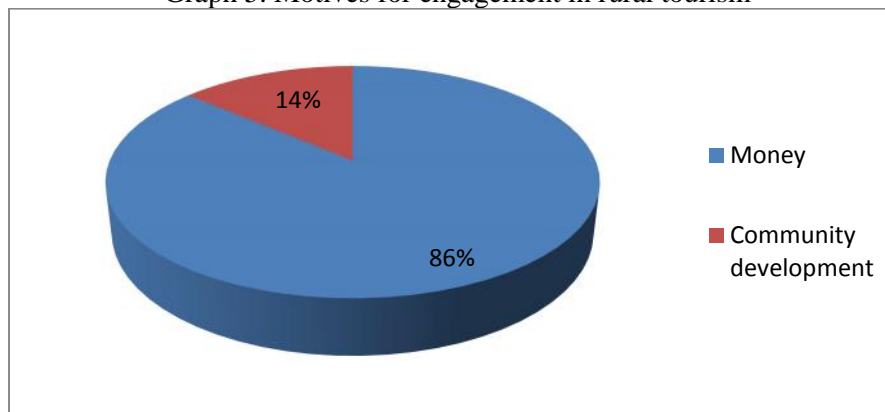
The general purpose of this study was to provide analysis of possibilities for rural tourism development on Bjelašnica, and findings have shown that local population is to a large degree interested in cooperation of rural tourism development.

Local population showed they believe that tourism development can contribute positively to job opportunities and increased income generation. Through creation of employment and the generation of local revenue, rural tourism can lead to economic empowerment of local communities on Bjelašnica; which could as a consequence lead to poverty alleviation and creation of population stability. In this way tourism development on Bjelašnica can enhance the livelihoods of the local people. From this we can conclude that the development of rural tourism on Bjelašnica has the support of the local people as they believe that it can lead to economic improvement. In order for Bjelašnica to succeed in the development of rural tourism, it must be ensured that all the tourism related activities benefit the local communities, especially local people that would directly be involved in such kind of activities. Since Bjelašnica is very close to capital Sarajevo, initiative of rural tourism development could be of benefit not only for local communities, but for wider area of the city, and thus the state.

Having in mind that this type of tourism is recognized as one of the consequences of possible national park proclamation, the positive attitudes of local population towards this issue were of great importance too. The findings presented make a basis for academics and policymakers to consider the social value and economic potential of rural tourism in the area; in order to evaluate the success of rural tourism development based on the values and goals set by the communities.

Although the research findings are related to Bjelašnica, to some extent, they can also contribute to body of knowledge on the characteristics and goals of local population in rural hospitality, as well as to understand the difficulties they have to deal with.

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ORGANIC MEAT CONSUMERS AND THEIR AWARNESS OF ANIMAL WELFARE AS REFLECTED BY PURCHASE PREFERENCES

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Abstract

This case study presents the results of a qualitative survey amongst organic meat consumers. Their ideas about and attitudes towards animal welfare were investigated together with their purchase preferences and behaviour. The authors focused their study on a group of consumers purchasing organic lamb meat from traditional sheep breeding in the south-east region of the Czech Republic. The research deals with the characteristics of specific organic animal products, consumer willingness to pay, and awareness of animal welfare. The results of interviews suggest that a conscious concern about animal welfare is not the primary incentive for purchase. A consumer typology based on their expressed attitudes towards welfare and purchasing behaviour is presented.

Keywords: *ethical consumerism, organic agriculture, purchase behaviour, anímal welfare, attitudes*

Introduction

Fraser and Broom (1990) define animal welfare as how an animal copes with its environment. From this definition, it is clear that welfare depends upon how animals view the situation in which there are in. In order to better understand animal welfare, Webster (2009) suggests three basic questions should be asked: Does the animal live a natural life? Is it healthy and in good condition? Is the animal happy? Our paper works with the concept of the "five freedoms," which combine various approaches to animal welfare (Fraser 2004, Webster 2009), and which, according the Farm Animal Welfare Committee of the U.K. Department for Environment Food and Rural Affairs, are defined as being:

"1. Freedom from Hunger and Thirst – by ready access to fresh water and a diet to maintain full health and vigour.
2. Freedom from Discomfort – by providing an appropriate environment including shelter and a comfortable resting area.
3. Freedom from Pain, Injury or Disease – by prevention or rapid diagnosis and treatment.
4. Freedom to Express Normal Behaviour - by providing sufficient space, proper facilities and company of the animal's own kind.
5. Freedom from Fear and Distress – by ensuring conditions and treatment which avoid mental suffering."
(FAWC 2014).

We consider conscientious purchasing preferences to be an expression of ethical consumerism, which is a type of socially responsible consumption. Harrison et al. (2005) deal with this issue and differentiate between traditional and ethical purchasing behaviors. The traditional consumer purchases products either of the highest quality her or she can afford, or selects the cheapest product among similar products of equal quality. The ethical consumer certainly does not ignore the price and quality of products but when selecting products makes decisions based on additional criteria, which often take priority, such as environmental concerns and supporting developing countries. Ethical consumers make decisions based on their beliefs, whether they are political, religious, environmental, or social in nature. No matter their specific motivations, all ethical consumers are aware of the fact that their behavior as consumers affects the world around them. However, not everything that seems to be ethical truly is, as Harrison et al. (2005) demonstrate with the case of organic food. People

who buy organic for health reasons are not acting ethically in the true sense of the word, unlike people who buy organic because they do not want to burden the environment with pesticides. Devinney et al. (2006) discuss a similar problem as they differentiate between purchases made for the functional attributes and social attributes of a product.

Studies clearly indicate that consumer interest in animal welfare is growing (Kendall et al. 2006, Mayfield et al. 2007, Vanhonacker et al. 2010, Burton et al. 2012, Spooner et al. 2014, Eurobarometer 2005, 2007). People consider welfare to be a positive attribute of products, even though it is not necessarily the most important one. For most consumers, their own enjoyment or well-being takes precedent over animal welfare. Several questions from the Eurobarometer survey indicate that consumer behavior in this regard differs by country. Consumers from northern countries generally have a better understanding of animal welfare and are well-informed about the high level of animal welfare in their country. Consumers in Central and Eastern Europe are not well informed about welfare and many people are not particularly interested in it.

Materials and Methods

The main goal of this study was to understand the attitudes of a select group of Czech consumers towards farm animal welfare. Qualitative methods were selected in order to obtain a large amount of information from a small number of individuals. The study sample was narrowed down to one particular group of consumers from the Brno area who regularly purchase certified organic lamb meat from a farm in the White Carpathian Mountains (appx. 100 km east of Brno).

An overview of participants: In total, two women and six men took part in the study. The participants ranged in age from 32 to 69. Consumer 1: Barbora, approximately 40 years old, works in public relations. She grew up both in the city and in a country and currently lives in the city. She has no pets. Consumer 2: Zden k, 45 years old, agricultural specialist, university teacher. He grew up and lives in the city. He has a dog. Consumer 3: Ludvík, 33 years old, works in construction. He grew up in the suburbs and now lives in the country. He has a cat. Consumer 4: Hana, 67 years old, educated in biology, now a professor of sociology, which she teaches at university. She grew up in the city and but was also in contact with the country. She now lives in the city and has a cottage with a large garden. She has a dog. Consumer 5: Karel, 69 years old, electrical engineer, astronomer, and a part-time university teacher. He grew up and lives in the city. He has no pets. Consumer 6: Jan, 32 years old, nanobiologist, works in research. He grew up in a small town and now lives in a village. He has no pets. Consumer 7: Boris, 58 years old, education in medicine, works in business. He lives in the city and has a dog. He often travels. Consumer 8: Miroslav, 60 years old, conducts research in the non-profit sector. He grew up and lives in the city. He has no pets.

Data collection - We conducted structured interviews utilizing open questions directly with each consumer. Open questions allow interviewees a large space for response. With the participants' permission, the interviews were digitally recorded and then transcribed.

The main research question is: *What attitudes does the selected group of consumers have towards farm animal welfare?*

Other research questions: *What does welfare mean to the consumer? How do consumers reflect upon the difference between conventional animal raising methods and other methods (e.g., organic, free range)? How do consumers view the influence of their purchasing behavior on welfare?*

Results and Discussion

One of the aims of this study was to understand the attitudes of this group of consumers towards welfare and their purchasing behavior. All of the consumers had a certain awareness about how animals are farmed and their conditions for living. However, they often mentioned their uncertainty in this area and spoke only about what they thought as they had never visited

a farm (or visited one long ago) and do not know what they are like today. In general, people view the conditions in which chickens are raised as being particularly poor. Mayfield et al. (2007) came to the same conclusion. The most interesting part of our research was when we asked about what motivated the interviewees to purchase lamb and about their consumer behavior regarding animal products. It was interesting to discover that not all behavior that seems ethical truly is. Based on these fine nuances in the ethics of each consumer, we were able to identify several categories of consumer. Nancy Williams' (2008) concept of affected ignorance also involves ethics. We discovered an example of affected ignorance in our sample; Barbora was not interested in being informed about animal welfare. In other words, she did not want to see any "sad cows." Jan also exhibited indications of similar behavior as he thinks that consumers can do little to influence animal welfare and sees no relationship between his behavior and conditions for animals on farms. We also found elements of discordance between the original purchasing intents of consumers and their actual behavior as Carrington (2010) describes. Amongst such people, their purchasing behavior is to a certain extent automatic or they are lacking information, which most of the interviewees mentioned.

Consumer awareness is key to animal welfare. Mayfield et al. (2007) and Vanhonacker et al. (2010) have demonstrated that almost 50 % of consumers do not feel they are well-informed about welfare. Most of the participants in our research also confirmed this. Restaurants could raise more awareness about this issue, as Hana mentioned in her interview. We found that there is a group of consumers who would appreciate a larger selection of organic meat and other organic products in restaurants and who would like to be informed about their options either in a brochure on the table, on the menu, or by the waitstaff.

In Great Britain, Italy, and Sweden, the influence of family and friends plays a much smaller role in people's ideas about welfare than our findings indicate (Mayfield et al. 2007). Interviewees were more affected by advice from their family and friends then by visiting a farm for example. This form of learning more about animal welfare is not very common in the Czech Republic. Foreign studies also indicate that it is often difficult to find welfare products in stores. The same is true in the Czech Republic which confirms Eurobarometer findings (2005 and 2007). Participants in our study also did not know how to find products with higher welfare standards, with the exception of organic products.

Some of the participants agreed that the promotion of organic food, and thus higher welfare products, should not only focus on health and safety issues but also issues of animal welfare. If only the "healthiness" of organic food is emphasized, not all potential consumers will be drawn to it. Many consumers refuse the health argument and in the process write off organic agriculture as a whole. Some of the participants in our study also refute the "healthiness" of these products, yet nonetheless purchase them for other reasons.

Based on the detailed study of the behavior of eight Czech consumers, we have created several categories of consumer types. Although in our research, we discussed only animal products, from the interviews certain purchase behavior trends could be identified (e.g., the tendency to reject organic products and vice versa). Most of the categories are based on what motivates the consumer. The three basic categories of consumers are determined by key dominant characteristics. We can divide consumers into three types: ethical, pragmatic, and skeptical. These types can also be combined, resulting in hybrid consumer types.

Basic types:

1. *The ethical consumer*

These consumers are sensitive to the region and country they live in, environmental problems, and to the entire planet. They are characterized by their optimism and their belief that their behavior can help them achieve what they believe in (for example, improving animal welfare, improving working conditions of farm laborers, improving the situation of local farmers, etc.) We should not however confuse optimism with naivete, as these consumers have at least a high school degree and know how to analyze information. They do not accept everything they hear or read about in the media. Hana and Zden k were both

examples of this type of consumer: both have university degrees and work in tertiary education. This is not an elitist category however; the ethical consumer does not need to make a great deal of money nor does he or she have to be well-educated.

2. *The pragmatic consumer*

Pragmatic consumers consider themselves to be the highest authority and do not recognize rules that have been set by others; they do not like to be subordinated. They use their own reasoning to determine what is important and good for them. Their needs are what drives their purchasing behavior. It may seem that such pragmatic behavior is similar to ethical behavior, but this is not the case. If consumers buy organic food only to benefit themselves, they are not behaving ethically. They may also reject organic or higher welfare products for their own rational reasons. Barbora is an example of the pragmatic consumer; she even labels herself as being pragmatic. What she takes and recognizes to be true is true to her. Barbora stated that purchasing lamb is a social event. For her, social contact is most important, and society partly forces her to change some of her attitudes.

3. *The skeptical consumer*

Skepticism is the main identifier of these consumers. Pure skeptics trust nothing, neither organic products nor conventional ones. They question where food comes from on both sides of the spectrum. They have a greater tendency to be skeptical about organic agriculture. This attitude may stem from negative experiences, a lack of information, etc. We did not find any skeptical consumers in our study. Nonetheless, we tried to characterize this type of consumer based on context and in order to fill out the possible consumer types.

Hybrid types:

4. *The comfortable consumer (ethical-pragmatic type)*

This type of consumer makes purchases that are partly ethical. Equally motivating for this type of consumer however are the momentary interests of the individual, which sometimes outweigh ethical issues. These consumers usually need a suitable opportunity or incentive for ethical consumption. They view organics and animal welfare positively and are willing to pay more for such products. However, when they are not momentarily available or they are too expensive, they will buy conventional products. They are not so strict about maintaining ethical principles. Ludvík is an example of the comfortable consumer; he likes purchasing organic products and products directly from farmers but he needs a middleman. He does not seek these products out in stores. He said he was motivated to buy lamb due to its general unavailability elsewhere and for its flavor. Here we can see the pragmatism of the comfortable consumer. How the sheep were bred was important to him, but it was a secondary issue. Miroslav is also a comfortable consumer. For him, where his meat comes from is important as he is against the conditions on factory farms. Just like Miroslav, Ludvík also believes that his choices as a consumer can affect the welfare of farm animals.

5. *The skeptical consumer with a tendency for ethical behavior (the ethical-skeptical type)*

This type of consumer displays signs of ethical purchasing behavior, but lacks the optimism and enthusiasm of the ethical consumer. In their stead, these consumers display distrustful or even suspicious attitudes towards organic products and organic agriculture as well as towards conventional agriculture. These consumers have had negative experiences with such products and are aware of the scandals that occasionally affect the food sector (Bánáti 2011, Kopferschmidt 2011) Boris is an example of this type of consumer. Although he is against organic food as he sees it as a marketing trick, animal welfare is important to him and is against conditions on factory farms.

6. *The resigned consumer (the pragmatic-skeptical type)*

Consumers belonging to this group do not take the ethical dimensions of their behavior into consideration. They have either resigned from ethical behavior, left it up to others, or pushed it somewhere into the background. Momentary desires are important for them without regard for the general environmental impact of their behavior or its impact on farm animal welfare. The skepticism of the resigned consumer means he or she rejects organic products because he

or she does not trust them, and therefore would rather choose the easily accessible products of conventional agriculture. This type of consumer does not really believe that he or she can affect the conditions farm animals are raised in by their purchasing behavior. Jan was identified as being a resigned consumer.

7. *The symbiotic consumer (a mix of all three basic types)*

The last mixed type of consumer is the symbiotic consumer. This type of consumer is partly able to support farm animal welfare and other environmentally friendly activities but may be skeptical about certain things (such as animal rights activists, but also about conditions on farm factories), which mainly depends on their personal benefit and how they imagine the situation which yields their pragmatism. This type of consumer is relatively complicated and variable. Karel is a typical example of the symbiotic consumer.

The impact of general factors on consumer attitudes towards welfare

A sample of eight respondents is unfortunately too small to demonstrate greater sociological correlation with how animal welfare is viewed, as studied by Kendall (2006). We also made similar findings when we asked about pets. Study participants who had pets cared more about animal welfare then those who did not have pets. The small sample size meant that no correlation between consumer behavior and whether the participants grew up in the country or the city could be determined. In order to determine this correlation, we would have had to have conducted a quantitative survey with more respondents. There certainly is, however, a relationship between how consumers view animal welfare and their educational level and profession. The less people were confronted with the environment at work, the less interest they had in animal welfare. This was clearly the case with Barbora who works in marketing and public relations and less so with Karel, an engineer, and Ludvík, a construction engineer. At the other end of the spectrum were Hana and Zdeněk whose education and current work in the environmental field influenced their positive view of animal welfare.

Conclusion

The main goal of this study was to understand the attitudes of a select group of Czech consumers towards farm animal welfare and their purchasing behavior. The conceptual framework of the study included the concept of farm animal welfare and the ethical aspects of the relationship between humans and animals.

A sample of consumers who purchase lamb from the White Carpathian Mountains was selected for qualitative research. We conducted structured interviews with eight people. Most knew about animal welfare. Good living conditions were viewed predominately from a biological perspective: animals can behave naturally. The consumers did not emphasize emotional aspects of welfare. Intensive farming practices were viewed as a bad form of animal breeding and were seen as meat factories. All consumers shared the same understanding of such farms, yet this did not stop some from purchasing products from such farms. In contrast, organic farms were viewed positively from the perspective of animal welfare. Most study participants surprisingly rejected the claim that organic products are healthier, and some were even opposed to the organic label. This is something that we did not expect from ethical consumers.

Although the meat came from a farm that was certified organic, research findings indicate that this fact was not critical for consumers. We made this discovery when we examined what motivated study participants to buy lamb. We identified four groups of consumers. The first group behaved ethically. How the animals were raised, whether or not they suffered when killed, supporting local farmers, etc. were important to them. The second group of consumers included people who enjoy good meat at a good price. These people stated they purchased meat in this way because lamb is unavailable in normal stores. The third group of consumers was socially motivated. These people viewed purchasing lamb as a social event and a cultural phenomenon. A closed group of buyers certainly gave the system an air of rarity and special

social meaning. The last group included one ambivalent participant whose motivations included elements from the above two groups.

Consumers generally unconsciously identified organic products as being high welfare. Otherwise, they did not know how to identify high welfare products. Therefore, it can be assumed that an independent evaluation of animal welfare and system of certification would improve consumer orientation. Some products from intensive farms may meet some welfare requirements but today there is no way to mark products as such. During our research, some people told us that the organic label is more complex in that is takes into account several criteria and is therefore sufficient. Most study participants considered the supply of organic products as well as the information they had about welfare as being unfavorably low.

Several categories of consumers were identified based on their attitudes towards animal welfare and their purchasing behavior. We characterized consumers based on their predominant characteristics. We divided consumers into three types: ethical, pragmatic, and skeptical. These types can also be combined to produce hybrid consumer types: the comfortable consumer (the ethical-pragmatic type), the skeptical consumer with ethical tendencies (the ethical-skeptical type), and the symbiotic consumer (a mix of all three basic types). This categorization is the major finding of this study of a select group of Czech consumers.

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NUTRITIONAL CHALLENGES IN ORGANIC LIVESTOCK SYSTEMS OF THE TROPICS AND SUBTROPICS: CASE OF SHEEP PRODUCTION IN IRAN

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Abstract

Considering the rapid growth of the organic food market in North America and Europe, an increasing number of agricultural producers in developing countries and especially tropical and subtropical areas tend to convert their production system to organic agriculture (OA). Due to the existing similarities between OA and traditional farming systems in many developing countries, it is possible for most traditional farmers to convert to an organic system. However, converting to such a system for livestock producers has always been challenging from a nutritional point of view. In this review, nutritional challenges in organic sheep production in Iran are studied. For this purpose, the general situation of sheep production, common feed resources and current rearing systems in Iran were described. Accordingly, present nutritional challenges for each production system to be converted to organic were also discussed. The results of this study revealed that sheep production in the range-band system to a large extent, and in farm-flock and semi-extensive systems to a favorable extent, were in line with international organic standards regarding animal feeding. On the other hand, the feed-lot system was in contrast with organic definitions in general. However, the evidence seems to show that finding the adequate organic feed resources may be the major challenge for organic sheep producers in Iran.

Keywords: *Organic agriculture, animal nutrition, sheep production, developing countries*

Introduction

Recent years have seen a rapid growth in the organic food market (IFOAM, 2005; Jaffee & Howard, 2010; Schleenbecker & Hamm, 2013). North America and Europe makes the biggest contribution in the organic products market in terms of consumption according to the statistics published by Research Institute of Organic Agriculture (FiBL) and International Federation of Organic Agriculture Movements (IFOAM) in 2013. Znaïdi (2001) concludes that this trend has led to the creation of new opportunities for farmers in developing countries to export their organic agricultural products to North America and Europe and their interest in expanding organic agriculture (OA) is increasing. Among the mentioned countries, tropical and subtropical areas may be considered as remarkable considering their good potential for agriculture production. In a study of Ben Kheder (2001), Znaïdi (2001) found that because of the existing similarities between OA and traditional farming systems in many developing countries, it could be possible for many traditional farmers to convert to organic system.

Livestock production, as one of the elementary units of the food chain system (Lamine & Bellon, 2009), has always been a matter of debate among scholars. Animal feeding, in particular, is of great importance considering its key role in livestock production. In all international guidelines and standards for OA, such as in European regulations, detailed requirements regarding animal nutrition can be observed. Therefore, one of the challenging issues that should be noted by livestock producers who want to convert to OA is animal nutrition. This paper aims to point out a number of nutritional challenges in organic livestock systems faced by one of the tropical or subtropical countries and further to come up with some useful recommendations in order to overcome these challenges.

Taking the local climate into account, Iran can be seen as a good example of a tropical or subtropical country (Badripour, 2006). Hence, Iran has been chosen as the case study in this research. In addition, as sheep production is considered to be the most important red meat in Iran (Hassanpour, 2012), the study will focus on sheep production.

Materials and methods

In the present paper journal articles, books, official statistical books about Iran and data banks, such as Food and Agriculture Organization (FAO) and Word Bank, are studied.

Background of sheep production in Iran

According to statistics published by FAO (2013), in 2011, Iran, with a total of 49.0 million, had the fourth largest number of sheep worldwide. Mirzaei (2010) reports that there are 26 different breeds of sheep in Iran and most of them are used for several purposes. He claims that Iranian sheep are considered the sixth best sheep in the world in terms of meat and milk quality. Currently, there is no official report which bodes on any certified organic sheep production in Iran.

Feeding methods

Sheep and goats in Iran are commonly kept in mixed small ruminant herds (Mirzaei, 2010). However, the main enterprise considered as sheep production (Koocheki & Mohalati, 1994). Valizadeh (2012) categorizes sheep production in Iran from the nutritional point of view in four different methods: range-band, semi-extensive, farms-flock and feedlot.

- *The range-band method*: Ruthenberg (1980) calls this system, total nomadism grazing system. In this system livestock keepers do not have a permanent living place and move with their families and animals from a very cold or very hot area to a temperate one with appropriate pastures, depending on the seasons (Ruthenberg, 1980). The flock has permanent access to open air and there is no specific fold yard for keeping animals (Saadat-noori & Sepah-mansoor, 2011). In unfavorable climate conditions, mating season or late gestation time, the herd will be fed by hand with fodder and concentrate (Valizadeh, 2012).

- *The semi-extensive method*: This system complies with a semi-nomadism grazing system defined by Ruthenberg (1980). According to him and also Valizadeh (2012), the farmers have a permanent living place and in cold seasons they keep their animals in an enclosed shed. In the time of sedentary, stock keepers are also engaged with cultivation (Ruthenberg, 1980). In other times they move with their animals in order to find appropriate pastures (Valizadeh, 2012).

- *The farms-flock method*: This method is very similar to Ruthenberg's (1980) definition of a fallow system. According to this definition, animals are allowed to graze on fallow lands, stubble of croplands and available pastures around the village and they would be fed by hand with fodder in case of necessity. Khaldari (2011) also names this method an intensive or village-flock system. He refers this to the system used by a cultivator who has access to the pasture and keeps sheep along with cultivation. The work of Saadat-noori and Sepah-mansoor (2011) indicates that this method is customary in most of rural areas of Iran.

- *The feedlot method*: Also called the intensive method or sheep fattening, this is a kind of high input system (Khaldari, 2011). The main purpose of this method is meat production (Valizadeh, 2012). In this feed-intensive and labour-extensive system, feed comes from outside of the farm and from the view point of the nutrient flow, the system is very open

(Seré et al., 1995). In this method, specialized animals with high yield are kept in sheepcotes and are fed intensively by feed including a high percentage of concentrate (normally 50-60% of dry matter) (Saadat-noori & Sepah-mansoor, 2011).

Feed resources of Iran

In the list of certified organic crop products of Iran, which was published by FiBL and IFOAM in 2013, no plant which may be considered as animal feed for commercial purposes can be observed. Jalali-zonnoor (2012) mentions fresh or dry fodder of pastures, dry legume fodder, cereals and grains and their straw, bran and stubble, corn forage and silage, and concentrate feed as the most common sheep feedstuffs.

Goli-eskardi (2007), Saadat-noori and Sepah-mansoor (2011) and Jalali-zonnoor (2012) separately state that in Iran pasture-based sheep meat production is the most practical and economic system and the cheapest and most appropriate resource for sheep feed is pasture. Forest, Range and Watershed Management Organization (FRWMO) (2013) classifies pastures of Iran with regard to their condition of vegetation holding. These classifications and their size and share of total existing rangelands of Iran are given in table 1.

Table 1: Pasture classification of Iran

Condition	Area (ha)	Percentage
Good	7,181,250	8.5
Poor- Fair	21,419,151	25.3
Poor	56,214,590	66.2
Total	84,814,991	100

Source: FRWMO, 2013

Jalali-Zonnoor (2012) states that in dry regions in Iran, flocks are fed by poor pastures, stubble of grain and cereal croplands, vegetation on fallow lands and wildlings. He also says during seasons with lack of pastures, sheep would be ad libitum fed by a diet including dry forage, alfalfa and silage. Generally, plant materials which are not used for feeding cows and poultry would be used for sheep feeding (Jalali-Zonnoor, 2012). Sheep diets normally include 50% of forage and 50% of concentrate, although formulating a ration including 40% of forage and 60% of concentrate is also prevalent in the country (Saadat-noori & Sepah-mansoor, 2011). Since using agro-industrial by-products may be more economic than the utilization of the other feedstuffs, farmers try to formulate a cheap and diverse ration for their sheep by application of available by-products in their diet (Mirzaei-aghsaghali & Maheri, 2008).

Discussion and conclusion

Considering the multipurpose and locally adapted sheep breeds existing in Iran, it seems that there is a good potential for organic sheep production. Similarity between some of the current feeding methods in this country and organic principles amplifies this claim. Taking into consideration the emphasis of OA in terms of the maximization of using pasture for herbivore nutrition (EU council, 2008), it can be concluded that the rang-band system might be in line with organic standards in terms of the feeding method. However, it might be possible that the producers who implement the semi-extensive or farms-flock methods in order to rear their animals, could adjust their production to OA by obeying some rules such as the necessity of using at least 50% of the feed produced at the farm unit itself or another regional organic farm (EU council, 2007) or a diet consisting of a maximum 40% of concentrate feed (in some exceptional cases up to 50% for a limited time period) (EU council, 2008). As Nardone et al.

(2014) comment, the conversion process of conventional small ruminant production to organic seems to be less complex in terms of management procedures than in other animal species. Meanwhile, due to the necessity of the establishment of a close cycle between animal production and management of agricultural land in the organic system and prohibition of landless livestock production (EU council, 2007), it could be concluded that compatibility of the feedlot method with OA appears to be unrealistic with respect to the nutrition.

Nevertheless, as regards the fact that in organic production system animals have to be fed by organically grown feedstuffs (IFOAM, 2005), Iranian livestock producers are definitely not able to certify their products as organic as long as they do not have access to certified organic feed, even when they comply to all organic standards in their feeding management. However, even though the largest share of pastures in Iran are natural, (Valizadeh, 2012) which means they are not interfered by artificial cultivation, fertilization and irrigation (Jalali-Zonnoor, 2012), since none of them are certified as organic, products obtained from animals grazed on them cannot be sold under the organic label. Above and beyond, the evidence seems to indicate that the country of Iran has a shortage of pasture feed resources. The work of Khaldari (2011) reveals that the annual required total digestible nutrients (TDN) needed to fulfill the annual feed demand in Iran is 31,740,713 tons. As revealed by the statistics from FRWMO (2013), the pastures of Iran produce 5,885,000 tons. This amount is sufficient to feed 37 million animal units during the 7 months grazing period in each year, currently 83 million animal units graze on them. The remaining required TDN should be supplied by non-pasture and non-jungle resources. According to Khaldari (2011), 22,756,400 tons of TDN are annually gained from arable lands, food industry by-products and food wastes in Iran. Nevertheless, among the mentioned resources, no significant amount of organic feedstuff can be used for animal nutrition purposes. Accordingly, it might therefore be recognized that the securement of adequate feedstuff is the most challenging issue not only for livestock producers interested in OA but also for those that are not.

However, particularly for those producers who are willing to convert to organic system finding certified organic feed and also certifying their own products can be considered as major problems. General observations of the current status of OA sector in Iran reveals that one of the primary barriers for developing organic food production is lack of certification systems. The work of Kledal et al. (2012) reveals that two responsible governmental organizations for organic legislation are Organic Committee of the Agricultural Ministry and the Iranian Standard and Industrial Research Institute. However, holistic organic policies or supports for farmers who want to convert to organic system does not exist yet (Kledal et al., 2012). In the country, there are no national certification bodies and only some international certifying companies are active (Kledal et al., 2012). The work of Znaïdi (2001) indicates that agricultural systems and conditions such as flock management or climate conditions are widely different between Europe and developing country. Similarly in Iran, because of lack of local certification bodies, certification procedure would be complicated and costly, especially for smallholder farmers (Mahmoudi et al, 2014).

Therefore, it could be concluded that in a country which is similar to Iran, according to what this study finds, the development and enhancement of a locally adapted certification system on one hand and the protection and expansion of both natural and agricultural feed resources on the other facilitate the conversion procedure for sheep producers from a nutritional point of view.

Acknowledgments

planning and development of this paper. My special thanks to Miss. Samira Sahami for her generous support and assistance during all steps of this study and my great appreciation to Miss. Katharine Cresswell Riol who helped me in revising and proofreading the content of the paper. Finally, I wish to thank my family for their support and encouragement throughout my study.

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RURAL TOURISM IN SOUTH-EASTERN BOSNIA: STRUCTURES MANAGEMENT AND SERVICE DIVERSIFICATION

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Abstract

Rural population has increasingly turned to tourism for achieving greater economic activity diversification. Rural tourism is considered as a form of alternative tourism. It includes tourism products and services in which the rural culture and assets are a key component. Rural tourism encompasses a huge range of activities, attractions, amenities and facilities. The paper aims at analysing rural tourism in south-eastern Bosnia and Herzegovina with a particular focus on structures management and services diversification. Primary data were collected by a questionnaire survey performed in summer 2012 with 45 owners and managers of rural tourism structures in 11 Bosnian municipalities. Different types of rural tourism structures can be found in the surveyed area. The clientele includes foreign tourists as well as locals. For most of the interviewed operators rural tourism is the primary activity. Visitors are attracted by typical food and drinks, diversified services offer, natural surroundings and landscape beauty. These are also the resources that could be used in the future for rural tourism development. Rural tourism structures provide a wide range of products and services including accommodation, food, recreational activities and organization of celebrations especially in summer. Most of them offer typical food from the region. They use different promotion channels and tools such as internet, billboards, advertising but they also rely on customers' recommendations. Bosnia has great potential for developing rural tourism, which can provide new opportunities windows for Bosnian rural areas, but it remains largely unexpressed. For unlocking rural tourism potential public support is highly needed.

Keywords: *Rural tourism, management, offer diversification, Bosnia*

Introduction

Primary producers and rural communities have increasingly turned to tourism as an alternative means of achieving sustainable economic growth and development through restructuring and greater diversification of economic activity (Hall, 1997). There is a great potential through tourism, for resolution of many chronic dilemmas faced by rural communities (Knowd, 2001). Even if rural tourism may be minor in relation to the overall tourism market its importance to the development of specific rural areas may be critical. Thus, the multiplier effect is often more impacting in rural areas where the entire rural lifestyle is looked for as the main attraction (Gopal *et al.*, 2008). Tourism has a wide range of positive livelihood impacts, many of which go beyond monetary benefits. Tourism in rural areas offers a viable option for livelihood diversification (Shakya, 2011). Rural tourism has been advocated as a means of farm diversification (Haines and Davies, 1987; Slee, 1989). Moreover, tourism considerably expands rural households' economic prospects by improving education, health, physical amenities and financial assets (Shakya, 2011).

Rural tourism is considered as a form of alternative tourism. Alternative tourism can be broadly defined "*as forms of tourism that is made to be friendly to the environment and to respect social and cultural values of the communities, and which allow both hosts and guests to enjoy positive and worthwhile interaction and shared experiences*" (Wearing and Neil, 2000). Alternative tourism can be viewed as being synonymous with the concept of sustainable tourism development (Holden, 2000). Different concepts have been developed on definition, relations and distinctions between rural tourism, agro-tourism and farm tourism (*e.g.* Bojnec, 2004). Tourism is termed rural when the rural culture is a key component of the product on offer. Depending on the primary activity component of this product, the terms used are agro-tourism, green tourism and eco-tourism, gastronomic, equestrian, nautical, hunting, adventure, historical/ cultural tourism and so on (Gopal *et al.*, 2008). Rural tourism encompasses a huge range of activities, natural or manmade attractions, amenities and facilities (Sharpley and Sharpley, 1997 in Irshad, 2010). Rural tourism is not just farm-based tourism; it also comprises special interest nature holidays and ecotourism, walking, climbing and riding holidays, adventure, sport and health tourism, hunting and angling, educational travel, arts and heritage tourism, and ethnic tourism (Irshad, 2010). The distinguishing feature of rural tourism products is the wish to give visitors personalized contact, a taste of the physical and human environment of the villages and, as far as possible, allows them to participate in the activities, traditions and lifestyles of local people (Gopal *et al.*, 2008).

Tourism is a growing sector in many Bosnian rural areas and can create new employment opportunities and increase the overall attractiveness of these areas. Rural areas have many places of natural beauty to draw upon, including mountains, rivers and forests (MoFTER, 2007). Bosnia and Herzegovina (BiH) has unlimited capabilities to develop rural tourism in its rural areas (Vujovic, 2007 in ejvanovi *et al.*, 2013). However, rural tourism is still a novelty within the tourism sector and touristic offer in BiH (Draganic, 2011; Radovic et al., 2013). Nevertheless, it is considered one of the important strategies for the diversification of rural livelihoods and economy in Bosnia (Draganic, 2011). Nurkovic and Dzeko (2014) identified rural tourism as a factor of development of economic activities in Bosnian rural areas taking into consideration rural economy diversification trend and the positive outlook of the global tourism industry. From a diversification point of view the types of tourism that BiH could consider focusing on include: cultural heritage, religious heritage, soft adventure, and eco-tourism. BiH is already well positioned especially in eco-tourism that has been recognized as an area for strategic development (FAO-ROECA, 2012).

The objective of the present paper is to provide an overview of rural tourism in south-eastern BiH with a particular focus on structures management, and services and products offer diversification.

Material and Methods

The paper is based on an extended review of secondary data and primary data collected by structured questionnaires carried out in summer 2012 with 45 rural tourism structures owners and managers in eleven Bosnian municipalities: Vlasenica, Han Pijesak, Milici, Zvornik, Kalinovik, Rogatica, Visegrad, Pale, Bratunac, Sokolac and Foca.

Apart from data about respondents (name, age, level of education, occupation, municipality) different issues regarding rural tourism structures were addressed: name; location; type (country home, vacation cottage, guesthouse, rural hotel, camping site); number of male and female employees; principal clients; if rural tourism is the primary business; whether rural tourism is a family business; peak season; profitability; offer of typical food products; offered products and/or services (food, B&B, recreational activities, event organizing, etc.); the main difficulties faced during the running of the facility; intention to diversify the business and other services that may be offered; strategies for marketing and promotion of products/services; main reasons for which visitors choose the rural tourism structure (food, services offer, landscape, service quality, building architecture, etc.); sources of agricultural

and food products (local producers and suppliers, city market, own production, etc.); and resources that could be used for the development of rural tourism in the area.

The age of the interviewed rural tourism entrepreneurs ranges between 22 and 66 years; average is 43. As for education level, most of the interviewees have high school education (77.7%) while the remaining have university (13.4%) and elementary school (8.9%) education.

Results and Discussion

Different types of rural tourism establishments and structures can be found in the surveyed area. These include: cottages, houses / apartments, restaurants, small hotels, camping sites, motels, horse farms, youth hostels, travel agencies. The clientele include foreign tourists as well as locals and visitors from other Bosnian municipalities.

For most of the interviewed rural tourism establishments owners and managers (86.7%) rural tourism is the primary activity and the main source of income. In addition, for a large share of them (45.5%) rural tourism is a family business. Among the surveyed municipalities, tourism in general and rural tourism in particular is more developed in Foca and Visegrad. Most of the interviewees (87.8%) consider rural tourism as a profitable business.

According to the rural tourism structures managers, visitors are attracted by: typical food and drinks, diversified services offer, natural surroundings and landscape beauty, quality of services, food quality, architectural and cultural heritage.

Rural tourism contributes to the creation of jobs in rural areas. In fact, the number of employees in the surveyed rural tourism structures reaches even 20 persons. Taking into consideration gender, average female employees number is 2.2 (maximum 15) while for male employees the average is 3.1 (maximum 20).

The main difficulties in running rural tourism facilities are lack of financial resources, high VAT and other taxes, and low number of guests in winter. Other difficulties faced by rural tourism providers regard procurement of goods, infrastructure maintenance, lack of qualified staff, lack of support from local authorities, complicated legal system and legislation, and outdated infrastructure and equipment. Moreover, rural tourism remains mainly a seasonal activity. In fact, the peak season is summer for 80% of the interviewees and winter (11.1%) for some tourism facilities located in mountainous regions or close to them. Development of tourism in Bosnia requires consolidating legal, political and strategic frameworks; improving tourism standards, services and infrastructure; ensuring more harmonised marketing and promotion; creating a more favourable environment for investment in rural tourism; strengthening capabilities of the support structure and facilities; and improving integration of tourism with general development plans in rural areas (Bejtovi , 2008; Hesse, 2008).

According to the interviewees, the main resources that could be used in the future for the development of rural tourism are: traditional villages; agricultural resources; natural resources (forests, streams, rivers, lakes, mountains, caves); cultural heritage (rural folklore) and old buildings (churches, monasteries, traditional houses); existing tourism facilities (hotels, ski centers, horse farms); traditional food and cuisine. However, some rural tourism establishments owners and managers think that there are few tourist attractions at the level of municipalities as many were destroyed during the civil war. Moreover, there are some current problems that hinder tourism development (e.g. low quality of infrastructure and services).

Rural tourism structures managers made many suggestions to attract more tourists to their municipalities: increasing investment in rural tourism and socio-economic development of rural areas; better promotion and marketing of tourism using different media *(e.g.* brochures, internet); creation of new tourist attractions (ethno villages, ski resorts, festivals, sport and cultural events, open days); improvement of service delivery and quality in rural areas; paying more attention to environment protection and natural (rivers, forests, waterfalls, springs) and cultural (monuments, historical sites, folklore, water mills) heritage preservation; renovation of hotels and tourism facilities (old village houses, ski centres);

improving human capital especially skills related to rural tourism services management; development of new tourism services in some municipalities (running trails, cycling, excursions, hiking, hunting, fishing, horse riding, paragliding, adventure and eco-tourism, winter tourism, traditional food restaurants).

Probably it is due to the above-mentioned difficulties that only 24.5% of the interviewees plan to expand their business by offering new services such as tourist transport services, football and tennis playgrounds, producing own meat and dairy products, selling tickets, creating a riding school, building cottages, mini-ethno villages and conference rooms or simply by increasing the number of rooms.

Apart from accommodation, rural tourism structures provide already a wide range of products and services including food, recreational activities and organization of celebrations (Table 1). As for food, many changes are being made to adjust menus to the needs and demand of visitors (Nurkovic and Dzeko, 2014). According to Ohe (2007), there is in general a degree of difficulty in internalisation of farm multifunctionality in rural tourism activities. However, among actual farm multi-functions, recreational and educational functions are the most suited for farm diversification or internalising by individual farming activities due to the relative ease in transforming these functions into service goods.

Table 1. Products and services offered by rural tourism structures in south-eastern Bosnia.

Service category	Examples	Percentage of structures offering the service category
Accommodation	-	26.7%
Food	-	71.1%
Recreational activities	Horse riding, carriage rides, swimming pools, gym, beauty salon, hunting and fishing, skiing, excursions and trips, hiking, visits to mills, shipping in Drina canyon	20.0%
Organization of celebrations	Religious celebrations, birthdays, graduations, baptisms, weddings, sport celebrations, dinners for hunters, celebration of the International women's day (8 March), different types of parties	40.0%

As activities of rural tourism have become diverse, the demand for rural tourism is becoming more and more experience oriented (Ohe, 2007). Rural tourism is a service good that is directly interchanged between producers and consumers (Ohe *et al.*, 2009).

Moreover, diversification of services implies building new partnerships and collaborations. In fact, many of the offered services are arranged in collaboration with other stakeholders such as other catering/tourist facilities, local authorities (*e.g.* municipal councils), local communities, NGOs, tourism organizations. Rural tourism create networks of people even outside the local community and these networks stimulate discovery of new local resources and eventually the creation of new activities that can be converted in rural tourism products and services.

Three thirds of the surveyed rural tourism facilities offer typical food from the region. The list of typical and local agro-food products offered change from a municipality to another and includes roasted lamb and pork meat, different types of cheese, corn bread, various soups, cheese pie, Kajmak, smoked meat, milk, donuts, gruel, potato, freshwater fish, polenta, Vlasenica steak, fruits and vegetables, rolled kebab, scrambled eggs, etc. Many of these agro-food products are provided by local suppliers and processors (*e.g.* drinks, cheese, meat,

vegetables, fruit, brandy, fish, prosciutto, honey, Kajmak, milk, corn flour) while others are bought from green markets (*e.g.* vegetables, fruits, cheese, eggs). Some rural tourism facilities produce their own vegetables, meat, cheese, fish, brandy and fruits.

Rural tourism in general and agro-tourism in particular has many advantages in relation to agriculture. In fact, it brings major primary sector, agriculture, closer to major service sector, tourism, thus creating win-win situation for both the sectors *i.e.* tourism sector has the potential to enlarge and agriculture sector has the capacity to absorb expansion in tourism sector (Gopal *et al.*, 2008).

Rural tourism structures use different channels and tools to promote their services and products such as internet, billboards placed near the restaurant, radio, and printed materials but also rely on customers' recommendations and word of mouth advertising.

Conclusions

Rural tourism has a high potential for the diversification of rural households' livelihoods. Therefore, rural tourism could be a strategy for sustainable development of rural areas and also a tool for product differentiation. One of the most common features of rural tourism that should be offered to farmers as an incentive to consider starting a tourism business is its ability to generate an alternative income stream. Tourism is a promising way of diversifying the economic base of farmers and rural dwellers.

Development of rural tourism is hindered by many difficulties. Therefore, it is necessary to improve tourism standards, services and infrastructure; create a more favourable environment for investment in rural tourism; strengthen support structures and facilities capabilities; and improve integration with general rural development plans. Furthermore, linkages between rural tourism and agriculture should be operationalized by establishing a better relationship between rural tourism structures and farmers in the area. This will help producers to easily sell their agro-food products and rural tourism providers to diversify their service offer by including, for instance, excursions and visits to farms. Nevertheless, this requires an improvement of the management of rural tourism establishment and an upgraded professionalization of managers.

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ECONOMIC OPTIMIZATION OF THE APPLE INVESTMENT AND GROWING SYSTEM ALTERNATIVES IN REPUBLIC OF MACEDONIA

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Abstract

Apple, among all fruits production, has traditional importance and contribution to the Macedonian economy. The favour agro-climatic conditions, combined with the long-lasting tradition, generated human capacity and expert knowledge offer huge potential for growing apples and development of this economic branch. The apple production in Republic of Macedonia is insufficient and uncompetitive on domestic and foreign markets as result of insignificant intensity of the growing system, poor productivity and high production and investment costs.

In order to identify the optimum investment and supreme apple growing system alternative, the economic optimization analysis were performed. For the purposes of this analysis, a field study has been conducted on 39 apple producing farms in the Pelagonia region for the production years of 2009 and 2010. Additionally, the production information are updated with data for the years 2011, 2012 and 2013 based on rapid research, semi-structured interview with the main stakeholders in supply chain and official statistics.

The investment calculations have been used to determine the comparative advantages of the investment in different growing system models. The economic justification to invest in the different growing system was assessed based on the standard indicators for investment evaluation as: internal rate of return, net present value and payback period. The findings show that economic performance of the apple farming depends on the apple growing system. Although, the highly intensive method of apple growing require much higher investment costs, it brings better results than the dominant extensive growing method with low plant density.

Key words: *apple, economic optimization, growing systems*.

Introduction

Fruit production has great significance in our Macedonian economy, as perceived by: share of 12% of the total value of agricultural production (SSO, 2008-2012), engagement of approximately 7,000 agricultural households and agricultural enterprises, 6,730,849 apple fruit trees, utilization of land area 7,742 ha (SSO, 2013), providing of row material to processing facilities and exports of fresh or processed fruits. Despite the favourable environmental conditions and potential for growing of many fruit species in Macedonia, the fruit production doesn't take its rightful place and is not represented in sufficient measure. According to the last official statistical data for 2013, orchards covered area of 15,000 ha, which constitutes only 3% of total cultivated land.

Apple production dominates the fruit farming sector in Macedonia, with the highest share of 44.7% in the orchards structure (SSO, 2013) and nearly 60% of total fruit production. In the period from 2009 to 2013, the apple production on average is 118,478 tons, reaching a pick in 2012 with 127,171 tones. Apple is a net exported product with a positive ratio of foreign trade balance in favour of exports, accounting for more than 99% compared

to imports (SSO, www). The export value of apples is in average 8.5 million US$, varies between 8.6 million US$ in 2009 up to 21.6 million US$ in 2012.

The highest concentration of apple plantations is in the region of the great lakes, 700 m above sea level, located in the geographical regions of Pelagonia and South-West (officially determined by the State Statistical Office), which takes around 79% of the total area with apple orchards in the country (SSO, Agricultural Census, 2007). The individual sector holds in possession 94% of the total area planted with apple orchards, while only 6% belongs to companies.

The focus of this study is the production of apples in the Pelagionia region which takes up to 67% of all apple production area, mainly located in Resen (2,567 ha apple orchards) and Bitola (135 ha apple orchards) municipalities.

The most typically growing systems in the country are characterized with insignificant (minor) density, using more vigorous rootstocks, the trees are higher, the crowns are denser, less in lighted, with a late full fruiting and reduced sunshine. The yields are unsatisfactory undersized and the fruits less coloured (AgBiz programme, 2009). As rootstocks, mostly are used MM106, MM104, MM111, MM109, M26, what give intermediate or high lush trees, with a density of 800 to 1,200 trees/ha. In recent years, although very moderately, can be noticed replacement of apple growing system with using of M9 as a rootstock, with density of 2,500 to 3,000 seedlings per hectare.

The growing system of apple and density of trees is of a huge importance for the fruiting and annual achieved yields. In accordance to Polish researchers, Kierczyńska and Wawrzyniak, three different types of apple (growing systems) orchards are recognized referring to the planting density: traditional or extensive (less than 1,000 trees/ha), intensive (1,000 to 2,000 trees/ha) and highly intensive (more than 2,000 trees/ha).

The aim of this paper is to conduct a comparative investment analysis of tree density impacts on the growing systems performance, on orchards managed by the individual apple producers in the Pelagiona region, as the biggest apple production region in the Republic of Macedonia.

Materials and methods

The research is based on primary and secondary source of data. The target group are the individual agricultural holdings (family farms), which according to the Agricultural Census data has the ownership under 94% of the apple orchards. The survey refers to the five years period from 2009 till 2013 encompassing data from 39 individual agricultural holdings from Pelagonia region. Field survey was conducted by using of specially developed questionnaire for collection of data. In addition, rapid assessment was performed on the field and many farmers were additionally interviewed with an extra set of questions mainly covering the issues of farms assets and investments. Following the initial data processing, panel discussions and semi-structured group interviews were performed with main stakeholders in the apple supply chain as: apple producers, researchers, processors, producers of plant material, advisors and extension agents. Apart from field survey, the researchers use secondary source of data, mainly from official statistics and previous studies.

Investment calculations were used in order to assess the economic viability of investments in different growing systems for apple orchards. The assessment of the economic viability in investment was performed based on the standard investment feasibility assessment indicators as net present value, the internal rate of return and the payback period.

The net present value was calculated based on the future value of annual cash flows discounted at the present time. The net present value is the calculation of the money value, taking in the consideration the time. Actually, the net present value calculates the present value of the money from the future period, taking in the consideration time and inflation.

$$PV_n = \frac{(I - VC - T)}{(1 + i)^n}$$

$$NPV = PV_1 + PV_2 + .. + PV_n$$

I – income
VC – variable costs
T - taxes
n – period (year)
i – interest rate (discount factor)
PV – present (discounted) value
NPV – Net Present Value

In the analyses, exploiting period of 30 years for the extensive, 25 years for intensive and 18 years for highly intensive growing systems were used. The discount factor was valued at 6%.

Internal rate of return is an indicator of investment efficiency and represents the interest rate of the investment. The internal rate of return is interest rate for which the net present value is zero.

Payback period is the period of time needed to recoup the investment.

$$PP = \frac{IV}{(I - VC - T)}$$

PP – payback period
IV – investment value

The investment value is calculated as sum of initial investment and variable costs of production in the first 3 years, reduced by the income generated in the 3rd year.

Results and discussion

The average yields of apple production are 32,715 kg/ha which is far from average yields in the countries with competitive apple production such as Italy, Poland, France and others (50,000 – 60,000 kg/ha).

According to the survey, 73% of the total surveyed apple orchards are established on the basis of intensive growing system, followed by the extensive apple orchard system representing 13% and highly intensive apple growing orchard system representing 10%

The results from the research show that the investment costs for establishment of the extensive growing system for the first three years is 10,002 EUR/ha, for intensive system 15,047 EUR/ha, while for the highly intensive system 19,510 EUR/ha or almost twice higher investment costs compared with extensive apple orchards.

Table 1. Specification of investment costs for establishment of apple orchard (in EUR/ha)

Cost for establishment of apple orchard	Extensive	Intensive	Highly intensive
Investment for orchard construction	6,920	10,500	18,089
Growing costs in 1 year	982	1,443	1,715
Growing costs in 2 year	1,153	1,755	1,978
Growing costs in 3 year	1,427	2,349	2,728
Income in 3 year	-480	-1,000	-5,000
Total	**10,002**	**15,047**	**19,510**

In regards to variable costs, the results illustrate that the higher values are within the highly intensive systems. The average yearly costs are amounted at 5,456 EUR/ha, which is

for 13% higher compared with extensive and only 11% compared with the intensive growing systems. The variable costs for intensive systems are amounted at 4,859 EUR/ha per year, while extensive have 4,735 EUR/ha.

Table 2. Yearly production cost indicators in EUR per ha (average for the period 2009 – 2013)[1]

Material and operational costs	Measurement unit	Extensive			Intensive			Highly intensive		
		Units	Unit price	Total	Units	Unit price	Total	Units	Unit price	Total
Fuel	l	250	1.12	280	350	1.12	392	400	1.12	448
Protection	No of spraying	9	69.59	640	14	67.54	959	14	72.49	1029
Fertilization	kg	250	1.28	320	400	1.28	512	500	1.28	640
Irrigation (drip by drip)	Yearly	1	75.00	75	1	62.00	62	1	62.00	62
Boxes	No/yearly	269	1.46	394	304	1.46	445	373	1.46	546
Transport costs	t	28	16.26	450	35	16.26	572	55	16.26	898
Winter pruning	Days	33	24.39	805	20	24.39	488	10	24.39	244
Summer pruning	Days	3	24.39	73	6	24.39	146	4	24.39	98
Harvesting (manipulation)	Days	42	20.42	864	39	20.44	805	41	20.42	838
Other labour	Days	25	13.33	333	17	13.33	227	19	13.33	253
Maintenance and other costs	Yearly	1	500.00	500	1	250.00	250	1	400.00	400
Total				**4,735**			**4,859**			**5,456**

The highest yields and income generation can be noticed within highly intensive systems with average yield of 42,050 kg/ha and average yearly income 9,880 EUR/ha. The income is almost twice higher compared with the extensive and one third from the intensive systems.

Table 3. Yearly yields and income (average for the period 2009 – 2013)[2]

	Extensive			Intensive			Highly intensive		
Apple	Yields (kg/ha)	Sell price (EUR/kg)	Income (EUR/ha)	Yields (kg/ha)	Sell price (EUR/kg)	Income (EUR/ha)	Yields (kg/ha)	Sell price (EUR/kg)	Income (EUR/ha)
	29,610	0.197	5,846	33,470	0.215	7,211	42,050	0.235	9,880

The average yearly profit amounts to 2,975 EUR/ha at the highly intensive growing system, which is almost twice higher compared with the intensive systems (1,575 EUR/ha) and more than four times compared with extensive system (700 EUR/ha).

Table 4. Profit calculation (EUR/ha)

Profit calculation	Extensive	Intensive	Highly intensive
Income	5,846	7,211	9,880
Variable costs (-)	4,735	4,859	5,490
Depreciation (-)	333	602	1,084
Income before taxes	777	1,750	3,306
Tax (10%) (-)	78	175	331
Profit (EUR/ha)	**700**	**1,575**	**2,975**

The production price of one kilogram apples is lowest in highly intensive system amounted to 0.131 EUR/kg, while in intensive the production price is 0.145 EUR/kg and at the extensive 0.160 EUR/kg. The situation is similar with full production price[3] and lowest values are generated within highly intensive systems (0.156 EUR/kg), followed by intensive

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[1] The presented values for the total costs and units are calculated as average of the costs and units in the 5 years period. The average unit price is calculated by dividing total costs with units.
[2] The average sell price is calculated by dividing average 5 years income with average yields.
[3] Production price is variable costs divided by the yield. The full production price additionally includes fixed costs.

(0.163 EUR/kg) and highest production price at the extensive production systems (0.171 EUR/kg).

Table 5. Apple production prices (EUR/ha)

	Extensive	Intensive	Highly intensive
Production price	0.160	0.145	0.131
Full production price	0.171	0.163	0.156

The highly intensive systems have shortest payback period and investment will repay in 5 years. The payback period on investment in intensive systems is 7 years, while for the extensive systems this period is longest (11 years).

Table 6. Payback period of investments in apple orchards

Year in project lifetime[1]	Extensive		Intensive		Highly intensive	
	Net inflow	Cumulative net inflow	Net inflow	Cumulative net inflow	Net inflow	Cumulative net inflow
I0	-6,920	-6,920	-10,500	-10,500	-18,089	-18,089
I1	-982	-7,675	-1,443	-11,943	-1,715	-19,804
I2	-1,153	-8,828	-1,755	-13,698	-1,978	-21,782
I3	-1,907	-10,735	-1,349	-15,047	2,272	-19,510
P1	1,033	-9,702	2,177	-12,870	4,059	-15,451
P2	1,033	-8,670	2,177	-10,693	4,059	-11,392
P3	1,033	-7,637	2,177	-8,516	4,059	-7,333
P4	1,033	-6,604	2,177	-6,339	4,059	-3,274
P5	1,033	-5,571	2,177	-4,162	4,059	785
P6	1,033	-4,538	2,177	-1,985		
P7	1,033	-3,505	2,177	192		
P8	1,033	-2,472				
P9	1,033	-1,439				
P10	1,033	-406				
P11	1,033	627				

Net present value at all growing systems is positive, which means that the investment is economically feasible in all cases. Still, the highly intensive production systems demonstrate highest net present value, while the extensive production system has significantly lower net present value compared with other systems. Furthermore, the calculations for internal rate of return illustrate higher values at the highly intensive apple growing system, compared with the other two growing systems.

Table 7. Comparative indicators of economically viability of different production systems

Indicators	Extensive	Intensive	Highly intensive
Internal rate of return (%)	7.10%	9.76%	12.13%
Payback period (years)	13	10	8
Net present value (EUR)	1,204	6,201	10,458
Relative Net present value (%)	12.04%	37.39%	48.02%

Conclusion

The apple production is one of the main perspective fruit in the Macedonian agriculture regarding to climate and soil conditions. Apple takes dominant place according area, production and export. The low productivity and high cost of apple production emerge as major constraints to competitiveness on domestic and world markets, mainly as result of inadequate and obsolete production systems, cultivation practices and technologies.

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[1] I – refers to investment period and P – refers to period of production/usage of the apple orchards.

The results from the research demonstrate that the investment value, yield and income vary in line with the apple production systems (trees densities). The highly intensive growing system demand higher investment costs, but gives more positive results. The higher net present value and internal rate of return and earlier payback indicate that investment in this system is economically more appropriate and suitable. Additionally, the high intensive systems result with higher profit and lower production prices. According to these findings, highly intensive growing system is a prerequisite for increasing the competitiveness of the sector. Therefore, the apple growers in Macedonia need to shift to more intensive production systems and introduce new technologies in line with the increased intensity and trees density. Still, the density and growing systems should be adopted towards the variety specifics.

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RURAL DEVELOPMENT IN THE SOUTHEAST PLANNING REGION IN THE REPUBLIC OF MACEDONIA THROUGH ENTREPRENEURSHIP

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Abstract

The aim of this paper is to find out more about present conditions of the rural entrepreneurship in rural parts of the Southeast Planning Region (SPR) in the Republic of Macedonia (RoM). For that purpose, interviews were conducted with 21 owners of Small-Medium Entrepreneurs (SMEs) in rural areas who were presented four sets of statements that are important for understanding of the situation with entrepreneurship in rural areas of the SRP in the RoM valued at five-degree scale from irrelevant to that of priority. One of the conclusions, by which the state of entrepreneurship and SMEs in rural areas of the Southeast Region of the RoM is assessed, based upon an empirical research and compared with the results of an identical research on rural entrepreneurship on the territory of the RoM, is that the rural entrepreneur there has reached a satisfying level of entrepreneurial qualities, which are required by the developed business world, in terms of commitment, desire for independence, flexibility etc.

Keywords: *Southeast planning region, rural entrepreneurship, rural entrepreneurs, SMEs, rural area*

Introduction

The SPR is located in the South-eastern part of the RoM with some highland and much larger part of flat land. The altitude varies between 64 and 2.157 meters (the peak Zelen Breg on Kozhuv mountain). This planning region is mainly characterized by Mediterranean climate, with 340 sunny days per year, making it the sunniest region of the country (Decision on the Classification of the Planning Regions according to the Degree of Development for the period 2008-2012, 2007),

This planning region consists of 10 municipalities with a total area of 2.739 km^2 and a population of 172.693. The average population density is 66 inhabitants/km^2, slightly less than the national average. Most of the population (60%) lives in 182 rural settlements (State Statistical Office: Announcement no. 2.4.10.10, 2010).

The planning region borders Greece to the south and Bulgaria to the east.

The SPR has excellent climate and soil conditions for development of agriculture and vegetable growing, especially early vegetables under plastic foil, an activity in which this planning regions has the greatest experience in the country. Dominant cultures are tomato, pepper, cucumber, cabbage, onion, muskmelon and watermelon, Approximately 60% of the needs of the RoM are covered by the production from this planning region. Other characteristic products are the persimmon and pomegranate (Ministry of Local Self-Government of the Republic of Macedonia, 2011).

Dojran Lake, the smallest natural lake in the RoM, and the only one in the planning region in question, is an isolated eco-system with specific flora and fauna that enjoys its natural habitat after the improvement of the hydrological conditions of the lake in recent years.

The natural heritage is enriched by the Smolarski and Koleshinski waterfalls, Dojran Lake and the thermal water springs that offer great potentials for development of tourism. The thermo-mineral hydro-potential is located in the two spa and wellness centres: Banja Bansko, at the foothill of maintain Belasica and Negorski Banji, at the foothill of maintain Kozhuv, both at an altitude of 250 meters, offering water temperatures of 71 ℃ and 50 ℃, respectively. The archaeological site Vardarski Rid (a multi-layered habitat from between the XIII and the I century BC), the Roman baths in Bansko, the monasteries in Vodocha and Veljusa, and the carnival in Strumica constitute the cultural and historical heritage of the planning region.

The SPR has a per capita Gross Domestic Product (GDP) of 3.088 EUR which is approx. 15.4% less than the national average for the RoM (State Statistical Office: Announcement no.3.1.11.03, 2011). Hence, this region is ranked fourth of the eight planning regions in the country and contributes 8% to the total Macedonian GDP. The following are the most important industries: agriculture, animal husbandry, metallurgy, food industry, tourism and trade.

The following are development priorities for this region:

1. Production of high-quality, branded fruits, vegetables and grapes, as well as processed foods, since growing demand trends are evidenced both on the regional and global markets.
2. Higher employment rate by increasing the number of SMEs, promotion of competitiveness and human recourses development.
3. Building of new and improvement of the existing physical infrastructure, particularly the infrastructure related to transport, energy and IT, with the aim of promoting economic growth and improvement of the competiveness in the region.
4. Development of spa and wellness centres, cultural, village and alternative tourism through cooperation with the neighbouring regions and countries.
5. Protection and improvement of the environment through renewable energy resources and sustainable development.
6. Promotion of the region with the view of attracting foreign direct investments related to sustainable growth.

The aim of this research is to find out more about present conditions of the rural entrepreneurship in rural parts of the SPR.

Materials and methods

This research encompassed extended literature review as well as field questionnaire survey carried out with 21 owners of SMEs in rural areas, the municipalities of Gevgelija, Bogdanci, Strumica, Vasilevo, Bosilovo of the SPR, during the year of 2011. The obtained results were compared with those relevant to the rural parts on the whole territory of the RoM through interviewed suitable sample of owners of 101 SMEs (Kostadinov, T., 2011) provided more insights on the entrepreneurship in the studied region.

Several commonly used methods of economic analysis were applied in the composition of this paper, primarily the method of generalization and specialization, the method of induction and deduction, statistical method and the comparative method.

Results and discussion

Survey respondents were presented the four sets of statements that are of relevance to the efforts to perceive the situation of rural entrepreneurship in the SPR in RoM, valued at a five-degree scale from 1 - unimportant to 5 - priority (Table 1, Table 2, Table 3 and Table 4).

The results are compared to those obtained from rural areas on the territory of the Republic of Macedonia.

Table 1. Degree of agreement with the statements in terms of constraints on the development of enterprises using the arithmetic means

	Republic of Macedonia (rural areas) _____ Mean value	Southeast planning region (rural areas) _____ Mean value
High rate of Value-Added Tax (VAT)	3.60	3.42
Problems with collection of claims	3.65	3.60
High rates of taxes and employee contributions	4.18	3.95
Administrative difficulties and complexity of procedures	3.99	3.77
Instability and ambiguity of the legislation	4.02	3.92
High interest rates of loans	4.28	4.08
Cost of energy	3.92	3.85
Cost of material, raw materials	3.80	3.76
Availability of funding sources	3.99	1.30
Loss of market in the former Yugoslavia	3.03	2.88
Unfair competition	3.70	3.66
Domestic competition	3.86	3.68
Obsolete technology	3.40	3.33
Quality of products	3.30	3.24
Products prices	3.32	3.30
Labour costs	3.32	3.24
Non-innovative products	3.12	3.10
Lack of funds for research and development	2.84	2.70

Source: Authors' own elaboration based on questionnaire survey results

As major obstacles to development activities in enterprises respondents indicated high interest rates on loans, high tax rates and contributions for employees, all that in an environment of limited availability of sources of funding. However, compared to the data obtained from SMEs in rural areas of the whole territory of the RoM, in SMEs in rural areas of the SPR these obstacles are emphasized in a slightly lower degree.

Table 2. Degree of agreement with the statements related to improvement of the competitiveness on the market using arithmetic means.

	Republic of Macedonia (rural areas) _____ Mean value	Southeast planning region (rural areas) _____ Mean value
Improving the quality of products and services	4.17	4.23
Improving the promotion of products	4.20	4.24
Obtaining quality certifications	4.03	4.11
Professional consulting assistance	3.46	3.54
Improvement and education in the field of entrepreneurship	3.83	3.86

Improvement and education in the field of Information and Communication Technologies (ICT)	3.88	3.96
Improvement and education in the field of management	3.83	3.89
Improvement and education in finance	3.65	3.71
Improvement and education in the field of sales	3.89	3.96
Improvement and education in marketing	3.91	4.03
Improvement and education in foreign languages	3.38	3.38
Association with companies in the sector for joint appearance on the market	3.37	3.38
Assistance from development programs through grants	4.31	4.41
Assistance from development programs through favourable loans	4.30	4.36
Assistance from development programs through guarantee funds	3.80	3.89

Source: Authors' own elaboration based on questionnaire survey results

The most important measures regarding promoting of enterprise competition on the market are development assistance programs through grants, development assistance programs through favourable loans, improving the promotion of products, and the quality of products/services. Respondents are aware of the benefit of obtaining/ having certificates of quality. Compared to the results obtained from the survey of SMEs in rural areas on the whole territory of the RoM, owners of SMEs from rural areas in the SPR demonstrate more competitive attitudes.

Table 3. Degree of agreement with claims with regard to plans for the business future (arithmetic means)

	Republic of Macedonia (rural areas) _____ Mean value	Southeast planning region (rural areas) _____ Mean value
Introducing new products or services	4.08	4.19
Sales on a new market	3.37	3.42
Exploring new markets	3.32	3.36
Search for new distribution channels	3.61	3.72
Expanding advertising and promotion	3.87	3.96
Investing in new equipment and machinery	3.69	3.77
Replacement of current equipment and machinery	3.73	3.86
Expansion of current facilities	3.68	3.77
Redesign/new arrangement of the current facilities	3.42	3.44
Search for additional financial capital	3.92	4.04
Computerization of current operations	3.29	3.33
Upgrading of computer systems	3.38	3.43
Redesign of work activities	3.29	3.32
Expanding the scope of work activities	3.77	3.86
Search for professional or technical advice	3.45	3.52
Additional engagement of staff specialists	3.37	3.42
Investing in staff training (elsewhere/not in the company)	2.63	2.80

Source: Authors' own elaboration based on questionnaire survey results

The results of the comparative analysis show that owners of SMEs have expressed a certain degree of higher consideration regarding future plans for their own businesses (SPR) than their average counterparts from rural areas of the RoM.

Table 4. Degree of agreement with the statements in terms of attitudes to entrepreneurship, using the arithmetic means

	Republic of Macedonia (rural areas) _____ Mean value	Southeast planning region (rural areas) _____ Mean value
My business is the most important activity in my life	4.13	4.17
I would do everything that is needed for my business to succeed	4.18	4.22
I plan to sell my business at the end	2.15	2.06
I would like to significantly contribute to the community by developing a successful business	4.29	4.33
I would prefer to have my own business than to earn higher wages working for someone else	4.78	4.82
To run your own business is more important than to have more time for the family	3.80	3.86
I would prefer to have my own business than to have another promising career	4.08	4.12
For the entrepreneur it is important to understand and accept the risk in order to start and run a successful business	4.26	4.33
I am ready to get into conflict with my family for the sake of running my business	3.70	3.77
I would put my house mortgaged to acquire capital for my business	3.52	3.56
I would be ready to have less security for my family in order to run my business	3.67	3.76
I run my business to continue the family tradition	3.34	3.43
I run my business to contribute to the welfare of my relatives	3.52	3.57
I run my business to live in a place that my family likes	3.47	3.55
I run my business to improve the status and prestige of my family	4.02	4.12
I run my business to have more flexibility in my personal and family life	4.08	4.22

Source: Authors' own elaboration based on questionnaire survey results

Generally, the responses to this set of questions by owners of SMEs from the rural parts of the Southeast Region indicate more positive attitudes regarding entrepreneurship, which permits us to acknowledge that the attitudes towards entrepreneurship among owners are more positive than those expressed from SMEs in rural areas on the whole territory of the RoM.

Conclusion

As major obstacles to development activities in enterprises, respondents indicated the high interest rates of loans, high tax rates and contributions for employees, all that in an environment of limited availability of sources of funding. Still, compared to the results obtained from SMEs in rural areas on the whole territory of the RoM these obstacles are slightly less emphasized by owners of SMEs in rural areas of the Southeast Region.

The most important measures regarding promoting of enterprise competition on the market are development assistance programs through grants, development assistance programs through favourable loans, improving the promotion of products, and the quality of products/services. Respondents are aware of the benefit of obtaining/ having certificates of quality.

In comparison to the results from the research of SMEs from rural areas on the whole territory of the RoM, owners of SMEs from rural areas of the SPR demonstrate higher levels of competitive attitudes.

The results of the comparative research has shown a certain level of higher consideration of plans among owners of SMEs for their own businesses in rural areas of the Southeast Region relative to those recorded from SMEs in rural parts on the territory of the RoM.

Generally speaking, the responses to this set of questions by owners of SMEs from rural parts of the Southeast Region indicate to more positive attitudes regarding entrepreneurship, which enables us to conclude that the attitudes towards entrepreneurship among owners are more positive than those expressed from SMEs in rural areas on the whole territory of the RoM.

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RURAL DEVELOPMENT IN THE VARDAR PLANNING REGION IN THE REPUBLIC OF MACEDONIA THROUGH ENTREPRENEURSHIP

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Abstract

This paper aims to incorporate new findings in the body of knowledge regarding entrepreneurship in rural areas of the Vardar planning region (VPR) in the Republic of Macedonia (RoM). With that in view interviewing was conducted with 18 individuals/owners of Small-Medium Entrepreneurs (SMEs) in rural areas. They were offered four sets of statements that are important for understanding the situation of entrepreneurship in rural areas of the Vardar Region in the Republic of Macedonia, valued at a five-level scale from unimportant to that of priority. The conclusion, which illustrates the state of entrepreneurship and SMEs in rural areas of the Vardar Region in the Republic of Macedonia, based upon empirical research, is that rural entrepreneurs of that region in the country, unlike the average rural entrepreneurs in the country, display lower levels of entrepreneurial characteristics. The state and local governments should undertake measures in view of promotion of entrepreneurial skills among the population of that region.

Keywords: *Vardar Region, rural entrepreneurship, rural entrepreneurs, SMEs, rural area*

Introduction

The VPR is located in the central part of the RoM and encompasses the central catchment area of the river Vardar, the lower courses of the rivers Bregalnica and Crna Reka, as well as the westernmost part of Ovche Pole valley. It has an area of 4.042 km2, which represents 16% of total territory of the country (Decision on the Classification of the Planning Regions according to the Degree of Development for the period 2008-2012, 2007).

This planning region has 9 municipalities and 215 settlements with a total population of 153.837 inhabitants (State Statistical Office: Announcement no. 2.4.10.10, 2010). The region has a very low population density of 38 inhabitants/km^2 (compared to the national average of 81 inhabitants/km^2) and a large concentration of the population in the urban centres (approx. 69%).

The VPR borders Greece on the south, with the border crossing Pulevec, still being inactive. This border crossing can be of exceptional importance for promotion of the cross-border cooperation with Greece, as well as the regional development, since it can offer quick access to the ski centre Kozhuf (Ministry of Local Self-Government of the Republic of Macedonia, 2011).

The studied region has excellent climate conditions for development of agriculture and winegrowing. Approximately 45% of the total area under wines in the country is located in this region (Tikvesh and Demir Kapija), which makes it internationally recognizable. Besides winegrowing, agriculture is highly specialized, most typical crops being fruit (peaches, mainly in Rosoman) and cereals (particularly wheat and barley), Ovche Pole offering favourable climate conditions regarding the latter.

Economically, most significant mineral resources in that region are the ferronickel ores and other mineral deposits include perlite, talc, quartzite and Diatomaceous earth. Water resources consist of the lower courses of the rivers Vardar, Crn Drim, Bregalnica, Babuna, Topolka and Otovica, giving potentials for the construction of 6 accumulation lakes, three of which - namely Tikvesh, Lisiche and Mladost - have already been built.

What is especially interesting regarding generation of electricity in the region is the possibility for use of the electricity producing potential of the river Vardar through the energy project Vardar Valley. The large number of sunlight hours per year (between 2.200 and 2.600, depending on the geographical location), as well as significant presence of wind (Ovche Pole), create opportunities for generation of renewable energy.

Among the rich natural, cultural and historical heritage of the region locations that deserve special attention are the nature reserve Tikvesh, the natural monument Demir Kapija, and the archaeological site of Stobi, since they offer great potentials for development of tourism. The long tradition of the Tikvesh wine harvesting festival and the production of wine provide opportunities for development of wine tourism, and the newly built ski centre Kozhuv is the most modern facility of that type in the country which is expected to be the flagship centre for winter sports in Macedonia.

The VPR has a per capita Gross Domestic Products (GDP) of 3.161 € which is approximately 3.1 % lower than the national average for the RoM (State Statistical Office: Announcement no.3.1.11.03, 2011). Hence, this region is ranked as third of the eight planning regions in the country and contributes with 7.3 % of the total Macedonian GDP. The following are the most significant economic sectors in the region: metallurgy, agriculture, food, tobacco, textile and metal processing industry. VPR is centrally located in Macedonia; the main transport corridor (north-south) on the Balkans passes through that region, making it one of the main crossroads in the country (after Skopje, Veles is the second most important transport junction in Macedonia), for both road and railway transport.

Development priorities of this planning region are the followings:

1. Increasing regional competitiveness and possessing well qualified and educated workforce, in line with the needs of the economy.
2. Development of transit, sustainable and cultural tourism.
3. Improvement of the infrastructure and energy-producing potentials in the region.
4. Securing conditions for improvement of the environment in the region.
5. Creation of preconditions for sustainable agriculture and rural development in the region.
6. Development of effective educational system, based on values, that will be accessible and able to prepare its beneficiaries for life's challenges.

The aim of this research is to observe the conditions of the rural entrepreneurship in rural parts of the VPR.

Materials and methods

The paper is based on desk research as authors consulted a number of secondary data and field research interviews with 18 owners of SMEs, from the municipalities: Kavadarci, Rosoman, Negotino, Gradsko and Veles, during the year 2011. The selection of owners was made randomly. The comparison of the obtained results with those relevant to the rural pats on the whole territory of the RoM through interviewed suitable sample of owners of 101 SMEs (Kostadinov, T., 2011), puts more light on the conditions of entrepreneurship in the researched region.

Several commonly used methods of economic analysis were applied in the composition of this paper, primarily the method of generalization and specialization, the method of induction and deduction, statistical method and the comparative method.

Results and discussion

Survey respondents answered four groups of statements important to perceive the situation of rural entrepreneurship in the VPR in RoM, valued at a five-degree scale from 1 - unimportant to 5 - priority (Table 1, Table 2, Table 3 and Table 4).
The results are compared to those obtained from rural areas on the whole territory of the RoM.

Table 1. Degree of agreement with the statements in terms of constraints on the development of enterprises using the arithmetic means

	Republic of Macedonia (rural areas) _____ Mean value	Vardar planning region (rural areas) _____ Mean value.
High rate of VAT	3.60	3.72
Problems with collection of claims	3.65	3.69
High rates of tax and employee contributions	4.18	4.24
Administrative difficulties and complexity of procedures	3.99	4.07
Instability and ambiguity of the legislation	4.02	4.10
High interest rates on loans	4.28	4.33
Cost of energy	3.92	4.04
Cost of material, raw materials	3.80	3.86
Availability of funding sources	3.99	4.04
Loss of market in the former Yugoslavia	3.03	3.16
Unfair competition	3.70	3.82
Domestic competition	3.86	3.94
Obsolete technology	3.40	3.55
Quality of products	3.30	3.33
Products prices	3.32	3.42
Labour costs	3.32	3.44
Non-innovative products	3.12	3.18
Lack of funds for research and development	2.84	3.03

Source: Authors' own elaboration based on questionnaire survey results

The responses to this set of statements indicate that in SMEs from rural areas of the VPR obstacles to development activities are more emphasized, compared to those from SMEs from rural areas on the whole territory of the RoM.

Table 2. Degree of agreement with the statements related to improvement of the competitiveness of market using the arithmetic means.

	Republic of Macedonia (rural areas) _____ Mean value	Vardar planning region(rural areas) _____ Mean value
Improving the quality of products and services	4.17	4.10
Improving the promotion of products	4.20	4.12
Obtaining quality certifications	4.03	3.95
Professional consulting assistance	3.46	3.42
Improvement and education in the field of entrepreneurship	3.83	3.75
Improvement and education in the field of IT	3.88	3.77
Improvement and education in the field of management	3.83	3.74
Improvement and education in finance	3.65	3.55
Improvement and education in the field of sales	3.89	3.79
Improvement and education in marketing	3.91	3.83
Improvement and education in foreign languages	3.38	3.28
Association with companies in the sector for joint appearance on the market	3.37	3.28
Assistance from development programs through grants	4.31	4.29
Assistance from development programs through favourable loans	4.30	4.23
Assistance from development programs through guarantee funds	3.80	3.74

Source: Authors' own elaboration based on questionnaire survey results

From the viewpoint of improvement of competitiveness, the responses to this set of questions indicate to lower level of competitiveness of SMEs from rural areas in the VPR, compared with SMEs from rural areas on the whole territory of the RoM.

Table 3. Degree of agreement with claims with regard to plans for the business future (arithmetic means)

	Republic of Macedonia (rural areas) _____ Mean value	Vardar planning region (rural areas) _____ Mean value
Introducing new products or services	4.08	4.00
Sales on a new market	3.37	3.32
Exploring new markets	3.32	3.27
Search for new distribution channels	3.61	3.55
Expanding advertising and promotion	3.87	3.77
Investing in new equipment and machinery	3.69	3.61
Replacement of current equipment and	3.73	3.69

	Republic of Macedonia (rural areas) _____ Mean value	Vardar planning region (rural areas) _____ Mean value
machinery		
Expansion of current facilities	3.68	3.59
Redesign/new arrangement of the current facilities	3.42	3.34
Search for additional financial capital	3.92	3.86
Computerization of current operations	3.29	3.21
Upgrading of computer systems	3.38	3.30
Redesign of work activities	3.29	3.21
Expanding the scope of work activities	3.77	3.69
Search for professional or technical advice	3.45	3.41
Additional engagement of staff specialists	3.37	3.33
Investing in staff training (elsewhere / not in the company)	2.63	2.58

Source: own calculations

Interviewed owners of SMEs from the areas of the VPR have demonstrated lower levels of agreement with the statements regarding plans for the business in future, compared to those of SMEs from rural areas on the whole territory of the RoM.

Table 4. Degree of agreement with the statements in terms of attitudes to entrepreneurship using the arithmetic means

	Republic of Macedonia (rural areas) _____ Mean value	Vardar planning region (rural areas) _____ Mean value
My business is the most important activity in my life	4.13	4.04
I would do everything that is needed for my business to succeed	4.18	4.10
I plan to sell my business at the end	2.15	2.22
I would like to significantly contribute to the community by developing a successful business	4.29	4.18
I would prefer to have my own business than to earn higher wages working for someone else	4.78	4.68
To run your own business is more important than to have more time for the family	3.80	3.70
I would prefer to have my own business than to have another promising career	4.08	4.02
For the entrepreneur it is important to understand and accept the risk in order to start and run a successful business	4.26	4.18
I am ready to get into conflict with my family for the sake of running my business	3.70	3.63
I would put my house mortgaged to acquire capital for my business	3.52	3.44
I would be ready to have less security for my family in order to run my business	3.67	3.60

I run my business to continue the family tradition	3.34	3.26
I run my business to contribute to the welfare of my relatives	3.52	3.44
I run my business to live in a place that my family likes	3.47	3.40
I run my business to improve the status and prestige of my family	4.02	3.95
I run my business to have more flexibility in my personal and family life	4.08	3.97

Source: Authors' own elaboration based on questionnaire survey results

What concerns the agreement with the statements regarding entrepreneurial attitudes owners of SMEs from rural areas of the Vardar Planning Region demonstrate slightly lower levels compared to those from rural parts on the territory of the whole Republic of Macedonia.

Conclusion

The responses to the set of statements in terms of constraints on the development of enterprises indicate that in SMEs from rural areas of the VPR obstacles to development activities are more emphasized, compared to those among SMEs from rural areas on the whole territory of the RoM.

From the viewpoint of improvement of competitiveness, the responses to this set of questions indicate to lower level of competitiveness of SMEs from rural areas in this region, compared with SMEs from rural areas on the whole territory of the RoM.

Interviewed owners of SMEs from rural areas of the VPR have demonstrated lower level of agreement with the statements regarding plans for the business in future, compared to those from SMEs from rural areas on the whole territory of the RoM.

What concerns the agreement with the statements regarding entrepreneurial attitudes, compared to those from rural parts on the territory of the whole RoM, owners of SMEs from rural areas of the VPR demonstrate slightly lower levels.

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FAMILY ENTREPRISES IN RURAL AREAS OF THE VARDAR REGION IN THE REPUBLIC OF MACEDONIA

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Abstract

The aim of this paper is to investigate some aspects of family enterprises and incorporate new findings in the body of knowledge about family businesses in rural areas of the Southeast Planning Region (SPR) of the Republic of Macedonia (RoM). With that on mind, 21 individuals from rural parts of the SPR in the RoM were interviewed, of whom 47.62% were owners of family businesses and 52.38% of non-family businesses. They were offered three sets of statements that are of importance for comparison between family and non-family businesses and determining the specifics of family businesses in rural areas of the SPR. The responses were measured at a five-level scale from irrelevant to those of priority.

From the results of the conducted research it can be concluded that family businesses significantly shape the economic environment in the rural areas of the SPR. General support for entrepreneurship and SMEs in rural areas of the SPR by the state and local governments can significantly stimulate the establishment of new family enterprises and the growth of existing ones.

Keywords: *Southeast planning region, Republic of Macedonia, family enterprises, rural areas.*

Introduction

Major part of the businesses around the world – that goes also for the United States and other developed countries – are led and managed by families. A family business is established by an entrepreneur who has a particular business idea, and afterwards is developed by him/her or his/her successors (Mantle, 1999).

It is very difficult to define the term of family business. The majority of people would say that a firm that is owned and led by one family member is in question, similar to a start-up of a small enterprise. According to other definitions two or more family members are owners of the family business and its managers (spouses, for instance).

In the world there are family businesses with a turnover above one billion dollars, but also there are family micro businesses run by one person who hopes that one day some of his/her children (or another family member) will inherit the firm.

According to assessments three of four businesses in Great Britain are of family kind and they have longer life compared with non-family businesses. When making comparison among family businesses the ownership, size, turnover and the market must be taken into account (Leach and Bogot, 1999).

Although family businesses face certain challenges – like internal discordances and rivalry between brothers and sisters, for instance – they considerably contribute to the growth of the society today. Family support is a major benefit, while company culture and values are considered as very significant in the family companies. New generations have to respond to the challenges they face and certain situations may occur when a professional team of

experienced managers has to be invited to join in case the family members are not sufficiently qualified or skilled for the position in question (Deakins and Freel, 2005).

Family businesses have their advantages but also demonstrate weaknesses. The following can be mentioned as advantages (Heller, 1998):

- They have managers who are members of the family and they keep a long term prospect of the company. This is evident in the relationship of the family members with the employees, customers, the society and other important players. Family members want to be proud of the success of their enterprise, do care about the position of their enterprise in the society and advocate for more reputation. When the company is connected with their family they are less committed to short-term financial effects, in case they jeopardize the family enterprise. Compared with non-family enterprises they are under less pressure for short-term successes.

- A significant competitive advantage of the family enterprise is the comprehensive knowledge of the company owned by the family members. They have contacts with the company from their early childhood, and the practice work during school holidays offers opportunities to learn more about the company. This kind of knowledge gives the family member an advantage over others in joining the company. Companies often also have a special way of working - for instance, special technology or "know how" - which is unknown to the competition. It is a knowledge that is developed and kept in the family.

- Clear relations are present in the top management of the company. Based upon the power originating from the ownership family companies have clear independence in the decision making process and therefore decisions can be made faster.

- The family exercises strong impact upon the behavior, norms and values within the company. The values expressed by family members shape the common goal of the employees helping to achieve a sense of identity and belonging to the enterprise.

- Employees have easier access and direct contacts with the top management, members of the family. The personal style of management and close contacts with colleagues lead to positive, motivational business stance.

- The high degree of flexibility allows customized responses to the market needs and thus secures their place in the market. The fact that family businesses are generally reliable with caring and direct relationships with customers and other business partners additionally secure their place on the market. Since managers, as family members, do not change often, buyers keep long direct relationships with the same persons.

The following can be listed among weaknesses of family businesses:

- Funding of the growth in family enterprise is problematic for the following reasons: the share of capital by non-family members is undesirable, while own capital increase by the owner, which is entirely dependent on the profit, is difficult.

- Since leading positions are usually held exclusively for family members, it adversely affects the activities of quality non-family employees in the family enterprise. This limits the opportunities for advancement of non-family members.

- The high rate of centralization of decision-making and work associated with low rates of formalization and low number of instruments of management easily leads to over-burdening of family entrepreneurs.

- Insufficiently regulated heritage matters could endanger the existence of the enterprise. It affects the recruitment and motivation of managers who are not family members. Also, instances of discord and lack of skills among individual family members can lead to a slowdown in the process of decision-making.

The aim of this paper is to investigate some aspects of family enterprises and incorporate new findings in the body of knowledge about family businesses in rural areas of the Southeast Planning Region (SPR) of the Republic of Macedonia (RoM).

Materials and methods

The research is based on literature, documents and particularly on analysis of a suitable sample of interviewed entrepreneurs (21 SMEs) from rural areas of the SPR in the RoM which were conducted between February and April, 2011 – of which 47.62% were family businesses and 52.38% non-family - is to obtain a certain amount of knowledge regarding the conditions of family businesses in that particular region. During the creation of this work several methods were applied which are usually used for economic analyzes, mainly the comparative method, the method of generalization and specialization, the methods of induction and deduction and the statistical method.

In this survey research three sets of statements were presented to the interviewees that are of importance for comparison between family and non-family businesses and for the assessment of the conditions of family enterprises in rural areas of the SPR in the RoM, assessed according a five level scale from 1 (unimportant) to 5 (of priority),

Results and discussion

Collected and processes data are displayed in Table 1, Table 2 and Table 3.

Table 1. Agreement with the statements in terms of improving the work for better competitive market position, compared by the type of enterprises (family/non-family)

	Family	Non-Family
	Mean value	Mean value
Improving the quality of products and services	4.22	4.19
Improving the promotion of products	4.15	4.11
Obtaining certifications for quality	3.89	3.83
Professional consulting assistance	3.53	3.40
Improvement and education in the field of entrepreneurship	3.79	3.63
Improvement and education in the field of Information and Communication Technologies (ICT)	3.77	3.63
Improvement and education in the field of management	3.69	3.55
Improvement and education in finance	3.44	3.39
Improvement and education in the field of sales	3.88	3.66
Improvement and education in marketing	3.85	3.80
Improvement and education in foreign languages	3.42	3.42
Association with companies in the sector to jointly appear on the market	3.89	3.12
Assistance from development programs through grants	4.30	4.24
Assistance from development programs through favorable loans	4.58	4.33
Assistance from development programs through guarantee funds	3.68	3.52

Source: Authors' own elaboration based on questionnaire survey results

In relation to the above mentioned statements, family businesses (almost without exception) have demonstrated more positive attitudes in comparison to non-family businesses, which indicates their higher level of competitiveness on the market.

Table 2. Agreement with the statements in terms of business plans for the future, compared by the type of the enterprise (family / non-family)

	Family	Non-Family
	Mean value	Mean value
Introducing new products or services	4.16	4.00
Sales on a new market	3.55	3.26
Exploring new markets	3.58	3.13

Search for new distribution channels	3.88	3.42
Expanding advertising and promotion	4.12	3.84
Investing in new equipment and machinery	4.28	3.57
Replacement of current equipment and machinery	4.25	3.55
Expansion of current facilities	4.22	3.53
Redesign/new arrangement of the current facilities	3.64	3.09
Search for additional financial capital	4.14	3.47
Computerization of current operations	3.65	3.03
Upgrading of computer systems	3.56	3.18
Redesign of work activities	3.15	3.04
Expanding the scope of work activities	4.14	3.74
Search for professional or technical advice	3.76	3.23
Additional engagement of staff specialists	3.73	3.13
Investing in staff training (elsewhere / not in the company)	2.97	2.37

Source: Authors' own elaboration based on questionnaire survey results

The attitudes presented above indicate that owners of family businesses pay more attention to plans for the business when compared to their counterparts from non-family businesses.

Table 3. Agreement with the statements about entrepreneurship, compared by the type of enterprises (family/non-family)

	Family	**Non-Family**
	Mean value	Mean value
My business is the most important activity in my life	4.29	4.18
I would do everything that is needed for my business to succeed	4.21	4.19
I plan to sell my business at the end	2.26	2.14
I would like to significantly contribute to the community by developing a successful business	4.43	4.27
I would prefer to have my own business than to earn higher wages working for someone else	4.17	3.85
To run your own business is more important than have more time for the family	3.52	3.86
I would prefer to have my own business than to have another promising career	3.91	4.04
For the entrepreneur it is important to understand and accept the risk in order to start and run a successful business	4.13	4.19
I am ready to get into conflict with my family for the sake of running my business	3.55	3.33
I would put my house mortgaged to acquire capital for my business	3.77	3.56
I would be ready to have less security for my family in order to run my business	3.59	3.65
I run my business to continue the family tradition	3.55	3.33
I run my business to contribute to the welfare of my relatives	3.38	3.45
I run my business to live in a place that my family likes	3.37	3.44
I run my business to improve the status and prestige of my family	4.12	4.08
I run my business to have more flexibility in my personal and family life	3.89	4.11

Source: Authors' own elaboration based on questionnaire survey results

The above statements show that entrepreneurial behavior is more characteristic for family businesses rather than non-family enterprises.

Almost without exception the more positive attitudes expressed toward competitiveness on the market, the attitudes towards business plans as well as attitudes towards entrepreneurship from non-family businesses speak in favor that family businesses significantly shape the economic environment in rural areas of the SPR in the RoM. They are unique because of their employee structure: they are not randomly selected employees, managers, but are family members. Their focus on the success of their company in the future clearly underlines their desire to remain in their place of residence and to contribute to the development of the local rural community. The future of family enterprises in rural areas of the SPR of the RoM - beside other - depends on how successfully legacy matters concerning management and ownership are solved. Support to SMEs and entrepreneurship in general and in rural areas in

particular by the state and local governments can significantly stimulate the establishment of new enterprises and family businesses and growth of the existing ones.

Conclusion

Family businesses in rural areas of the SPR in the RoM, almost without exception, have demonstrated more positive attitudes than non-family businesses towards:

- Market competitiveness,
- Attitudes towards future businesses,
- Attitudes towards entrepreneurship.

Beside that, their unique structure regarding staff, their orientation towards the success of their company currently of in the future, as well as the intention to stay in the place of residence and contribute to the development of the local rural community clearly speak in favour of the fact that they considerably shape the economic environment in rural areas of the SPR in the RoM.

As a kind of incentive for establishment of new family businesses and growth of existing ones the support for entrepreneurship and SMEs by the state and local self-government is crucial.

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IMPORTANCE OF AGRICULTURE IN MONTENEGRIN ECONOMY

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Abstract

As the oldest economic sector, which was root for other industries, the level of agricultural development has always been a measure of the community development. The importance of agriculture in economic development, depending on the level and intensity of development of a particular area is constantly changing. In the overall development, non-agricultural industries develop faster than agriculture. This results with an increasing reduction of the relative importance of agriculture. However, this does not diminish the absolute importance of agriculture as the primary economic activity. Agriculture has a significant impact on economic growth, especially in the economies which are developing rapidly. Otherwise it becomes a barrier to economic development. In determining the importance of agriculture in the national economy different methodological approaches can be used. Through the analysis of relevant macro-economic indicators, the paper will analyze the role of agriculture in the economy of Montenegro.

Keywords: *Agriculture, economy, multifunctionality, rural development*

Introduction

Agriculture is one of the key sectors of Montenegrin economy, and represents a major source of employment and income generation, especially for people in the northern mountains region, whose income generation possibilities are limited.

The surface of agricultural land in Montenegro takes 516 070 ha or 37.4% of the total land area of Montenegro. It makes 0.83 ha of agricultural land per capita, and this represents an important resource for development of agriculture. However, total arable land in Montenegro is 190 000 ha or 0.30 ha per capita. The largest share of agricultural land is pasture and grassland, which together make up 88%. While the share of arable land (fields and gardens) is only 9%, and the orchards and vineyards take the remaining 3%.

Even though the small family farms dominate, with average size of a holding 6.3 ha of available land, Montenegro is ahead of its neighbors, including some of EU member states. Regarding the size of used land per holding, which is 4.6 ha, Montenegro is close to Slovenia (6.5 ha), Bulgaria (6.3 ha), Poland (6.5 ha) and Italy (7.5 ha). However, Montenegrin agriculture is characterized with predominantly small holdings with areas of less than 2 ha (73%). On the other hand, more than 62% of used agricultural land belongs to holdings, whose size exceeds 20 ha.

Total number of agricultural holdings in Montenegro is 48 870, 46 of which are business entities, and the remaining 48 824 are family holdings. Total economic value of agricultural holdings in Montenegro is €125 817 765 or in average €2 574 per agricultural holding. Average economic value of family holdings is €2 239 or €513 per ha of family holding.

Objective of this paper is to analyze role of agriculture in the economy of Montenegro using relevant macro-economic indicators.

Material and Methods

Comparative historical method has been used for the analysis of the role of agriculture for economic development of a country while statistical method has been used for analysis of importance of Agriculture for Montenegrin economy. The analysis of the relevant macroeconomic indicators has been implemented by studying secondary data on the basis of existing documents and statistical data.

Results and Discussion

Contribution of agriculture in the national economy can be demonstrated through different indicators. In the literature, following indicators are stated as the most important:[1]

- The share of agriculture in total population and the share of active agriculture in total economic active population;

- The share of agriculture in the GDP;

- The importance of agriculture in the foreign exchange;

- The share of investment in agriculture in the overall economic investments;

- The share of expenditure related to food in total individual consumption of households.

The share of agriculture in total population and the share of active agriculture in total economic active population

The share of agriculture in total population decreased significantly over the last 20 years. The decrease in share of agriculture in total population first started slowly, from 47% in 1961 to 35% in 1971. It then significantly declined on 7% in 1991, and further on 5.3% in 2003. According to the agricultural census, in 2010 Montenegro had 48 870 agricultural holdings, while the census of population conducted on 2011 does not provide clear information about the agricultural population.

According to employment data, business entities in area of agriculture employ a relatively small percentage of people compared to total number of employed in Montenegro, only 1.5% in 2012.[2] However, according to 2010 agriculture census data, on 48 870 agricultural holdings, there are 98 949 persons working, whereby 98 341 (99.4%) work on family agricultural holdings. Workforce in family holdings is made of head of the household, family members, as well as other persons who are regularly employed (not family members). In average they have 0.47 annual work units per holding which makes 46 473 annual work units in agriculture.[3] The average number of workers per holding is below one person per holding in many EU countries, while average in EU is 0.8.

Montenegrin agriculture is characterized by unfavorable structure of employees, from the age and education viewpoint. More than 44% of them are older than 55, while 65% are older than 45 years. Majority of people employed in agriculture have completed high school - 55.33%, while only 9.11% have completed either vocational training or university.

The share of agriculture in the GDP

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[1] Boži, D; Bogdanov, N; Ševalri M (2011), , 17.
[2] Monstat, This number includes only legal entities whose main activity (statistically) is agriculture. Number of employees is received on the basis of the records kept by the Central Register of Tax Administration.
[3] The annual work unit (AWU) is used as the equivalent of employment in agriculture and represents the time spent working in agriculture, excluding household works.

After the Second World War, Montenegro was an underdeveloped agrarian country where agriculture had the highest share in domestic product and national income. However, in the post-war period, a relatively rapid economic growth has been achieved, primarily due to the orientation on industrialization and infrastructure construction. According to this orientation, industry takes over the leading position from agriculture during 1963. The share of agriculture in GDP was 48.4% for the year 1947, 1953 - 38.5%, 1962 - 24.3% while on 1972 it fell on 15.2%.[1] Decreasing trend continued in the following years. Namely, on 2012 the share of agriculture in national income has almost halved in comparison to 1972 and was 7.37%.[2]

In 2012, Montenegrin GDP was EUR 3 149 billion, and sector of agriculture (together with forestry, hunting, and fishing), accounted for EUR 232 million or 7.4% of the GDP. Processing industry, taking into account all processing sectors not just food processing, accounts for EUR 135 million or 4.3% of the GDP. Agriculture contributes to GDP 72% more than the processing industry.

Table 1: The share of agriculture and processing industry of the GDP in the period 2003-2012[3]

Year	Agriculture (%)	Processing industry (%)
2003	10.76	9.50
2004	9.69	9.31
2005	8.76	8.19
2006	8.29	7.66
2007	7.24	5.41
2008	7.47	5.40
2009	8.28	4.89
2010	7.72	4.66
2011	7.94	5.03
2012	7.37	4.30

Compared with EU countries, the share of agriculture in GDP is high, taking into account that in EU-27 the average for year 2011 was 1.7%. In some countries of the EU-15 the share of agriculture in GDP is even lower than 1%.
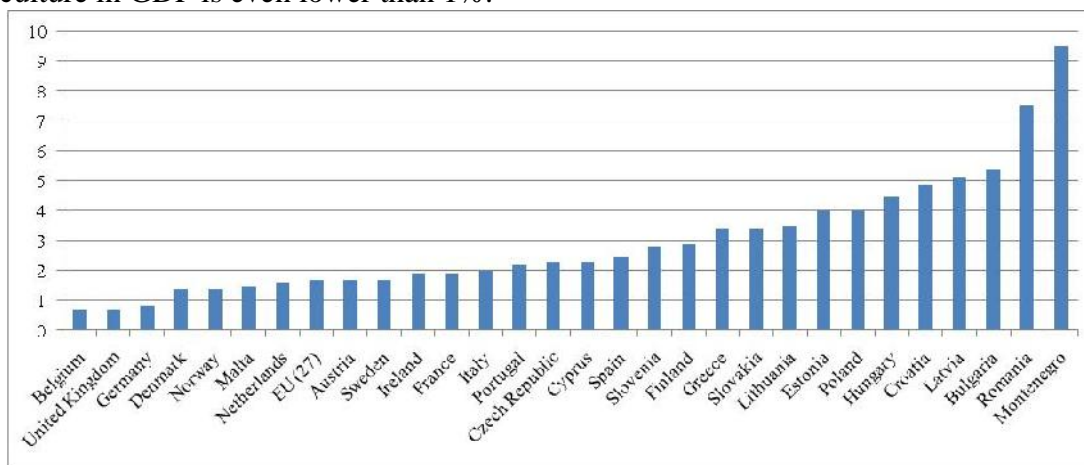
Figure 1: Share of agriculture in GDP in the EU countries and Montenegro – 2011.[1]

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[1] Kalezi , Ž (1976), , 32.
[2] Monstat
[3] Monstat

The structural characteristic of Montenegrin food production is a higher share of primary agriculture in gross domestic product, compared to the food processing sector.
This indicates a low level of finalization of agricultural products, a significant share of the self-supply of rural population with food, as well as the selling of agricultural products through unregistered trade channels.[2]

The importance of agriculture in the foreign exchange
Food and agricultural products play an important role in foreign trade. Montenegro is a net importer of food products. Export of food, beverages and tobacco in 2012 was 53.1 million euro while the import value of 421.6 million euro.[3] Foreign trade of food and agricultural products accounted for 21.71% of total trade of Montenegro.
In the period 2005 to 2012 export of food and agricultural products increased by 18% while in the same period, import increased by 136%. Coverage of import of food and agricultural products with export decreased from 25.22% to 12.62%.

Table 2: Trade balance of food and agricultural products [4]

Year	Import of food and agricultural products (000 €)	Export of food and agricultural products (000 €)	Trade balance of food and agricultural products	Coverage of import of food and agricultural products with export (%)
2005	45 054	178 616	-133 562	25.22
2006	36 492	218 616	-182 124	16.69
2007	37 070	298 396	-261 326	12.42
2008	40 699	405 460	-364 761	10.04
2009	40 158	379 713	-339 555	10.58
2010	45 039	388 139	-343 100	11.60
2011	50 662	417 707	-367 045	12.13
2012	53 195	421 649	-368 454	12.62

A small number of exported products highlight the problem of the competitiveness of domestic producers in terms of food safety, quality, price competitiveness and the quantities that could be distributed on international markets. Prices in agriculture are relatively high and thus quite cost uncompetitive.

The share of investment in agriculture in the overall economic investments
Despite the fact that agriculture is recognized as the strategic priority of Montenegro, level of investment is not in line with the dynamic of investment in other industries. The amount of investment in fixed assets in agriculture in the last ten years shows no significant differences and in the year 2012 amounted to 5.82 million euro. In absolute terms, the value of investment remains on almost the same level, while relative share of the total investment is significantly reduced from 2.79% to 1.33%.

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[1] Eurostat

[2] Government of the Republic of Montenegro, Ministry of Agriculture, Forestry and Water Management (2006), *Montenegro's agriculture and European union, Agriculture and Rural Development Strategy*, Podgorica, 9.

[3] Monstat - according to the Standard International Trade Classification

[4] Idem

Table 3: Total investments in fixed assets in the Montenegrin economy and the share of investment in agriculture[1]

Year	Total investment (000 €)	Investment in agriculture (000 €)	Share of investment in agriculture in total investments (%)
2003	213 620	5 965	2.79
2004	292 903	5 709	1.95
2005	331 573	10 900	3.29
2006	411 044	7 340	1.79
2007	594 102	8 573	1.44
2008	724 640	9 391	1.30
2009	618 422	8 577	1.39
2010	561 587	5 099	0.91
2011	415 395	6 696	1.61
2012	436 548	5 827	1.33

The share of expenditure related to food in total individual consumption of households.
Despite a certain decrease in recent years, food expenses have a high share in total expenditure of individual consumption of the population of Montenegro. Often, about half of the households' budget is being used on the purchase of food, beverages and tobacco.
The values of these indicators are significantly higher compared with those of economically developed countries. Average consumption in the EU in 2011 was 16.4%.[2] This is a result of the low level of real purchasing power of the population of Montenegro.

Table 4: The share of expenditures on food, beverages and tobacco in total for personal consumption[3]

Year	Total (€) used resources[4]	Share of expenditures for food beverages and tobacco (%)	Total (€) used resources	Share of expenditures for food beverages and tobacco (%)	Total (€) used resources	Share of expenditures for food beverages and tobacco (%)
	Montenegro		Rural area		Urban area	
2005	469	46.48	423	53.90	495	43.03
2006	453	46.58	405	51.60	482	43.78
2007	560	41.96	499	46.49	595	39.66
2008	638	42.16	564	48.40	682	39.00
2009	587	41.06	458	47.60	665	38.20
2010	564	43.26	450	53.11	632	39.08
2011	557	42.01	443	49.44	625	38.88
2012	581	39.93	494	44.53	626	37.86
Average	**551**	**42.93**	**467**	**49.39**	**600**	**39.94**

There are significant discrepancies in consumption in rural and urban areas of Montenegro. In the last eight years in the urban areas, the average share of spending on food, beverages and

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[1] Idem
[2] Eurostat
[3] Idem
[4] Monthly average per household in €

tobacco was 39.94%, while in rural areas is significantly higher at 49.39%. At the same time, the overall resources used in urban areas are 29% higher than those in rural areas. In urban areas €238 out of €600 were spent for food, beverages and tobacco. While in the rural areas €229 out of €467 were spent. This confirms the Engel's law, which states that by increasing overall income, the share of food in total expenditure for individual consumption decreases (at constant prices).

Conclusion

Considering importance of agriculture for its economic development Montenegro has chosen a concept of sustainable agriculture development, which means achieving a balance between economic development and preserving both the environment and social cohesion. This concept is based on a multifunctional role of agriculture that places agriculture in the wider context of its external effects, rather than just looking at its gross domestic product contributory value. It promotes a multifunctional role of agriculture, with special emphasis placed on rural development. National development plan 2013-2016 also indicates multiple role and importance of agriculture. By that plan the multi-functionality of agriculture is reflected by the high share in GDP, sustainable rural development; environmental function; economic function; support to tourism development; social function; food safety and preserving tradition and cultural heritage in rural areas.

Having in mind above mentioned, it is clear that importance of agriculture for Montenegro is higher than what is its contribution to the GDP as well as it is its contribution to above listed indicators. Moreover, with no agriculture there is no sustainable regional and rural development but also tourism development as a broad range of domestic products enriches the tourism offer and make it unique.

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KOŁOCZ ŚLĄSKI ‑ THE INCREASE IN PRODUCTION GROWTH DUE TO PRODUCT CERTIFICATION

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Abstract

In Polnad are 35 product in the list 'Geographical indications and traditional specialities in the European Union'. One of them is Kołocz Śląski is a traditional, regional baking product derived from Silesia in Poland. It is a ritual product , which is present during all major. It comes in four flavors: with poppy-seed, cheese, apple sauce or without filling. It is baked with yeast dough then the filling is added (or not) and crumble. The study was conducted with a survey among all producers who are associated in the Consortium of Kołocz Śląski Producers. The association was founded in mid-2007 in order to obtain a certificate of Protected Geographical Indication in the European Union. The certificate ensures a legal form of protection so that no other producer from outside can sell the product under the name Kolocz Sl ski. The official granting of the certificate took place in the year 2011. To this day Kołocz Śląski has been the only regional product in the EU from Opolskie region. Despite extensive advertising the majority of production is sold on the local market, which is deeply rooted in the tradition of eating Kołocz. The study analyzed the increase in production in year 2004-2013. The aim is to demonstrate the relevance of product certification.

Keywords: *kołocz l ski, traditional baking, Protected Geographical Indication in the European Union.*

Introduction

Kołocz Śląski is a traditional, regional baking product derived from Silesia. Its history datesback to the Middle Ages[1]. It is a ritual product , which is present during all major celebrations such as baptisms, communions, weddings and funerals [2]. Originally, its shape was round but with the passage of time rectangular plates came to be used for practical reasons. It comes in four flavors: with poppy-seed, cheese, apple sauce or without filling. It is baked with yeast dough then the filling is added (or not) and crumble[3].

Graphics 1. Kołocz l ski with poppy-seed
Source: www.kloskujakowice.pl

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[1] http://kolocz.info/page/index/22/historia-access: 20.03.2010
[2] *Wielka Ilustrowana Encyklopedia Powszechna Wydawnictwa Gutenberga*, (1929) Vol. VIII, Kraków, page 21
[3] Oziembłowski M., (2011) *Kołacz l ski - specification (regionalSilesiancake)* published by EC

Traditional or regional product has been formed over a long period of time and has been affected by a lot of natural and cultural factors, and is therefore common good of the region and can not be usurped by one manufacturer. It is therefore a prerequisite for the application for a protected designation of origin to be submitted by the group of producers. Products entered to the European Commission's register of protected designations of origin and protected geographical indications are products, whose high quality is related to the characteristics of the region in which they are produced. The rule is that the unique characteristics of the region can not be owned by an individual , so a whole producer group is authorized to apply for registration of Protected Designation of Origin or Protected Geographical Indication. In some cases, a natural or legal entity may be treated as a group. Regional products may be registered by the European Commission as a Protected Designation of Originor Protected Geographical Indication. Regional products or other products of "knownorigin" are products whose quality is definitely above average, associated with the place of origin and local methods of preparation. Protected Geographical Indicationcan be awarded to a product whose at least one stage of production takes place in the area. The product name uses or refers to:
- the region
- a specific place
- in exceptional cases the country where the product is manufactured[1].

Graphics 2. Graphic symbol awarded to products labelled Protected Geographical Indication

Source: minrol.gov.pl

Kołocz Śląski may be marketed only if it receives a certificate issued by the Quality Inspection of Agricultural and Food Products**.** Cakes without the certificate can be traded under different names. Non-compliance with this EU regulation may result in financial penalties of up to ten percent of manufacturer's annual turnover[2]. Benjamin Godyla, president of the Consortium Kołocz Śląski, baker from Kujakowice Górne says: - "The certificate confirms that kołocz is produced according to the recipe, and it is for the customer to assure the quality of this product." In modern societies, especially in economically developed countries, there is a growing number of people for whom important are protection and nurturing of what traditional and local. This is manifested, among others, the increase in demand for local products and traditional[3].

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[1] http://produkty-tradycyjne.pl/europejskie-systemy-jakosci/produkty-tradycyjne-i-regionalne-we-wspolnej-polityce-rolnejaccess: 20.03.2013

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[3] Minta S., Tańska-Hus B., Nowak M. (2013). Koncepcja wdro enia produktu regionalnego „Wołowina Sudecka" w kontek cie ochrony rodowiska, Annual Set The Environmental Protection (Rocznik Ochrona Środowiska), Vol. 15, pages 2887-2898.

Materials and methods

The study was conducted with a survey among nine producers who are associated in the Consortium of Kołocz Śląski Producers. The association was founded in mid-2007 in order to obtain a certificate of Protected Geographical Indication in the European Union. The certificate ensures a legal form of protection so that no other producer from outside can sell the product under the name Kolocz Sl ski . In the product promotion media played an important role as well as the local authorities of Opole province, for which this was the first product to have a chance of being granted a certificate of regional product. The official granting of the certificate took place in the year 2011. To this day Kołocz Śląski has been the only regional product in the EU from Opolskie region. Despite extensive advertising the majority of production is sold on the local market, which is deeply rooted in the tradition of eating Kołocz.

Basic collective actions and decisions within the Association "Producers Consortium Kołocz Śląski" are performed by the Management Board:

President – Beniamin Godyla
Vice President – Edyta Grabowska
Secretary - Antoni Bończyk
Treasurer - Paweł Schlensag

The detailed list of companies that currently belong to the Association "Producers Consortium Kołocz Śląski" is presented in Table 1.

Table 1.Companiesbelonging to the Association "ProducersConsortiumKołocz   l ski"

	Name of company	Address	Business profile
1.	Przedsi biorstwo Produkcyjno-Handlowo-Usługowe „KŁOS" S.C. Beniamin Godyla, Ewa Godyla	Ul. XXX-lecia30A 46-211 Kujakowice Górne	bakery and confectionery
2.	Przedsi biorstwo Produkcyjno-Handlowo-Usługowe „Piekarnia Grabowski" Edyta Grabowska	Ul. Ko ciuszki 67 Otmice 47-180 Izbicko	bakery and confectionery
3.	Cukiernictwo S.C. Józef i Ryszard Izydorczyk	Ul. Ks. Lange 11 47-100 Strzelce Opolskie	confectionery
4.	Gminna Spółdzielnia „Samopomoc Chłopska"	Ul. Góry Św. Anny 6 47-300 Zdzieszowice	bakery and confectionery
5.	Kawiarnia – Cukiernia „Europa" Krystyna Długosz	Pl. Wolno ci 7/8 45-057 Opole	confectionery
6.	Ciastkarnia „Paweł" Paweł Schlensag	Nowa Kolonia 77 47-133 Jemielnica	confectionery
7.	Zakład Piekarniczo - Cukierniczy L.B. Zimmermann S.J.	Ul. Powstańców 50 47-320 Gogolin	bakery and confectionery
8.	Piekarnia – Cukiernia Krystian Stosiek	Rzepcze 30 48-250 Głogówek	bakery and confectionery
9.	Cukiernia "Pty " s.c. Teresa i Urszula Wieczorek	ul. Dworcowa 2 47-330 Zdzieszowice	confectionery
10.	Piekarnia Józef Lipa	ul. T. Boya-Żeleńskiego 2 40-750 Katowice-Kostuchna	bakery and confectionery
11.	Piekarnia-Cukiernia Antoni Bończyk	ul. Oswobodzenia 67 40-404 Katowice	bakery and confectionery
12.	Cukiernia MAGOSZ Maria Magosz	ul. Prudnicka 31 47-300 Krapkowice	confectionery

13.	Piekarstwo-Ciastkarstwo Handel Krzysztof Poloczek	ul. Ks. Tunkla 110 41-707 Ruda Śląska	bakery and confectionery
14.	Piekarstwo Cukiernictwo Produkcja Sprzeda Marek Jakubiec	ul. Piastowska 6 41-700 Ruda Śląska	bakery and confectionery

Source: www.kolocz.info

Results and discusion

Figure 1 shows the results of the survey research concerning changes in the dynamics of the Kołocz Śląski production several years before and after the certification.
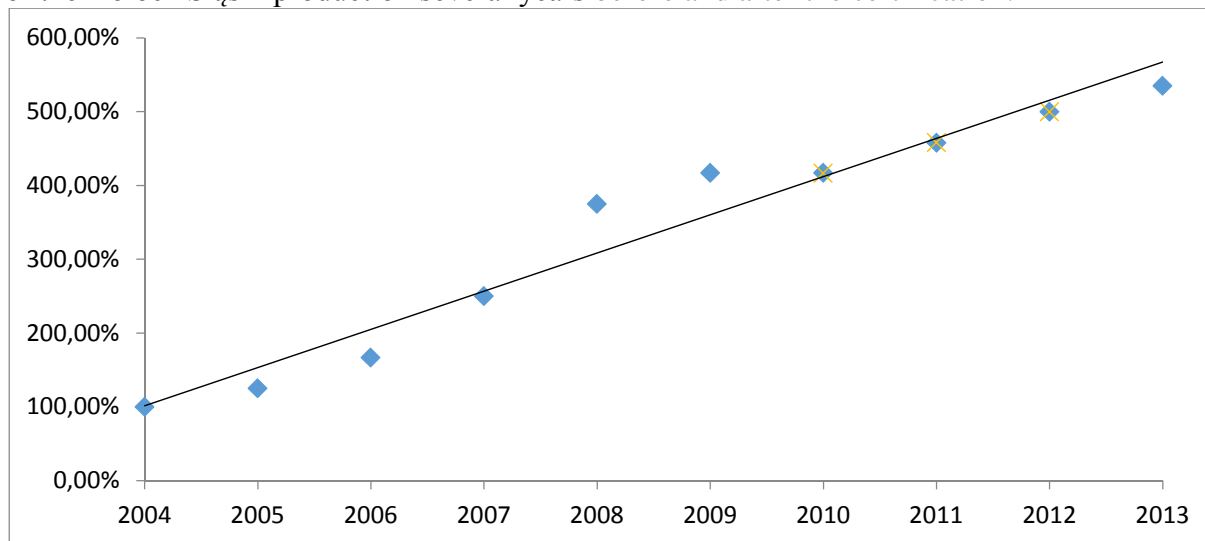
Graph 1. Dynamics of production of Kołocz l ski
Source: Own study based on a questionnaire

Over the past eight years from 2004 to 2013 the production has increased five-fold. A gentle rise is noticeable in 2007 when in the mid-year there was a meeting of the founding committee of the consortium. This resulted in the increased media interest in the subject of the certification. In 2008 there was a sharp increase by 125 per cent against the previous year. In 2009, you can still see an increase, but not as big as in the previous year, but still above the trend line. In 2010, the growth slowed down , production remained at the same level as the year earlier. The next three years show a trend similar to that observed in 2004-2006.

The line which is the highest is the trend line for the years 2010-2013, the lowest line is for 2004-2006, and the middle one is for all the years. It may be noted that the increase in production in 2007-2009 resulted in an upward trend line which is almost parallel, so if it was not for the certification effort, probably the production trend would run as shown the lowest line. On the other hand, there are also shown various barriers which limit the development of the market for this type of products. Examples of such barriers may include: inadequacy of legislation to the specificities of these products, too low consumer awareness of the products, high production costs due to the traditional recipe[1]. Local newspaper in Opole writes a lot about grow the production this cake. This shows that Kołocz Silesia is important in the region[2].

Nowadays in the bakery and confectionery „KŁOS" is being baked 1600-2000 kg of cakes per week. The biggest production per day in this company is on Christmas and Easter. The day before the feast of is being baked 1500 kg. One baking tray cake weighs an average of 6,2 kg (depending on filling) and has dimensions 600x400mm. 1500 kg cakes

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[1] Minta S. (2013). Bariery rozwoju rynku produktów regionalnych i tradycyjnych na przykładzie Dolnego Śląska, Roczniki Naukowe SERiA, Vol. XV, Z. 4, pages 280-284.
[2] http://www.strefabiznesu.nto.pl/artykul/rosnie-sprzedaz-kolocza-slaskiego-w-opolskiem

this is ~60 m^2. Normal cake is being baked from Monday to Friday and time to time on Saturday. 85% cake is being selled in manufacturer's retail store, 7% in restaurants, 6% in other stores, 1,5% for local organizations and 0,5% for foreign customers.

Producers Consortium Kołocz Śląski are promoting the product through spots in local newspapers, on radio and television. In 2013 the consortium has placed 14 arrays promoting the product in region. Two arrays promoting are in district Kluczbork, Olesno, Strzelce Opolskie, Rudniki, Krabkowice, Prudnik and Opole. Producers uses EU subsidies for advertising.

Conclusion

Regional and traditional products are strongly associated with the image of the region[1]. Based on the survey we have found a sharp increase in production in the early years of efforts to be granted the certificate. This was due to the curiosity of the people, willing to try the baked product , which the media gave a lot of attention to . It would seem that being granted the certificate should have a significant impact on the size of production, but it did not happen. In the year 2011 we can see a slight increase against the previous year, but it is not like in 2007-2008. This is due to the saturation of the local market, which is the main recipient of the product. Opportunity for further growth could be opening up for sale in oth rparts of the Polish and foreign markets. It will not be easy because kołocz Slaski is not as well known as the most famous Polish regional products, such as Rogal Świętomarciński or Oscypek.

One factor that certainly does not have a direct impact on the demand for Kołocz is the price, as in the case of regional products it is generally higher than in conventional food. Consumers are people who can always afford to buy the product or those who buy occasionally. A large impact on the demand have the tastes and preferences of buyers[2].

The result of our study is a clear indication for other manufacturers who want to obtain a certificate for their regional product. Before you announce to the public in the media your intention to apply for the certificate you must already have a ready formal aspect for the application, the elaborate sales and advertising and promotional tools. The example of Kołocz Śląski shows that the first year may be the most important. Receiving a certificate is just the icing on the already formed cake. What really works here is the folk saying that you have to strike whilst the iron is hot. The coming years will show how much people's minds have been affected by the promotional and informational campaign in the years 2007 - 2011 when the interest in the product was the greatest . Certainly, it will be interesting material for further study of the problem.

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[2]M. G siorowski, *Specyfika produktów tradycyjnych na rynku ywno ci*, Prezentacje z seminarium "Znaczenie produktów lokalnych dla rozwoju regionu na przykładzie Karpia Zatorskiego 20-21.10.2011"

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INNOVATIVE TECHNOLOGIES AND INCREASING COMPETITIVENESS OF RURAL TERRITTORIES

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Abstract

The quality of life of rural population as a most important factor of increasing the competitiveness of rural territories is studied in the paper by analyzing the dynamics of consumption of high-tech goods and services. Having analyzed the results of the households' budget and time-use surveys conducted by the Federal State Statistics Service (Rosstat) and the results of the sociological survey performed with the personal involvement of the author, we find that the use of high-tech goods by the rural population of the Russian Federation tends to rapidly grow. As a result, of this, the quality of life of the rural and the urban population is converging. At the same time, the social differentiation within local rural communities is on the rise, and the way of life in the city and the countryside remains different. Particular attention in this study is paid to the rural population's taking of new opportunities in the fields of education, employment and leisure activities arising from the proliferation and inclusion of innovative technologies in the local rural communities.

Keywords: *innovative technologies, rural development, consumption, quality of life, social differentiation.*

Introduction

The contemporary everyday life is difficult to imagine without innovative technologies, the range of which is constantly expanding. High-tech goods and services are increasingly changing the way and quality of life of the population.

Since 2005 the rates of growth of the average per capita incomes in rural households in Russia steadily outpaced that in urban households. Thus, in 2005 the average per capita cash incomes in rural households constituted 48.9% of the incomes of urban residents with a subsequent increase up to 55.5% in 2009 and 61.2% in 2012. (Rosstat 2008, Rosstat 2010 Inc., Rosstat 2013) Comparing the nominal income with the subsistence minimum, which allows reducing the impact of inflation, we see that both the nominal and the real incomes of the rural population increased. Between 2005 and 2012 the ratio of the average per capita disposable resources of rural households to the subsistence minimum grew from 1.2 to 2.1 times.

Higher incomes enable rural residents to purchase modern high-tech goods and services. Despite the remaining urban-rural differences in technological and economical accessibility of modern technology, innovative products are being increasingly used by rural residents. For instance, in 2001 the level of availability of personal computers and microwave ovens in the countryside was 10 times lower than in the city (for mobile phones the figure was 17.5 times), but by 2012 the availability of personal computers, microwave ovens and mobile phones in rural households respectively constituted 73.0%, 84.5% and 93.5% of the urban level (Table 1).

An example of a new technology that in a short time passed through all stages of development and inclusion – from recognition to prevalence – is mobile cellular communication. In 2000, only 2% of Russians used mobile phones. Today, the use of cellular

communication has become a common practice, both in the city and in the countryside. The Internet and satellite TV are beginning to be used more widely in the rural areas too. The use of such technologies is one of the main solutions to the problem of information inequality of the rural population, which is still relevant.

The proliferation of innovative technologies changes the everyday life of the contemporary rural population in very many ways – from reducing the time and effort on housekeeping and household farming to offering new opportunities in the spheres of education and employment. At the same time, the evolution of modern technology itself does not eliminate the previously existing differences, but on the contrary, gives rise to new kinds of differentiation.

Table 1: Availability of modern household appliances, TV and radio receivers on average per 100 rural households, units. Households with access to the Internet, % of all households*

					Countryside, % of the urban level			
	2001	2005	2009	2012	2001	2005	2009	2012
Camcorder	1	3	6	9	20,0	30,0	37,5	50,0
Microwave oven	1	11	35	60	10,0	36,7	61,4	84,5
Personal computer	1	11	34	54	10,0	35,5	55,7	73,0
Air conditioner	0	1	6	10	0,0	25,0	66,7	76,9
Mobile phone	0	59	191	232	5,7	49,2	82,3	93,5
Car	25	34	47	55	92,6	103,0	100,0	101,9
Households with access to the Internet, % of all households	-	6,7	21,6	50,0	-	28,9	46,2	73,1
Including that with the home PC	-	2,1	13,9	43,4	-	19,1	35,5	67,6

*Sources: Income, Expenses and Consumption of Households in 2012: The Results of Random Analysis of the Budgets of the Households. Moscow: Federal State Statistics Service, 2013, .122, 130; Income, Expenses and Consumption of Households in 2009: The Results of Random Analysis of the Budgets of the Households. Moscow: Federal State Statistics Service, 2010, .115, 121; Income, Expenses and Consumption of Households in 2007: The Results of Random Analysis of the Budgets of the Households. Moscow: Federal State Statistics Service, 2008, .189

Materials and Methods

The paper is based on the results of the comparative analysis of incomes, level of providing with high technological goods and services, structure of time budget of rural and urban households on the basis of materials of selective budget surveys of households (2001-2012) and the usage (budgets) of time by population (1990-2008), comprehensive monitoring of living conditions (2011), conducted by the Federal State Statistics service (Rosstat), the results of the sociological surveys of the processes of proliferation of and familiarization with innovation practices in local rural communities conducted by the Institute of Agrarian Problems of the Russian Academy of Sciences in one of the Russian regions (Saratov's oblast) in 2010-2011with personal involvement of the author. The selective budget

investigation of households involves 47765 households living in the Russian Federation. The two-stage territorial based sampling provides the results of investigation representative for the whole of Russia (population on the whole and by main socio-economic groups). In the sample survey of time usage the number of the observed households was 47000 in 1990, while in 2008 there were 2016 households with 5000 respondents. During the Complex Observation of Population Conditions of Life the sample size was 20000 members of households with the age of 15 and older. In each of three researches the multistage sampling represents both urban and rural population of the Russian Federation. In the research of the Institute of Agrarian Problems of the Russian Academy of Sciences the randomized sample represents the able-bodied and working-age rural population of the country and includes 743 respondents.

Results and Discussion

The growing availability of high-tech cultural and household appliances and goods in rural households and the increasing technological accessibility of new kinds of services make the living conditions in rural areas qualitatively equal to that in the city, while the positive features of the rural way of life remain in place the same. This fact creates the basis for equalizing the prestige of living in urban and rural settlements.

High rates of growth of availability of "innovative elements" of the rural households' property compared to the urban households not only enabled to reduce the lag of the countryside in terms of qualitative characteristics, but also affected the convergence of the time budget patterns of the urban and rural population (distribution of the daily time spent on critical activities). This growth of the level of availability of high-tech appliances in rural households became one of the factors considerably reducing the time spent on housekeeping.

The comparative analysis of the time budget surveys conducted by the state statistics bodies in 1990 and 2008 shows that in 18 years the time rural working women would spend on housekeeping (excluding the time spent on private farming and purchasing goods) reduced from 4 hours 33 minutes (average per day of the week) to 3 hours 19 minutes. For working men the reduction of the time spent on working around the house was just 19 minutes.[1] This is partially a result of redistribution of family duties and is largely due to the advent of new household appliances (Shabanov, 2011).

Special attention in this study was paid to the issues of mastering modern information and communication technologies (ICT). Computer technology and the Internet are qualitatively new phenomena that cause profound changes in all spheres of life – work, consumption and leisure. The availability of access to these technologies, the degree of computer literacy and awareness of their capabilities, the level of information activeness today are the factors contributing to overcoming the constraints in choosing the kinds and types of activity in rural areas, and to the accessibility of cultural values, advisory information and certain kinds of social services. The ability to make avail of the opportunities offered by information and computer technologies is becoming a new asset much helpful in climbing the social ladder. But at the same time, the rapid proliferation and continuous improvement of information technologies cause the expansion and deepening of the "digital inequality" (inequality in access to information and communication technologies among the population) not only between the city and the countryside, but between different social groups within local rural communities. The research shows that the degree of accessibility of modern technologies depends not only on technological capabilities, but also on such factors

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[1]Calculated by the author from data of statistical digests: National Economy of the RSFSR in 1990: Stat. yearbook. State Statistics committee RSFSR. - M.: National Information and Publishing Centre, 1991,p.122; Rosstat (2010) Results of the pilot sample survey of use (budget) time population. - Moscow: Federal State Statistics Service, URL: http://www.gks.ru/doc_2010/bul_dr/btime10.doc

as age, the levels of education and well-being, and on the activeness of participation in continuous education.

The use of information and communication services in the everyday life of the Russian rural population considerably differs by social-demographic groups. The respondents aged 16-35 years are the most active users of computers and the Internet. In 2012, every second representative of this age group would use the Internet at least several times a week. Older age groups are featured by an inverse relationship between the respondents' age and the intensity of their using information and computer technologies. The older the rural people, the less often they use computers and the Internet compared to both their younger fellow villagers and urban residents of the same age (Table 2).

Table 2: The share of home personal computers and the Internet users, in different age groups in 2008 and 2012., a percentage of all household members of the corresponding group*

	The age groups							
	To 16 years old		From 16 to 35 years old		From 36 to 55 years old		From 56 to 74 years old	
	2008	2012	2008	2012	2008	2012	2008	2012
The share of home PC users among household members under 74 years, living:								
in urban areas	37,4	52,8	59,4	85,0	38,5	69,9	8,1	29,3
in rural areas	24,3	44,3	29,8	66,9	18,8	47,7	3,3	15,1
The share of regular Internet users among household members under 74 years, living:								
in urban areas	12,7	35,9	35,2	75,9	16,6	46,4	3,0	18,1
in rural areas	4,4	29,0	8,8	50,6	4,3	26,7	0,7	7,1

*Source: Income, Expenses and Consumption of Households in 2012: The Results of Random Analysis of the Budgets of the Households. Moscow: Federal State Statistics Service, 2013, .134.

Interestingly, in contrast to computers and the Internet, the use of satellite television directly depends on the respondent's age. 46.4% of the respondents older than 45 years have satellite TV. The respective fractions of the satellite TV owners aged 31-45 years and those younger than 30 years are 35.3% and 29.6%. (Morekhanova, 2011) Probably, this is because this relatively new technology does not cause any changes in the lifestyle, but just satisfies (although on a qualitatively new level) the traditional, long-standing need.

The dependence of the intensity of Internet use by education level also takes place. It's especially true for people from 35 years (Table 3).

Table 3: The frequency of access to the Internet, respondents living in rural areas at the age 35 and over depending on their level of education, as a percentage of the respondents in the corresponding group*

	The level of education					
	Graduate and incomplete higher professional	Secondary professional	Primary professional	Secondary (complete)	Basic general	Not have the basic
The frequency of access to the Internet:						
constantly (more than 1 time per week)	51,4	41,9	26,4	22,0	5,5	0,0
from time to time	37,7	39,9	41,5	28,3	16,7	16,7
do not use	10,9	18,2	32,1	49,7	77,8	83,3

Household income level has an impact on the presence of rural household modern informational-communication equipment (Table 4).

Table 4: The share of rural households with satellite dishes, mobile phones, computers, depending on the financial situation of the assessment as a percentage of the number of households in each group *

	Self-evaluation of the financial situation of the household					
	Income is not even enough for food	The food there is enough money, but to buy clothes, pay for housing utilities difficult	Enough money for food and clothing, but we can not afford purchase essential durables	Can not afford to buy food, clothes, necessary durables, but not enough money to buy:		Means enough to buy everything that we see fit
				new car	Apart ments, villas	
The share of households in which there are:						
satellite antenna	16,8	22,7	33,8	50,3	44,7	50,0
mobile phone (s)	80,5	86,5	90,2	97,4	97,4	89,1
the home personal computer (s)	15,4	21,3	30,9	60,8	72,4	34,4
a laptop computer, a digital organizer	3,4	6,0	7,6	15,0	13,2	9,4

Age-related differentiation of interests of the rural Internet users can also be observed. Rural residents less than 20 years of age are mostly interested in entertainment: 76,3% compared to 20.2% among the users older than 50 years. Internet users aged 16-45 more often than the representatives of other age groups prefer social networking, checking the news and obtaining their education distantly with the help of mandatory or optional programs. The respondents aged 35-39 years use the Internet to find a job more often than the others (8.8% versus 3.0% for the whole sample).

Gender preferences also differ inside rural community. Women are more active in using the Internet for distant education (20.0% versus 14.2% for men). Men, in their turn, more often use the Internet for playing online games and downloading movies and music (46.5% as against 31.3%).

In general, being almost no different from urban residents in terms of the intensity of using the Internet for communication, entertainment and education, rural people use it less for the others, practically significant purposes: to search and get a job , implement trade or financial transactions or to communicate with public authorities (Table 5) .

Table 5: Differentiation of households according to the purpose of using the Internet in 2012, per cent of all households[*]

	Households:	
	Urban	Rural
Fraction of households using the Internet, per cent of all households, including for the purpose of:		
Searching for or performing paid work, distributing information	7,9	3,0
Getting information, doing paperwork on websites of public authorities, government agencies or departments	20,2	10,7
Searching for information about goods and services for everyday life, ordering goods, and submitting their own ads for the sale of personal belongings or property	49,5	23,0
Making financial transactions (payments for services, money transfers, etc.)	17,9	8,2
Obtaining distance education under mandatory or optional programs	8,5	8,4
Reading the news and articles, using electronic libraries and encyclopedias, etc.	74,2	59,5
Social networking to maintain personal contacts and exchange information, correspond with family and friends	92,2	91,9
Downloading movies, music and games, playing online games, etc.	77,6	67,6

*Sources:: Income, Expenses and Consumption of Households in 2012: The Results of Random Analysis of the Budgets of the Households. Moscow: Federal State Statistics Service, 2013, . 130

Conclusion

The continuing backlog of rural areas according to the whole number of parameters of technical and social-economic development is manifested in the lower level of availability of high-tech goods and services in rural households. However, in recent years, that gap has been steadily declining. This is because the innovative technologies are becoming more and more economically and technologically accessible and play an increasingly important role in improving the quality of life. The growing penetration of advanced modern technologies in the everyday life of different social groups indicates that these technologies are no longer something for elite use and increasingly becoming accessible for a large part of the rural population. At the same time, the differentiation in the degree of accessibility and mastering modern technologies (especially ICT) is prominent within the rural community itself.

Growth of availability of high-tech goods and services in rural households and more active use of the opportunities they offer by all strata of the population can be achieved through a set of measures aimed not only to provide technical and economic accessibility of modern technologies and improve their quality, but also to form the necessary skills of using new technologies and raise awareness of the advantages they have among all strata of the rural population. It seems necessary to set up educational and training systems that would provide basic knowledge and skills of using modern technologies with taking into account the specific interests and abilities of different rural social groups, arrange for demonstration and awareness campaigns to stir up the rural residents' interest in using advanced technologies in their everyday life, to primarily develop electronic information resources and services in such fields as health care, education, job search and interaction with public authorities and make them accessible for all strata of the rural population.

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MODELING AND FORECASTING THE NUMBER OF THE EMPLOYED IN AGRICULTURE IN RUSSIA UNTIL 2020

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Abstract

The purpose of this study is to assess the impact of individual areas of the agrarian policy on changes in the parameters of agricultural employment in the Russian Federation. The paper presents a quantitative analysis of the dependence of employment in the Russian agriculture from the changes in production volumes and dynamics of investments in fixed assets set out in the State Program for Agricultural Development and Regulation of the Markets for Agricultural Products, Feedstock and Food for 2013-2020. The authors carry out predictive modeling of the number of the employed in the Russian agriculture using the parameters of development of the agriculture laid down in the state program and assess the social-economic consequences of the current agrarian policy for the sphere of agricultural employment in Russia. The results show that if the targets set out in the State Program for Agricultural Development are attained, by 2020 the agriculture's need for labor will drop by 2.4-5.5%, and the degree and rate of this reduction will depend on the trends that will prevail in the forecast period. Decrease in the number of agricultural workers due to technological modernization reasons could be offset by creating new agricultural and non-agricultural jobs. These new segments of employment could include organic agriculture, biofuel production, deep processing of agricultural products and development of the production, transport, financial and social infrastructures and services. Intensive development of primary, secondary and deep processing of agricultural products could give impetus to both rural communities and small towns. The results of this study could be used in rural development strategies.

Key words: *agricultural employment, forecasting, modeling, state agricultural programs*

Introduction

The agro-food complex and its key branch – agriculture – form the basis of the Russian agrarian economy, ensuring food security, on the one hand, and shaping the rural employment and settlement pattern, on the other hand. The growing global demand for quality food and agricultural products urges the Russian agro-food complex to expand its production. In view of this, the Government of RF approved the State Program for Agricultural Development and Regulation of the Markets for Agricultural Products, Feedstock and Food for 2013-2020 by a special decree. According to this Program, the major priorities are to ensure food independence of the country, modernize the agrarian economy through the use of modern technology, create conditions for sustainable development of rural areas, increase the employment rate, and improve the quality of life of the citizens [State Program, 2012]. Agrarian policies are one of the factors of forming long-term agricultural employment trends. It is therefore important to know how the agrarian sector's demand for labor will change, if the tasks set out in the Program are fulfilled. This question can be answered through analyzing the key trends on the basis of medium-term forecasting, which allows expand the time horizon for the social-economic analysis of agrarian policy achievements.

The purpose of the study is to perform forecast modeling of agricultural employment with taking into account the changes in agricultural production and investment in fixed assets set out in the State Agriculture Development Program for 2013-2020. The object of our forecasting is the number of the population employed in agriculture, hunting and forestry in RF (hereinafter – the number of the employed in agriculture). The methodological basis of the medium-term forecasting is the modeling that describes the system of interrelationship and interdependence of the key parameters. Since the demand for labor is derived, we made an econometric assessment of the dependence of agricultural employment from changes in production and investments in fixed assets. Forecast modeling is an important research tool, allowing evaluate the decisions made, identify the risks, opportunities and problems that are difficult to detect by a retrospective analysis (Ksenofontov, 2002).

Medium-term forecasting of the number of the employed in agriculture until 2020 enables to:

- Identify the different degree of impact of individual social-economic parameters on the dynamics of agricultural employment;
- Trace the adaptation of the rural employment sphere to the new conditions of technological and social-economic development, changes in the situation with investments and production growth;
- Assess the social-economic consequences of implementing the priority agrarian policy measures for the sphere of rural employment;

Materials and methods

Our forecasting of agricultural employment until 2020 is based on analyzing the trends and relationships of the number of workers on the one hand, and the volumes of production and investment in fixed assets, on the other hand. For the forecasting purposes we used econometric models of employment in economic sectors that establish relationships between its dynamics and basic economic parameters. When modeling, as explanatory variables we selected the parameters, whose forecast values are set out in the State Program for Development of the Agriculture until 2020: the gross value added (GVA) and the amount of investments in fixed assets. The data for our forecast calculations was obtained from official publications of the Federal State Statistics Service (Rosstat) [Rosstat, 2012].

Values of the indicators measured in monetary terms (gross value added and investment) were revalued by direct deflation in prices in 2010. The amount of investment in fixed assets was included in the model with a retarded one-year lag. The resulting dynamic series of the selected indicators were logarithmed and used in the construction of our econometric models. The initial data for the analysis is presented in Table 1.

Table 1 – Initial data for econometric calculations

Year	Number of the employed in agriculture, thousand people	Investments in fixed assets, billion RUR	Gross value added, billion RUR
1998	8963	188,9	322262
1999	8738	147,9	431853
2000	8996	130,9	496806
2001	8509	137,3	606362
2002	8229	160,8	692006
2003	7796	189,3	835448
2004	7430	190,4	861598
2005	7381	213,5	933770
2006	7141	233,7	1332368

2007	6925	334,2	1397157
2008	6675	441,9	1482188
2009	6733	436,6	1633300
2010	6656	341,0	1473237
2011	6583	303,8	1706008
2012	6515	336,6	1625826

A retrospective analysis showed that the number of the employed in agriculture, forestry and hunting had been on the decline, having dropped by 27.3% (1998-2012). The amount of gross value added, calculated in comparable prices, was augmenting, with the exception of 2010 – a year of abnormal weather conditions. The amount of investment in fixed assets, in comparable prices, was on the steady rise until the 2008 crisis: the global financial-economic crisis was one of the causes for this parameter to decrease between 2009 and 2012. Nevertheless, during the entire reporting period the amount of investment in fixed assets generally grew. Thus, the growth of the selected factors of agricultural development between 1998 and 2012 is accompanied by a decrease in the number of population engaged in this activity. The anticipated dynamics of these parameters of agricultural development in 2013-2020 set out in the State Program is presented in Table 2.

Table 2 – Forecasted parameters of agricultural development, % of the previous year [State Program]

#	Parameters	2015	2016	2017	2018	2019	2020
1	Agricultural production index for all categories of farms (in comparable prices)	102,7	103,1	101,9	101,9	101,9	101,9
2	Index of physical volume of investment in agricultural fixed assets	104,2	104,3	104,5	104,8	104,9	105,0

It is assumed that the factors determining the development of agriculture in Russia include increasing global demand for food, increasing internal and external demand for quality food, increasing the export potential of regional agriculture and food industry in Russia, the implementation of the import substitution strategy based on domestic demand, household incomes, quality and environmental safety of food, increasing demand for biofuels, and the expansion of non-food use of agricultural raw materials. In addition, the most important factors are the introduction of innovative technologies, modernization of machinery and equipment in agriculture and food processing industry, and the growth of labor productivity. The predicted growth of agricultural investments will expand the use of modern technologies. It should be emphasized that the projected rate of growth of labor productivity is higher than the rate of growth of production, which means that the demand for agricultural labor will inevitably drop. Many leaders of enterprises today keep excessive number of workers to maintain social stability, because the number of jobs in rural areas is limited. But this leads to lower productivity of labor and reduces its motivation. This paper represents one of the stages of studying the impact of economic policy measures on the parameters of employment in the Russian agriculture (Blinova and Bylina, 2011).

Results and discussion

For the purposes of our study we built multifactor and single-factor models characterizing the dependence of the number of the employed in agriculture, forestry and hunting on each of the factors separately and their combinations. Statistical parameters of the obtained models are presented in Table 3. The forecasting capabilities of our models were checked by making a retrospective forecast with the use of existing dynamic data (1998-

2012). The following abbreviations are used: L – number of the employed in agriculture and forestry; Y – gross value added (GVA); I – investments in fixed assets of the industry.

Table 3 – Statistical evaluation of regression dependencies of agricultural employment on the parameters of development of the Russian agriculture

Model 1

Variable	Coefficient	Std. Error	t-Statistic	Sig.
Const	11,87	0,189	62,71	1,59E-17
Ln Y	-0,215	0,014	-15,6	8,52E-10

R-squared	Adjusted R-squared	Std. Error of the Estimate	F Change	Sig. F Change
0,949	0,945	0,028	243,26	8,524E-10

Durbin-Watson statistic	Std. Deviation Predicted Value	Sum of Squares Residual	Average relative error, %
1,27	0,116	0,010	1,86

Model 2

Variable	Coefficient	Std. Error	t-Statistic	Sig.
Const	10,347	0,191	54,30	1,03E-16
Ln I	-0,261	0,035	-7,49	4,54E-06

R-squared	Adjusted R-squared	Std. Error of the Estimate	F Change	Sig. F Change
0,812	0,798	0,054	56,2	4,54E-06

Durbin-Watson statistic	Std. Deviation Predicted Value	Sum of Squares Residual	Average relative error, %
0,69	0,107	0,038	3,5

Model 3

Variable	Coefficient	Std. Error	t-Statistic	Sig.
Const	11,609	0,178	65,18	1,13E-16
Ln Y	-0,164	0,027	-2,86	0,014
Ln I	-0,078	0,021	-7,92	4,18E-06

R-squared	Adjusted R-squared	Std. Error of the Estimate	F Change	Sig. F Change
0,970	0,965	0,022	192,65	7,59E-10

Durbin-Watson statistic	Std. Deviation Predicted Value	Sum of Squares Residual	Average relative error, %
1,40	0,118	0,006	1,58

Model 1 has a sufficiently high quality of approximation determined by the coefficient of determination: the resulting model describes 94.5% of the variation of the independent variable. The value of the Fisher's F-criterion that characterizes the reliability of the regression equation as a whole is also very high, amounting to 243.26, and the probability of obtaining this value by chance does not exceed the acceptable level of significance of 5%. The standard deviation of the estimation that characterizes the deviation of the residuals from the approximating line is significantly below the standard deviation of the dependent variable, which also indicates a fairly high quality of the model. The coefficients of the obtained dependency are statistically significant at the 5% level by the Student's test, as the r-values are close to zero. The values of t-statistics for the variables point at the importance of these parameters in the model. According to the retrospective forecast made with the model, between 1998 and 2012, with a real 4-times growth of production, the calculated number of the employed in agriculture and forestry dropped by 29.3%, which is by 2% higher than the actual data. Thus, this model can be considered adequate.

The parameters of Model 2 show a much worse quality of approximation. The value of the Fisher's F-criterion is much lower, the Durbin-Watson coefficient is quite low, and the average relative error is much higher.

Model 3 has the best quality of approximation, as evidenced by its statistical characteristics. The reduction of the number of the employed calculated with Model 3 in the reviewed period differs from the actual reduction by 1.1%.

So, Models 1 and 3 are the most appropriate for forecasting. Nevertheless, to make our forecasting of the number of the employed in the Russian agriculture more informative, we used all our models.

The forecast modeling made it possible to (1) assess the quantitative relationship between the number of the employed in agriculture and the parameters of growth of production and investment in fixed assets; (2) measure the degree of closeness of the connection between the effective and the factor variables; (3) identify the form of this connection and analyze the aggregate impact of the factor variables. The results show that agricultural employment is likely to reduce, and the scope and rate of this reduction will depend on the trends that will prevail over the forecasting period. According to our estimates, between 2012 and 2020 the decrease in the number of the employed in agriculture and forestry will make: 2.4% in Model 1 describing the dependency of the number of the employed on the amount of production; 5.5% in Model 2 depicting the dependency of the number of the employed on the amount of investments in fixed assets; 3.9% in Model 3 representing the dependency of the number of the employed on the amount of production and the amount of investments in agricultural fixed assets. It should be mentioned that with the introduction of modern agricultural technologies the demand for skilled labor will increase, accompanied with a decrease in the contribution of those economic activities that do not require professional education and skills. The forecasted dynamics of the number of the employed in agriculture and forestry is presented in Figure 1. We have not estimated the impact of labor productivity growth, however, its endogenous impact causing the number and fraction of the employed in agriculture to reduce is embodied in investments in new technologies. If, during the forecasting period, the rates of labor productivity growth lag behind the amounts of production, the demand for labor may grow. If the rates of growth of production and labor productivity are more or less similar, the number of the employed in agriculture is likely to remain on the same level.

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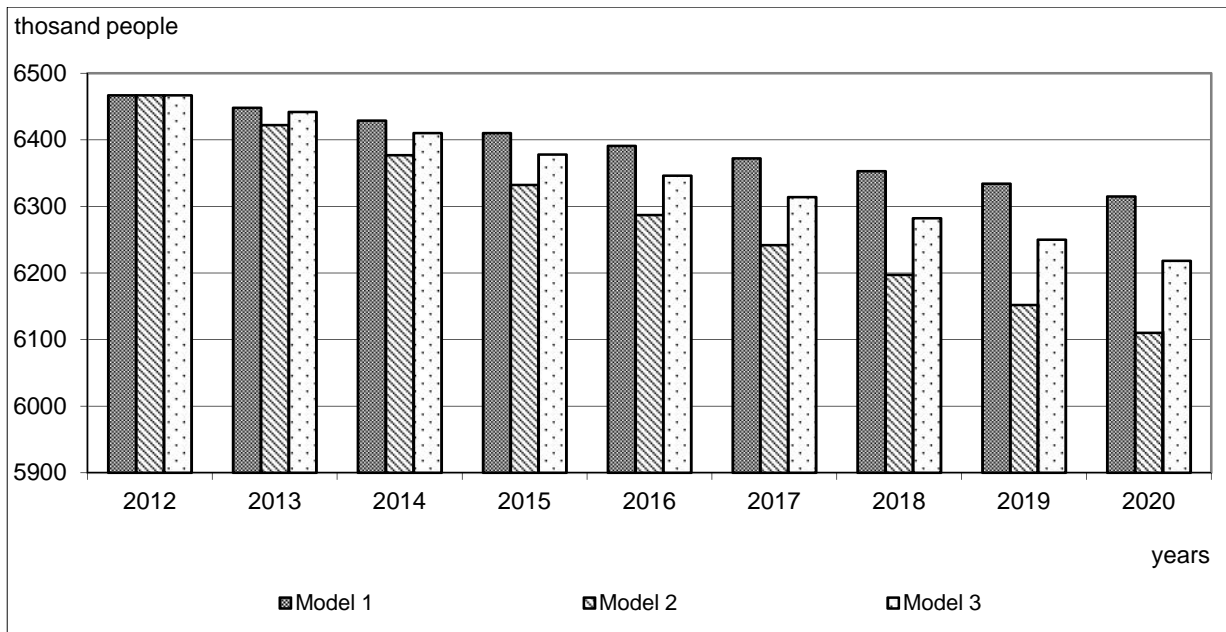
Fig. 1 – Forecast of the number of the employed in the agriculture and forestry of RF

The introduction of labor-saving technologies leads to elimination of inefficient and low paid jobs and reduction of redundant and informal employment that exerts inflationary pressure on the agrarian economy. At the same time, in the short term there may be an increase in rural unemployment, which is more durable than urban unemployment, thus creating the background for social tension. Particular attention should be paid to the fact that the aforementioned public policy measures are being implemented in the conditions of Russia's membership in the World Trade Organization (WTO), which bears additional risks of job losses and employment decline.

To our opinion, an important strategic task is to diversify the agrarian economy through promoting non-agricultural activities, creating an up-to-date production and social infrastructure and improving the functional diversity of rural areas. The role of non-agricultural employment in rural development was discussed by many authors (Bezemer and Davis, 2003, Davis, J.R., Bezemer, D.J., et al., 2004 and others). Responding to the new challenges facing the agricultural sector of Russia implies (1) consolidation of the agricultural policy's social functions and (2) diversification of the employment pattern and sources of income of the population to facilitate sustainable rural development.

Conclusion

An important tool for system analysis of rural employment is the medium-term forecast of the number of agricultural workers reflecting the outcome in particular areas of the public agricultural policy. Forecast modeling allows assess the possible social implications of agrarian policy for the sphere of employment, compare the different options of influence and provide sound advice on choosing the most efficient development strategy. The forecast assessment we made specifies and clarifies the nature of the interrelationship between the dynamics of agricultural employment in the medium term and some individual economic parameters reflecting the directions of the agrarian transformations outlined in the State Program for Agricultural Development and Regulation of the Markets for Agricultural Products, Feedstock and Food for 2013-2020. It is shown that despite the increase in production and investment in agricultural fixed assets projected in the State Program until 2020, if labor productivity grows, the demand for labor may still decrease by 2.4% - 5.5%. To our opinion, it is essential to increase the role of non-agricultural employment and expand the range of recreational, touristic, environmental, social, ethnic and cultural functions of the

countryside, which will allow diversify the sphere of application of labor and make the rural areas more attractive for both business and households.

Acknowledgements

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COOPERATIVE SIGNIFICANCE FOR ECONOMIC DEVELOPMENT OF AGRO - RURAL ECONOMY OF BOSNIA AND HERCEGOVINA

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Abstract

Cooperatives in Bosnia and Herzegovina (BiH) have a long term tradition according to the data from 1991 year with 196 registered agriculture cooperatives organization of which 72 were on the today's territory of Federation of Bosnia and Herzegovina (FBiH) and 124 on the territory that belongs Republic of Srpska (RS) according to the Dayton agreement. Today on the territory of BiH according to the data of cooperative association there is around 500 cooperatives and on the territory of RS 347 cooperatives. Cooperatives have been through different phases of development and many ups and downs of economic trends, especially in sector of agriculture production. In this paper, intension of autors is to show the number of cooperatives with description of types that existed on those areas.
Cooperatives have significant factor of agriculture development in many of the countries of Europena Union (EU) and they contribute to economic vitality of rural areas, economic growth and development, creation of social and national income, employing population and tourism development. Represent a main link in a food chain as a long arm of agriculture production. Despite the difficulties that cooperatives in BiH and RS has been it is necessary to do a thoroughly revitalization of cooperatives with stronger competitiveness, rational usage and protection of natural resources, continuous agriculture and rural development, preservation of culture and historic values.

Key words: *cooperatives, analysis of the situation, agriculture sector, Bosnia and Herzegovina.*

Introduction

Historical development of cooperatives
The beginning of historical development of cooperatives was in England, Manchester (21.12.1844 year). Cooperatives was formed in very difficult economic and social conditions Farmers have improved their position on the market with joint forces and with joint activities for supplying raw materials, marketing, distribution and promotion.
Today, agriculture cooperatives and associations of producers and enterprises represent main link in the food industry chain in all of the EU countries and in BiH. According to the data, there are about 250.000 cooperatives in EU owned by 163 million citizens and they are employing about 5 million people (Borzaga and Defourny. 2001). Under the influence of European practice, the first cooperatives were formed in BiH in the 1888 year in municipality of Derventa, and the first housing cooperatives were formed in Sarajevo in the year 1897. First peasant cooperatives were formed in Orašje municipality in the year 1904. The first Serbian agriculture cooperatives in BiH were formed in the year 1907 in the village Strpci, near Visegrad municipality, under the name «Serbian agricultural cooperatives with unlimited guaranty».
Muslims (Bosnians) established their first agriculture cooperatives in the village Šije, near Tešanj municipality, in the year 1910 under the name «The first Muslim peasant cash register for loans and savings cooperatives with unlimited guaranty».

Merger of cooperatives represent a way of improving the competitive position on the domestic and foreign market. They also represent a big contribution to the development of agriculture production (through their own agriculture production with their own resources), purchase of agricultural products, they contribute to the economic vitality of rural areas, they are hiring young population, and they contribute to the tourism development.

Through the cooperatives, individual agricultural manufacturer can significantly increase their production capacities, level of technical and technological equipment as a volume of their production, with the pooling of possessions.

State of cooperatives in Bosnia and Herzegovina

Cooperatives in BiH have a long tradition (with ups and downs). It was developing really fast until the World War II. World War II and changes in political system have stopped positive cooperative flows. Period from World War II until the first democratic elections in 1990 was the period of abandoning principals of cooperative development, converting cooperative into the instrument of government policy, abolition of cooperative ownership. The importance of the private sector, property, business initiatives and entrepreneurship was underestimated. Only at the end of this period, there was a realization that the cooperatives should be returned to its original principles and re-established cooperative property.

In the post-war period, a large number of cooperatives faced with various difficulties, there was a collapse of the economy and infrastructure, war and destruction caused extensive damage and the entire cooperative (production facilities, machinery and equipment, warehouse and retail space, damage to crops, minefields, changes in organizational structure and staffing, etc.), but despite all of that, cooperatives have proved their vitality and popularity. In wartime destruction of the pre-war cooperative in BiH, only law on agricultural cooperatives and a small number of surviving cooperative has been preserved. Most cooperatives disappeared and all forms of agricultural cooperatives have been stopped. *(Off. Gazz. B&H nr 41/89, 1989)*

Cooperatives are among the oldest of the formed organizations, the concept of cooperative refers to the development of human society, the formation of families and their communities. According to the definition, cooperatives are so-called home cooperatives that began stratification in the arrival of capitalism and some examples are known to survive in BiH until the 50's of this century (Stoisavljevi , 1973).

A long number of years, between the last two wars, cooperatives did not perform its basic functions to improve the quality of business and life.

There are 2 type of cooperatives in BiH:
- pre-war cooperatives,
- newly formed cooperatives with new management.

The newly established cooperatives face many problems after their privatization, the overcapacity in relation to the current capabilities and business needs. There are obstacles to the privatization of land, restore collective property seized in the 60's, unused and unacknowledged cooperative entrepreneurship in rural areas. Among the agriculture, there are other activities, like lack of government incentives, were through subventions reaffirmation of the cooperative movement would be accelerated in the rural economy and all of that can be developed through the cooperatives. All the problems and obstacles can be solved by radical changes that would lead to the promotion of co-operatives as a third sector of the economy (Ševarlic. 2011)

The newly formed cooperatives in BiH operate like any other business entity in the market. They are a function of intermediaries between farmers and markets.

According to the list in 1991, in BiH were registered a total of 196 cooperatives, of which 72 are active in the current territory of the FBiH, and 124 in the area that was given to the RS according to the Dayton agreement. In recent years, the number of cooperatives in the BiH is

constantly growing, especially after the entering into force the General Law on Cooperatives BiH. According to the data from registration courts and entities cooperative associations in BiH in 2006 was registered a total of 767 agricultural and other cooperatives (574 were registered in the RS and 193 in FBiH). *(*Cooperative Association of BiH, 2013).

Figure 1. Structure of cooperatives according to their headquarters in BiH (2010)
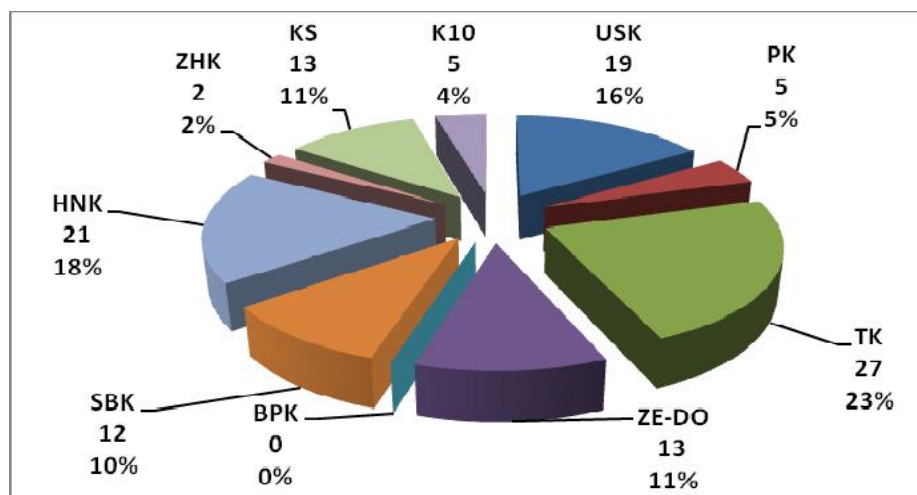
Source: AFIP

The figure notes that in Tuzla Canton exists about a quarter of registered cooperatives while the number of other cantons (Una-Sana Canton and Herzegovina-Neretva) was significantly lower but still exceeds 15% of the total number of registered cooperatives.

In Zenica-Doboj Canton exists 13% of cooperatives, few exist in Western Herzegovina and Posavina while in Gorazde there is no cooperative.

Cooperative activity is most pronounced in areas where there is significant capacity of the food industry. The most intense growth of cooperatives is in the areas where processing capacity exists and in the areas where has been revitalization (Canton Sarajevo 86%, Herzegovina-Neretva County-Canton 50%, Posavina Canton 25%).

It is difficult to obtain data on the actual number of co-operatives their number is constantly changing. Closest data can provide AFIP (Agency for the financial, IT and intermediary in FBiH), from which it can be seen which Cooperatives are active and which generate income and which are not.

One of the criteria of classification of cooperatives is their status where it can be seen are they operative or not. Cantons in BiH are 10, and the number of cooperatives in the court registry is much larger than the active cooperative. According to the AFIP in BiH in 2010, the number of cooperatives was 117, while the number decreases the value of capital (2006 to 2008) has grown from year to year at different rates, but in 2007 there is a slowdown in growth capital. The maximum value of the capital by a cooperative of over 82 million convertible marks (BAM)[1].

BiH also have a decreasing trend of employees in cooperatives, which indicate that cooperatives are not ready to face the challenges of rapid growth. Therefore, BiH come to the situation for the occasional hiring of labor.

The largest number of cooperatives turned to the organization of production and purchase of

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[1] BAM – Convertible mark (Bosnian currency)
[2] The current agricultural policy and its future impact on the development of the food sector in the FBiH, (2011): Project 2007/2008 - 2010/2011, Faculty of Agriculture and Food Sciences University of Sarajevo, Sarajevo

agricultural products (milk purchase, vegetables, fruits and herbs, along with the supply of agricultural raw materials and equipment). About 50% of co-operatives in their structure have their own production (fruits, vegetables, grains, nursery production, and production of broilers, cheese and wine).

Cooperatives are registered as general agricultural cooperatives, agriculture, specialty agriculture, specialized beekeeping, and fisheries, environmental (Šolji et al., 2005).

Half of the cooperative is focused on agricultural production (Figure 2), a quarter of cooperatives are engaged in the purchase of agricultural products, trade 13% and 4% on the organization.

Most cooperative believes that their core business is in mediation between farmers and customers with exports, imports, the processors or retail. The remaining 9% of cooperatives focused on the provision of services (treatment of land, maintenance of facilities, promotion of products and cooperatives).

An example of this type of co-operatives in Europe is "The Best" cooperative that provides services of loading, unloading, sales promotion, promotion through the organization of different ways of prizes, stimulating, monitoring competition.² In BiH there this kind of cooperative those not exists, because of expensive services

The largest numbers of cooperatives are in agricultural production, milk production (15%) and meat (livestock 23%), production of cereals (15%), fruit production (12%), potato production (10%), production of vegetables (7%) and production of honey (3%).

Based on data from the Cooperative Association of FBiH agricultural cooperatives are usually engaged in the purchase of fruit and vegetables, buying seedlings and purchase of honey, as the main activity.

The most important thing is the placement of products on the market; cooperatives have guaranteed sales of 30% based on the signed contracts. Products are sold through various forms of sales through wholesalers, supermarkets, food industry and via dealers. There is evidence that about 70% of co-operatives have problems in the sale of agricultural products. Produced quantities are mostly small; cooperatives lack commercial centres, storage and the processing capacity.

Chart 2: The structure of cooperative activity in FBiH
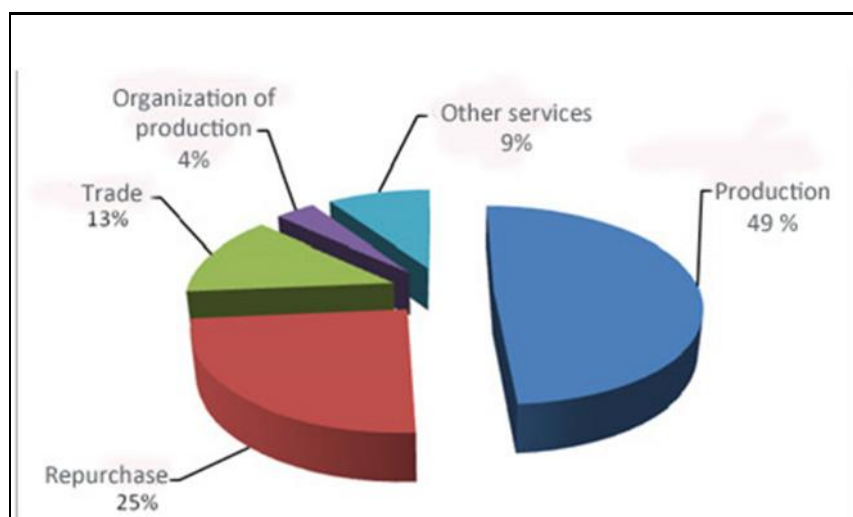
Source: cooperative association FBiH

Good examples of cooperatives in the FBiH are: ZZ "GRA ANKA" Gra anica, who cooperated with two municipalities in the FBiH and two municipalities in the RS, with a number of collaborators of 1000 and 40 points in municipalities in rural areas, where achieves the purchase of about 4,000 t in the field of animal and plant production. Then, SZP

"APIMED" Sanski Most, which has 30 co-operatives in Canton, the volume of honey production of 30-50 t, wax 10 t. "Golden drop" Cooperative Tesanj, buys milk from 120 small producers, with an annual processing of milk from about 400 000 liters and annual sales of various cheeses from around 40 t. Cooperative "Bios" in Visoko (agricultural and manufacturing cooperatives traffic) is engaged in the production and installation of greenhouses, nursery, buying fruits and vegetables from 380 cooperatives in over 60 municipalities.

Bad example of agricultural cooperatives is "Vo ar" in municipality of Kalesija, which has 700 acres of land, issued under the lease and thus makes a profit. Before the war, "Vo ar" was part of the working organization of the ZZ "Unity" Kalesija. Later, the disassociation of the "Unity", "Vocar" has 700 acres of state land and buildings that were located on the property. At the Cabinet meeting of the Municipal Council, it was decided by the majority of individuals that there is no need for the development of agriculture and the land must be excluded. BiH also have an agricultural cooperative "ZZ Trebava" Grada ac that in the year 2008 went bankrupt.

Directions for the development of cooperatives and importance for the development of agro-rural economy of Bosnia and Herzegovina

Cooperatives are an important factor in the development of agriculture in many developed and developing countries. Apart from all the misfortunes that occurred in BiH, the main objective of cooperatives should be directed to the redefinition of the role and importance of cooperatives, fundamental revitalization of cooperatives through existing cooperatives, creating the conditions and support the establishment of new farms.

After the revitalization of the old cooperatives based on the Law on Associations and Law on Cooperatives, as a special form of agricultural cooperatives was formed with various forms of independent organization that undertake various activities such as environmental co-operatives operating under the protection of the environment.

These include the production of healthy food, organic food. Also included is the new co-operatives that encourage tourism, traditional work (weaving, knitting, etc.) (Kolin and Petruši , 2008.)

Cooperatives as a generator of economic prosperity in rural areas are gaining its importance during the transition process. The cooperative movement, which offers various forms of associations of people, can greatly ease the painful effects of the transition to further build up the action of the economic crisis. *"The cooperative model of privatization"* is not recognized or supported here (as a form of generating new jobs), as is done in other countries in transition. Cooperatives have an important role in the agricultural and integrated rural development, development of rural areas through strengthening the competitiveness of the agri-food chain, establishing a solid relationship between the cooperative and its members, rational use and protection of natural resources.

In order to strengthen competitiveness, many cooperatives are joining with other cooperatives or economic entities, retail chains, processors, in order to obtain the highest possible profit. In many countries, cooperatives unite horizontally, with the same activity or vertically engaged in other activities and thus make great competitive systems that control the market. Following international co-operative values and principles, cooperatives has focused primarily on making profits for its members.

In this mode of operation, many cooperatives earn big money as a monthly salary or money to invest in investment. The contribution of co-operative development of rural households, the rural economy is reflected in preserving the vitality of rural areas and rural communities and reducing the level of the poor population. Strengthening the market position of cooperatives is achieved through the support of agrarian policy, the association of farmers in cooperatives, as well as the fragmentation of fragmented unions and their joining in

secondary cooperatives - Integrated autonomous cooperative business alliances in order to acquire the highest possible benefits for members of the cooperative (Mari i , 2006.)
Perspectives of development of agricultural cooperatives can be positive under certain conditions, social conditions, which do not fall from the sky, they have to be created by social actors.
The EU has enacted a law on the development of co-operatives in Europe in order to: significantly promote cooperatives across Europe as well as to promote establishment of new cooperatives, promotion of cooperative legislation, the maintenance and improvement of the cooperative role and contribution of the cooperative society. EU plans is to support the promotion of co-operative business, development cooperation, the development of new techniques, the organization of training, education, support the development of cooperatives through funds and programs. *"Agenda 21"* – passed at the conference in Rio de Janeiro (1992), provides guidance for the application of the concept of "sustainable development" in all sectors, which use the basic factors of the environment and defines instructions on how to prepare the world to the challenges of the XXI century.
It also shows the contribution of cooperatives from all sectors in terms of promoting the objectives of the new concept of sustainable development.
The success of agricultural cooperatives in BiH with implementation of the concept "sustainable development" can be seen through a number of good reasons for the establishment and development of cooperatives as generators of economic, social and cultural development and environmental sustainability of our local communities:
-   cooperative members learn how to solve the problems of democratic development in their local community,
-   strengthen the economic power and improve the position of small producers, not only locally but also in the broader markets,
-   Enable cooperatives to influence changes and to solve economic and social problems in the community
-   Connecting business communities in the regional and national economy.

Conclusion

The goal of cooperatives in countries around the world, including BiH, regardless of their level of development, is to help members to create activities that bring income-profit, which maintains higher employment, entrepreneurship development and management, strengthening the competitiveness of the agri-food chain, both domestic and international markets, integrated agro-rural development, rural areas, tourism development, improving social and economic conditions. Cooperatives in BiH entered into the second century of existence and activity. According to the number of employees and value of revenues belong to the group of micro enterprises and facing a number of problems that are typical for small business. Cooperatives operating on the edge of the economy that can threaten its survival. Cooperative are for some time is in crisis, because it is necessary to revitalize cooperatives in both, FBiH and the RS, and to consolidate existing co-operatives, as well as the creation of conditions and to support the establishment of new agricultural cooperatives. There are no economic or non-economic activities where cooperatives are not present.
Only the common interest of its members in achieving their objective contributes to the overall development of cooperatives.

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AGRICULTURE AND TOURISM IN SERBIA

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Abstract

About 20 million t of agricultural produce in the value of up to 6 billion EUR has been annually produced in Serbia on arable land area of 4.1 million ha. In 2013, the exported food, i.e. agricultural and food products, reached the value of 2.7 billion USD (which accounts for one fifth of the total Serbian exports), while the import was 1.5 billion USD and thus the surplus of 1.2 billion USD was recorded in this field. Bigger food production and its realization with support to stronger rural tourism development could be realized with the investment of about 1.5 billion EUR and the entire region be proclaimed as an area without genetically modified products. This is very important because 10% of the EU inhabitants or near 50 million people say that they want to consume such kind of food. With such investments Serbia could double its agricultural production in terms of quantity and value in three years, and its value could reach 12 billion EUR. In this case, the exports would also reach five million USD, and with higher processing phases, the export could reach the value of seven billion USD by 2030. After a decade, it could reach 10 billion USD. Bigger food production should provide for development of tourism and survival of a village in Serbia. This means that the withering away of rural areas shall be stopped, since out of 4,600 villages in Serbia, every fourth village is on a way to disappear. Provided that equal living conditions are created in villages as those in towns, young people would remain to live in villages and to work there, not only in agriculture but also in related sectors such as tourism. With its large number of food brands (44), Serbia could attract a significant number of visitors through development of rural tourism (about 3000 manifestations have been held annually). Today in Serbia one half of its population lives in rural areas and there are 631,000 rural households. If only 10% of them would be engaged in tourism, this would bring to Serbia additional income of at least two billion EUR per year. Serbia has 40 spas and about 400 mineral or thermal mineral water springs and only 10 percent of it is used.

Key words: *Agriculture, tourism, Serbia, healthy food.*

Introduction

Food production, food security and production of raw materials (for the purpose of other industries, exchange with the world, social, demographic and other aspects) determine multiple importance of agriculture of Serbia. According to it, it can be estimated that the agriculture and its supporting activities participate in the creation of gross domestic product of Serbia (in 2014, it will amount to 29.2 billion USD) with up to 30 percent, depending on the year, whereas its share in the exports of the country is 25 percent.

For example, besides an annual decrease of 2 percent in the livestock fund of Serbia, the meat production amounts to 450,000 t. Consumption per capita is 43 kilograms, primarily pork meat of around 289,000 t, whose consumption exceeds 21 kilogram per capita. To increase the export and consumption on the domestic market, it is necessary to increase the production and consumption of beef meat. The production of beef meat is less than 100,000 t, whereas its consumption per capita is slightly over four kilograms annually. In addition to it, the total production of mutton is 20,000 t and near 100,000 t is the poultry meat production. It

would be necessary to increase the number of fattening cattle, because the European Union lacks around 700,000 t of beef meat annually. Serbia has an opportunity to export 8,875 t of this kind of meat to the EU market annually. However, in 2008, the total of only 1,700 t was exported, whereas in 2013, it was less than 700 t. To achieve that it is necessary to have for that purpose 100,000 cattle in stables. However, in Serbia there are only 15,000 – 20,000 of them! The main reason why there is no such export is the lack of fattening cattle. For example, in 1990 the SFRY exported 500,000 t of "baby beef" which reveals the position of the region in terms of the production and export of meat. Out of that Serbia exported 30,000 t of beef meat to 40 different countries! If there were sufficient cattle in stables and enough beef meat for export, Serbia would secure the export to the EU for the next five decades. The existing decreased livestock fund in Serbia provides 1.5 billion litters of milk annually. In addition to it, the production of wheat amounts to three million tons annually, then six million tons of maize, one million tons of potatoes. Serbia produces over 420,000 t of sugar and exports up to 200,000 t of this sweet crystal. The total 220,000 t of sugar is enough for Serbia's own needs and stocks. Serbia's average annual production of vegetable oil is around 200,000 t, which means that it can export near 70,000 t. Serbia also produces 600,000 t of plums, 220,000 t of apples and 420,000 t of grapes. In 2009, the food from Serbia was exported in the value of 1.94 billion USD, while the import was worth near 1.3 billion USD. In 2010, the income from export amounted to two billion USD, but the export was lower in quantities, the surplus was one billion USD. In 2012 and 2013, the export was 2.7 billion USD, respectively. Surplus was 1.5, i.e. 1.2 billion USD. The agriculture is the only economic activity in Serbia that records a surplus in the exchange with the world. It is a good thing. However, the analyses of this export indicate that even 62.5 percent refers to the inherited market of the former Yugoslavia. Yet another thing: Serbia exports raw materials for food production. It is Serbia's misfortune. For example, near 1.4 million t of maize are exported annually and final products are imported later on (per 11,000 t of pork meat annually)! Such agricultural policy is not good and leads toward a long term crisis in food production. Serbia's opportunity lies in the market of the Non-Aligned countries. It is about 170 countries with 1.7 billion population, i.e. consumers, where annual turnover of halal foods amounts to 600 billion USD. It is a great opportunity for Serbia because today's ministers in the Non-Aligned countries are people who used to get their education in the SFRY. It is about 32,000 experts who had graduated from the faculties in the former SFRY. A majority of them holds positions in their countries. Therefore, these people are friendly-like willing for cooperation with Serbia and it is Serbia's chance to sell its food on these markets. Serbia can be a competitive in these countries. It is especially important at the time of crisis to make such a decision, because Serbia would launch its food to the global market and would attract foreign tourists and investors from these countries. It has been done almost nothing to return to the former global markets or to get to new ones.

Food production is the first prerequisite for development of tourism in Serbia. Only when there is enough food produced for our own needs, reserves and export, it is possible to think about development of tourism. Under the condition that the nation earns enough money to go on holiday (it requires higher income than the average which currently amounts to 400 EUR monthly). Of course food has to be quality, safe and thus it will become a Serbian brand. Serbia has soil, science, qualified workers and capacity for food production. However, these capacities are untapped because they used to be built for needs of the former SFRY and now only 15 to 80 percent of it is used the most.

It is Government's next move

If the Government of the Republic of Serbia decided to proclaim agriculture and tourism for its strategic activities and the entire Serbia for the region without genetically modified products, the production of quality food would increase as well as the utilization of food production industry. The very domestic and foreign tourism would start developing. However, it is necessary to invest one billion and a half euro in the strengthening and

modernization of agriculture, which would double the value of its production (which in 2009 amounted to 3.5 billion EUR, in 2013, it was 5.7 billion EUR, and in the last decade it amounted to six billion EUR). If so, the food production would be enough for reserves and domestic demand, whereas the export would bring the income of over four billion euros, while untapped manufacturing capacities would be engaged. With these investments, the development would record a substantial growth rate of up to 10 percent by 2020. The demand at more quality and higher level would be met and the foreign exchange inflow from food export would be provided to the amount of six billion USD. With such growth pace, by 2030, the export revenues would amount to 10 billion USD. By 2020, instead of the current 631,000 agricultural holdings, Serbia would have near 350,000 commercialized agricultural holdings with an average agricultural land of around 15ha. The rest small agricultural holdings would have substantial natural production and consumption and products for tourism development. There would be purpose production of food for tourism (domestic and foreign). For example, it is known that the EU has about 500 million inhabitants (ten percent or 50 million of them state that they want to consume only non-GMO food), then it is a great opportunity for Serbia to produce and sell food for this market. We should bear in mind that this kind of food is more expensive in the world by 30-50 percent than the ordinary food. Experts believe that organic food could be useful to Serbian rural households dealing with tourism. Serbia has excellent conditions for development of this kind of tourism which could be its new development opportunity, too. The advantages for developing this kind of tourism are versatile relief, which is distinguishable for straight-street-arranged villages in Vojvodina and dissected villages in mountain-like sceneries. If we did so, we would earn foreign exchange on the domestic market. Therefore, this kind of tourism and entire Serbia would be made a well-known brand all around the world. In that way, agriculture would become a significant business which would bring money to two million people in the country dealing with agribusiness.

Agriculture is the activity by which Serbia can create its product in the fastest way possible, i.e. competitive brand in the global market. We have to act quickly, in the short run, with agricultural products from higher processing phase and they will set in motion untapped manufacturing industry. Domestic brand has to be protected, along with the meeting of global quality standards. Serbian Diaspora can help Serbian products enter global markets. It can be a bridge with other countries and a "transformer" of new technologies, business experiences and a trust guarantee for foreign investors and buyers. Serbian Diaspora's capital available (around four million people in all continents) has been estimated at 50 - 60 billion USD. Only ten percent of this investment would be enough to recover Serbia's economy. This is the reason why Serbia needs the powerful name for the creation of its brands. We have to admit that it is difficult to define what Serbian brand actually is for the world. If we try to explain that, we would say that it is something quality, well-known on market, nice and very often expensive with renowned name. A successful brand has to be immortal, unique, compelling and quality. When it comes to food, a Serbian brand has to have ***Made in Serbia*** trademark.

As for foreign tourists, Serbia can offer its products such are water, raspberry, plum, wine, smoked ham, cheese, kajmak, duvan varci, mushrooms, mutton, kid's meat, Futog cabbage... The total of 44 products have the certificates of geographical indication. There are few products that gained domestic and international reputation such are "žuta osa"', "sokolova rakija", "Šumadija tea", medical herb beverages, pumpkin oil, soybean products, sunflower oil, Futog cabbage... The healthy food is something that Serbia can firstly launch on the global market and offer to foreign tourists. The first branding of products has been started in Vojvodina and thirty or so of such articles already have "***Best of Vojvodina***" trademark. Tourists are also interested in waters. Serbia has around 400 thermal and mineral water springs, but only ten percent of them has been used in spas and for the food production in greenhouses. It has been estimated that the food from Serbia can be sold on the Western market in the value of at least 500 million USD annually. Over four million people from

Serbia live all around the world. If only two million of them spent 200 USD on Serbian products, which is an amount spent in one shopping in super market, it could be a way out for Serbian economy from its lethargy. If products were offered to so-called "Serbian houses" in the states they live, they would buy them and in that way they would protect themselves and their identity. It would be a silent and clever way for to return with its products to the global markets.

Global Recommendations

The Republic of Serbia is a distinctly rural country. About three-quarters of its territory is occupied by approximately half of the population (there are about 7.5 million inhabitants). The World Tourism Organization has recommended Serbia to develop rural and spa tourism. And not without reason. Its geographic position is very favourable, the climate is pleasant, the scenery is versatile, with rich world of flora and fauna, rich culture, folklore, tradition... Annually, it hosts around 3,000 tourist events. There is a trumpet festival in Gu a, Exit in Novi Sad, The Wine Ball in Vlasotince, Župa Harvesting Festival in Aleksandrovac, the Gathering of Pipers in the village of Grljan near Zaje ar, the Sausage Festival in Turija, the Bacon Festival in Ka arevo, the Prosciutto Festival in Zlatibor , the World Food Days in Velika Plana, the world competition in egg knocking in Mokrin, the Cabbage Festival in Futog... The development of tourism and the arrival of visitors would change the image of Serbia in the world even more quickly. Now, the fact that more than 70 percent of chronically undernourished people in the world live in poor rural areas is definitely not true of Serbian villages as the most visited events are bacon festivals, sausage festivals, beans stew festivals, barbecue festivals, cheese festivals... All these products require a new marketing approach – with the information that they originate from the Republic of Serbia where there are no genetically modified organisms or products, that they are produced manually, that they are made in the traditional way (that rakija – fruit brandy is not produced in distilleries, but boiled in brandy boilers, that the jumpers in Sirogojno are knit by hand, not by machines). Finally, it should be understood that tourism is not only an economic category. Tourism also comprises culture, art, education, folklore. All of these are interwoven in spa tourism, which Serbia should develop together with rural tourism, combined into an integral offer. In the world, this type of tourism is now called "green tourism" since it is a return to nature. Thus, tourism is a way out of the crisis for Serbia, the way to reduce unemployment and increase total revenues from goods and services and a way to total well-being.

If a farm in Serbia had two rooms with two beds and rented them to foreigners for 200 days a year, at a price of EUR 20/full board, mathematics is the most accurate science here and it shows us the figure of EUR16,000 in revenue. It should be noted that the bulk of the expenses goes to food and drink that our farmers usually produce themselves. So, no more going to the market, the expenses for fuel, renting stalls, wasting time... If we were to calculate this for Serbia, where half of the population lives in villages, then, it would become obvious that this is a huge contribution not only in money but also in overall development of Serbia. If only 10 percent of the households were involved in tourism, this would mean additional annual revenue of EUR1.6 billion for Serbia! Most Serbian villages have spas. Some are ready for guests, and the majority of them just improvise, but they still have an increasing number of guests year by year. Things cannot change overnight, but in the long run, it is possible to achieve remarkable results. We can take Slovenia as an example, which has been working on the promotion and popularization of its rural tourism for 15 years, and it largely involved spa tourism, and it has achieved remarkable results. It is encouraging that, year after year, even in the times of crisis, when there is less money for tourism, we have had increasing the number of households engaged in rural tourism.

The Country of Spas

The World Tourism Organization has recommended that Serbia develops its spa and rural tourism since it has 40 mineral spas and areas with specific climate and weather conditions, 25 rehabilitation centres and about 400 hundred mineral springs. Considering all

this wealth, Serbia can rightly be called – the country of spas. If it were to utilise this wealth in tourism, it would be the best way to valorise or consume the food it produces. That would also be the most profitable, because the food would not be exported in the form of raw material but as a product of higher levels of processing. This would develop tourism as well. In 2013, revenue from foreign tourists amounted to more than one billion euros.

So far, these spas and all that is offered within rural tourism in Serbia (there are about 4,600 villages) has not even remotely been utilised to its full potential. According to records, historical data and archaeological findings, the Romans were the first to use the spas in the territory of today's Serbia. After the wars in Dacia, they would bring their legionnaires and veterans to spas "to cure them, to treat their combat wounds and to rest them". Archaeological remains have proven that the Romans used the spas. For example, even today, in the middle of the Crni Timok river bed in Gamzigradska Banja there are bathtubs where the Romans bathed themselves. Roman Emperor Galerius also came "to take a bath" there, and he built a magnificent complex of Felix Romuliana near Gamzigradska Banja. Even during the period of Serbian kings and emperors from the Nemanji dynasty they went to spa resorts. The Nemanji rulers, resourceful people, took their wives to spas to demonstrate these princesses from Byzantium, Hungary and France what Serbia had. After the Nemanji rulers, Serbia, as it is popularly said, "languished" under the Turks. However, despite the lack of freedom, Serbian people remembered where mineral springs and hot water springs were located. People "secretly" swam in flumes, and drank mineral, healing, water... At the beginning of the nineteenth century, Serbs rebelled against the Turks, and in the second half of that century, Serbia was freed and began its restoration. Spas too underwent their own restoration, modeled after those in Europe. Some Serbian spas were, as they used to say in those days, gentlemanly. Gentlemen bathed in such spas. Such were the times, such were the spas and their guests...

Tourism in the world and in Serbia

Despite the global economic slowdown, in 2013, the tourism industry recorded 53 million new tourists, whereas in 2014, an increase of four percent is expected. The World Tourism Organization forecasts that by 2030 the international tourism can expect to get new 45 million people every year. Statistically speaking, an annual average growth will be 3.3 percent, which implies that by 2030 the international tourism can expect to get even 800 million people. Tourism industry in Serbia also records a constant growth. Serbia has 921 companies dealing with tourism, i.e. 1,039 accommodation facilities. Of which the total number of categorized facilities is 330 with 17,041 accommodation units.

In 2013, the total number of guests was 2.2 million, which was an increase of 14 percent. Of which the domestic guests were 1.2 million, which was 58 percent of the total number of tourists. The total of 6.5 million overnight stays was recorded. The number of domestic overnight stays was 4.5 million and of international guests was two million. The income gained from tourism in 2013 exceeded 2.5 billion USD (a billion USD was gained from international guests). Tourism, as very strong economic sector, is not in the place in Serbia where it should be, although it has great importance and potential for economic recovery of the country.

The current results have been achieved without sufficient investments and allocations of the state. The investment of only 13 million EUR is planned for 2014. It is forgotten that tourism encourages an economic growth and development and therefore, investing in tourism and agriculture is an income and investments for the country. For this reason, the forthcoming strategy of tourism has to be founded on realistic facts. The share of tourism industry in the GDP (which currently amounts to 29.2 billion USD) is beyond 5.5 percent. Tourism industry in Serbia is in a post-flue-like state: unstable, but it is still on its feet. This economic activity in Serbia is not officially a strategic branch, like agribusiness too, although it brings the foreign exchange inflow of billion USD annually. It includes 40 spas, 25 leisure centres, 301 registered hotels (only ten percent of them are five-star hotels), and the tourism industry

employs a totally of 170,000 people. Despite the global economic crisis, which decimated the investments in all economic areas, the investment of one billion EUR has been lately put into 250 new hotels. If more attention was drawn to this industry, i.e. to spa tourism, more food would be used and the economic development of Serbia would be encouraged. However, tourism can be developed on long-term basis, patiently and according to the plan, without any Serbian specific desire to do something in a hurry. Dealing with tourism requires a certain level of skills, knowledge, culture and will. Scenery beauty is not enough for gaining success in development of Serbia.

Spas in Serbia advanced between the two world wars. It is interesting to note that more guests came to Vranja ki Banja in those days than in Dubrovnik, although it too was designated as an elite tourist destination. Banja Kovilja a was frequented by trendy people, by gamblers, but also by members of the royal family. Sokobanja was the place that hosted intellectuals, especially writers. Witty Branislav Nuši wrote a rhyme, which in translation reads: "Sokobanja, Soko Grad, you come old, you leave young'!" And there is some truth to that. Ivo Andri said that it was sufficient to spend three weeks (21 days) in Sokobanja, and after that, one can work for the whole year. Well, these examples illustrate and support the view that in spas you can recuperate, refresh, and in modern day - relieve stress, caused by mobbing and "fast" modern times. Nowadays, spa guests are recovered through wellness programs.

Privatization in tourism

As for the privatization in tourism, almost all hotels and tourist companies in Mataruška Banja, Bogutova ka Banja, Sokobanja, Banja Kovilja a, Bukovi ka Banja have been privatized by auctions. The privatization of the HTP Fontana in Vrnja ka Banja was cancelled and a procedure is expected to be commenced again in the following period. Gornja Trep a near a ak may serve as a good example of properly carried out privatization. This spa centre was reconstructed and five times more money was invested.

After the Second World War in Yugoslavia, and in Serbia, focus was on the working class, at least nominally. Class, race, mass, were ideological preferences of the self-management society. Spas turned into healing facilities and resorts for the working class. So what? Like guests, like spas. Poor, people would say, but still, they went to spas. In "Tito's Time", politicians, and tourism workers, favoured the Adriatic. Spas became neglected, forsaken, and finally dilapidated... After the recent wars, the end of the nineteenth/twentieth century, spas too "caught" up with the spirit of the time in this region. Like everything else, they were struck by "transition"... The slow recovery of spas started as late as in 2000. Investment in them started. However, it was also necessary to change the approach towards spas. It was necessary to eradicate the perception that spas were mere healing facilities, a sort of dispensaries and sanatoriums, to show that they also serve to recuperate the body and the soul. People need entertainment, especially in these stressful times. Some spas have adopted the new approach. And it soon became apparent that it is good and useful. This is best illustrated by the fact that, in 2013, the number of overnight stays increased by 11 percent, and in some places, by even more than one hundred percent!

Nevertheless, there is still a lot of work to be done. After the adoption of the Law on Tourism, which is in line with the requirements of the World Tourism Organisation, a new law on spas should (finally) be adopted. Declaratively, Serbia has opted for European standards in spas, but the progress is difficult and slow. But there is progress! The best example for this, it would seem, is the offer of Kanjiža (Vojvodina), which reads "a room with a view over Europe!" Since, apart from rural and spa tourism, which are very often related - or even united – the only other thing it can offer to tourists is local food. In this way it is possible to fully utilise all that nature has offered, man has made and created, and then valorised. It would, thus, increase food production; the food would be sold to domestic and

foreign tourists and thus the economic circle of agriculture, quality food - brands and tourism would be closed.

In addition to the spas, where you come for treatment, rest, recreation, there is the question of why foreigners (and local guests) would be happy to come to picturesque villages. It should be said that tourism is a phenomenon which was provoked by the great need of people from developed countries and cities for a true rest. People are tired from unnatural lifestyle in the cities and they need to spend some time surrounded by unspoiled nature, where the climate is pleasant, the accommodation is affordable, where they can see the cultural and historical monuments... The best proof of this is the fact, or a prediction, that by 2020, there will be 1.6 billion tourists per year, an increase by more that 100 percent compared to 2003!

Conclusions

The World Tourism Organization has recommended that Serbia develops rural and spa tourism, emphasizing that these are ideal conditions for its development. It is also the best way for the development of rural regions (occupying 80 percent of Serbia), which would maintain traditional production in modern conditions. Serbian villages are true ecological oases characterised by on truth: those that come here once, always return. The offer eco-business and spa tourism is already an important source of foreign currency for Serbia, but there are also local guests. A tired business man, at the end of an exhausting work week (of course, when the economic crisis in Serbia is over), will enjoy most in the views of the green landscape, the murmur of a clear brook or the freshness of the mountain air. These can be found in rural and spa tourism. It is only necessary that the creators of the agricultural and tourism economy realize that agriculture and tourism, strategic development opportunities for Serbia, are interconnected. Since agriculture produces food, and its sales in tourism turns over the money and makes profit. Therefore, these two branches must become strategic in Serbia, and only then they will make their full contribution to the development of the country. They overlap, they depend on each other, and – they cannot sustain on their own. Thus, in the long run, the production of healthy food and the development of spa and rural tourism represent the opportunity for Serbia in the world market. At the same time, the development of agriculture and tourism can stop the emigration of young people and enable prospective return to the villages and spas for those who lost their jobs in the cities, during the transition.

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ECOLOGICAL CLUSTERS IN TERMS OF THE ENVIRONMENT PROTECTION

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Abstract

Liberalization of domestic economy implies not only the international competition, but also more severe business conditions. New terms of business competition imply being familiar with conditions and implementation of the regulations in the field of environment, health care, safety, protection of producers and the adequacy of products. The managers in Serbia do not have sufficient business experience in market conditions, so they need a support in knowledge, skills and acknowledgement with the standards of ecological production. Since that an ecological factor gets its significance, there rises a need for joining into the ecological clusters, in order to improve a competitive advantage of a cluster's members and, at the same time, protect the environment. Accordingly, a manager's task is to change the production, marketing, as well as using the products and services, i.e. performing activities in accordance with scientific and technical knowledge, in a way to prevent serious and irretrievable degradation of the environment. Instantaneously, there is necessary to measure an effect on the environment protection, to conduct a regular control of the environment protection and evaluation of adjustment with the internal requirements of a company, legal requirements and other regulations. This will give a contribution to preservation of favourable conditions for development of ecological production in Serbia.

Key words: *clusters, management, standards, environment, competitiveness.*

Introduction

Association, or in a modern terminology word – networking, represents globally widespread trend. The association goal is a synergy which contributes to networked actors more than an individual appearance on the market. The business networking has become a modern strategic need, a new model of an entrepreneurial behaviour and the global megatrend, which just bases on searching for a key competence of enterprises and an efficiency of organizational-process network, and it consists of creating adjustable, synergetic and competitive organizational structure (Draskovic, 2004).

A key goal of network connection in the ecological clusters bases on realizing their useful economic, organizational and ecological effects. In the literature, it explains through their fundamental principles of forming and a functional specificity of existence, which reflects in a dynamic tendency of organizational development, a permanent spreading and improvement aiming to realize as better as possible positioning and a greater success on the market.

The network economy is a new entrepreneurial organizational-process model, which develops thanks to basic building blocks (information, innovations, communications, new technologies etc.). It significantly changes the international trade performances and the competition generally. The network connection does not appear as a substitute of traditional hierarchical-bureaucratic organizational-managerial structures, but as a new management strategy, even a paradigm, used by many world (especially global) enterprises, which base their success and development on modern structuring of business processes. The network connection improves the abilities of adjustment to changes, innovativeness, modernizing and training in regard to a hierarchical-bureaucratic organizational structure. Besides, the strategic

management of network organizations provides decreasing costs, increasing a profit and better reactions to change of the market conjuncture.

The practice has shown that, by networking the organizational structures, business processes, scientific-research work and similar, has come to key acknowledgements, skills and other advantages which valorise on the market as the competitive. The networked partners in business processes more and more use mutually their key competences aiming to make faster, cheaper, more flexible, quality and better result, by which makes a competitive advantage on the global market (Draskovic, 2006).

Materials and methods

In implementation of a research task was used a desk research of data which refer to the ecological clusters and the environment protection in Serbia. Such research implies using the data from the official resources: programs for clusters development in the Republic of Serbia (RS), the data from domestic and foreign literature, using the internal documentation base of the Institute of Agricultural Economics, Belgrade. Using the stated sources for the research can get more reliable response to the key questions which impose within the analysis of the ecological clusters and their role in the environment protection in Serbia.

Results and discussion

One of the ways to encourage development and quality of the local environment, i.e. a rhombus of national competitiveness in Serbia – are exactly the ecological clusters, although the local business environment is not favourable to this form of association. The clusters can be defined as critical masses of enterprises and institutions in one place, of unusual competitive success in certain fields (Porter, 1998).

According to Porter (1998), strong competitive advantages in global economy mostly lie in local issues – knowledge, relations, motivation – differences which the competitors cannot copy easily, and which the best can develop through the clusters. The cluster association is characterized by cooperation and correlation (unification and complementarity) of members, their geographic, i.e. a local boundedness, active channels for business transactions and communications, making a common product and/or a service or mutual resolution of some need or a goal.

The main factors in the clusters development must be the enterprises-participants. Only through their active participation, a cluster will strengthen and develop. Educational institutions also have their role and, in some cases, have shown as a significant catalyst in a cluster's development. The faculties can have an educational role, but can also be the key factors in research and development, as well as the innovativeness in the clusters. Also, an integral part of clusters are the organizations for providing business services with an expertise, which suits to the clusters needs, like marketing, consulting and similar organizations. All these bodies can contribute to strengthening of clusters development and can have a legitimate role in its development. That is to say, in a knowledge-oriented business, raises a significance of concentration of researchers, consultants and laboratories at one location, and by that increase the possibilities to create such innovation, i.e. a value and a quality of supply, which remote competitor cannot copy and overcome easily (Parauši , Cvijanovi , Subi , 2007).

Finally, the local authorities, the regional developmental agencies and other economic bodies have a significant share in hastening the clusters development by the interventions, strategic directions, donations, making favourable development conditions, organizing educational seminars by regions, decreasing a risk for starting a business or in taking credits, etc. There are several mutual elements in the clusters functioning:

1. Basic businesses – businesses as a leading cluster's participants and mostly bring the highest incomes from the users outside the cluster.

2. Supportive businesses – businesses which directly and indirectly support the basic cluster's businesses. Here belong the suppliers of specialized machines, components, raw materials, as well as all other service firms, including also financial/brokerage firm and their capital, lawyers, designers, marketing and public relations services. These firms mainly are highly specialized and physically located in the vicinity of the firms for the basic businesses.

3. Intellectual supportive infrastructure – in clusters which function top-class, the basic and supportive businesses do not work separately, isolated. In successful clusters take part many members of a local community: local schools, universities, poly-technical institutes, local commercial and professional associations, centres for economic development and many others which support the activities of clusters and are, in fact, the key factors in clusters. The quality of this intellectual supportive infrastructure, as well as a level of a team work within, makes a very important factor in development of any cluster.

4. Physical supportive infrastructure – primarily, a physical infrastructure: roads, ports, arranged waste areas for a classic or a specific waste, communications, etc. Such infrastructure quality must be at least at the same level as the competitive one, and preferably even much better.

In most of cases, making the clusters by a "bottom up" line, leads to, so called, quasi-cluster, accurately – associations, which have a perspective to become clusters. There should emphasize the following "clusters", associations, founded at the initiative of members, not to get the state's incentives, but to position better the enterprises within the cluster on the market (Mihailovic, Parausic, Simonovic, 2007).

The initiatives for forming the cluster in Serbia are in the field of ecology. The enterprises, the members of the Ecological Cluster of Serbia have been authorized for taking over and recycling the specific types of dangerous and secure wastes. It is important to emphasize that all enterprises – the cluster members, have all technical conditions, as the necessary documentation for recycling and taking over the waste. The enterprises – members of the cluster are authorized services providers in the activities in the table 1:

Table 1. Fields of consulting services within the ecological cluster

▪ Consulting in the field of implementation the standards ISO 9001, ISO 14001, EMAS, BSI OHASAS 18001, HACCP/Codex Alimentarius, EUREPGAP, ISO 17025 , ISO 22000
▪ Making reports on a strategic impact evaluation of plans and programs to the environment
▪ Making integral local plans of waste management in municipalities
▪ Preparing the projects for contesting with domestic and foreign donors, for credit
▪ Making and implementing the LEAP and the Agenda 21
▪ Consulting services in the field of law and policy in the environment protection
▪ Lectures and trainings according to your wishes in the field of management system and the environment protection
▪ Preparation of study of the environment impact evaluation and preparation of all accompanying requirements through all phases of assessment procedure of the environment impact.
▪ Preparation of risk assessments of chemical accidents
▪ Expertise in the field of eco-toxicology
▪ Production and sale of an equipment for disposal and recycling of secondary raw materials

The ecological clusters provide more efficient apply of an economic-ecological policy. Namely, the instruments and measures of the economic-ecological policy must have a strategic position. Although their evolution and application is still at the very beginning, there are necessary the following measures (Pejanovic, 2000): 1) Internationalization of externalities is a procedure by which the external costs (taxes and other instruments) make

"internal", in a way they must become a part of a market (retail) price. This particularly refers to ecologically less acceptable products or production procedures, in order to discourage their mass production and use, 2) Prohibition (the biggest polluters' work prohibition) or determination of a tolerable level of pollution. There is necessary to define by norms and regulations an interest for the environment quality, and then by the efficient mechanisms to provide these norms and regulations apply, through introduction of rigorous measures for their contempt. It is necessary, in the same way, to regulate a genetic engineering and to introduce the norms, which would make a boundary between the research results apply, by which improve incomes of the others, which represent a long-term risk for the environment, 3) Recycling is a procedure of a production reuse of already used products and side products of some production, where achieves a double goal: decreasing use and consumption of natural resources and a reduction of a final emission of harmful substances. This is relatively cheap measure which means less pollution and greater chances for the natural balance preservation, 4) Favouring of ecologically acceptable projects, especially of, so called, no-waste technologies, with ecological standardization and other accompanying measures. This measure cannot conduct partially, but in accordance with well-known ecological principle: „Think globally, act locally", 5) Prevention realizes by timely informing, consulting, raising the ecological awareness and education. This measure realizes according to an old popular principle: „Better safe than sorry", 6) Preventive thinking means also introduction and respecting the ecological standards. ISO 14000 is a series of the international standards meant for managing the enterprises activities (ecological management) due to decrease of harmful effect to the environment, 7) eco-label means labelling of products, by which points out to the potential users that the product has been adjusted to the ecological standards.

The experience has showed that the greatest chances for success have those ecological clusters (initiatives) which have a consensus on mutual goals and activities, which have a clear framework for cooperation and have been founded based on own initiative. In the economy of Serbia, during the pilot program of clustering, these are, at the same time, the greatest problems. That is to say, a successful work of clusters limits a high level of members distrust, misunderstanding of a cluster concept, a need for a horizontal association, without readiness to cooperate deeper, insisting on individual problems, fear of losing the business decision-making autonomy. Instantaneously, a shortage and under development of institutional and infrastructural support largely hinders these processes in the Serbian economy. The cooperation between universities, scientific-research organizations and an economy sector is not sufficiently developed (Program for development of business incubators and clusters in the Republic of Serbia 2007-2010).

Conclusion

The Serbian economy clustering is only at the very beginning, and the clusters contribute to development of competitiveness, through the productivity growth and creation of innovation strategies, which cannot be lost out of a sight in the future period, when should expect more intensive processes of clusters creation and functioning. Such way of strategic correlating the enterprises, due to further growth, should get its fly-wheel and to play a key role in strengthening the competitiveness and performance of the Serbian enterprises on the foreign market.

Acknowledgement

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PROFITABILITY OF HAZELNUTS PRODUCTION IN SERBIAN ENCLAVES IN KOSOVO

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Abstract

Moderate continental climate of Kosovo provides opportunities for successful cultivation of hazel. Hazelnut production is not represented in the area of Serbian enclaves in Kosovo, but due to the increasing market demand for this product certain agricultural holdings show interest for this type of production. Favourable natural conditions should contribute to raising new modern plantations in considerably larger areas. For fitting 1 ha of intensive plantations of hazels (land preparation costs, planting, irrigation, the cultivation costs in the I, II, III and IV year of growing it is necessary to invest from seven to ten thousand euros, depending on what the grower wants to achieve. In the year full-yield the expected core yield is four kg per tree or two thousand kg per hectare, the yield providing income of ten thousand euro. The initial investment per hectare is extremely high, but taking into account the fertility of hazel tree of fifty to seventy years we come to the conclusion that the investment is profitable and cost effective thereby contributing to raising standards and ensuring the existence of Serbian enclaves in Kosovo.

Key words: *hazelnut, production, costs, profitability*

Introduction

According to the importance and attractiveness hazel is a very important fruit species in nut group. Its fruits are especially popular in the confectionery industry, primarily due to the aroma and a number of other properties. Due to such actuality worldwide there is great interest in expanding and growing this fruit. In Turkey, there is a special cult to the fruit crop. Vast areas are under hazel on various soils and wide open spaces from the Black Sea level to the mountain ranges of 1200 m above sea level. In numerous steep slopes hazel is cultivated in the most extreme conditions, but is expanding in order to preserve from erosion. In contrast to such terrains, hazel is also grown in significantly favourable conditions where with the use of notable agricultural measures (fertilization, irrigation, pruning, cultivation, dense plantings, mechanized harvesting), considerably higher yields are achieved (Mitrovic, 2002). Serbian enclaves (by districts: Kosovo, Kosovska Mitrovica, Kosovo Pomoravlje district, Pe , Prizren district.) in Kosovo and Metohija are the places populated by Serbs, the population not completely ethnically cleansed in 1999 and 2004. The enclaves population live in to a less or greater extent isolated from the surrounding Albanian population under very difficult conditions. The Serb population is seeking economic survival perspective in the efficient agricultural performance (Maksimovic, 2013,2014). Determination to invest in the hazel production stems from the fact that there are good climatic and other conditions for this type of intensive production in the Serbian enclaves in Kosovo and Metohija. Past experience has shown that this production is very profitable and that demand exceeds supply. Investing in this type of production is an ideal investment and good income of agricultural holdings in the Serbian enclaves for the following reasons:
- tolerance to agro-ecological conditions,
- the gap between the actual needs for fruit and the state of the production,
- favourable market price,

- long fertility of hazel
- regular fruitfulness,
- increasing the standards and providing livelihoods for the household members.

The main goal of this research is to determine the economic viability and profitability of hazel plantations in one hectare in Serbian enclaves in Kosovo.

Material and methods

Moderate continental climate of Kosovo provides opportunities for successful cultivation of hazel. There are two systems of cultivation of hazel tree, one is grafted hazels when one of the varieties that are commercially viable is grafted on the base of Corkscrew hazel (Corylus avellana), that is on the stem plant. The second system is the hazelnut shrub that is often used in intensive production because of its benefits (healthier and more resistant to insects and disease in relation to grafted hazelnut). A good selection of varieties and their distribution in the plantation provides a good pollination. The main variety should be present in about 60% and other pollinating varieties with 40%, and accordingly the authors propose the following varieties: Istrian 60%, Apolda (Rome) 10%, Davijana (Fihtverder) 10%, Ludolf 10% , Avelino (Helski) 10%. The varieties arrangement in the plantation should be set so that the main variety and pollinators alternate in a row. Based on the proposed recommended varieties planted at a distance of 4 meters between rows and 4 m between trees, since it is about medium lush varieties, the spacing between rows and plants in the row is determined. It is best that the direction of rows is north - south for better lighting, the most appropriate time for planting hazels is in autumn because the root system has significant activity during the winter period. After planting the plants are truncated to 15-30cm, the number of primary branches depends on the vigour of the variety, and the leaves are left as long as necessary for the formation of the bush (bush consists of 3-6 main branches). Pruning is performed for thinning and leaving only the branches needed for the formation of the bush and for regular removing of shoots. In order to make the orchard enter the full yield as soon as possible and to give the expected results, it is necessary to promptly and fully implement cropping practices.

In the past three years the authors monitored the production of hazelnut plantations around Gornji Milanovac (Serbia) and based on the collected data performed economic analysis, provided the table of hazelnut plantation investment, spreadsheets of hazel yield presented by years, planned calculation of hazelnut production and sensitivity analysis of hazelnut production.

Results and discussion

Hazel is characterized by high capital investments required to raise seedlings. The hazelnut plantation investment period is four years, i.e. until the moment when the production makes profit, thus progressing the hazel from investment into regular production. High investment per unit area is justified in a very long and profitable full yield period which can last over fifty years (Milic and Radojevic, 2004). The investment value of hazelnut plantations include costs of preparing the land and planting pesto seedlings, costs of plantations cultivation during the first four years (in the fifth year revenues cover the production costs). In modern intensive production of hazelnuts irrigation is also necessary and due to it in the investment summary of hazel plantation raising we have predicted a system of drip irrigation, as well as the cost of building a fence to prevent the intrusion of unwanted visitors and animals.

Table 1 Investment summary of hazelnut plantations rising.

	Types of costs	Amount (Euro/ha)
1.	Bedding of land and planting	3200
2.	Cultivation in first year	600
3.	Cultivation in second year	600
4.	Cultivation in third year	700
5.	Cultivation in fourth year	800
6.	Building a fence	1900
7.	Drip irrigation (approximate price)	2000
8.	Total	9800

Table 2. Overview of the hazelnut yield per year.

Year from planting	Yield in % from full fruitfulness
III	10%
IV	20%
V	40%
VI	80%
VII	100%

In the planned calculation all cost groups are included that charge the operating hazel planting in full yield in the seventh year and therefore the average yield is planned and the purchase price is provided on the basis of which the expected production gains are calculated.

Table 3. Planned calculation of hazelnut production in the 7th year of planting.

Types of costs	Unit	Per 1 ha	Price (Euro)	Amount (Euro/ha)
1	2	3	4	5
A: MATERIAL				
Fertilizer 1.Urea	kg	200	0,35	70
2.NPK 8:16:26	kg	350	0,30	105
3. Pesticides	kg	4	90	360
4. TOTAL				535
5.B: SERVICES				
6. Atomizer protection (5x)	w.day	0,7	60	42
7. Chisel plowing (2x) -Tillage	w.day	0,6	30	18
8. Transportation and distribution of urea	w.day	0,15	25	4
9. Harrowing	w.day	0,6	20	12
10. Transportation and distribution of NPK	w.day	0,15	25	4
11. Cultivation of fertilizers	w.day	0,3	30	9
12. Fruit harvesting (by shaking)	w.day	2	30	60
13. Costs of drying fruit	w.day			250
14. TOTAL				399
15. C: LABOUR				
16. Labour work	w.day	6	10	60
17. Pruning	w.day	6	10	60
18. Manual cultivation	w.day	10	10	100
19. Fruit collecting	w.day	15	10	150
20. TOTAL:				370
21. Total direct costs (A+B+C)				1.304

22. Indirect costs (10% to direct)				130
23. Depreciation of planting and fence (50 years)				143
24. TOTAL COSTS				1.577
25. ACHIEVED RESULTS	pcs	500x4kg=2.00 0kg	5	10.000
26. PROFIT (25-24)				8.423
27. Production cost-effectiveness (25:24)				6.34
28. The rate of profit (profitability income) 8,423 (gain) / 9.800 (Investment) x 100				85,95%

Cost effectiveness of production shows that on every euro of costs incurred in the seventh year of hazelnut production the production value of 6.34 euros is realized. The rate of profit that is the income profitability shows that in the seventh year of hazelnut on every euro invested in the production and cultivation of planting 85.95% euro profit is achieved. Taking also into account that even before the seventh year we have incomes we come to the conclusion that the production of hazelnuts is extremely cost effective and profitable.

Sensitivity analysis: (gross margin)

Yield (kg)	The product market price (euro/kg)		
	4,00	**5,00**	6,00
1.600	6.400	8.000	9.600
2.000	8.000	**10.000**	12.000
2.400	9.600	12.000	14.400

Change of yield +/- 20%
Market price changes +/- 20%

The sensitivity analysis shows the movement of gross margin depending on the change in yield and selling price of the product for a total of +/- 20%. It is clear that achieving positive margin is not affected, because even by reducing the yield and reducing prices by 20% we have the cost-effectiveness of production - on one euro invested in the production we realize 4,06 euros of production value.

Intensification of nut fruit production and especially of walnuts and hazelnuts is a significant prerequisite for achieving satisfactory production and economic results. Highly intensive production of walnuts and hazelnuts should ensure enriching the invested capital and high cost effectiveness of production that is high profitability of raised plantations, regardless of the high initial investment and a longer period before the entry of full-fruiting (Milic and Prenki , 2001).

Conclusion

For the investment in hazelnut plantations in one hectare, it is necessary to invest 9,800 euro, and this investment includes the cost of preparing the land and planting pesto seedlings, costs of plantings cultivation during the first four years (in the fifth year the revenues cover the production costs). In modern intensive production of hazelnuts irrigation is also necessary and due to it in the investment summary of hazel plantation rising we have predicted a system of drip irrigation, as well as the cost of building a fence. Costs and planned and the expected value of production in the year of full yield are predicted by the planned calculation. Cost effectiveness of 6.34 and profit rate of 85.95% is achieved by hazels production. The benefits of growing hazelnuts are seen from the performed calculations in relation to other types of fruits and they are reflected in the fertility of hazels for fifty to seventy years, thus leading to the conclusion that the investment is profitable and economically viable, which contributes to raising standards and ensuring the existence of Serbian enclaves in Kosovo.

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ECONOMIC PROFITABILITY OF MILK PRODUCTION AND POSSIBILITY OF ORGANIC SYSTEM DEVELOPMENT ON PEŠTER REGION FOR RURAL DEVELOPMENT CAUSE

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Abstract

This paper analyzes the dynamic of expenses structure and basic economic indicator in milk production of Pešter area in conventional conditions of production and possible price of produced milk in system of organic production. Although the investment in milk production is least profitable, the main strategy of Pešter population survival is primary milk producion. Considering this concernes hugely pasture space and large interest for milk production in organic system in local government as well as residents of this area, this paper presents some guidelines related to this type of production as a framework of rural development in southwest part od Serbia. Based on entire study reviews , it was concluded that the production of milk in Pester was full of structural problems. Development of organic livestock in Pester involves serious investment. Profitable milk production from organic systems depends not only on reduced costs while increasing quality, but also of customers purchasing power, culture and habit of healthy purchasing, trained personnel and similar. Reduced production volume manufacturer will compensated by higher selling price and various state incentives.

Key words: *milk, production, organic, conventional, rural development*

Introduction

According to the results of the IFCN (International Farm Comparison Network)[1], in the long terms is expected a continuing increase in the world price of milk. However, in the short run, increasing price volatility is expected as a result of extremely low inventories that are available right in the event of a shortage. During 2014th is expected for the volume of milk production to meet demand and relaxing prices. In the next decade is expected to increase production by an additional 230 million tons, which will maintain the balance with the growing demand. The demand for dairy products increases under the influence of two factors: population and increasing per capita consumption in countries with rising living standards. Milk production is growing only in some countries with growing economies mainly the number of farms.

Experiences from countries where organic livestock farming already has a longer tradition shows that organic farming organization of ruminants, whose nutrition is based on pastures and solid food (cattle, sheep and goats), is not a bigger problem. In the production of the food Serbia has all conditions and excellent chance. Serbian Chamber of Commerce has proposed to declare all its space for the area without genetically modified products, i.e. the region where developed organic farming is and where is produced healthy safe food.

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[1]Established in 1997, is a global network of researches in the field of economics in milk production from more than 90 countries that produce 98% of world milk production. Foci of IFCN network in world milk production are the most important elements in the supply chain of dairy products: production costs, resource use, farm management results, emissions and political challenges (agricultural policy)

This study includes dairy sector of Pešter. The region grows about 67.447 sheep and more than 52.608 head of cattle, and by strategic documents with relatively small investments livestock could be doubled. The aim of this study is to present the main issues of introducing organic livestock production system in the same area.

Materials and methods

Besides analytical synthetic methods, by theoretical analysis is defined the meaning of concepts, theoretical framework of this study and analysis of the relevant literature. The research was based on the primary data as well as the secondary data source. Based on the obtained results, we can design a strategy of rural development based on appropriate utilization of the rural capital areas. The overall objective of sustainable development is to create economically viable and environmentally acceptable milk production, which would be the basis for rural development and the basis of the existence of the rural population in studied region. Problems in preparing calculations of milk production are different data, and therefore should be continuous efforts to further improvement of the source data quality.

Results and discussion

Daily people give more importance to organically produced food, in a natural biologically expedient manner. The main reasons for the expansion of organic farming in the world are the results of medical studies that indicate an increase in health risks when consuming food units originating from intensive conventional production. WTO data indicate that pesticide poisons about three million people each year. Food produced under the principles of organic agriculture is safe from the presence of any artificial synthesized substances as well as pesticides.

Characteristic of studied region
Observed area is one of the most economically underdeveloped areas of Serbia. It has a huge pasture and meadow areas which are traditionally used for livestock production, and livestock production has traditionally been an important source of household income. Livestock production in the region primarily involves cattle and sheep breeding (67.447 sheep and more than 52.608 head of cattle). The area has great potential for the development of organic livestock, particularly in organic farming of ruminants. Organic animal husbandry and agriculture are actually the only possible way of development of poor regions. Pastures in the region have low yield which results in many years of unplanned use and constant degradation of grasslands. With some ameliorative measures yields would be significantly increased. Compared with the largest dairies in Serbia, studied dairies have relatively short supply lines which transport costs are reduced. Most households have one to three cows, but they are more numerous and considerably younger than the households in Central Serbia and Vojvodina. Weaknesses of areas for the organic food production are manifested through the lack forage, poor modernization and introduction of technological solutions, of seasonal character in livestock production, poor infrastructure, fragmentation of property (from 1.01 to 3 ha), lack of processing capacities, lack of financial resources, high level of illiteracy in the rural population and the lack of purchasing stations for livestock products If weaknesses were lined up hierarchical, certainly the priority would be given to poor infrastructure. Chances for rehabilitation and sustainable development of organic livestock production can be seen in international development and national rural development programs, increased support of local governments, increasing the processing capacities and support to existing ones, better developed capital markets and similar. The most important internal forces are reflected in rich livestock fund, rich tradition in milk and dairy products production, a large number of young working age population, large pastures and meadows and non treated surfaces by synthetic chemicals. The analysis of the factual situation speaks that the weaknesses overcomes strength, chances overcome threats, and such internal external matrice supports the development strategy of the sector.

The calculations of gross margin for milk production in conventional production

The goal of each production, including farming, is to maximize the total gross margin. Variable costs are those which vary in amount depending on the size of production. In livestock production variable costs usually include: livestock feed, water, veterinary services, medicines and similar. Fixed costs are those which exists on the farm for one year, regardless of whether it does business or not.

Calculation of gross margin, presented in the table refers to the production of cow's of on the farm from Pester which owns 10 dairy cows of Simmental breed, with average annual milk production of 4500 liters, overhaul of heifers from their own herd of the number of received calves is 0.8, and the excreta of cows is 0.2. It should be noted that none of the calculations is perfect (rarely are calculated amortizations of milking and facilities). During data collection purchase prices of milk were from 32 - 35 rsd[1].

Table 1. Calculation of gross margin for milk production in conventional production

	Income	Amount	Measure unit	Price (RSD)	Amount (RSD)
1.	Milk sold to dairy	27.000	l/year	32	864.000
2.	Milk sold for consumption	3.650	l/year	45	164.250
3.	Milk for calves	3.750	l/year	32	120.000
4.	Milk for household	10.600	head of cattle	32	339.200
5.	Calves	10	head of cattle	20.000	200.000
6.	Livestock manure	150	t	1.500	225.000
7.	Subsidies	10	rsd/ head of cattle	20.000	200.000
A	**Total income (1 -7)**				**2.112.450**
Variable costs					
1.	Concentrated fodder	21.900	kg	28,00	613.200
2.	Fodder	91.250	kg	7,32	667.950
3.	Litter	18.250	kg	2,00	36.500
4.	Veterinary services				80.000
5.	Insemination	10	dose/ head of cattle	2.000	20.000
6.	Water		rsd/ head of cattle	900	9.000
7.	Services				200.000
8.	Supplies				20.000
9.	Interest on variable costs				102.165
B	**Total variable costs (1-9)**				1.748.815

Based on composed calculations was made a summary of the costs and some additional indicators of production. The most important item in the cost structure are fodder (39.15%) and concentrated fodder (35.94%), labor costs (11.72%) and veterinary services (5.8%). Food participates with 77% of the total cost of milk production. Production efficiency is 1.05 and safety level is 32.08, which clearly demonstrates that this type of production is on the verge of profitability, as is the case with many production in Serbia

What would be the price of milk produced in organic systems? Price of organic milk is 25-40% higher than the price of milk obtained in the commercial production. According to the analysis of Sredojevi (2002), calculations on milk production in organic process shows that such milk has reason to be more expensive by 40 per cent from the ordinary one. As any manufacturer, dairy farmers are also primarily interested in profit.

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[1] Serbian dinar

Table 2. Summary of costs and performance indicators

	Income	Amount in RSD	% participation
1.	Milk	1.487.450	70,41
2.	Calves	200.000	9,47
3.	Livestock manure	225.000	10,65
4.	Subsidies	200.000	9,47
A	Total income (1-4)	2.112.450	100,00
	Variable costs		
6.	Concentrated fodder	613.200	35,06
7.	Fodder	667.950	38,19
8.	Litter	36.500	2,09
9.	Watter	9.000	0,52
10.	Insemination	20.000	1,14
11.	Veterinary services and medicines	80.000	4,57
12.	Supplies	20.000	1,14
13.	Labor services	200.000	11,44
15.	Interest on variable capital 10%	102.165	5,85
B	Total variable costs (6-15)	1.748.815	100,00
C	Gross margin, coverage margin (A –B)	363.635	
D	Estimated fixed costs (15 % from variable costs)	246.903	
E	Total costs (B+D)	1.995.718	
F	Profit (A-E) or (C- D)	116.732	
G	Efficiency of production (A : E)	1,06	
K	Profit rate (C : E) x100	18,22	
H	% of margin participation cover in operating expenditures (C : A) x 100	17.21	
I	Breakpoint of profitability (D : H) x 100	1.434.648	
J	Level of safety (A – I): A in %	32,08	

For this reason, according to Sredojevi (2002), is very important for comparison of cost per unit of resulting products to be done, ie their costs in conventional conditions and the costs of products in organic conditions. Based on the calculation the level of variable costs and differential calculations in milk production, the lowest prices that are economically viable for producers are established. Of course that other factors also affects the selling price, and such are: supply and demand, the purchasing power of consumers etc. Gross margin is the difference between total revenue and total variable expenses expected in production (in agriculture is usually a period of one year). The milk cost from conventional production, according to data from the calculation is:

$$Mc = (1.995.718 – 625\ 000) : 45\ 000 = 30,46\ rsd$$

Based on the calculation cost of 1 liter of milk produced in the conventional production methods and research results of Sredojevi (2002), the cost of organic milk production would be by 40% higher, or 42.64 rsd.

How to reduce variable costs? From an organizational point of view, in order to efficiently and productively production, it is necessary to divide cows according to stage of lactation on product groups. Division of cows in production groups is necessary for, according to the needs of each group, a suitable meal should be put together. Exposed calculations clearly

show that in the structure of variable costs, the highest percentage are food costs. Proper eating habits will not only be able to reduce the costs meal, but also the costs of treatment. In the stables with associated system of rearing, every cow gets an individual meal, but with freestyle of keeping when in a group are held together highly productive and low productive cows, it is not possible for each cow separately to provide a desired meal. Considering this is necesary to separate cows by product groups.

Conclusion

The aforementioned milk production in organic system was chosen for study for it is mentioned as an important development resource of the region examined region, regardless of the limits to their exploitation. Pester dairy sector is very important and has significant potential for further development, primarily because it includes a large number of manufacturers and thereby contributes significantly to rural development of the region. This sector is due to the quantity and nutritionally significant consumption, important for the food security of the country, but in the case of poor quality control and degradation of sanitation can represent a serious risk to human health. Sector, which is the most demanding by standards to be met when joining the EU may be one of the major obstacles in joining the Serbian agriculture to common agricultural policy of EU. Development of organic livestock in Pester involves serious investment. These investments are primarily related on investment in human capital development in rural areas, the development of transport and telecommunication infrastructure, water supply network, the establishment of new processing capacities, various ameliorative measures, improvement of breed composition, formation of purchasing stations, supporting clusters, associations and cooperatives, raising silo facilities etc. One of the main ways to increase profitability in organic livestock production is the reduction of operating costs that manifest through the reduction of cost per unit of product, or service. It is important to emphasize that this is about lowering costs while increasing quality. Except the aforementioned facts, should be noted that the profitability of organic production depends on the purchasing power of customers, culture and habit of buying healthy, trained personnel and etc. Reduced production volume manufacturer will compensate for higher selling price and various state incentive measures. The new Law on incentives in agriculture and rural development, adopted January 30th 2013., minimum amounts of incentives were established, and the Government of the Republic of Serbia, by its Decree on the allocation of subsidies in agriculture and rural development, has determined the maximum amounts. Incentives for organic production increased by 40% compared to conventional production incentives. Bearing in mind the potential possessed by this region, the dairy industry may be the backbone of the agricultural and rural development in the region and Serbia itself.

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PREDICTIONS OF TOMATO PRODUCTION CHARACTERISTICS IN SERBIA

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Abstract

In this work are analyzed tomato production characteristics in Serbia, in the period 1991-2010 year. Production characteristics are: harvested area, yield and year production. Based on that time series, by using the ARIMA model, the production characteristics of tomato were predict until year 2015. Results of analysis are show that the average harvested area of tomato in Serbia in observed period was 20.277 ha, and shows a slight tendency of increasing (change rate 0.29 %). Yield of tomato was 8.6 t/ha, and shows a very slight tendency of decreasing (change rate -0.28 %). Year production was very stable, with average of 174.000 tons, and change rate of 0.01%. The results of prediction show that area of tomato slightly decreasing in predicted period, and in 2015 will be about 20.000 hectares, what is les than 1.200 ha than maximal area in observed period. The yield of tomato also slightly deceasing in predicted period, and in 2015 will be about 8.8 t/ha. Total production of tomato also decreasing in observed period, and in 2015 will be on the level of 177.000 tons.

Key words: *tomato, production, analysis, prediction, Serbia*

Introduction

About forecasting, by using quantitative methods and models in agriculture, write many authors. Jankovic et. al. (2007) predicts development in cattle breading in Serbia. Mutavdzic et al. (2007), in their papers made analysis and predict parity of maze/pig prices. Novkovic et al. (2006) made analisis, and predict parity of wheat/mineral fertilizers prices. Tendency of vegetables development were observ by: Mutavdzic et al. (2011, 2011a), Novkovic et al. (2011, 2012, 2012a, 2013) and Ostojic et al. (2012). Mutavdzic et al. (2013), Novkovic et al. (2009, 2013a) predict tendency in vegetables and potato production.

Subject of this paper is tomato production characteristic in Serbia. The main objective is to predict harvested area, yield and year production of tomato in Serbia, until 2015.

For the prediction will be used ARIMA model, based on data of tomato production in Serbia in the period 1991-2010.

Materials and methods

In this research the quantitative methods are implemented. Observed period of analyzed data is 1991-2010. The data source is official publication of the Institute of Statistics of Serbia, and their databases. Analysis is base for prediction in the future. The goal of this research is to predict tomato production parameters (harvested area, yields, production) in Serbia for the period 2011-15. On the base of observed time-series, there were formulated and tested models of time-series, which are lately used for prediction time-series in the future. Verification of prediction models are done by statistical tests and criteria for review models. For prediction are used ARMA $_{(p,q)}$ models. Program Statistica 10 are used for creating the models, and predict values.

Result and discussion

Basic characteristics of tomato production in Serbia in period 1991-2010 are presented in Table 1. Harvested area, yield, and year production were very stable, which proves low coefficients of variation, and changing rate.

Table 1. Basic characteristics of tomato production in Serbia, in the period 1991-2010

Parameters	Average value	Interval of variation		Coefficient of variation (%)	Change rate (%)
		Minimum	Maximum		
Harvested area (h)	20,277	18,425	21.209	4.16	0.29
Year Production (t)	174,390	140.725	199.184	9.68	0.01
Yield (t/ha)	8.60	7.39	9,90	9.05	-0.28

For analysis of harvested area under tomato, review model (Table 2) shows that for harvested area in present year, significant influence have harvested area from the previous year.

Table 2. Parameters of model for prediction harvested area under tomato

Paramet.	Input: POVPARAD (povrcesrbija) Transformations: none Model:(1,0,0) MS Residual= 2564E2					
	Param.	Asympt. Std.Err.	Asympt. t(18)	p	Lower 95% Conf	Upper 95% Conf
Constant	19234,27	603,5248	31,86990	0,000000	17966,32	20502,23
p(1)	0,94	0,1060	8,90852	0,000000	0,72	1,17

Contrary from the analysed, in predicted period harvested area under tomato shows insignificant decreasing. That prove predicted areas in the period 2011-15 (Table 3). In last year of predicted period (2015) tomato area is about 20,000 ha, what is lower for 1,200 ha than maximal value in analyzed period.

Table 3 Prediction of areas under tomato (2011-15)

CaseNo.	Forecasts; Model:(1,0,0) Seasonal lag: 12 (povrcesrbija) Input: POVPARAD Start of origin: 1 End of origin: 20			
	Forecast	Lower 50,0000%	Upper 50,0000%	Std.Err.
21	20128,25	19779,69	20476,82	506,365
22	20078,44	19599,04	20557,85	696,444
23	20031,41	19460,07	20602,75	829,998
24	19987,00	19344,68	20629,31	933,100
25	19945,06	19245,51	20644,61	1016,249

Tendencies in changing of tomato areas are presented on Graph 1.

Graph 1 Changes in tomato harvested areas
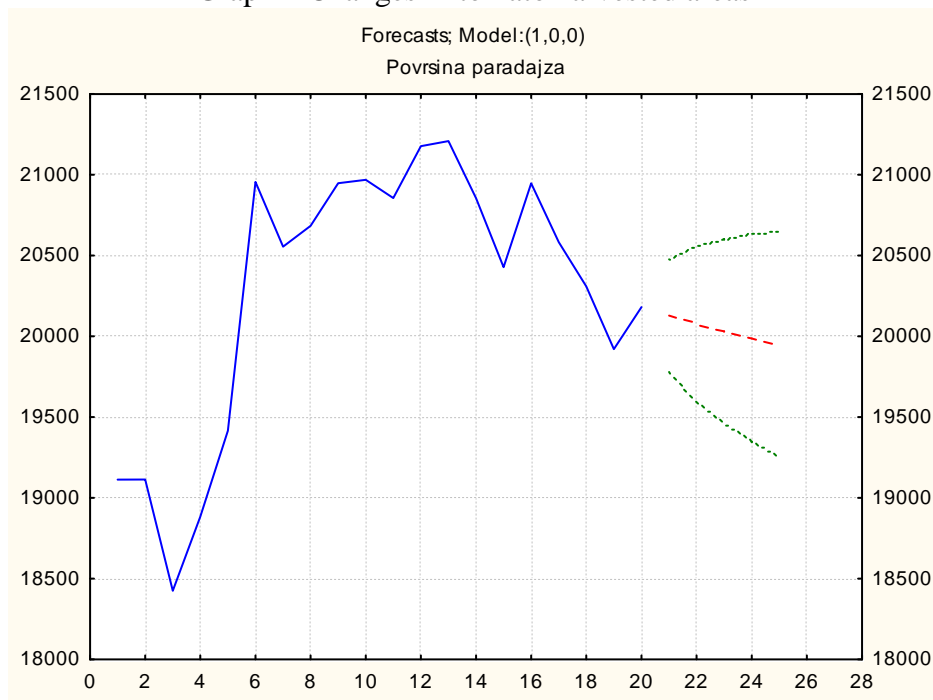
Year production of tomato show characteristics similar like tomato harvested area. Review model for prediction of year production of tomato (Table 4), show that significant influence on value of production in present year have production of tomato in previous year. Predicted values of tomato production (Table 5) have tendencies of insignificant decreasing in the period of prediction.

Table 4 Parameters of model for prediction of tomato production

	Input: PROIZPAR (povrcesrbija) Transformations: D(1) Model:(0,1,1) MS Residual= 4231E5					
Paramet.	Param.	Asympt. Std.Err.	Asympt. t(17)	p	Lower 95% Conf	Upper 95% Conf
Constant	-105,584	1119,567	-0,094308	0,925967	-2467,66	2256,495
q(1)	0,849	0,178	4,776580	0,000175	0,47	1,224

Table 5. Prediction of year productions under tomato (2011-15)

	Forecasts; Model:(0,1,1) Seasonal lag: 12 (povrcesrbija) Input: PROIZPAR Start of origin: 1 End of origin: 20			
CaseNo.	Forecast	Lower 90,0000%	Upper 90,0000%	Std.Err.
21	177846,1	142063,5	213628,8	20569,40
22	177740,6	141551,4	213929,8	20803,09
23	177635,0	141043,7	214226,2	21034,19
24	177529,4	140540,5	214518,3	21262,78
25	177423,8	140041,5	214806,1	21488,93

Tendencies in changing of tomato year productions are presented on Graph 2.

Graph 2. Changes in tomato year production
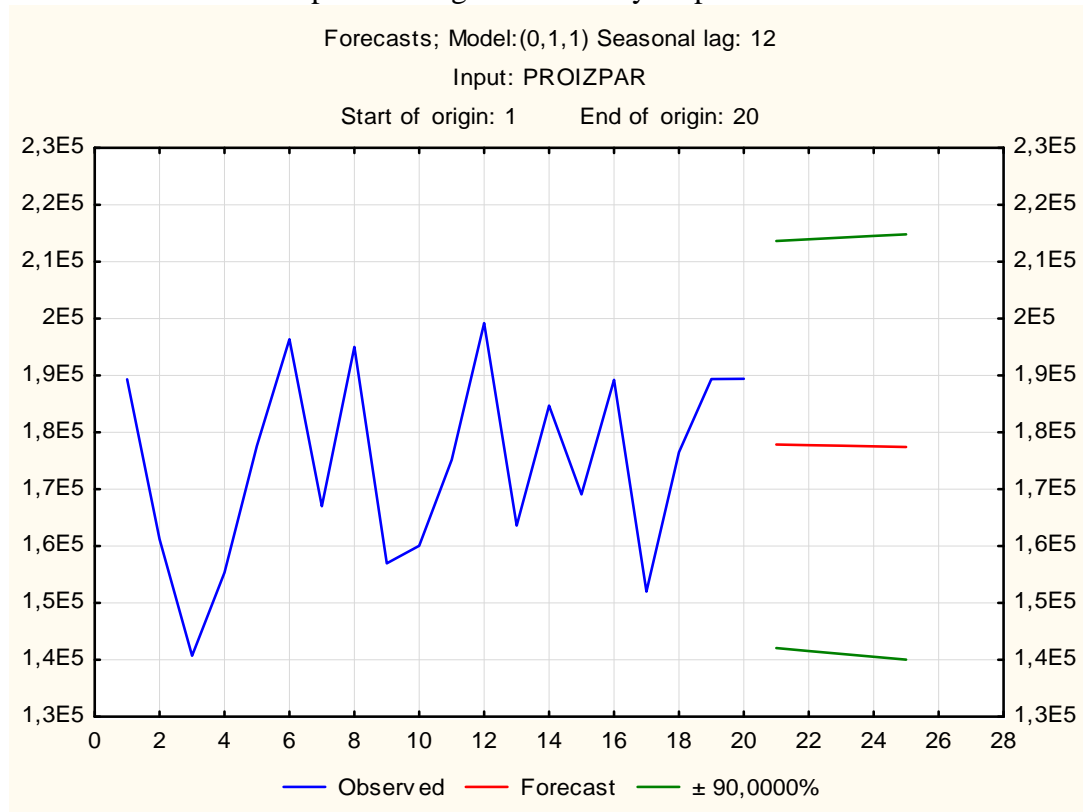
Model for tomato yield prediction (Table 6), show that yield in present year have significant influence yield from previous year.

Table 6. Parameters of model for prediction of tomato yield

Paramet.	Input: PRINPARA (povrcesrbija) Transformations: D(1) Model:(0,1,1) MS Residual= 9794E2					
	Param.	Asympt. Std.Err.	Asympt. t(17)	p	Lower 95% Conf	Upper 95% Conf
Constant	-21,8648	83,05874	-0,263245	0,795526	-197,103	153,3738
q(1)	0,6866	0,20322	3,378782	0,003568	0,258	1,1154

Values of tomato yield (Table 7), based of model for prediction shows that, yields, like area and production of tomato have tendencies of insignificant decreasing. Predicted yield of tomato, at the end of predicted period (2015) will be 8.8 t/ha.

Table 7 Prediction of yields under tomato (2011-15)

CaseNo.	Forecasts; Model:(0,1,1) Seasonal lag: 12 (povrcesrbija Input: PRINPARA Start of origin: 1 End of origin: 20			
	Forecast	Lower 90,0000%	Upper 90,0000%	Std.Err.
21	8866,030	7144,449	10587,61	989,638
22	8844,165	7040,043	10648,29	1037,086
23	8822,300	6939,252	10705,35	1082,456
24	8800,435	6841,638	10759,23	1126,000
25	8778,570	6746,847	10810,29	1167,921

Conclusions

Results of tomato analysis in the period 1991-2010 in Serbia show that the average harvested area of tomato was 20.277 ha, and shows a slight tendency of increasing (change rate 0.29 %); Yield of tomato was 8.6 t/ha, and shows a very slight tendency of decreasing (change rate -0.28 %). Year production was very stable, with average of 174.000 tons, and change rate of 0.01%.

The results of prediction show:

- Area of tomato slightly decreasing in predicted period, and in 2015 will be about 20.000 hectares, what is les than 1.200 ha than maximal area in observed period;
- The yield of tomato slightly deceasing in predicted period, and in 2015 will be about 8.8 t/ha;
- Total production of tomato also decreasing in observed period, and in 2015 will be on the level
  of 177.000 tons.

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POTATO PRODUCTION CHARACTERISTICS ‑ COMPERATIVE ANALYSIS IN EUROPEAN UNION COUNTRIES AND SERBIA

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Abstract

This paper analysed potato productions in some important producer countries of European Union (EU). The analysis included six countries: Germany, Spain, France, Netherland, Poland and Romania. The following production characteristics are analysed and statistically processed: area of production, yields and harvested production. Nominated countries encompass about 82% of total production of potato in EU.

This research included official statistical data from „EUROSTAT" for the period of 13 years, 2000-12. Descriptive statistical analysis included accountings of: average and extremes values of characteristcs, coefficient of variations, and change rate. The results of analysis have been compared with the same data in Serbia.

The results of analysis show the next:
- It is present tendency of decreasing the areas of potato in all observed countries. The largest areas of potato have Poland (665.000 ha), Germany (273.000 ha), and Romania (265.000 ha). The average potato area in Serbia in observed period was 85.000 ha.
- Opposite of areas, yields of potato have tendency of increasing (except Romania). Three countries have (almost, the same) the highest yields: Netherland (44.1 t/ha), France (42.2 t/ha) and Germany (41.6 t/ha). Average yield of potato in Serbia is 10.5 t/ha.
- The all of obsereved EU countries have tendencies of decreasing production. The largest producer of potato in EU is Poland, with about 12,6 million tons. Next are Germany (11,4 million tons). Average production of potato in Srebia is 886.000 tons per year.

Key words: *potato, production analysis, EU countries, Serbia*

Introduction

The main six countries in potato production in European Union are: Germany, Spain, France, Netherland, Poland and Romania.

Novkovic et al. (2008, 2013) analysed vegetables production in Serbia and Vojvodina region in the period 1981-2007. Vegetables production in Vojvodina region is about 5% in the production structure of plough land, what is fare from Serbia, where is that share 8, 5%. Area under vegetables is very stable. Tendency of low increasing is present in Serbia, and low decreasing is present in Vojvodina region.
Mutavdzic et al. (2010), using regression models observe influence of yield and total production of some important sorts of vegetables in actual year, on sowing area in the next year. In general, in vegetables production, yield and total production don't have influence on sowing are in next year, as it is case of crops and industrial plants. Mutavdzic et al. (2011) analyzed natural results in vegetables production in Serbia in period 2001-10 year. Results of

analysis are compared with adequate for the period from previous decade, 1992-2000. For last ten years, vegetables production in Serbia increase in all observed sorts of vegetables. Novkovic et al. (2012, 2012a) analysed vegetable production in the Republic of Srpska (RS), and comparatively analysed vegetable production in Serbia and RS.
Novkovic et al. (2013a) defined statistical model for predicting potato production parameters in Germany, Serbia and Vojvodina region.

The main objective of this paper is to analyze production characteristic of potato in main six potato producer countries in EU and to compare obtained data with Serbia. Harvested area, yield, and total year production of potato were analyzed.

Materials and methods

This research included quantitative methods. The descriptive statistical analysis included harvested areas, yields and total year productions of potato in six important potato producer countries in European Union and Serbia. Analyzed period is 2000-12. Data have been processed by standard statistic measures: average value ($\overline{X}$) of characteristics in observed period, extreme values (minimum-maximum), coefficient of variation (CV), and change rate (r). Different data sources have been used for research such as official published data of „EUROSTAT" and of the Serbian Statistical Office. After separate analysis for EU countries and Serbia, the comparative analysis between EU and Serbia was done.

Results and dissccusion

Analysis of Potato Areas

The results of statistical analysis about harvested areas of potato in the important producer countries in EU for the period 2000-12, are given in Table 1. Extremely the largest harvested area under potato has Poland (2.4 times more than Germany which took the second place). Also, Poland shows extremely high variation of areas. Romania, on the third place has similar harvested areas as Germany. The same situation is with the Netherlands and France, on 4th, and 5th place. All observed countries shows negative change rate of areas, France symbolic, and Poland extremely high.
Area under potato in Serbia was similar as it is in Spain, coefficient of variation is as on the level of Germany and Romania. Harvested area under potato in Serbia also show negative change rate in observed period.
In the future, can be expectance of further reducing harvesting area under poteto in main EU countries, potato producers.
Real data of harvested areas of potato in main EU countries – producers in the observed period (2000-12) are presented on Graph 1 where can be seen extremely drop of harvested area of potato in Poland (from more than 1 million hectares, to less than 400.000), and relatively stable areas in other countries.

Table 1 Basic indicators of potato harvesting area (000ha) in studied EU countries and Serbia (2000-12)

Countries	Average $\overline{X}$ (000 h)	Interval of variation		Coefficient of variation CV (%)	Change rate r (%)
		Minimum	Maximum		
Germany	273.41	238.30	304.40	6.62	-2.02
Spain	88.95	54.20	118.80	19.42	-4.09
France	158.95	154.10	163.60	1.80	-0.45
Netherland	159.51	150.00	180.20	4.81	-1.52
Poland	664.20	373.00	1,250.60	42.67	-9.59
Romania	265.49	228.90	284.90	6.82	-1.74
Serbia	84.35	75.45	93.90	7.58	-1.81

Graph 1 Changes in harvested areas of potato in 000 ha, in period 2000-12
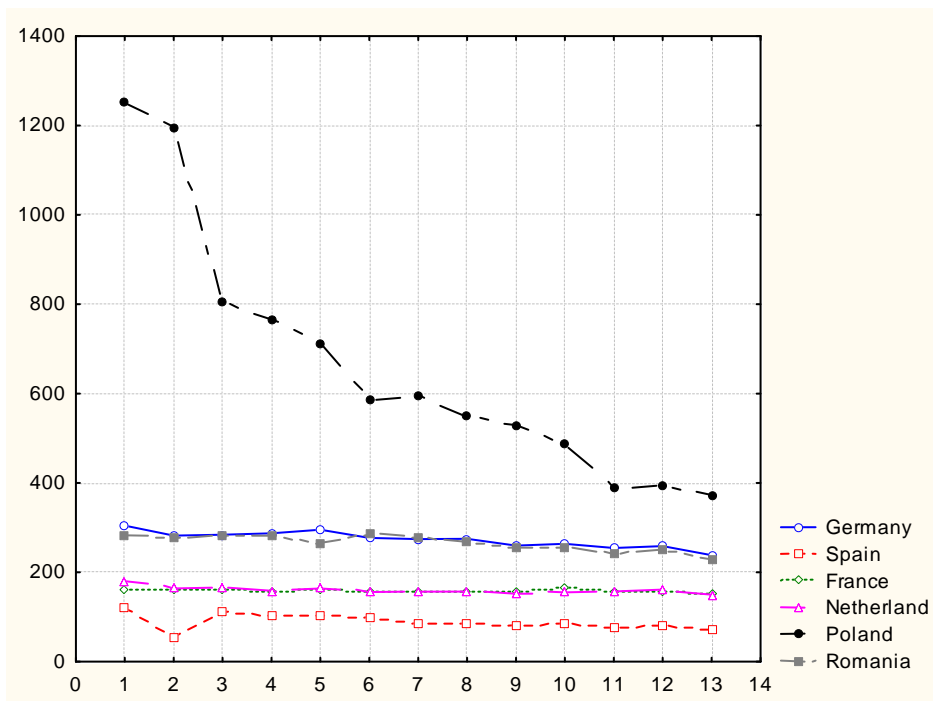
Analysis of Potato Yields

Statistical data about yields of potato in observed EU countries are presented Table 2. The highest average yield of potato in the period 2000-12 had the Netherlands, with about 44t/ha. Very near is France and Germany, with yield lover for 4.2 and 5.6%. Spain, on the 4th place had average yield lower than the Netherlands for 31%, Poland 56%, and Romania 68% lower yield. The highest variation of yield, showed Spain, and the lowest Netherlands. All observed countries (except Romania which shows low decreasing tendency) shows low tendency of increasing of potato yield. The potato yield in Serbia was extremely low. It was 4.4 times lower than the highest in EU (The Netherlands), and 28.5% lower than in Romania which is on the last place. Potato yield in Serbia had high coefficient of variation (only Spain had higher), and tendency of increasing, in observed period. Real data of potato yields in main EU countries – producers in the observed period (2000-12) are given on Graph 2.

Table 2 Basic indicators of yield of potato (00kg/ha) in the period 2000-12

Countries	Average $\overline{X}$ (00kg/ h)	Interval of variation		Coefficient of variation CV (%)	Change rate r (%)
		Minimum	Maximum		
Germany	416.37	345.10	457.60	8.05	0.27
Spain	303.98	258.90	552.10	25.37	1.35
France	422.59	374.40	462.00	6.10	0.27
Netherland	441.05	400.50	462.70	4.48	0.002
Poland	194.93	150.40	242.40	13.18	1.88
Romanija	140.92	107.60	165.50	10.87	-1.09
Serbia	100.17	661.20	115.73	16.88	1,23

Graph 2 Changes in yields of potato in 00kg/ha, in period 2000-12
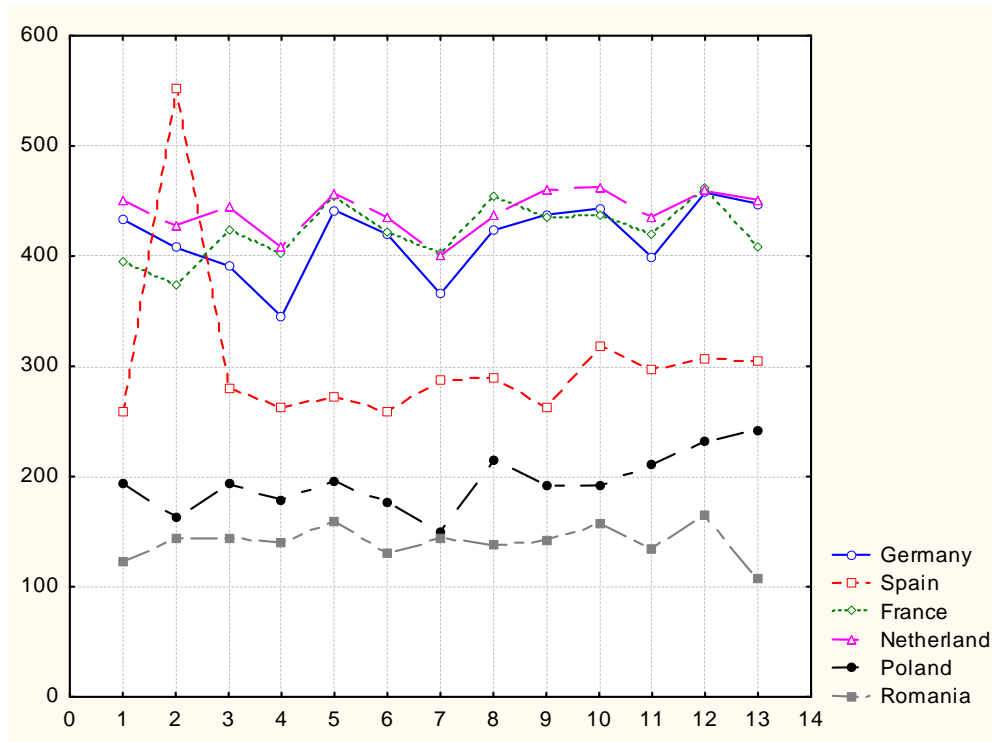
Analysis of total potato productions

The results of statistical analysis related to potato productions per year in EU, important producer countries in EU and data for Serbia during the period 2000-12 are given in Table 3. In average, EU produces about 55 million tons of potato per year, and show low tendency of increasing (less than 1% per year). As for of potato production in EU during the studied period, the first place took Poland, mainly thanks to its harvested area. On the second place, is Germany, mainly thanks to its high yield, but, in the second part of the observed period Germany took primate (Graph 3). Both countries show high rate of decreasing potato production, but Poland much higher than Germany.

Table 3 Basic indicators of potato year production (000t) in studied EU countries and Serbia (2000-12)

Countries	Average $\overline{X}$ (000t)	Interval of variation		Coefficient of variation CV (%)	Change rate r (%)
		Minimum	Maximum		
EU	55,198.79	40,996.40	66,021.00	14,64	0,94
Germany	11,366.59	9,915.70	13,193.00	9.01	-1.76
Spain	2,615.15	2,146.90	3,078.10	11.90	-2.79
France	6,716.15	6,049.60	7,280.90	6.17	-0.18
Netherland	7,035.72	6,239.60	8,126.80	6.83	-1.52
Poland	12,602.87	8,187.70	24,232.40	37.82	-7.89
Romanija	3,744.44	2,463.90	4,230.20	12.65	-2.81
Serbia	842.29	577.97	1,015.02	16.79	-0.60

Graph 3 Changes in year production of potato in 000t, in period 2000-12
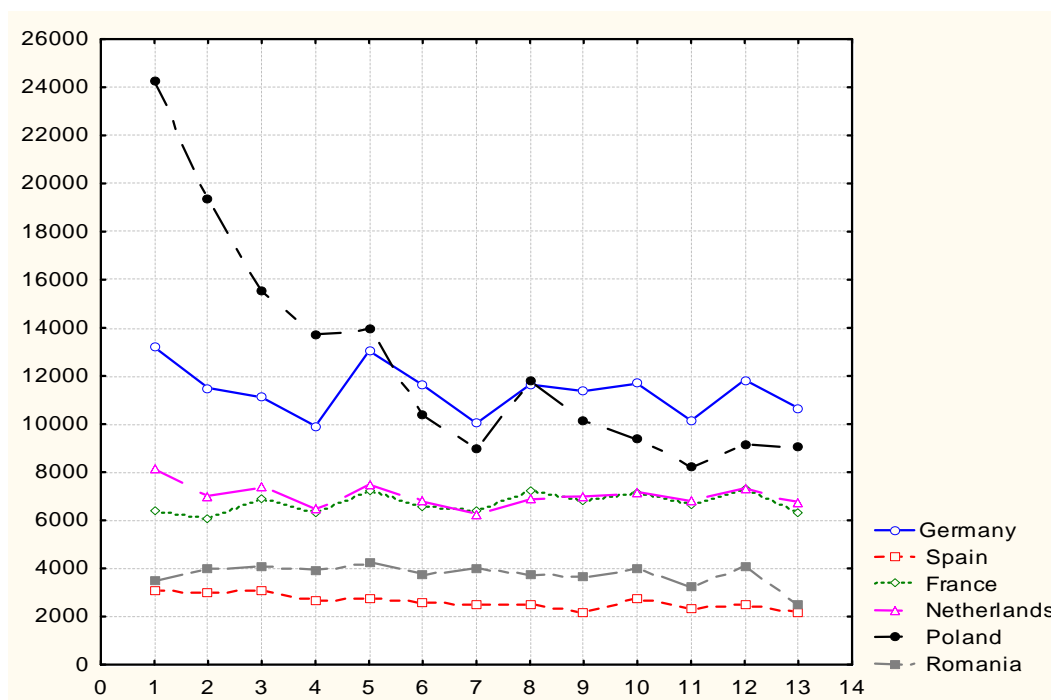
The Netherland and France took the 3rd and the 4th place of potato producers in EU with similar level of year production (44.4% and 46.8% lower than Poland). On the 5th and 6th place are Romania and Spain (3.4 and 4.8 times lower production than Poland). All main countries in EU had negative change rates of year production of potato even EU shows tendency of increase. That mean, that potato production increase in other EU countries. Serbia is not competitive with its year production. Also, Serbia show negative change rate, too.

Conclusions

The characteristic of potato production in EU and Serbia, in the period 2000-12 in generally was:
- Poland had the largest harvested area under potato (2.4 times more than Germany on the second place). All six observed countries shows negative change rate of harvested area under potato. Serbia had similar area under potato as Spain on the 6th place, and show tendency of decreasing.
- The Netherland had the highest yield of potato (44t/ha). Serbia, had 4.4 les (10t/ha). All observed countries show tendencies of increasing yield of potato.
- Poland (12.6 mill.ton), and Germany (11.4mill.ton) participate with 43.6% of total year production of potato in EU.

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WINE TOURISM AS A FACTOR OF RURAL DEVELOPMENT OF FRUŠKA GORA (VOJVODINA PROVINCE)

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Abstract

The authors emphasize the importance of developing wine tourism for rural development of Fruška gora. Fruška gora has a long historical and cultural tradition of over 1,700 years in viticulture and wine production in the Republic of Serbia. This tradition is a result of the excellent climate and soil conditions. Although there are significant land resources in the area of Fruška gora for grape production, lower part of the area is intensively farmed, which is a limiting factor for the development of wine tourism. In recent years there has been a growth in wine tourism and other related activities in the area (activation of private museums, ethno-house, wine cellar, etc.). However, despite the existing potential, wine tourism on Fruška gora is at the beginning of development since the wineries are not organized to achieve the maximum benefits from wine tourism. The authors point out that it is necessary to improve viticulture and wine production to ensure a better tourist offer of wine roads. A better organization within the wine tourism is necessary in order to attract and motivate a greater number of tourists. The importance of wine tourism in rural development of Fruška gora is that through initiating the development of a series of related economic activities (agriculture, industry, education, trade, transport, hospitality, manufacturing, etc.), which contributes to improving the socioeconomic living conditions of the local population.

Key words: *wine tourism, wine roads, rural development, Fruška gora, Vojvodina*

Introduction

Wine tourism is the subject of a large number of studies all over the world. Because of its specificity and complexity, the definition is not unique. Johnson (1997) was among the first that defined wine tourism as "*a visit to the vineyards, wineries, wine festivals and exhibitions that are organized for the purpose of recreation*", and then in the study, "*Wine tourism in the world*", Hall et al. (2000) presented a definition for wine tourism which means "*a visit to the vineyards, wineries, wine festivals and wine exhibitions, with wine tasting and / or experience attractions, wine-growing region are the primary motives*". Although there is no unique definition, many authors are in agreement about the premise that wine tourism is an important component of the wine industry and tourism, and that it brings many economic and social benefits, especially in rural areas (Olaru, 2012; Pivac, 2012; Presenza, et al., 2010). Viticulture of Fruška gora has a long tradition. It is assumed that the grape vine is autochthonous plant species in the Fruška gora, but seriously dealing with viticulture refers to the period from the third century AD, when the Roman Emperor Probus increased areas planted with vines by draining wetlands of Fruška gora. Viticulture of Fruška gora since then had ups and downs, caused primarily by permanent colonisations and conquests of this area. At the present time, winery owners in Fruška gora are becoming to deal more with tourism, because they realized that the economic and social benefits of wine tourism are significant (e. g. increased sales of wine "from the cellar"). Tourist product of wine tourism in Fruška gora is diverse and consists of, besides the winery and cellars, also numerous museums dedicated

to winemaking and viticulture, the manifestations dedicated to wine and the grape vine, and established wine routes.

The aim of this paper is to consider the characteristics of the wine tourism in Fruška gora's vineyards, to determine the current state, and analyze the degree of attractiveness of the existing offer of winery owners.

Materials and methods

In order to achieve the objectives, we used a number of methods such as historical research methods (review of existing international and domestic literature, written documents, etc.), methods of analysis, descriptive method, critical, empirical method to identify individual demographic characteristics and rural development in the region of Fruška gora, and a method of observation of the winery of Fruška gora.

Results and discussion

About the region of Fruška gora

The region of Fruška gora includes municipalities of Sremski Karlovci, Petrovaradin and Beo in, which are entirely in this area. Municipalities of Irig, In ija, Šid, Ba ka Palanka and Ruma, and the city of Sremska Mitrovica are partially included in the coverage of this area. The central and highest part of this region is incorporated into the National Park, which is surrounded by villages and agricultural land with extensive use. In a broader scope there are larger settlements, as well as areas that are intensively used. Agriculture is the traditional and main economic activity in this area. Tourism is the second most important business. National Park "Fruška gora" is the first national park in Serbia (established in the 1960s) and represents a natural resource of great importance for the country.

Viticulture of Fruška gora as a precondition for the development of wine tourism

Contemporary viticulture of Fruška gora is based on conventional production with mostly white wine varieties of grapes. In accordance with the recommendations, there are possibilities of organizing organic grape production at approximately 10% vineyards of this area, which are right near the national park "Fruška gora" (Univerzitet u Novom Sadu, 2011). The largest part of this production is realized on small holdings, at about 1,500 ha of fertile vineyards (Univerzitet u Novom Sadu, 2011).

According to the data available for 2013, for municipalities and the cities which are part of the region Fruška gora[1] vineyards were represented in approximately 2,000 ha:[2]

- 233 ha in Petrovaradin;
- 167 ha in Ba ka Palanka;
- 317 ha in Beo in;
- 237 ha in Sremski Karlovci and In ija;
- 236 ha in Irig,
- 540 ha in Šid;
- 22 ha in Ruma, and
- 56 ha in Sremska Mitrovica.

In terms of total production in the cultivation of grapes, the highest production in 2013, was achieved in municipality of In ija with about 5,914 tons, and other municipalities had the following prodaction volumes:

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[1] Due to the lack of accurate statistical information for Fruška vineyard, we used statistical summary data for municipalities and cities, where the values refer to those parts of the settlements which are not in the coverage region of Fruška gora.
[2] According to the National Statistical Office, Republic of Serbia.

- Novi Sad[1] with 2,939 tons;
- Ba ka Palanka 689 tons;
- Beo in 1,497 tons;
- Sremski Karlovci 2,124 tons;
- Irig 2,571 tons;
- Ruma 880 tons;
- Sremska Mitrovica 1,620 tons;
- Šid 3,872 tons.

On the basis of the total area and achieved production in the region of Fruška gora are noted the visible differences which are the effect of primarily insufficiently advanced technology of production. Possibilities for the development of viticulture in the region of Fruška gora are much higher, and it is and necessary development measures. It is possible to improve the production of at about 5,000 ha, but it means that it is necessary to: planting new vineyards; improving the technology of production of grapes and wine, establishment of appropriate varieties; faster development advisory services, and association of producers (Univerzitet u Novom Sadu, 2011).

Wine tourism in the region of Fruška gora
Viticulture and wine production in Fruška gora has a tradition of over 1,700 years. Authentic wine of the region is "bermet" which was exported to the United States 150 years ago, and the wines from Fruška gora were used in the Czech Republic and Poland in the fifteenth century (Vlastelica, 2011). Within wine regions of Fruška gora, wine tourism is developed in the municipalities of Sremski Karlovci, Beo in, Irig (where are located the largest number of wineries) and Šid, and the total number of registered wineries is 49, while 26 wineries are engaged in wine tourism.
Some of the wineries and cellars with the most developed tourist offer are:
- Winery "Kova evi " is located in Irig and has a tradition of winemaking and grape growing for more than 100 years. Wines produced by this winery are: Chardonnay, Aurelius, Sauvignon Blanc, Riesling, Roseto and Bermet. In 2009, the winery produced 350,000 bottles of wine (http://www.vinarijakovacevic.co.rs/onama.html). Beside wine house, winery has a restaurant, tasting room, covered lobby and accommodation in modern apartments.
- "Ma kov (cat's) basement" is located in Irig and is one of the oldest wineries in the area with more than 10 acres on the slopes of Fruška gora. The winery produces white, red and rose wines, and wine quality is confirmed by numerous national and international awards. Tourists are provided with the possibility of tasting wines and local specialties and it is possible to visit the vineyards. The winery often organized numerous training programs on the topic of wine producing and wine tourism.
- Basement "Bajilo" is located in Sremski Karlovci. Vineyard area is 8 acres, and it annually produces about 30,000 liters of wine, mostly red varieties. Tourists have the possibility to taste the wine and to buy it and also to try food specialties. Tourists can visit the vineyards of the family Bajilo.

For the development of wine tourism in the region of Fruška gora, great importance has the wine route that brought together family wineries and other stakeholders that support the

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[1] There is no statistical data for that year for the municipality of Petrovaradin.

development of the vineyards. The great importance of the wine route is that it enhances and enriches the offer, and increases the quality of services provided to tourists.

To attractiveness of wine tourism of Fruška gora contributes numerous events dedicated to wine. Wine events - which are often the main motive for tourists' visits to the area, but also additional content during their stay in the wine region - are:

- Event "Karlova ka berba grož a" (Vintage in Sremski Karlovci) is held in Sremski Karlovci and is organized by the Municipal Assembly of Sremski Karlovci with the aim to preserve the tradition in viticulture. The event lasts for three days with a rich culture and entertainment program, and is held in late September and early October. Besides wineries, the domestic producers of food and handicrafts present their offer. This event is visited by more than 100,000 people.

- "Pudarski Days" are organized in Irig since 1993. The event is dedicated to pudar, the man who protect the vineyards during the summer from many pests. A special attraction of the event is carriage parade, costume party and contest in the making lanterns and masks from pumpkin. For the most distinguished guests (friends and business partners of Irig) are organized tours through vineyards.

- "InterFest" is an international wine festival, which is organized in Novi Sad since 2004, and between 30,000 and 50,000 people visits it. The festival promotes the synthesis of winemaking, gastronomy and music and is organized at the end of June and lasts three days. The program includes numerous special workshops and presentations.

Valuable cultural and historical sites in the territory of Fruška gora should be put at disposal of wine tourism, so this would enrich the offer and attract more visitors, while the integration could bring the positive effects to the entire local community (Pejanovi et al, 2011a). Particular importance has the archaeological sites, traditional architecture, 17 monasteries, castles and summer houses (especially Špicerov's castle in Beo in which is protected as a cultural monument).

The tourist offer of the winery in Fruška gora region (Table 1) is not yet a complex tourism product, and it will be necessary in the future to offer beside wine tasting, food and accommodation, possibility of active participation in the work of the winery (wine production activities in the vineyard) supplemented with visits to attractions. The attractiveness of the offer could be increased by opening a museum dedicated to winemaking and viticulture (suitable location could be Sremski Karlovci because of a long and well-known tradition in winemaking and viticulture). It is necessary to educate owners and workers in the wineries through various seminars and panel discussions so they could be more acquainted with the concepts, examples of good practice in other regions, and to realize what are the benefits of dealing with wine tourism. Due to the specific location of Fruška gora and all the natural and cultural attractions that are located in its territory, it is necessary to establish cooperation with other forms of tourism such as rural, nautical or ecotourism (Pejanovi and uki , 2011; Pejanovi et al, 2011b; uki and Glavaš-Trbi , 2012). In order to attract more visitors, it is necessary to perform segmentation in accordance with that to plan promotional activities - creation of individual or joint web site with a detailed proposal of the wineries, production of leaflets and brochures. In order to encourage further development of wine tourism, the relevant ministries and secretariats should assist winemakers in the form of various benefits (loans).

Table 1. Tourist offer of selected wineries on Fruška gora

Winery/ basement	Wine tasting	Reception room for visitors	Basement	Direct sale of wine	Organized visits	Food	Accommodation
"Kuzmanovi "	x	x	x	x	x	x	x
"Kova evi "	x	x		x			
"Ma kov besement"	x	x					
"Bajilo"	x	x	x	x	x	x	
"Šija ki"	x	x		x		x	
doo "Vinum"	x	x	x	x	x	x	x
Basement "A anski"	x		x	x	x	x	

Source: Authors' survey

Conclusion

Viticulture on Fruška gora has a long tradition, but the number of vineyards is not satisfactory. There is a possibility to increase the grape growing area, which would contribute to the successful development of wine tourism in the region. Advantages of this area for the development of wine tourism are events dedicated to wine and grapes, the hospitality of the local population, as well as the rich cultural and historical heritage. However, during the analysis of the current situation, have been identified limitations for the development of wine tourism on Fruška gora:

- Poor transport infrastructure;
- Lack of tourist signalization;
- Insufficient accommodation facilities;
- Inadequate marketing approach, and
- Unattractiveness of the offer during the stay in wineries.

In order to overcome these limitations, it is required a more active role in public-private partnerships in the region of Fruška gora, that would represent a significant source of funding. The owners of wineries should be able to adequately respond to the changes and challenges that come from the environment in which they operate and to ensure further growth by identifying internal strengths, which will become a strong point in offering wine tourism, as well as weaknesses, whose overcoming will provide a more certain future in business.

Successful positioning and increasing the competitiveness of wine tourism has its implications for rural development. This is primarily reflected on the possibility of better marketing of agricultural products, increasing the number of employees and the quality of their life and the development of other services (such as education, industry, trade, crafts, hospitality, transportation).

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CHARACTERISTICS AND DEVELOPMENT TRENDS IN FISH PRODUCTION IN THE WORLD

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Abstract

Fishery represents a very important production in entire agricultural production in the world. It includes primary production which is made of freshwater fishing and marine fishing as well. A number of factors (ecological, economic etc.) influence on trends and development of fishery. Production from inland waters–freshwater fishery, provides significant part of a diet for a large number of populations in the world, especially in the developing countries. According to Food and Agriculture Organization (FAO) estimates, over 55 million people are employed in this sector, with a part time or a full time job, in a primary fish production or in its catching. Human influence on ecosystems in a form of pollution, fragmentation of a habitat and changes in biological cycles due to floods, reduce ability to recover from the pressures on fish catching. In recent decades along with development of fishing technology and the use of modern means for fish harvesting in the seas of the world, there has been an intensive exploitation with negative implications on the sustainability of the world fish stocks. More than three quarters of global fish production is used for human consumption, while the rest is used as an animal food in pharmaceutical industry and so forth.

Key words: *fishery, competitiveness, production, market, agricultural policy*

Introduction

Fish production in the world had an increasing trend in the recent decades and it represents one of the dynamic sectors in food production. However, intensive fish harvesting in the seas of the world influenced that so far we used a bit more than a half of all fish stocks approaching the maximum of all sustainable limitations, with the significant reduction in space for further expansion. Fish meat is an important of proteins, minerals, vitamins, essentials fatty acids etc. Total fish production in the world is on the average at about 137 million tons. World's oceans and seas provide approximately about 70% worlds catches, while the inland waters surpassed 30 million tons, which presents at about 30 % of total fishing production. China, Peru, Indonesia, the USA, India, Russia and Japan are the leading countries in fish harvesting, while aquaculture i.e. fish production is dominated by China, India, Bangladesh, Thailand and Norway. Over 90% of entire world catch include marine fish, and the most important species are: hake, tuna, mackerel, herring, cod. At about 10% of the world production which comes from the fish ponds presents rainbow trout, carp and catfish, grass carp and silver carp from open waters. Developing countries make more than three quarters of the world's fishery production and almost a half of world's export. World fish consumption per capita is constantly increasing from an average 9.9 kilos in the 1960's up to 18.8 kilos in 2011. Because of sensitivity of fish product deterioration, especially live and fresh fish, more than 90% of world trade refers to some form of processed fish. The proportion of live, fresh or iced fish in the world trade makes at about 10% with tendency of growing. The biggest world's fish exporters

are China, Norway, Thailand, Vietnam and the USA, and importers are the USA, Japan, China, Spain, France and Italy.

Materials and methods

The defined goals of this research were carried out with the use of different methodological procedures. The methods of descriptive statistics were used for the fish production analysis in the world. Descriptive statistics analysis includes methods of collecting, sorting and displaying data as well as methods of assessment of the specific indicators that are relevant for description and explanation of the changes for observed features. Basic data sources are taken from the United Nation FAO Database. The research is based on available data for a defined period of time. Relevant data were grouped and processed by applying statistical and mathematical methods and displayed through tables and charts. The comparative method of analysis is applied. We used the available literature which deals with the issues of fish production and its main features.

Results and discussion

The significance and tendencies of fishery production in the world

Fish production has significantly increased in the last few decades. In the period from 2000 to 2011, this sector has recorded growth, especially after 2003. (Chart 1). The development of this sector has great importance for entire food production and nutrition of the population. More than a half of all fish supplies in the world is completely exploited so far, approaching close to maximum of all sustainable limitations, with the reduction of space for further expansion. Fish meat is very important source of proteins, minerals, vitamins, essentials fatty acids etc. Fishery, directly or indirectly, plays a very important role in life and existence of a large number of people around the world.

Chart 1. Tendencies of fishery production in the world from 2000 to 2011.
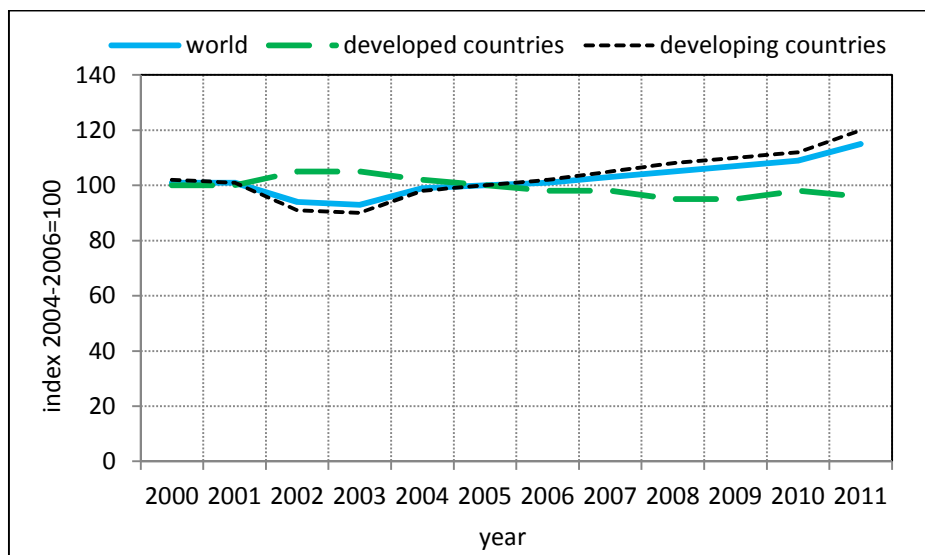
According to FAO estimates, about 55.3 million people are employed in this sector, with a part time or a full time job, in a primary fish production or in its catching. In the last three decades, number of employees in the fishery increased faster than world's population and employment in traditional agriculture.

In 2011, fishery production reached the level of about 156 million tons in total value of over $135 billion, of which approximately 132 million tons are used for human consumption (FAO). The oceans and seas provide nearly 90% of the world catch while the catch of the inland waters surpassed 55 million tons. Over 90% of total world catch make marine fish, and

the most important species are: hake, tuna, mackerel, herring and cod. At about 10% of world's production from fish pond make rainbow trout and carp and from open waters there are catfish, grass carp and silver carp. The developing countries made 82% of world fish production and 53% of world export in 2011. A large part of the export from the developing countries aims to supply developed countries which have growing demands and domestic production stagnation in fishery.

Table 1. Fish production in the world from 2000 to 2011. (millions of tones)

Year	Catch of fish	Index 200=100	Share in total production (%)	Aquaculture	Index 2000=100	Share in total production (%)	The total fish production	Index 2000=100
2000.	95.7	100	76.0	30.2	100	24.0	125.9	100
2001.	90.7	95	72.4	34.6	114	27.6	125.4	99
2002.	91.0	95	71.2	36.8	122	28.8	127.8	102
2003.	88.3	92	69.4	38.9	129	30.6	127.2	101
2004.	92.7	97	68.9	41.9	139	31.1	134.6	107
2005.	92.5	97	67.6	44.3	146	32.4	136.8	108
2006.	90.2	94	65.6	47.3	156	34.4	137.5	109
2007.	90.7	95	64.5	49.9	165	35.5	140.6	112
2008.	90.1	94	63.0	52.9	175	37.0	143.0	113
2009.	90.0	94	61.8	55.7	184	38.2	145.7	116
2010.	89.0	93	60.1	59.0	195	39.9	148.0	117
2011.	93.5	98	59.9	62.7	208	40.1	156.2	124
average	91.2	-	66.7	46.2	-	33.3	137.4	-

Source: FAO, Database, Rome.

According to analyzed data for the period from 2000 to 2011, an average of 137.4 million tons of fish was produced in the world. An average production in aquaculture was 46.2 million tons, while the catch was at the level of 91.2 million of tons (Table 1). Looking at the dynamic of changes in the actual fish production, strong growth of fish production in aquaculture can be seen i.e. it was doubled in 2011 comparing to 2000 and increased from 30.2 million tons to 62.7 million tons. In terms of actual tendencies to catch fish, we can conclude that there has been stagnation and reduction without any significant developmental progress throughout the period.

When it comes to the actual fish production and when we observe it through the production index we can note that it had stable upward trend in all these years. In terms of structure of achieved production in analyzed period, the average production achieved by catch was 91.2 million tons, which represents 66.7% of total production, while the aquaculture production was at an average level of 46.2 million tons which make 33.3% of total global production.

Chart 2. Dynamic of fish production in the world from 2000 to 2011.
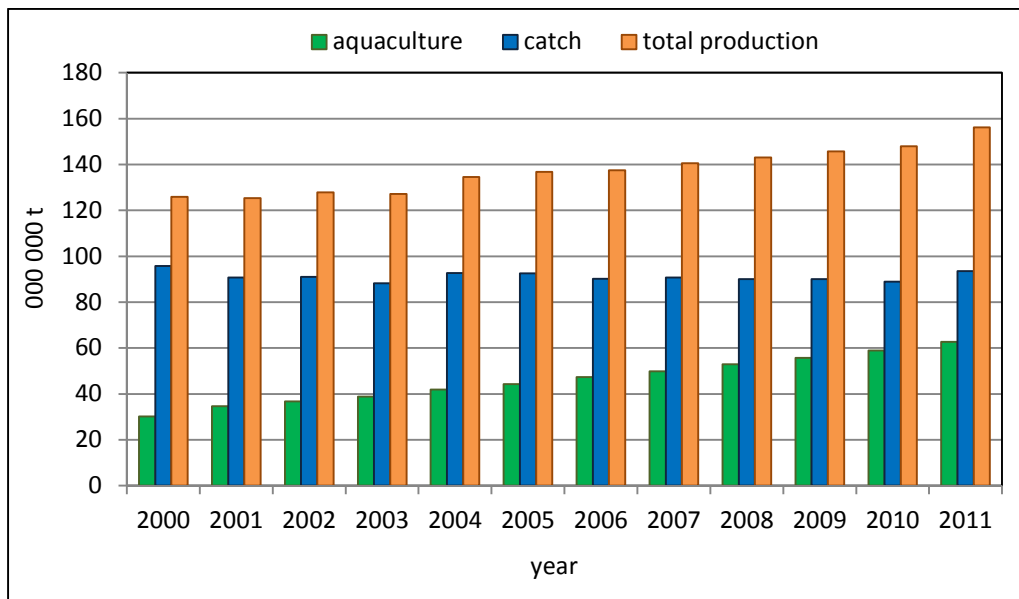
In terms of distribution of total fish production by continents, Asia comes first with the production of 97.4 million tons, followed by South America with 16.2 million tons, Europe with 15.8 million tons, Africa with 8.4 million tons, North America with 6.1 million tons and Oceania with 1.4 million tons. From the position of participation in total world production, Asia participates with 66.9%, South America with 11.2%, Europe with 10.9%, Africa with 5.8%, North America with 4.2% and Oceania with 1.0%.

Chart 3. Structure of fish production in the world by continents from 2008 to 2011.
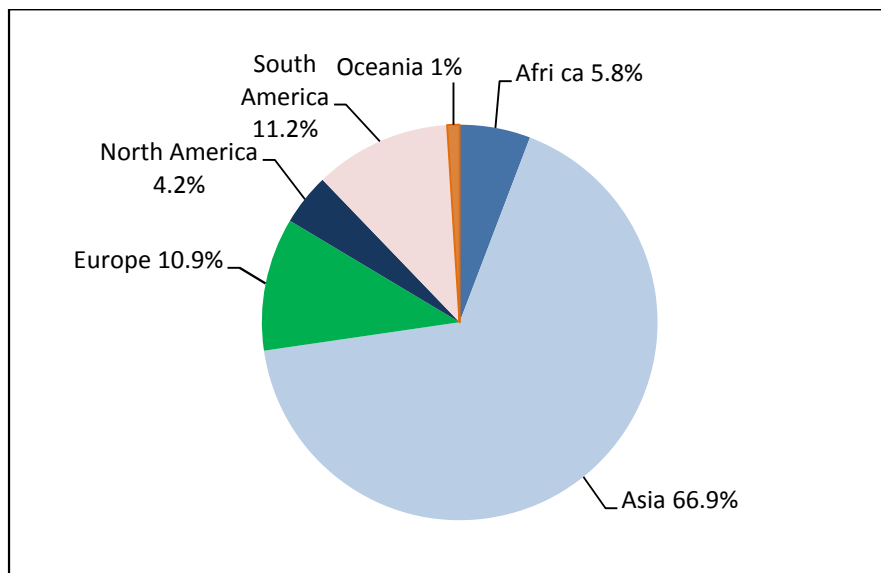
China has the largest fish production in the world. The second biggest fish catch is Peru with 6.4 million tons and the third is Indonesia with 5.4 million tons followed by the USA, India, Russian Federation and Japan (Table 2).

In terms of achieved fish production in aquaculture, China is the leading country with the average production of 36.7 million tons, the second is India with at about 4.0 million tons, the third ranked is Vietnam with an average of 2.6 million tons, followed by Indonesia, Bangladesh, Thailand and Norway. A global leader in fish production is China and it is

definitely in the first place by a catch of marine and freshwater fish and aquaculture while all Asian countries make 52% of global production.

Table 2. The biggest fish producers in the world from 2009 to 2011.

Countries	2009.	2010.	2011.	Average
Catch of fish in tons				
China	14 919 596	15 417 011	15 772 054	15 369 553
Peru	6 914 452	4 261 091	8 248 482	6 474 675
Indonesia	5 103 608	5 380 196	5 707 684	5 397 163
USA	4 222 052	4 425 961	5 153 452	4 600 488
India	4 066 756	4 689 316	4 301 534	4 352 535
Russian Federacija	3 826 129	4 069 624	4 254 864	4 050 206
Japan	4 091 314	4 069 135	3 761 176	3 973 875
Aquaculture in tons				
Countries	2009.	2010.	2011.	Average
China	34 779 870	36 734 215	38 621 269	36 711 785
India	3 791 920	3 785 779	4 573 465	4 050 388
Viet Nam	2 556 080	2 671 800	2 845 600	2 691 160
Indonesia	1 733 434	2 304 828	2 718 421	2 252 228
Bangladesh	1 064 285	1 308 515	1 523 759	1 298 853
Thailand	1 416 668	1 286 122	1 008 049	1 236 946
Norway	961 840	1 008 010	1 138 797	1 036 216

Source: FAO, Database, Rome

China is by far the largest overall fish producer with an average production of 52 million tons (15.3 million tons of fish catch and 36.7 from aquaculture), providing about 29.4 kg of fish per capita, as well as significant production for export.

Norway is among the first when it comes to fish catching per capita and fish products, while in Japan the fish is the most important in the diet with consumption of over 54 kg per capita per year. In terms of fish production in the world Asian-Pacific region dominates, which makes about 89% of production in terms of quantity and 77% of its production value. This domination is mostly based on the huge production of China which makes 34% of total world production in terms of quantity and 49% of its production value. China achieves 77% of total world carp production, while Chile and Norway are two leading world producers of cultivated salmonids, with about 33% of world production.

World fishery is increasingly faced with certain limitations in its development. Eutrophication from excessive intake of phosphorus and nitrogen through the sewerage and polluted waters of agricultural areas represent a great danger for freshwater and marine fishing. Coastal areas which have less oxygen so-called "dead zones" often coincide with the areas of intensive agricultural production. Eutrophication combined with unsustainable fishing leads to loss or reduction of fishing resources in general. Current projections show that for the fish production, previous growth is unlikely to be sustainable in the future mainly due to limitations in availability of marine fish. In certain regions, such as certain parts of Africa and South-east Asia, increase in production and harvesting of fish as well as expanding areas under arable land, are the main factors for increase in food supply. We should point out that fishery products are the main source of energy and proteins for poor coastal population, especially in West Africa and South-east Asia and that every reduction in fish production will have a great impact on lives of a large number of populations in these zones. A high level of exploitation indicates that the maximum potential of the world's marine fishing is achieved and that we must take measures and activities aimed at reducing excessive harvesting of fish. (Asche, et al., 2008).

Regardless of economic and social importance that fishery has, attempts of sustainable management are insufficiently successful in many parts of the world and it is necessary to take

certain measures in order to find sustainable solutions. Imbalance of fishing ecosystem on one hand, as well as provision of food, income and livelihood of fishing on the other hand, require appliance of sustainable approaches to solving these problems (Brugère i Hishamunda, 2007). Combination of measures directed towards protection of fish ecosystems should include a ban of certain fishing practices, the establishment of marine protected areas for harvesting of fish, limiting the rights of access, improving the system of licenses and quota etc.

Freshwater fishery production provides main part of the diet of many people throughout the world, especially in developing countries. Human influences on ecosystems-in a form of a pollution, habitat fragmentation and changes in biological cycles due to floods, reduce the ability to recover from the pressures of fishing, so in this segment it is necessary to take measures to control the exploitation of these resources.

Conclusion

Fishery production has a great significance for total food production and nutrition of population. Nowadays more then a half of all food supplies in the world is totally exploited, and that to a great extent complicate future development of this production. This production reached the level of 156 million tons in 2011, of which about 132 million tons are used for human consumption. The average production of aquaculture from 2000 to 2011, the period we analyzed, was 46.2 million tons while the catch was at the level of 91.2 million tons. In terms of the structure of achieved production, the average production achieved by the catch, participated with 66.7% of total production, while the production of aquaculture was 33.3% of total world production. Developing countries made 82% of world fish production in 2011. China is the leading world producer, with the average production of 52 million tons, of which 15.3 million tons include fish catch and 36.7 include aquaculture, followed by Peru, Indonesia, the USA, India, Russian Federation and Japan. In the following period it is necessary to find sustainable solutions for exploitation of fish ecosystem because with the stronger pressures it comes to its devastation which can have unforeseeable consequences in the entire value chain of fishery production.

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ASSOCIATIONS AND COOPERATIVES AS DEVELOPMENT FACTORS IN REVITALIZATION OF VILLAGES

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Abstract

Bout 43% of populations lives in rural areas of Serbia. Fragmentation of possessions, outflow of the rural population and unfavourable age structure have negative effect on competitiveness of agricultural sector which requires addition, reorganization and encouragement in development of rural economy. In the process of accession, EU gives logistic support to candidate countries in order to adjust their agricultural sector with implementation of EU legislation within the Common Agricultural Policy. According to IPA implementation regulation, the aid from the component intended for rural development should contribute to improve market efficiency. Certain problems in implementation of planned aid occur in attempt to apply solutions which are not inherent for domestic economic conditions and available resources. The aim of this paper is to highlight the need of reviving cooperatives and connecting small and medium-sized farmers with market basis and activating the potential of a group of citizen gathered around various ideas in the field of agriculture (eco- villages, organic production, etc.) in a function of encouraging rural development as a whole.

Key words: *associations, cooperatives, diversification, village*

Introduction

In the recent period there were significant changes (socio-economic, political, economic-system changes, etc.) which strongly affected economic activity in the country as well as entire agricultural production. Changes we have done so far in the agricultural sector did not achieve expected positive effects. One of the problems is the fact that the state through diversification of rural economy fails to fully relate traditional agriculture to interactive relationship with the need of the small farms to be market oriented which is necessary condition of market competitiveness.

Trends in domestic agriculture are influenced by calamitous tendencies and seasonal adjustments. A large part of basic problems in agriculture is expecting its solutions: uncompetitive production, inefficient system and policy of incitement, unresolved ownership issues, the problem of state-owned agricultural land, lack of working capital, unadjusted financing system of production, etc. Agricultural market in Serbia is liable to monopoly structures and influences. There is a lack of associations of agricultural producers and stronger support for the small landowners while cooperative movement is undeveloped, devastated and moved to the margins of economic system. In order for agricultural producers to reach a competitive level they are imposed to, it is necessary to approach to dynamic and massive foundation of associations, cooperatives and other associations through which more successful and long-term needs and interests would be articulated.

Materials and methods

The aim of this research will be carried out with appliance of different methodological procedures. The main data sources are taken from the Republic Institute of Statistics. Relevant data are grouped and analysed by using statistical and mathematical methods and they are presented through tables. The analysis of the indicators led to necessary knowledge and conclusions. By drawing key conclusions, method of generalization and abstraction is used as a logical method.

Results and discussion

Rural areas in Serbia are defined as areas whose main physical and geographical characteristic is to use land for production of agricultural and forestry products. Nearly 80% of territory of Republic of Serbia can be classified as a rural area where 43% of population lives. There are most of natural resources (agricultural land, forests, and waters) with extremely valuable ecosystems in the rural areas. Human resources employed in various economic activities make particularly significant potential. Rural population constantly decreased after the Second World War. Proportion of rural population in Serbia was 77% in 1953. In the following period intensive emigration of the population happened due to difficult living conditions, poor choice of occupations and lower wages comparing to work in the cities. Depopulation and the unfavourable age structure are the most important characteristics of demographic development of Republic of Serbia and its rural areas (Spalevic, 2012).

Figure 1. Dynamic in trends of agricultural population in Republic of Serbia from 1961 to 2012.
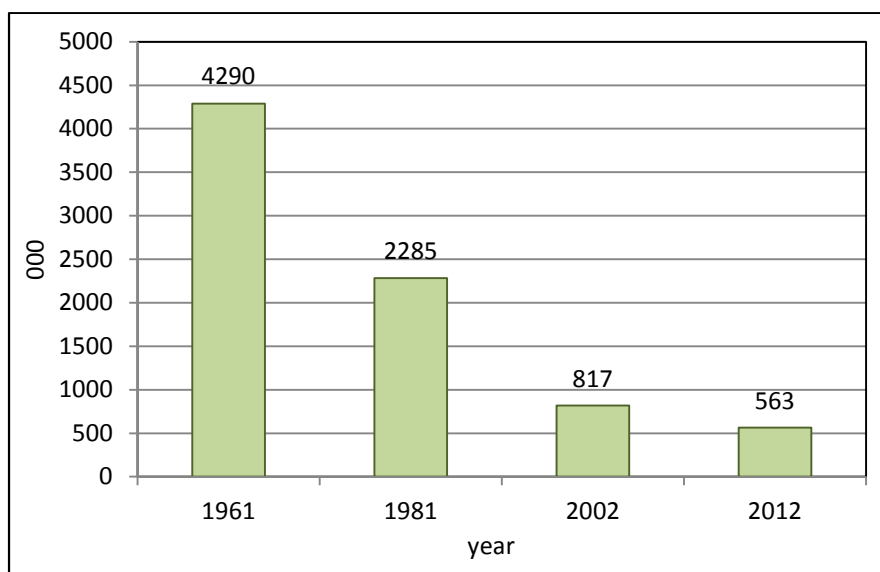
Rapid depopulation of the village had extremely negative consequences which manifested in excessive urbanization, concentration of population in a few large cities, insufficient usage of spatial, production and human potential and uneven economic development. Under the influence of powerful process of industrialization there was intensive land reclamation i. e. abandonment of agriculture as a source of income and occupations of the population who were leaving rural areas in search of higher wages.

These trends have influenced the formation of agrarian structure in our country. Basically there has been an appearance of unfavorable processes which manifested in continuous reduction in the number of family agricultural holdings, reduction of their average size, increasing in number of plots per farm and growth of uncultivated agricultural areas.

In table 1 is displayed an overview of the use of agricultural land in relation to farms in 2012. Based on the presented indicators it can clearly be seen that, in total structure of used agricultural land, fragmented agricultural holdings dominate. Agricultural holdings with the largest estates are in Autonomous Province of Vojvodina with the average size of 10.83 ha per farm, and the smallest holdings are in South and Eastern Serbia with 3.45 ha per farm. In Republic of Serbia an average agricultural holding uses 5.32 ha of agricultural land and without AP Vojvodina only 3.61 ha.

Table 1. The use of agricultural land by regions in Republic of Serbia in 2012.

Region	Agricultural holdings (number)	Used agricultural land (ha)	Hectares per farm
Vojvodina	147,588	1,598,065	10.83
Belgrade	33,207	134,117	4.04
Northern Serbia - total	**180,795**	**1,732,182**	**9.58**
Šumadija and Western Serbia	262,531	975,672	3.72
Southern and Eastern Serbia	187,796	648,006	3.45
Southern Serbia - total	**450,327**	**1,623,678**	**3.61**
Republic of Serbia - total	**631,122**	**3,355,860**	**5.32**

Source: The Republic Institute of Statistics, Belgrade.

With growing competitive pressures and more intensive openings of new market segments for marketing of agricultural and food products, there is a need to keep pace with these changes. This requires continuous market research, new product development, innovative approaches to marketing, packaging, advertising, etc. The answer to these challenges which provide survival and development of domestic agriculture, in the moment of encounter with West European models of rural development and the system of world market, should be based on the development of its own production structure, which will allow intensive development of cooperatives, various associations and so forth. Under these complex circumstances these organizations should be the essential factor of the development and competitiveness of agriculture on family farms, especially small ones.

The basic concept of modern cooperatives and cooperative organization is merger with a certain business goals. Considering that the cooperative is a joint organization, the basic meaning of cooperative organization is to work together, solve problems and weaknesses of its members ie to overcome the difficulties in business which are induced by economic and market impacts in business of small economic subjects. Cooperative organization in agriculture is complex and systematic process. One part is connected to specificities of resources and production in agriculture and partly it is connected to historical features of ownership and user structure. Considering agricultural characteristics (large number of small holdings), production and business forces cannot quickly ensure physical enlargement of production resources but by business organization of bigger number of agricultural holdings, limited investment and other expansion opportunities. If the concept of cooperatives expansion in our country is systematically and business designed, then it will be an important factor of production and market development stability of agricultural holdings in rural areas.

However, in present conditions, there are many difficulties and limitations which disable prosperity and long-term stable development of this sector. Unfavourable situation in agricultural cooperative movement is a consequence of long-term unadjusted incentive and legal instruments of a state, unregulated market, and the lack of interest of the banks for financing production and cooperative development programs, lack of incentives of the local

government for cooperatives, lack of young and educated experts who would initiate and implement new cooperative projects, etc.

Figure 2. Number of agricultural cooperatives in Republic of Serbia from 2000 to 2012.
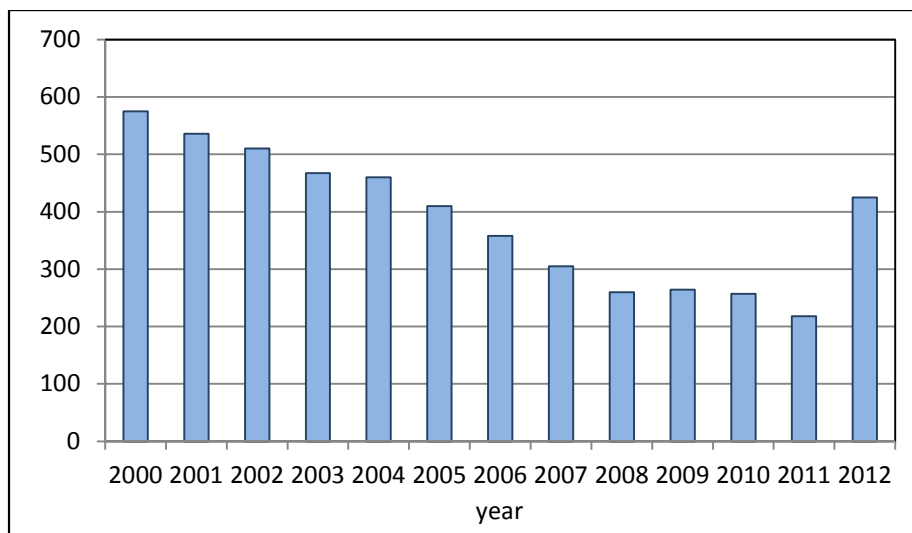
      Business policy of agricultural cooperatives is primarily focused on existing activities which employees are interested in and it generally does not comply with the interests of farmers, potential members of cooperatives.

Besides traditional forms of association in agriculture, such as cooperatives and associations, in present condition alternative forms of interconnection are increasingly developing. These trends are particularly manifested in Europe. Today, informal groups are more and more organized and they conduct their activities gathering around a few key themes such as: concept of eco-village, organic production, preservation of traditional values of the village, interest gathering of small and medium-sized agricultural producers etc. Experiences so far show that the groups who work the best are gathered around clear and achievable goals such as: exchange of information and knowledge, trade, specific activities such as amateur gardening, then around eco-village concept which is particularly developed in Western countries and it has a positive influence on awareness of people about importance of the village and organic production. These groups are different in structure and size, from 100 to 7000 members, horizontally and vertically connected but decentralized, gathered around individuals who formed them and hence have become their leaders. Problems occur in groups which have professional and semi-professional goals, so that existing energy is sometimes used on debates and agreement on the projects which are also unfounded and contrary to declared goals of the group.

As one of the possible forms of connection of consumers and agricultural producers which can be used is an example of Group of solidarity exchange. These are groups of people who exchange-buy certain products and services, but on the principles of solidarity, with the aim of developing equitable economy and support for small agricultural producers who generally have limited access to the market. These groups together buy products from producers who are selected according to certain principles. That is economy of direct relationship of producers and consumers. At the first sight this concept is marginal but basically it means a choice of different basic model of development. At a time when huge corporations rule the world markets of agricultural and food products, such a connection of consumers with small and medium-size agricultural producers can have positive economic and social effects. In Europe, especially in France, these groups are well known as AMAP (*Association pour le*

Maintien d'une Agriculture Paysanne). Lately we can see that the trend of this international connection becomes more expressed (Medic et al., 2012).

In the current domestic economic conditions, by reviving and popularization of cooperatives and giving support to formal and informal groups of citizens engaged in agricultural sector we can expand and strengthen their role in domain of decision-making and thus to prevent the creation of "monopoly on systemic solutions" where only "the chosen one" can influence decision-making process, and if it happens that the proposed solutions are inexpedient that can lead to improper and irrational usage of human, economical and environmental resources. Such negative experiences can have a negative affect the subjects in agriculture, in terms of their passivity and creation of illusion that someone " aside will provide all necessary support and help", which in combination with pressures of large corporation in agricultural sector , activities of domestic import lobbies and groups that support production and sale of GMO food, can have long-term disastrous consequences for agriculture and sustainability of rural areas in economic and ecological terms.

LEADER axis is methodological and it doesn't directly represent measure set. It focuses on the ways how to get to specific programs and supports organizing Local Action Groups, local communities who gather in order to implement projects in a group of measure of the first three axes (Jankovic, 2009). According to IPA implementing regulation, the aid from the component intended for rural development should contribute to improvement of market efficiency. However, difficulties in attempt to apply proper solutions are not immanent to conditions in our country. This, among the other things, reflects in insufficient number of agricultural cooperatives and associations of agricultural producers, who could benefit from this kind of support. Therefore, it is necessary to fully promote establishment of these organizations.

A special strategic interest in development of rural areas should be achieved through the establishment of strong cooperatives. Agricultural cooperatives are certainly the most rational and the most convenient form of organization of family agricultural holdings in these areas. They are important component of development strategy of rural and less developed areas. In this context, we need concrete and strong support of local communities in the establishment and functioning of cooperatives which can be achieved in the following ways: educating and informing farmers, providing support during registration, providing retail space or offices for work, release utilities and other expenses during the construction of processing or storage capacities by cooperatives and by direct support to investments and others.

Conclusion

In order to achieve the stated aims of rural policy and to apply the necessary standards, it is needed to conduct a series of concrete measures from restructuring of agricultural holdings, supporting the establishment of farmers' associations, creating better business environment and the implementation of concrete measures of agricultural policy. Especially important measures and activities are those directed towards development of rural economy through diversification and development of economic activities in rural areas. Sustainable solutions should be sought in the context of comprehensive overview of these areas taking into consideration demographic, social, ecological and economic conditions. Cooperatives have long tradition in Serbia and they can play significant role in development of agricultural production, to improve the position of agricultural producers and to provide opportunities for the optimal use of EU pre-accession funds. The cooperative movement of Serbia needs fundamental changes, firstly through innovative legislation, taking into account national interests as well as local tradition.

Informal groups should be supported in order to legalize their status and to more precisely define their goals and tasks. These groups can be useful link between small and medium- size landowners and market with the aim to prevent creation of different forms of monopoly and at the same time to empower small and medium-size agricultural producers. There are

examples of good practice in the world, like France, through the concept of AMAP (*Association pour le Maintien d'une Agriculture Paysanne*), which is expanding rapidly and it gives very good results with the tendency of international networking. These experiences can be used in our country as well.

By taking activities and measures listed above it is possible to create positive environment for development of rural economy of Serbia and to mitigate the negative trends (outflow of rural population, the increase of unemployment, a decline of production), which have an adversely effect on competitiveness of the agricultural sector.

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CO-OPERATIVES AS A FACTOR OF THE SOCIO-ECONOMIC DEVELOPMENT OF SOUTH BANAT AND BRANICEVO DISTRICT

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Abstract

Co-operatives, as one of the most important factors of the socio-economic development of farms and villages nowadays, can be a strong driving force of economy through increasing employment and the standard of living, especially in poverty-affected rural areas in the Republic of Serbia. Although co-operatives in Serbia are traditionally the most important form of farmers associations and farm business organisations, their scope of business has been limited for decades due to the poor implementation of agrarian policies.

It is therefore necessary to determine the direction of co-operative development at macro and micro levels, through the reforms of Serbian economic legislation to the restructuring of the production-economic and organisational status of co-operatives.

This paper analyses and compares the standpoints of directors of differently organised agricultural co-operatives on the situation and prospects of agricultural co-operatives in Serbia, as well as on restructuring measures and activities necessary for them to have a positive impact on the economic and social position of their members, farms and the agricultural sector in general.

Questionnaire-based survey was conducted with 43 registered co-operatives in South Banat and Branicevo District.

In this paper, the authors point out it is necessary that all regional and local institutions and co-operatives make more serious efforts to establish a viable and operational co-operative model as one of important factors of creating future agrarian policies.

Key words: *Co-operatives, socio-economic factors, organisation, development, Serbia.*

Introduction

Current situation in Serbian agriculture is a result of a long-standing inadequate approach to addressing on-going problems and unviable long-term plans, mainly related to the development of villages and agriculture in general (Tomi and Ljiljani , 2012).

Boži and Bogdanov (2006), as well as Tomi and Ševarli (2010) agree that for a long time the main goal of Serbian agriculture was to ensure food security, thereby maintaining the social order. These authors also state that Serbian agriculture is undergoing a period of transition, having many problems caused by the national and global socio-economic crisis, which altogether lowers farmer revenue, brings fewer foreign direct investments and reduces the purchasing power of consumers.

Over the last few years, in circumstances of an acute economic crisis and growing problems related to the market of agricultural produce, there is an increased interest and a rising need for farmers to establish co-operatives.

From a historical point of view, co-operatives as organisational entities have a long tradition and an important role in developing agriculture and making it operational, both worldwide and in Serbia. There are 386 agricultural co-operatives registered in Serbia (Statistical Office of the Republic of Serbia, 2012). This implies that the number of co-operatives is too small. Considering many of these co-operatives are undergoing an organisational transformation, and some are under bankruptcy, it is necessary to re-organise the whole co-operative sector towards a balanced regional development. A well-developed and organised co-operative sector can contribute to balanced sustainable and regional development (Jankovi et al., 2010).

The goal of this paper was to analyse and determine key limiting factors of socio-economic development of co-operatives in Branicevo and South Banat District. The final goal is possible improvement of these co-operatives' performances towards diversification of rural economy - through increasing employment and the standard of living, especially in poverty-affected rural areas in Serbia.

Material and methods

The field questionnaire was carried out with 43 registered agricultural co-operatives (mainly mixed crop/livestock farming) in the Branicevo and South Banat District in the second half of 2013. A comparative method was used.

The first part of the questionnaire addressed the socio-economic structure of co-operatives. The authors had defined target productions and ownership structure, as a precondition of economic stability and legal certainty, as well as the specialisation of production. The second part of the questionnaire consisted of a set of questions aimed to inquire the standpoints of directors of co-operatives on competition, business and investments. The last part of the questionnaire addressed the support system and awareness of co-operatives on possibilities of using financial funds and subsidies.

This paper analyses and compares the standpoints of directors of differently organised agricultural co-operatives on the situation and prospects of agricultural co-operatives in Serbia, as well as on restructuring measures and activities necessary for them to have a positive impact on the economic and social position of their members, farms and the agricultural sector in general. The results will serve as a basis for a comparative analysis of the current situation, potential and limitations to further development of co-operatives.

Results and discussion

Target production of agricultural co-operatives

To obtain reliable results on the type of production that generate the most part of the revenue of the surveyed co-operatives, the questionnaire listed some most common types of production for the covered districts: field crops production, livestock production, beekeeping and so-called "other" – that comprised many types of production, neither of which prevailing. In both districts, field crops production is prevailing and most common type of production (72%). In South Banat, 86% of the co-operatives are engaged in this type of production, whereas small percentage are engaged in "other" production (Table 1). In contrast to this, the co-operatives in Branicevo District are engaged in more diversified agricultural production. Field crops production is also most common (54%); 24% of the co-operatives are engaged in "other" production, whereas few co-operatives are engaged in livestock production. It is also apparent that the field crops production co-operatives have the largest number of members.

Table 1. Target production by district

Ag Advisory Service / Target production	Vrsac	Vrsac in %	Pozarevac	Pozarevac in %	Total by district	Total by district, in %	Number of members
Field crops production	19	86%	12	57%	31	72%	884
Livestock production	0	0%	3	14%	3	7%	35
Beekeeping	0	0%	1	5%	1	2%	84
Other	3	14%	5	24%	8	19%	135
Total	**22**	**100%**	**21**	**100%**	**43**	**100%**	**1138**

Property of agricultural co-operatives

The most common type of ownership structure of the surveyed co-operatives in Branicevo District is co-operative property – 62%, whereas 24% of the co-operatives do not own any property. When compared to the aforementioned co-operatives, twice as much co-operatives in South Banat District do not own any property, and about 20% less of them own co-operative property. The least common ownership structure of the co-operatives in both districts is state-owned property.

This only confirms the theory that co-operative property, as a special form of an ownership structure, represents a basis for economic and legal security. Co-operatives without their own property do not have that security. Those co-operatives do not have collateral so cannot take certain loans to improve their business.

Table 2. Ownership structure of co-operatives

Property:	Vrsac	Vrsac u %	Pozarevac	Pozarevac in %
Co-operative property	9	41%	13	62%
State-owned	2	9%	3	14%
No property	11	50%	5	24%
Total	**22**	**100**	**21**	**100**

On the question whether the property should be the property of the members or of the co-operative, 90% surveyed co-operatives from Branicevo District and 64% from South Banat District answered the co-operative property should be the property of the co-operative, while fewer percentage answered it should be the property of the co-operative members.

Investments

The goal of the research was to determine whether co-operatives within their regular scope of work invested in capital assets to improve their business. In South Banat District, more investments were recorded (59% co-operatives). The situation in Branicevo District was somewhat different, since 57% of co-operatives had not invested in capital assets.

Further analysis covered investments in capital assets, depending on the type of production identified as most common in the surveyed districts. Fifty-one per cent of the co-operatives of both districts invested in capital assets. When compared to Branicevo District, the co-operatives in South Banat District invested much more in capital assets.

Most co-operatives in South Banat District invested in capital assets for field crops production, unlike in Branicevo District, where 56% of field crops production co-operatives, 22% of livestock production co-operatives and 22% co-operatives engaged in other type of production invested in capital assets. Such a low percentage of investments can be explained

by the fact that about 55% co-operatives in South Banat and 34% in Branicevo District do not own any property.

Table 3. Investments made by co-operatives

Agricultural Advisory Service	Vrsac				Pozarevac			
Production / Investments in	Yes	%	No	%	Yes	%	No	%
Field crops production	10	77%	9	100%	5	56%	7	58%
Livestock production	0	0%	0	0%	2	22%	1	8%
Beekeeping	0	0%	0	0%	0	0%	1	8%
Other	3	23%	0	0%	2	22%	3	25%
Total	**13**	**100%**	**9**	**100%**	**9**	**100%**	**12**	**100%**

Specialisation of production

Table 4.Specialisation of production of co-operatives

Specialisation of production	Vrsac	%	Pozarevac	%
Yes	4	18%	12	57%
No	18	82%	9	43%
Total	**22**	**100%**	**21**	**100%**

The survey results show the co-operatives have divided opinions on their interest for the specialisation of production.
Unlike in Branicevo District, where 57% of the co-operatives were interested in this, only 18% of the co-operatives in South Banat District showed an interest for the specialisation of production. The authors explain this discrepancy with the fact that co-operatives gain tentatively enough profits, therefore not having a need for specialisation of their production.

Networking of co-operatives
The survey determined that 86% of the surveyed co-operatives from both districts had an interest in networking with other co-operatives. Fifty-nine per cent of the co-operatives in South Banat and 33% in Branicevo District were interested in territorial networking, whereas 36% and 43%, respectively, were interested in production and selling networking.
Although co-operatives so far have not demonstrated an interest for networking, there is a mutual understanding that a joint approach to the market, when it comes to purchasing, negotiations and produce placement, can reduce a business risk of each independent unit.
Professional support. Agricultural advisory services are an indispensable institutional support that can contribute to co-operatives development. To achieve that, good business collaboration is needed. The survey determined that a large number (77%) of the co-operatives from both districts are clients of the Agricultural Advisory Service, which is an indicator of good collaboration between these organisational entities.
Financial support and awareness. When it comes to funding, the questionnaire asked some questions to determine the level of using financial resources (state subsidies, development loans, and foreign donations) and the awareness of co-operatives on possibilities for using EU pre-accession funds (Jankovi et al., 2010). The results show that very low percentage of the co-operatives in both districts use state subsidies and development loans (7% on average), while none of the co-operatives have used EU pre-accession funds so far. This can be due to their unawareness this kind of financial support is available, or not knowing how to use it.

Eighty-one per cent of the surveyed co-operatives declared they were not aware of possibility to use pre-accession funds, while the others stated they were partially aware.

Conclusion

In the co-operatives from both districts, field crops production is the most dominant and most common type of production.

The most common type of the ownership structure of the co-operatives in Branicevo District is co-operative property, while there are 20% less co-operatives in South Banat District with this type of ownership structure. The least common type of ownership structure in both districts is state-owned property.

Investments in capital assets are recorded mostly in field crops production co-operatives in both districts.

As for specialisation of production, there is no complete consensus since co-operatives think this would mitigate the impact of the market, manifested in price oscillations. The authors consider this is justified in current economic conditions.

From the aspect of introducing new technologies and expanding our knowledge on the existing ones, as well as from the informational aspect, it is necessary that co-operatives collaborate with all relevant entities, and primarily with the Agriculture Advisory Service. This collaboration should extend on other institutions, such as faculties and research institutes.

A very low level of awareness was recorded regarding possibilities for using EU funds and financial sources in general, which is one of the basic preconditions for their further existence.

In the period 2009-2012 the number of registered co-operatives decreased from 2,267 to 386. This is a result of inadequate approach to addressing problems that co-operatives are facing in current economic conditions.

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OPPORTUNITIES AND CHALLENGES OF WOMEN CASSAVA PRODUCERS IN BITYILI (SOUTH-CAMEROON) AND THE IMPLICATIONS FOR GENDER ROLES

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Abstract

In Cameroon, rural women have a significant role in farming and post-harvest activities. Nevertheless, a complex set of rights and obligations reflecting social and religious norms prevail within rural communities, these dictate the division of labour between men and women and act as constraints to women farmers. In fact, women fulfil the reproductive roles of child bearing, home management and food provision for the family. Thus, these women are unable to exercise any influential economic voice, they can hardly earn income. Cash agriculture like cassava production provides a possible outlet for the empowerment of these women in cassava producing areas. However, this agricultural work would solve one problem for the women and create another. Any attempt to encourage these women to work outside their homes may increase their workload. This paper examine the situation of female cassava farmers in *Bityili*, a village of South region of Cameroon, by evaluating the gender specificities within division of labour, daily hours, access and control of resources and benefits. To address this, 44 women cassava producers-processors were randomly selected and interviewed. Both quantitative and qualitative methodologies were used, including focus group discussions, participant observation, and semi-structured interviews. Quantitative data were analysed using descriptive statistics. The results show that although cassava production may have been beneficial to women and the society as a whole, it has implications for gender roles that go beyond the purview of women's empowerment.

Keywords: *cassava, production system, gender roles, Bityili, Cameroon*

Introduction

Women's triple role in development has been recognized as meeting their strategic and practical gender needs (Moser, 1993; Mosse, 1993; Taylor, 1999). These women's triple roles have been classified into reproductive, productive and community management (Moser 1993: 48-49). Taylor (1999, 18) argues that women perform multiple roles, which are too simplistically enveloped into Moser's framework of triple roles. Many societies, particularly in developing countries, usually emphasize only women's domestic and community roles. The economic and political spheres are considered as exclusive domains reserved for men. Even where women's economic role is obvious such as in the case of water and fuel wood collections, vegetable gardening, dairy and poultry keeping, these economic contributions are minimized and dismissed as emanating from their biology (Mosse, 1993: 30). Thus, women's productive work is often less visible and valued than men's (Williams et al., 1994).
Nonetheless, with increasing economic intensification and diversification as a result of the emergence of new challenges, there is a gradual movement away from the status quo. The forces of colonization, and globalization accelerated the circulation of new ideas and cultures around the globe. As a result women are being gradually brought into the centre of

development. In the economic domain for example, rural women are involved in the cultivation of crops like cassava, maize, grownup, rice, vegetable and others not only for the feeding and consumption of the family but also for cash. They also cultivate cocoa, palm oil, coffee which are considered male crops. Their expanded economic activities significantly alter their traditional gender roles with far-reaching effects on their empowerment and national development.

The cassava sector in Cameroon, where women are primarily farmers, generates an important share of family income. It appears that, for men, the family is not always a priority, unlike women. Thus, in estimating demand functions, Lachaud (1998: 9) argues that the share of female income significantly and positively influences food and energy costs and negatively expenditure on cigarettes, tobacco, etc. Engle (2001: 213), also confirm that women's income has a stronger association with children's nutrition than men's. The importance of women's expenditure on children can be explaineds part of their triple roles.

Women in Cameroon play an important role in cassava marketing.While this presents opportunities for women farmers, the challenge is to ensure that women retain control over production, processing, and marketing. Ogbu and Lyelaran-Oyeyinka (1995) observe that while urban markets for cassava thus create opportunities for women farmers, smallholder farmers often cannot marshal sufficient working capital to meet supermarkets' demands for products of consistently high quality. Thro (1994) observed that in Tanzania, men usually control the profits when cassava is grown as a cash crop, while women control small cassava sales and often use the money to buy household necessities and support their children's education. Thus control over cassava profits vary depending on the end use of the crop. It is against this backdrop of the mixed opportunities and challenges of women cassava farmers and the mitigating circumstances surrounding their participation in cassava production, that this paper examines the situation of women as cassava farmers in *Bityili*. This investigation provides profiles and reasons for their involvement and illuminates how cassava farming relegates to their traditionally assigned roles as women.

Material and methods

Our study was conducted in 2012 in *Bityili*, near *Ebolowa*, capital of the south region of Cameroon (see figure1), where cassava production and processing is a tradition. In order to adequately address the above elements of the study, we adopted a data collection method that conveniently captures these elements. A cross-section of the population of the villages of *BityiliI*, *BityiliII*, *Nvoutedoum* and *Minkok* which are the major cassava production areas in *bityili* was chosen for the study. We started by collecting qualitative data through focus group discussions to get an idea of the overall activities and task involved in cassava production and processing. Based oninsights from the qualitative research phase, we formulated a structured questionnaire and individual interviews. Using a random sampling method, questionnaires were administered to 44 women from all the strata of the studied villages in September to December 2012. The main criteria used for the stratification of the population included age, marital status, occupation and social background. The questionnaire, which was designed with the nature of the rural population in mind, focused on the profile of the respondents, reasons for undertaking cassava production and processing, tasks as cassava producer-processor, and changes brought on their socio-economic lives as a result of cassava farming.The questionnaire survey was complemented by four interviews on the same subject conducted with both very poor and influential female cassava producer in *Bityili*. The discussion with the interviewees focused on a common theme, that is, their perception of women in cassava production and processing and its impact on the family. These interviews provided opportunities to gain clarity about some of the issues raised by the questionnaire, and the particular viewpoints of respondents of different ages and social groups. The data collected from the key informants has been analysed quantitatively and qualitatively alongside data from the questionnaires. The results obtained have been discussed alongside

existing related literature to project the implications of the activities of female cassava producers on women's triple roles.

Figure1: Location of the study area in south Cameroun
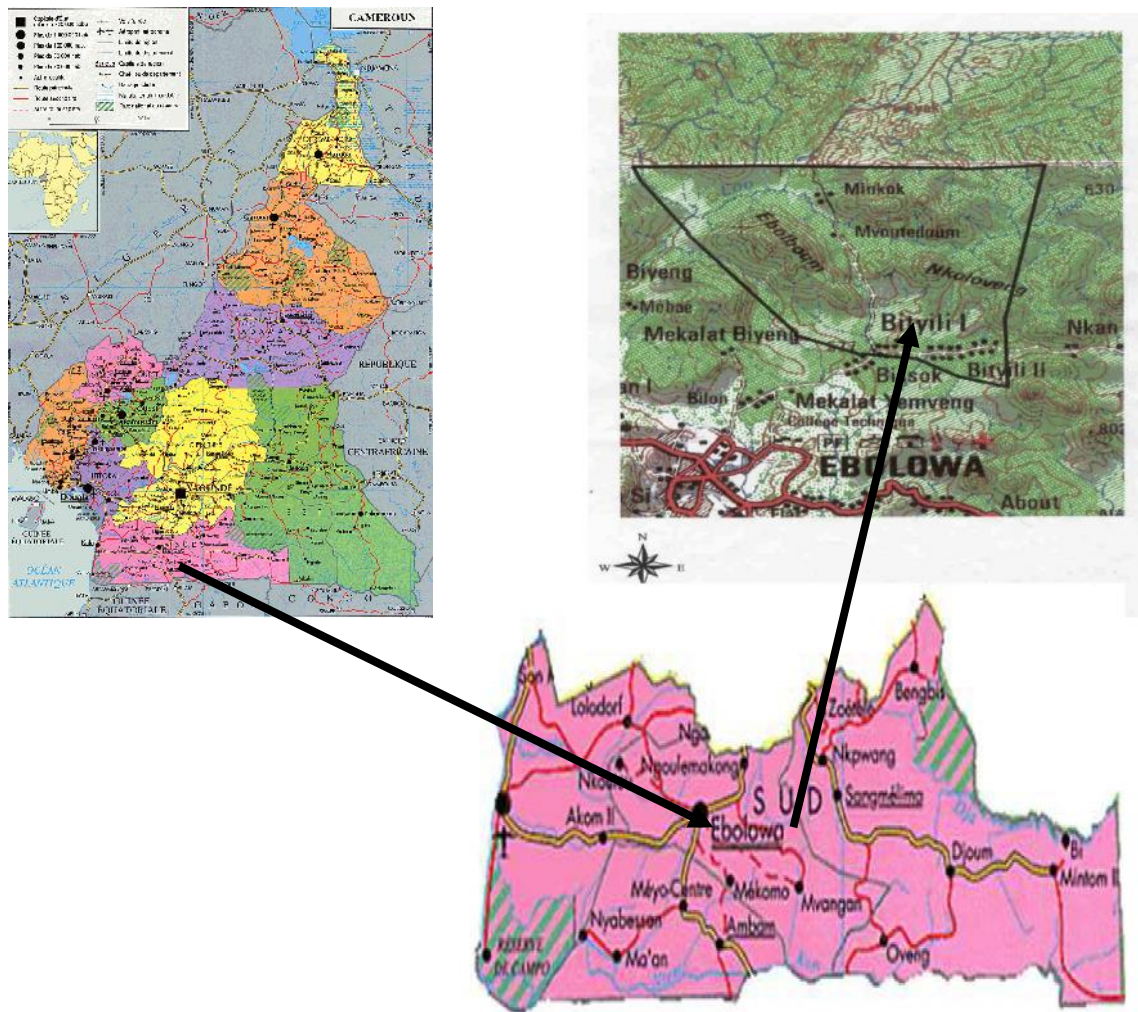
Results and discussion

Women in cassava production

In Cameroon, cassava cultivation dates as far back as the colonial era. In the centre and south region, responsibilities' allotment in a Bantu family prior and just after the independence states the man was the financial provider and in-charge of the hardest work. In rural areas, his activities scope was hunting for bush meat, fishing and picking. Additionally, he cultivated cash crops such as coffee, cocoa and rubber tree. He also took part in community farms and nation building initiatives. The woman was in charge of children's education and housekeeping. She has to provide food, placing herself at the bottom line of the family diet manager (Vincent, 1976; Anonymous, 2012). There was therefore a marked division of labour in the agricultural sector in which the women were exclusively concerned with food-crop production and the men with cash crop production.

Nowadays, because of the dynamic of local and global economic the situation have change. Both men and women have become competitive farmers in *Bityili* and in Cameroon as a whole. The mid 80s crisis, The Breton Woods institutions structural adjustments in early 90s and the country's currency devaluation in mid 90s made cash crop prices unpredictable and the government ceased to provide financial aids to farmers (Fonjong, 2004). Many rural-

farming households faced critical financial down sloping and many coffee and cocoa farms were abandoned (Sonwa et *al*., 2006). In addition, the increasing number of women in the intellectual arena, some with high-institutional positions and women empowerment initiatives contributed to the raising of a self-determined and powerful generation of women, with the quest of using what they have in order to upgrade their family's living conditions.All these created market opportunities for many food crops, among which cassava holds an upright place, moving from a family food crop to a high financial return crop.

Apart from the need to earn wages and become financially independent as indicated by 60% of those surveyed, the women see cassava production as a means of employment, given that 80% of them are not adequately educated for white-collar jobs, which in any case are not readily available. Cassava cultivation is also a means to fight hunger. The majority of respondents (90%) reported that they became cassava producers because cassava is the staple of their diet, while some were motivated by others. These reasons are closely related to the socio-economic profile of the individual farmers and the economic realities of the country.

Most female cassava producers in *Bityili* fall within the early 20-45 years and late reproductive and productive (ages) stages of life. This is the period when women tend to shoulder more reproductive and/or productive responsibilities as mothers, single parents or widows. The fact that most of them (67%) are married and 70% have between 6 to 10 persons in their households, justifies their involvement in cassavaproduction. Moreover, the responsibility involved in taking care of a large household, coupled with the fact that the women are not sufficiently literate to pick up well-paid jobs, pushed them into cassava production. Thus women have to work for longer hours, engaging in cash and food crop production as well as other income generating activities like petty trading, to increase household income, cushion the stress of family financial demands, and meet the needs of household members. This can lead to negative health outcomes, as they remain overburdened with their triple roles (reproduction, production and community), which in this case are labour intensive and energy sapping.

Women and men's respective responsibilities in agricultural production are in part determined by the local ecosystem and farming systems (Huvio, 1998). Although women in *Bityili* play a crucial role in cassava cultivation, supplying about 70% of the labour needed for cassava cultivation, there is a need to understand the age-based power relation within households and cultural norms of cooperating and dealing with conflict in families as well as the dynamics that shape the distribution of work, income and assets (Cagatay, 1998: 4). The field realities in *Bityili* reveal that the average cassava field per household was less than one hectare and contained on average 8,000 cassava plants. Women are mainly involved and provide the majority of the labour in activities such as, cleaning, burning, sowing, tilling the soil and creating mounds that house the stem-cuttings from which cassava is grown, 1st and 2nd weeding, harvesting and processing for both household consumption and market sale. Processing begins with peeling the root, which is laborious and time consuming. Men, on the other hand are involved in slaughtering or clearing the cassava fields. Both men and women undertake activities like clearing and harvesting (Fig. 2).

Fig. 2: Gender division of labour in cassava cultivation in Bityili, 2013
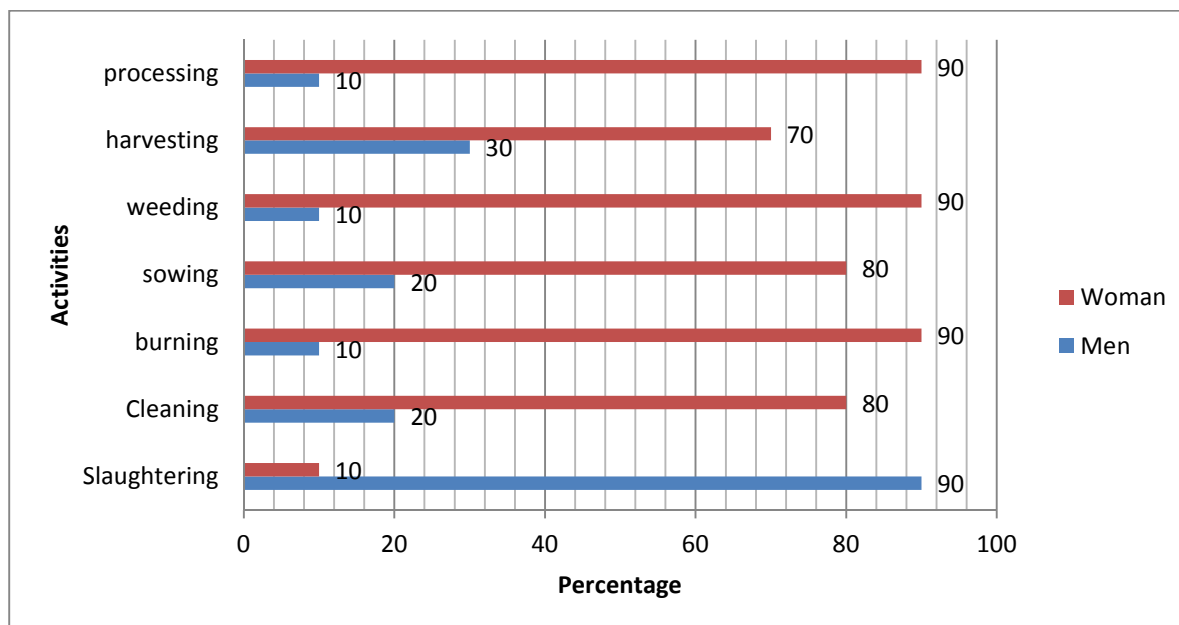
This situation is similar to what FAO and IFAD (2005), Nweke *et al*., (2002), observed in the Collaborative Study of Cassava in Africa (COSCA) where because of the physical demands, men more often than women prepare land for cassava planting, provided 85% of the labour in clearing the land, though their share of labour dropped during tilling and planting to 65% and 40%, respectively. These findings were fairly constant across the six countries, with the exception of Congo, where women provided over 75% of the labour for both ploughing and planting. This production work is of course, in addition to their traditional gender roles as home managers and community organizers.

Fallouts of women's involvement in cassava cultivation

As the most reliable and major source of income for most female farmers in *Bityili*, cassava production and processing is fast becoming an integral part of the culture of the people. It serves as the mainstay of the present day economy of *Bityili*. Cassava production has employed the women, raised the income levels of the population as well as changed local consumer preferences.

Women's income from cassava production has an overall impact on household income. The incomes of these women have a positive and significant effect on household maintenance and feature prominently in terms of expenditures on children's education and health. It was observed that money raised from cassava production has been very instrumental in the education of children as indicated by 80% of the respondents.

Respondents reported that they have been able to educate their children through primary school (grades) and in some cases they have succeeded to put their children through, the university from incomes earned on cassava production and processing. It confirms the general view that women's incomes in poor societies are mostly spent on their children (Engle, 2001; Fonjong, 2002)

Access to land, labour and technology

Women's ability to access land for cassava cultivation varies considerably across regions and cultures. Some women may have legal rights to land but lack of enforcement restricts *de facto* rights (Quisumbing & Pandolfelli, 2009). In *Bityli*, this is not true because 90% of respondents argue that they have access to land by inheritance. When married or widowed

women grow on land belonging to the family of their husbands. However, when single or divorced, they are entitled to a share of their father's land. Also, women can own land for cassava cultivation by buying a plot because there is no sex discrimination, upon payment of the amount of money desired from the seller. Women cassava cultivators in *bityili* have secured access to cassava land, provided they can continue to abide by the rules and regulations governing their tenancy. The major limitation of such a tenancy agreement is that women can only use this land for cassava and other staple food production. Women's control of the land can be considered as partial ownership and is subjected to the use and land disposal as defined by the empowerment framework (Moser, 1993).

In performing the various farming activities, 80% of the respondents make use of family labour or help group. Family labour and help group are employed more in activities such as weeding, sowing, harvesting and processing. Hired labour is employed for land preparation (slaughtering and clearing) and certain stages of processing (crushing and attaching the cassava sticks). When labour is hired, most of those who supply this labour are men and children. However, 60% of the respondents make use of both family and hired labour, while 6% depend on hired labour only. This shows how demanding cassava cultivation is for women.

Implications for gender roles

Traditionally, any activity that is geared toward the upkeep of the home is looked upon as a woman's domain. This amongst other reasons is due to gender segregation, which has narrowed women's range of occupational choices (Baden and Milward, 1997: 28). However, women are increasingly working outside their homes. Women in *Bityili* perform a number of key roles; first as food producers (subsistence farmers), secondly as mothers, where they bear and raise children. Thirdly, they are responsible for the overall household management that is, cleaning and preparing meals. Finally women execute a number of community tasks such as dancing during traditional festivals, and orchestrating death ceremonies, and annual celebrations. All these activities are more or less linked to women's reproductive rather than productive roles. The introduction of cassava cultivation in *bityili*, in which women's labour constitutes an important component, has drastically changed the traditional patterns of division of labour and gender roles, which formerly forbade women from engaging in economically profitable activities in this area. Today, women do not only engage in food crop production, but also in the cultivation of cash crops as well as other income generating activities, through which some of them have become major breadwinners. The logical outcome is a phenomenal reduction in household poverty among many families, particularly female-headed households.

Conclusion

Since its introduction, cassava has become one of the major cash crops in *bityili*, it is one of the staple foods of a majority of people in and around the area. Cassava production-processing has provided both social and economic benefits for a vast population in *Bityili*. The income women generate from cassava is very crucial for family survival. Impacts have been felt especially with regards to children's education, health care, petty trading and improved standards of living. In fact, cassava cultivation has been a profitable enterprise for most women; it has empowered them, making it possible for them to efficiently perform their productive and community roles. Female cassava farmers have been ushered into a new horizon where their participation in local development is no longer felt just in their homes, but in the whole community. Women can hire both male and female labourers to perform various activities on their cassava farms. These cannot just be described as changes in the gender roles, but a revolution that is capable of ushering in a new era for men and women in *Bityili* and Cameroon as a whole.

For this revolution to take place and the new order *marshaled* in, however, there needs to be major reforms and sensitization at all societal levels. By emphasise the status of women' farmers, land-reform programs, which provide secure tenure to farmers, can have direct and indirect benefits for environment (Gueorguieva and Bolt, 2003). Men in local and public institutions must acknowledge the efforts of women as crucial for the wellbeing of communities. This means lightening women's task by, men jointly participating in the household chores. Traditional authorities would be wise to eliminate traditional norms that act as a check on women's public activities and reduce their mobility. Public, private and non-governmental organizations should create an enabling environment, for female cassava farmers to be more productive, by providing them access to credit, better farm technologies and labour saving devices at home. With the increasing responsibilities assumed by women as a result of cassava production and processing, society stands to gain if women are integrated into the main stream of development, and permitted to work together with men as partners in development.

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AN ANALYTICAL STUDY OF THE PRODUCTION EFFICIENCY AND MARKETING OF CHAMOMILE CROP UNDER ORGANIC FARMING SYSTEMS IN EGYPT

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Abstract

The Study aim to identify the current production possibilities of chamomile in Fayoum governorate, besides, it has also estimate many economic measures and coefficients such as, net return per feddan, marketing margins, marketing channel, marketing efficiency and the breakdown of consumer pound. Moreover, it also estimate the return of invested pound and, examine the problems of production and marketing that face the producers .

A questionnaire had been carry out in 20 organic and conventional chamomile farms during the year 2013/2014.in Fayoum governorate, where over 74 % of the Egyptian chamomile is produced.

Keywords: *chamomile, organic Agriculture, conventional, marketing efficiency, production coast.*

Introduction

The main objectives of this study is reducing the marketing margin between farm price and retail price and economic aspects of organic chamomile production in the fayoum governorate, also identify the problems of both production and marketing that face the producers.

Comparative studies (Lampkin, 2004) of organic versus conventional systems are frequently used by researchers to establish the differences between the two systems in terms of yields and productions costs, as well as other aspects, like impacts on biodiversity, energy consumption, water demand and labor requirements. Some sties focus only on one crop, while other ones investigate entire systems. Some studies have lasted one year, whereas other ones have covered several years, to consider the effects of climate and market fluctuations.

Such studies are also useful to determine the level of subsidies for organic farmers, as in the European union and other neighboring countries.

In this research, only chamomile is investigated from marketing efficiency within the paradigm of conventional economics (Kahan, 2004).

Chamomile is one of the most popular and documented herbal medicines . it is used externally for wounds, ulcers, ulcers, eczema, and leg ulcers(salamon, Ghanavati and Khazei, 2010). Chamomile is also very much consumed as a tea or tonic to treat anxiety, hysteria, nightmares, insomnia and other sleep problems, convulsions and even delirium tremens (Garginer, 1999).

In Egypt, according to the ministry of Agriculture and land reclamation, in 2013 the total area of chamomile was 8763 fedden represented 13 % of total area cultivated with medicinal and aromatic plants about 74% of organic chamomile was in fayoum governorate.

About 35.9 % of chamomile in Egypt is nowadays organic. In 2013 the total area organic chamomile estimated at 3,150 fedden, which accounts for 45 % of total organic area of medicinal and aromatic plants. Organic chamomile in fayoum governorate, meaning 52% of total organic area in the governorate. Also conventional farmers are conscious that chemical and pesticides must be used carefully or totally abandoned, because exporters have

established high quality standards and the presence of residues may eliminate any chance of foreign markets.

Materials and methods

The study used the descriptive and qualitative methods such as ratio averages some economic measures like marketing efficiency and marketing margins, the breakdown of consumption pound, The study depended on the primary and secondary date form their available different sources in addition the designed questionnaire to achieve the objectives of study.

The study has been conducted in the fayoum governorate, where over 74% of the Egyptian organic chamomile is produced.(Ecoa, Ecoa, 2013).from Total area 3150 Feddan, average productivity1.100 dray chamomile. (Table-1)

Table (1) Area, Productivity and production of Conventional and organic chamomile during the period 2003-2013.

year	Organic chamomile[*]			Conventional chamomile[**]			Org. /conv. %
	Area (fed.)	Productivity (ton)	Production (ton)	Area (fed.)	Productivity (ton)	Production (ton)	
2003	570	0.750	427.5	7621	0.833	6348.29	7.5
2004	820	0.760	623.2	9813	0.954	9361.6	8.4
2005	860	0.800	688	9483	0.837	7937.27	9.1
2006	917	0.800	733.6	7284	0.827	6023.87	12.6
2007	1170	0.820	959.4	8776	0.832	7301.63	13.3
2008	1320	0.850	1122	9304	0.816	7592.06	14.2
2009	1435	0.860	1234.1	11502	0.843	9696.19	12.5
2010	1730	0.890	1539.7	10184	0.867	8829.53	17.0
2011	2200	0.910	2002	10038	0.858	8612.6	21.9
2012	2700	0.960	2592	11549	0.866	10001.4	23.4
2013	3150	1.100	3465	8763	0.925	8105.78	35.9

Source: [*]Egyptian center of organic Agriculture (ecoa).
[*]Center of Organic Agriculture In Egypt (coae).
[**] Ministry of Agriculture and land Reclamation, Economic Affairs Sector, Agricultural Economics Bulletin, Different Volumes.

Table (2) linear model Area, Productivity, production of Conventional and organic chamomile during the period 2003-2013.

	items	Equation	t	R^2	F
Organic chamomile	Area	$\hat{Y}_1 = 97.582 + 239.4 X_1$	9.626	0.91	92.6
	Productivity	$\hat{Y}_2 = 0.695 + 0.028 X_1$	7.360	0.85	54.26
	Production	$\hat{Y}_3 = 177.13 + 262.6 X_1$	7.311	0.85	53.45
Conventional chamomile	Area	$\hat{Y}_4 = 8237.2 + 207.6 X_1$	1.755	0.25	3.08
	Productivity	$\hat{Y}_5 = 60.846 + 0.0024 X_1$	0.560	0.034	0.314
	Production	$\hat{Y}_6 = 6998.4 + 194.4 X_1$	1.719	0.25	2.956

Source: Table (1)

Table (2) shows coefficient of determination (R^2) reached 91% of total deviation in value dependent variable (organic chamomile area) explained Linear relations for regression model , 9% another factors. also (Table-2) shows There is significant increase in the organic chamomile area which was about 239.4 fedden a year.

All small farmers sell the chamomile as green flowers and they do not have access to foreign or local markets directly, but sell their output at farm gate price to private companies. All farmers hire permanent and seasonal workers. A questionnaire has been carried out to collect two types of date (i) general characteristics of the selected farms (location, total area, chamomile area, buildings and machinery, etc.) and (ii) economic data (production, marketing cost, prices, cost of marketing services, etc.)

Date were collected for about eight-months starting by mid September 2013, to may 2014, when the chamomile growing season ends. Each farm was visited several times to check the progress of the crop and to meet the farmer.

The formula used to calculate the gross margin for each farm has been the following one.

- Gross margin = Total value of output – Variable costs

The profit per feddan has been calculated with the following formula.

- Profit = Total value output – (variable costs+ fixed cost)

For evaluating the organic chamomile marketing efficiency, have been calculated as follows:

- Total Marketing margin (%) = ((Retail price(RP)- farm price(FP))/ Retail price)*100
- Marketing efficiency = 100 – ((marketing cost/ (marketing cost+ production cost)) *100
- Farmer share (%) = (Farm price/ Retail price)*100
- Wholesaler share(%) =((Wholesaler price (WP)- Farm price)/ Retail price)*100
- Retail share (%) = ((Retail price- Wholesaler price)/ Retail price)*100

Results and discussions

To Study the marketing efficiency for organic and conventional chamomile must studying the production and marketing costs.

1- Production cost for organic and conventional chamomile

Production costs (also called operating costs) are the expenses necessary to maintain a plant (Table-3)

Table 3 shows organic farms have higher variable cost, because the organic fertilizers (compost) are much more expensive, represent 31.4% of the total cost. Similarly chemical Fertilization for Conventional chamomile represent 19.5 % of the total cost. Also there increase in total cost of organic chamomile about 27.5 %, total cost for Conventional chamomile.

Table (3) . production cost for Conventional and organic chamomile at season 2013/2014.

items	organic chamomile		Conventional chamomile	
	production cost	% of total costs	production cost	% of total costs
Rent	2400	33.7	2400	39.1
Registration cost	300	4.2	-	0.0
Soil preparation	450	6.3	450	7.3
Fertilization	2240	31.4	1200	19.5
Fertilizer vital	500	7.0	-	0.0
Pest and disease control	400	5.6	600	9.8
Weed control	600	8.4	600	9.8
Transplanting	340	4.8	340	5.5
Irrigation	400	5.6	400	6.5
Seedlings	200	2.8	150	2.4
Total cost	7830	100.0	6140	100.0

Source: Questionnaire 2013/2014.

Economic indicators for organic and Conventional chamomile
Table (4)showed that a very good profit for was 8370 L.E/fedden dry flowers for organic chamomile compared net profit of Conventional chamomile which was 5860 L.E/fedden dry flowers, 42.8 %. An increase for organic chamomile price than Conventional chamomile price. Also there are improve in productivity organic chamomile by12.5 %, about Conventional chamomile.

Table (4). Economic indicators for organic and Conventional chamomile at season 2013/2014.

items	unit	organic chamomile	Conventional chamomile
Productivity (dry)	ton	0.900	0.800
Price per kg fresh	L.E	18	15
Total value of output	L.E	16200	12000
Net profit	L.E	8370	5860

Source: Questionnaire 2013/2014.

2- Marketing cost

Table (4) Shows that total marketing cost for organic chamomile reached about 3205 L.E, costs of flower collection and harvest represents about 62.4 %, from Total marketing cost, and processing costs about 11.5%. from total marketing cost. While total marketing cost for Conventional chamomile reached about 2680 L.E, flower collection and harvest represents about 67.16 %, from Total marketing cost, and Packaging costs about 10.45 %. from total marketing cost.
The organic product interested in marketing services and high quality of Packaging type, processing, drying to prevent product Contamination.

Table (5). marketing cost for organic and Conventional chamomile in fayuom governorate during season 2013/2014.

items	Organic chamomile		Conventional chamomile	
	Value (L.E/Feddan)	% from Total Marketing cost	Value (L.E/Feddan)	% from Total Marketing cost
Flower collection costs	2000	62.4	1800	67.16
Drying costs	290	9.0	200	7.46
processing costs	370	11.5	250	9.33
Packaging costs	365	11.4	280	10.45
Transportation costs	180	5.6	150	5.60
Total marketing cost	3205	100	2680	100

Source: Questionnaire 2013/2014.

Marketing margin:

The marketing margin (Thomsen F.L 1951) of a product or service is the difference between the retail or selling price of the product and the actual cost it took to produce that product. The production costs take into account the average unit cost in terms of operating expenses, manufacturing and packaging. The retail price or selling price reflects the mark-up on the cost of producing that product.

Total Marketing margin(%) = ((Retail price(RP)- farm price(FP))/ Retail price)*100

Total Marketing margin of organic chamomile(%) = ((27-18)/27)*100 =33 %.

Total Marketing margin of conventional chamomile (%) = ((21-15)/21)*100 =28.6 %.

The marketing margin were 3&6 L.E for wholesalers and retailers respective Table (6), while the price spread was about 9 L.E for organic chamomile, also marketing margin were less about 2&4 L.E for wholesalers and retailers respectively, while the price spread was about 6 L.E for Conventional chamomile represent, 50 % from organic chamomile.

Table (6) .Marketing margin for organic and Conventional chamomile

item	farm price	Wholesalers price	Retail price	Marketing margin		
				Wholesalers price - farm price	Retail price - Wholesalers price	Retail price -farm price
organic chamomile	18	21	27	3	6	9
Conventional chamomile	15	17	21	2	4	6

*price L.E/Kg

Source: Questionnaire 2013/2014.

Marketing Efficiency

Marketing efficiency is the ratio of input and output, An increase in this ratio represents improved efficiency, A decrease denotes reduced efficiency (Sheth et al. 2002)

Marketing efficiency = 100 – ((marketing cost/ (marketing cost+ production cost)) *100

Marketing efficiency of organic chamomile = 100- (3205/(3205+7530))*100 = 70.1%.

Marketing efficiency of conventional chamomile = 100- (2680/(2680+6140))*100 = 69.6.%.

Marketing efficiency represented about 70.1 % for organic chamomile, while Marketing efficiency represented about 69.6 % for Conventional chamomile, which indicates efficiency of the marketing services, during the marketing channel.

Breakdown consumer pound

Table (7) shows Breakdown consumer pound between farmer and marketing (Wholesalers and Retail)

Table (7). Breakdown consumer pound for organic and conventional chamomile.

item	Farmer share	Wholesaler share	Retailer share
organic chamomile	66.7 %	11.1 %	22.2 %
conventional chamomile	71.4	9.4	19.0

Source: Table (5)

The share of farmer, wholesaler and retailer from consumer pound for organic chamomile represented was 66.7%, 11.1%, 22.2% respectively. While The share of farmer, wholesaler and retailer for consumer pound for conventional chamomile represented 71.4%, 9.4%, 19.0% respectively

The point of view and the opinions of interviewers which related to the designed questionnaire indicated that the major problems were: Increase in collection costs. Increase of chemical analyses price. Increase of fertilizes prices. Increase of both production and marketing costs. Finally the low capability of finance resources for most small farmers, besides the low offered credits and loans, and increase of interest rate for the nongovernmental credits.

Conclusions

Recommendations can be illustrated as follows:
1. launch an extension campaign to attracting small farmers to cultivate organic chamomile due to the highly local marketing and exporting returns.
2. Both governorate agencies and marketing cooperatives must work together to establish factories for drying organic chamomile to increase the value chain.
3. To make the finance and credit more available to encourage cultivation and marketing organic chamomile.

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TRENDS IN PRODUCTION OF RAW MEDICINAL AND AROMATIC PLANTS IN SERBIA

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Abstract

The largest amounts of medicinal raw plant materials that are sold in the market of Serbia and the international market, originate from nature, and are gotten from picking of wild medicinal and aromatic plants. This trend will continue for a longer period of time due to many factors: the large number of medicinal species originating from taxonomic groups for which there is little or no experience in cultivation, research has led to the conclusion that the domestication and cultivation of a large number of medicinal plant species expensive because a relatively small number of species is large enough or has secure market, collecting does not require additional infrastructure and investment in many countries wild species are an important source of income for local communities. However, the trend is in the market of medicinal and aromatic plants in the world and in Serbia for a greater share of cultivated plants. Most of the companies operating in this market (Over-the-counter (OTC), pharmaceutical, etc.) prefer raw plant materials products from plantation production, especially in manufacturing, which is certified as biodynamic or organic.

Key words: *Medicinal and aromatic plants (MAP), trends, raw, production, organic*

Introduction

Serbia is located on the Balkan Peninsula, extending from the Pannonian Plain in the north, to south Albanian high mountains Dinara and Sar-Pindos system in the south, covering an area of 88766 km^2. The geographical position of Serbia is unique, characterized by geomorphological, geological and pedological diversity, as well as the influence of different climate that caused the wealth of genetic, species and ecosystem diversity. Serbia is an important center of biodiversity, with about 700 species of medicinal characteristics. Of that number 420 is in use (Panjkovi et al. 2000), and it is estimated that 279 medicinal and aromatic plants (MAP) were placed in a trading turnover. Intensive cultivation of medicinal plants in Serbia began in the mid twentieth century. Compared to the past, today in our country about 30 species of medicinal plants is cultivated. Increased demand for medicinal raw materials of plant origin has led to the introduction of a large number of medicinal species in plantation production.

Picking of Medicinal and Aromatic Plants

Collection from nature still plays a key role in the sale of plant raw material for several reasons: many plant species is difficult or impossible to cultivate (mistletoe, moss, etc.). Many are used in small quantities, the quality of some plant species from the wild is superior, the cost of the cultivation is high, some species have a long life cycle and long periods to the stage of harvest (horse chestnut, elder, linden, hawthorn, etc..).
European countries, particularly the Mediterranean, have great genetic potential to medicinal wild plants as well as the cultivated. In Europe, there are somewhat less than 2000 taxons of

medicinal and aromatic plants, of which about two-thirds (1200) originated from Europe (Donnelly et al., 2003). The collection of wild medicinal plants is dominant way of supply, and the price of these raw materials is slightly less than the raw materials that are produced by cultivating. The collection is dominant in Albania, Spain, Hungary and Turkey. In Hungary, 30-50% of plants were collected from the wild in Germany between 50-70%, 75-80% in Bulgaria, while almost 100% of plants that is on the market in Albania, is obtained by collecting.

Picking wild medicinal plants and wild fruit is an integral part of the activities of many rural households (especially in the mountainous area of southeastern Serbia), and it is the most accessible form of activity within the LAB sector. There are many reasons: low investment, jobs can be done seasonally comparatively jobs on the farm, any generation can do it despite of their age. This work is usually popular among older people, especially women. The most commonly medicinal plants are sold dried. However, some companies organize pickers to pick the plants in the field (Ramsons, blueberry), which are then dried in a dryer. The reason is certainty that the necessary amount of plants will be collected in the short term, and that that obtained materials will have good quality.

During the research of LAB sector in Serbia (SEED, 2003) it is estimated that there are about 4000 organized pickers of medicinal and aromatic plants, or picker's households. Given that in the work the members of the household are involved, it is estimated that there are about 12,000 pickers. In addition, there are occasional pickers, whose economic activity has lower weight, and dealing with it only when prices are high and there is a high demand for certain plant species (Turudija, 2010).

This sector now provides employment (permanent or seasonal), as well as income for about 50,000 persons, including pickers, as well as the owners and employees of companies engaged in processing, distribution, and retail products. In the late 90s the number of people who were employed in the sector was around 150,000th total value of the industry in the domestic market is estimated at $ 150 million, with exports valued at $ 50 million (USAID, 2008).

Based on interviews with processors and other stakeholders in the sector, in large quantities it is picked about 30 types of plants and 10 types are produced in the plantation production. The main limitation of the expansion of this sector is a small number of vital rural households. The depopulation of rural areas in Serbia is active for decades. In the few mountain village households live mainly old. Young people are poorly or not at all familiar with wild medicinal plants, and often are not interested in this activity. Also, the lack of purchasing places in Serbia. Companies purchase products mainly in the place where the headquarters of the company are. Other areas, where the plants are picked are covered with temporary buyers who work in the field. This type of organization is followed by a series of problems: an inadequate storage, insufficient knowledge of plants by the person making the purchase, and by people who picked plants, inadequate quality of the harvested plants, collecting a small number of plant species, and so on.

Under the protection of the state until recently was located 8.09% flora of Serbia, and now that number is 12.52%. It is difficult to estimate the total amount of MAP which is picked in Serbia, because there is no need for permission for all plant species. Quotas were relatively low from 2000 to 2004 year, from 2005 to 2007 or 2009 are increased. In 2012th quotas are slightly lower, and the reason is because for many plant species no permit is required for circulation, which is provided by the Institute for Nature Conservation of Serbia (USAID, 2008). Quotas used to be around 6-8000 t of fresh plant material, depending on the year. From that you can get around 1500-2000 t dried plants. In the last 5 years, quotas were increased and range from 14-19000 t of fresh plants or about 3-6000 t dry. It is impossible to know whether all quotas have been used, but on the basis of permits granted it is safe to conclude that market turnover is about 2000 t (average drying 4:1).

Chart 1 presents quotas for the picking of medicinal and aromatic plants in Serbia (in kg of freshly picked plants) for the period 2008-2012. From this graph it can be seen that the contingents are much higher than the required amount, reviews and by permits granted.
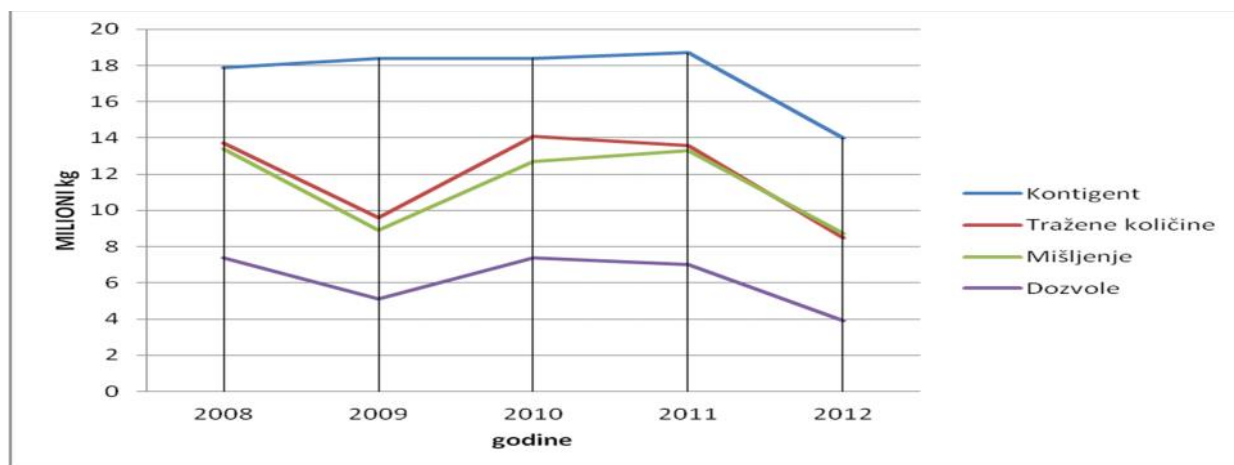
Source: Institute for Nature Conservation of Serbia, 2013.

Figure 1 Quotes for the collection of medicinal and aromatic plants in Serbia in the period from 2008 to 2012.

Cultivation of medicinal and aromatic plants

Overall, in all countries, the trend in the market of medicinal and aromatic plants is toward the greater participation of cultivated plants. Most of the companies operating in this market (OTC, pharmaceutical, etc.), prefer cultivated plant material, especially from plants whose production is certified as biodynamic or organic (FAO, 2002).

According Máthé and Math (2008) the benefits of cultivation are: reliable botanical identity, guaranteed continuous supply of raw materials, it is possible to control the production process and monitor production standards in accordance with the regulations and requirements of the market, provides a relatively simple procedure of certification of crops   offers opportunities for growing wild plant species   allows contracting between manufacturers, wholesalers and pharmaceutical or other companies in the quantities and at prices that are acceptable to all.

Cultivation of medicinal, aromatic and spice plants has a long tradition in the agro ecological conditions of Europe and originated in the Mediterranean area, where many species were produced in the past. From the point of view of biodiversity in Europe is now grown between 130-150 and picked between 150-170 plants of species. The most commonly cultivated species in Europe are: Kim (Carum carvi L.), coriander (Coriandrum sativum L.), fennel (Foeniculum vulgare Mill.), adders herb (Silybum marianum L), anise (Pimpinella anisum L.), wormwood (Artemisia absinthium L.), chamomile (Matricaria recutita L.), St. John's wort (Hypericum perforatum L.), peppermint (Mentha piperita L.), melissa (Melissa officinalis L.) and lavender (Lavandula angustifolia Mill.) (Laird and Pierce, 2002).

Table 1 shows the statistically analyzed data on area under medicinal plants in European countries that are the largest producers. It can be seen that Bulgaria, France, Finland and Poland are the biggest producers of MAP in Europe. Tendencies of changes in the area under MAP machine are very different across countries. The highest rate of growth (from major manufacturers) record Spain, Hungary, Croatia, Finland, and the highest rates of decline record Bulgaria, Romania and the Czech Republic.

Table 1: Key indicators of land under medicinal and aromatic plants in Europe in the period from 2004 to 2012.

Countries	The average value (000ha)	Variation interval		Coefficient of variations (%)	Rate of changes (%)
		Minimum (000ha)	Maximum (000ha)		
Belgium	0,16	0,10	0,20	33,88	-8,30
Bulgaria	49,64	30,60	83,50	34,55	-9,73
Czech Republic	7,34	4,00	11,70	32,82	-5,90
Germany	6,42	5,70	7,40	9,50	0,73
Estonia	0,38	0,10	0,90	84,52	18,90
Greece	2,72	1,00	5,00	56,78	-2,25
Spain	8,46	5,60	13,60	34,51	10,34
France	34,16	29,50	36,50	7,68	-0,42
Croatia	3,00	2,20	4,00	17,08	4,80
Lithuania	6,43	2,00	25,60	115,59	-1,31
Hungary	3,39	1,60	4,60	31,45	5,94
Austria	3,81	3,30	4,20	6,87	0,34
Poland	15,88	14,00	21,60	18,33	-0,42
Romania	10,41	4,60	23,70	56,29	-6,32
Slovakia	1,23	0,90	1,50	17,67	0,87
Finland	16,26	10,60	22,50	24,64	3,54

World production and processing of medicinal plants remains focused in Europe, particularly in Germany and France. Other important areas of production include the countries of former Yugoslavia, Bulgaria, Germany and Hungary.

Intensive cultivation of medicinal plants in Serbia began in the midtwentieth century. Compared to the past, today in our country about 30 species of medicinal plants are cultivated, depending on market demand. Increased demand of medicinal raw materials of plant origin has led to the introduction of a large number of medicinal species in plantation production. Cultivation of LAB, as well as the production of a species of wild medicinal plants is achieved uniform quality of raw materials produced while collecting wild species from different localities raw materials are of uneven quality. Improving the technology of plantation cultivation, seed production and cultivation of the most endangered or rare species is a prerequisite for the preservation of medicinal plants in their natural habitats. Plantation growing in addition to increased raw materials significantly reduces the pressure on natural resources, which are often due to unprofessional or unplanned exploitation threatened.

In some parts of our country cultivation has a long tradition (Vojvodina), while in other areas more often is present purchase of wild MAP (eastern and south-eastern Serbia). Production of cultivated medicinal plants has been most active in the area of Banat and Ba ka. In this region, medicinal plants were grown even before World War II. Regionalization in this area is conditioned by the multiple factors: soil, climate, altitude, MAP prevalence in nature, tradition, proximity to markets, household machinery, labor etc.

In order to secure the supply and provision of additional quantities of medicinal and aromatic plants possibilities are explored plantation growing of many wild species. Based on which some methods are implemented in the projects of the Ministry of Science and Technology in Institute for Medicinal Plant Research "Dr Josif Pan i " the technologies is achieved of cultivation of many wild MAP species, and the practice has proven that there is economic justification for growing (Sage, Plantago, Oregano, White mallow etc.).

There are circumstances that limit large-scale production of MAP, such as: lack of knowledge agro biological seed characteristics and conditions of reproduction and cultivation, undeveloped technological processes for many species, a relatively long period of introduction into production, (non) existence of appropriate biotic and abiotic conditions in a particular location, insufficient market interest etc.
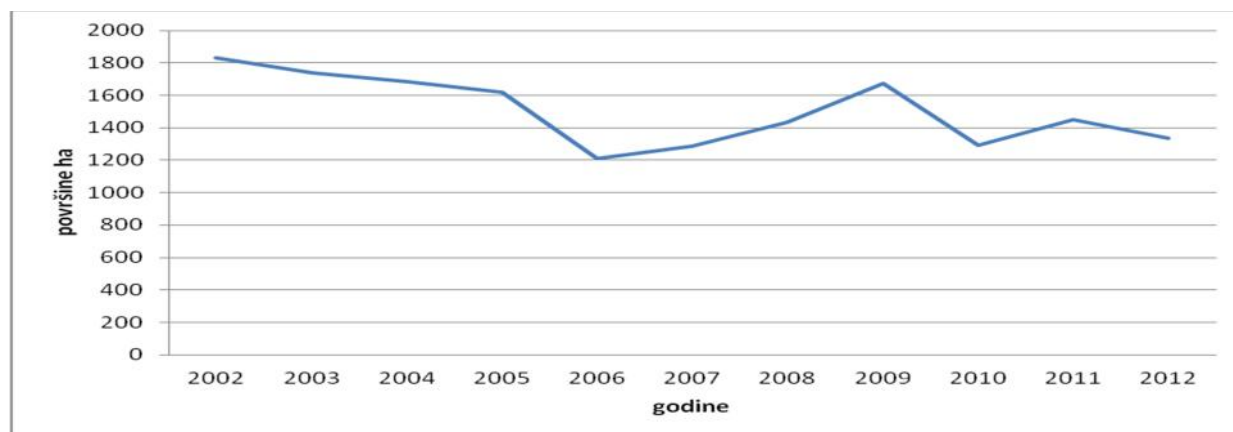
Source: Serbian Chamber of Commerce, 2013.

Figure 2: Areas under medicinal and aromatic plants in Serbia in the period 2002-2012. in ha.

Areas under MAP in Serbia are shown in chart 2 Part of the cultivated plants companies produce on their own parcels, in cooperation or buy on the open market. According to estimates the areas under MAP are below 5,000 ha, and never exceeded 10,000 ha. The maximum area for cultivation would be about 15,000 ha, in order to avoid a surplus of raw materials.

The maximum area during the period amounted 1832 ha, 1211 ha minimum. The mean value of area in the reporting period amounted to 1503.36 ha with a coefficient of variation of 14.18 and the rate of change of -3.1%.

Table 2 shows the estimated area under certain types of LAB in Serbia in 2013. Areas under medicinal plants, and growing regions, are approximately the same for last ten years. The largest areas are under mint, next is chamomile, fennel, lemon balm etc. Some plant species, for which there is a constant demand, are grown in the garden.

Table 2 Estimated area under medicinal and aromatic plants Serbia in 2013 in ha

Plant species	Area (ha)	Plant species	Area (ha)
Peppermint	300	basil Bosiljak	5
Chamomile	250	sage Žalfija	10
Melissa	50	marigold Neven	20
Parsley	200	immortelle Smilje	40
Fennel	60	lavender Lavanda	40
Marshmallow	50	Other Ostalo	50
Thyme	10		
Coriander, kim flax	20		
Total			1095

Source: Self-Assessment, 2013

Conclusion

At the international and domestic market MAP raw materials, demand for cultivated medicinal plants is rising, especially in manufacturing, which is certified as biodynamic or organic. The plant material from plantation production have reliable botanical identity, it is possible to continuously supply the market, the introduction of production standards in accordance with the regulations and requirements of the market   possibility of growing wild plant species, thus protecting natural resources, contracting between producers and distributors of raw plant materials for quantities and at prices that are acceptable to all. Problems that occur in gathering are: control of collecting medicinal plants limits the amount that can be picked; reduces the number of pickers, inadequate storage, lack of knowledge of plants by the person making the purchase, and the people who pick crops, inadequate quality of the picked plants, collecting a small number of plant species, and so on. Contrary, there are all prerequisites for the cultivation of medicinal plants in this region (relief, climate, well-known technology of cultivation, traditions); labor force in this manner can be employed; There are institutional capacities of professional services that can organize and monitor the complete production and processing and export sector MAP.

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PROFIT EFFICIENCY OF POULTRY EGG PRODUCTION SYSTEM IN OGUN STATE, NIGERIA.

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Abstract

The study aimed at investigating the disparities in efficiency among deep-litter and Battery-cage Poultry Egg farmers in Ogun State, Nigeria. Primary data from a cross-section of 237 poultry egg farmers through a two-stage random sampling technique were used. The data were analyzed using descriptive statistics, budgetary analysis, and Stochastic Frontier Analysis techniques. Egg production for both systems was male dominated with 87.2% deep-litter and 81.86% battery-cage. The rate of return on investment of Battery-cage (17.07%) is greater than that of Deep-litter (9.05%). The estimated profit efficiency of battery cage (74.74%) is higher than the deep litter (62.28%). The profit inefficiency analysis of the battery cage farmers revealed that farmer's experience ($P<0.01$), age, credit access and education are negatively significant ($P<0.05$). Besides, in deep-litter, age and education were positively significant ($P<0.05$) and household size negatively ($P<0.05$). The study concludes that battery-cage system is more profitable than deep litter production system. Poultry farmers should be trained on the use of inputs.

Key words: *Efficiency, deep-litter, Battery cage, Poultry-Egg, Nigeria.*

Introduction

The challenges of food insecurity and hunger worldwide and in developing countries like Nigeria in particular have continued to receive attention from experts and governments (FAO, 2003). Consequently, several conferences and world Food summit on human nutrition have brought to the fore deliberations on the issue of eradicating poverty and hunger. FAO (1995) asserted that, the most critical in the global food basket crisis is animal protein. In Nigeria, the contribution of poultry production (meat and eggs) to total livestock output increased from 26% in 1995 to 27% in 1999 with an increase in egg production alone accounting for about 13% during the period. (Ojo, 2003). Inadequate protein intake has been identified to be responsible for health hazard and malnutrition among Nigerians. In Nigeria, food demand is increasing at the rate of 3.5%. The population growth of 2.83 is higher than the rate of food production of 2.5 percent (FOS, 2000; Ojo, 2003.) This is an element of food crisis and a problem that requires urgent solution. The task of solving the problem of protein-deficit and malnutrition in Nigeria calls for the collective efforts by all the stakeholders. The subject of profit efficiency of egg production is of significant importance in this case. The specific objectives of this study are to estimate profitability, compare the profit efficiency estimates and determine the factors affecting profit inefficiency of poultry egg production in ogun state, Nigeria. Ogun state has an estimated population of over 3 million people according to National Population Commission (NPC 2006). The state is located in the rain forest vegetation belt of Nigeria within longitude 2^0 45'C and 3^0 55' C and latitude 7^0 01' N and 7^0 8' N in the tropics. The main occupations of the people in the state are agriculture, fishing, clothing, textiles and civil servant.

Materials and Methods

The study was conducted in Ogun State in south-western Nigeria. Livestock are reared extensively in the area and. intensive livestock production is expensive. Findings have shown that 65% of commercial Poultry farms in Nigeria are located in south west. This justifies the choice of the area for this study (Okoruwa and Obayelu, 2004).

Source of Data and Data Collection

Combinations of primary and secondary data were used for this study. A set of primary data was collected from poultry egg farmers by face-to-face questionnaire between March 2012 to December 2012. These farmers used both deep litter and battery cage systems of egg production in Ogun state.

A two-stage sampling technique was employed for the collection of data from the poultry egg farmers (practicing both deep litter and battery cage systems in Ogun state). The first stage involved a purposive selection of three out of the six zones that made up Ogun State. This was due to the predominant position of the three zones in poultry egg production. The poultry farmers in each zone were stratified into deep litter and battery cage based on the production system. The second stage involved a random selection of poultry farmers from farm households. All the total respondents selected for the study were 237 farmers .

Method of Data Analysis

To determine the profitability of poultry egg production in Ogun state, the gross margin was calculated which is the difference between the total revenue and the total variable cost.
The mathematical notation for calculating the gross margin is given by the equation below

$$GM = P_i Y_i - r_i c_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(1)}$$

Where: GM = Gross Margin in ₦, $P_1 Y_1$= Total Revenue in ₦, $r_i C_i$ =Total Variable cost in ₦, P_i =Farm gate price of the ith egg in crate in ₦, Y_i = Output of the ith farm producing i^{th} egg, r_i = price of the ith variable input, C_i = Quantity of the ith variable input

Stochastic frontier profit function was used to compare the estimates of profit efficiencies of deep litter and battery cage production systems (Battese and Coelli, 1995). Raman (2004) using a normalized profit function, which is assumed to behave in a manner consistent with the stochastic frontier concept. The stochastic frontier normalized profit function is defined as

$$\pi = f(P_{ij} Z_{kj}) exp e_i \qquad (2)$$

Where: $e_i = V_i - U_i \qquad (3)$

When linearized, the estimable form of Profit function becomes

$$L_n = A* + \theta_1 \ln P_1 + \theta_2 \ln P_2 + \theta_3 \ln P_3 + \theta_4 \ln P_4 + {}_1 \ln Z_1 + {}_2 \ln Z_{2} + V_i - \mu_i \quad (4)$$

Where: π = Normalized Profit of egg output per Farmer, P_{ij} = Vector of normalized price of variable input, Z_{kj} = Vector of normalized price of fixed input; A' = Intercept, P_1 = Price of wage rate normalized by the price of egg output, P_2 = Price of feeds normalized by the price of egg Output per farmer, P_3 = Price of drugs normalized by the price of egg output per farmer, P_4 = Price of day old chicks normalized by the price of egg output

Z_1 = Number of point of lay bird used by the farmers (proxy of farm size) Z_2 = Capital inputs measured in naira including Depreciation charges machinery, equipment, implements, cost of machine hired, interest, charges on loan. $\theta_1, \theta_2, \theta_3, \theta_4, {}_1, {}_2$ and A^* are the regression parameters estimated. Vi = Normal random errors which are assumed to be independent and identically distributed having zero mean and constant variance. Ui= It is non negative one sided error term representing the inefficiency of the farm.

To determine the factor influencing profit inefficiency, the farmer's socio economic factors that affect the profit inefficiency were evaluated in a single stage estimation using Frontier4.1. The inefficiency model is stated as:
Where; $\mu_i = \eth_0 + \eth_1 Z_1 + \eth_2 Z_2 + \eth_3 Z_3 + \eth_4 Z_4 + \eth_5 Z_5 + \eth_6 Z_6 + \eth_7 Z_7 \ldots \qquad .(5)$

$\mu_i = Profit\ inefficiency,$ $\qquad$ $Z_1 = Age\ of\ farmer\ (years),$ $\qquad$ $Z_2 = Formal\ education\ (years),$

$Z_3 = Membership\ of\ cooperative.\ (1 = membership, 0 = otherwise,$ $\quad$ $Z_4 = House\ hold\ size,$

$Z_5 = Source\ of\ income\ (1 = off\ farm\ income, 0 = otherwise),$

$Z_6 = Access\ to\ credit\ (1 = access;\ 0 = otherwise)$ $\quad$ $Z_7 = Experience\ in\ egg\ production\ measure\ in\ years$

$\beta_0,$ $\beta_1,$ δ_0 and δ_1 are the parameters to be estimated

Results and Discussion

Table1 shows the Socio economic variables of the farmers. Majority of the deep litter farmers (51.22%) whose ages fall between 41-50 years were practicing deep litter system, while the majority of battery cage farmers (66%) were between ages 31-40 years. Egg production was male-dominated in both systems with deep and battery cage systems having 90.24% and 85.71 % respectively.

Deep litter farmers were more educated (65%) compared with battery cage system (46.03%) had secondary education. With regards to farming experience, 65.85% deep litter farmers had 1-10 years' of experience, while 86.51% battery cage farmers had 1-10 years of experience. Majority of the deep litter farmers (53.66%) got their credit facilities from bank. The battery cage system farmers (78.57%) got their credit from personal saving and relation. About 7.14% got their loan from banks. In deep litter system, 97.56% have the house hold size ranging from 1-5; while in the battery cage the majority (67.46 %.) have the household size ranging between 6-10.

Table 1: Socio Economic characteristics of the Poultry Egg Farmers

VARIABLE	RANGE	Deep Litter		Battery Cage	
		Freq.	%	Freq.	%
AGE	21-30	03	07.32	18	14.20
	31-40	11	26.83	66	52.30
	41-50	21	51.22	50	23.80
	51-60	04	09.76	08	6.35
	> 61	02	04.87	04	5.17
	Total	41	100.00	126	100.00
EDUCATION	Primary	03	07.31	12	09.53
	Secondary	11	26.34	58	46.03
	Tertiary	27	65.85	56	44.44
	Total	41	100.00	126	100.00
EXPERIENCE	01-10	27	65.85	109	86.51
	10-20	14	34.15	17	13.49
	Total	41	100.00	126	100.00
CREDIT	Bank	22	53.66	09	07.14
	Cooperative	13	31.71	18	14.29
	P/Savings	06	14.63	99	78.57
	Total	41	100.00	126	100.00

Source: Data Analysis, 2013.

The profitability analysis of both deep litter and battery cage system (in table 2) shows that the average total revenue of the deep litter farmers was ₦5, 920,063 while that of battery cage farmers was ₦1,222,510. The total variable cost for deep litter and battery cage systems was ₦ 5,212,070 and ₦9, 020,810 respectively. The battery cage system was more profitable than the deep litter system with average profit of the farmers ₦1,782,750 compared with ₦491350 in deep litter. The rate of return to investment of the cage system 17.07 was higher than that of deep litter 9.05. This implies that for every naira spent on battery cage, will give the return of 17.07 and 9.05 for battery cage and deep litter respectively.

On the profit efficiency analysis, the values vary widely from minimum of 12.89 percent to a maximum of 93.53 percent. The average efficiency estimate for cage system is 77.86. However, in deep litter; the minimum is 10.22 and the maximum value is 93.10, the mean value is 62.28. This

suggests that on the average, about 22.14 percent efficiency in cage system is lost to profit inefficiency. While about 37.72 percent is lost to profit inefficiency in the deep litter system. From the result it can be concluded that cage system of egg production are more profit efficient than deep litter system.

Table 2: cost and return structure of poultry egg farmers

Description	DEEPLITTER	BATTERY CAGE
INCOME in '000₦		
Egg Revenue	5038.03	10,434.24
Spent layer	441.30	1,781.12
Bags & Litters	14.64	11.15
Total Revenue	5920.63	12,226.51
COSTS in '000₦		
DOC	90.55	452.92
Feeds	4,200.43	4,799.09
Vet. Services	362.97	1,357.32
Labour	147.47	1,147.35
Water	81.58	205.65
Energy	97.75	365.67
Transport	117.88	478.39
Other Variable Cost	113.44	214.42
Total Variable Cost	5,212.07	9020.81
Total Fixed Cost	217.21	1,422.95
Total Cost	5,429.28	10,443.76
G/Margin	708.56	3,205.70
Profit	491.35	1,782.75
Profitability Indicators		
RROI	9.05	17.07
RRFC	326.21	225.29
Farm Size	605.43	2,036.42

Source: Data Analysis, 2013.

The sources of inefficiency in deep litter and battery cage were examined by using the estimated δ coefficient for the egg production system from the maximum likelihood estimation as shown in table 3 below

The profit inefficient analysis of the battery cage farmers, the estimated coefficient of age, education and credit access are negatively significant ($p<0.05$). It means that age and education variables would decrease the profit inefficiency. Farmer's experience is found to be negatively significant ($p<0.01$). This means that the more experience the farmers, the more profit efficient he becomes. In contrast, in deep-litter, age and education were positively significant ($00P<0.05$) and household size negatively ($P<0.05$). This implies that, the more aged and educated the deep-litter farmers are, the more profit inefficient they tend to be

. Table 3. The Profit inefficiency of the Poultry Egg Production System

Inefficiency	Parameter	Deep Litter System	Battery Cage System
Age	δ_1	0.031** (0.0145)	-0.0507** (0.0235)
Education	δ_2	0.0428** (0.0201)	-0.0310** (0.0142)
Cooperative	δ_3	0.0221 (0.093)	0.2618 (0.033)
House hold size	δ_4	-0.1059** (0.0414)	-0.1423 (0.1016
Source of Income	δ_5	0.4756 (0.1163)	-0.1499 (0.4627)

Credit Access	δ_6	0.1665 (0.0880)	-0.2272** (0.0437)
Experience	δ_7	-0.0147 (0.009)	0.0148*** (0.1052)
Sigma-squared	σ^2	0.87	0.74
Gamma	γ	0.73	0.50
Log likelihood Function		-83.38	-31.25
Log-likelihood		6.38	11.23

Source: Data Analysis 2013. ***significant at 1%, **significant at 5%   *significant at 10%

Conclusion

The results of the study showed that battery cage poultry egg system is more profitable than deep litter system. The statistical analysis reveals that there is no significant difference in the two egg production technology. However, Variables that are necessary to launch policy for poultry egg industry includes: Education, credit access, Age, Household size, and years of experience.

Policy Recommendations

- Policies and strategies that will promote the local production of battery cage equipment at affordable price and also support the farmers' use of the locally made cage materials.
- Capacity Building of the Poultry Farmer should be encouraged by government through training and education at the grass root level through farmers' professional association.
- Farmers should be subsidized to have access to credit facilities in cash or in kind without collateral security.Such credit should be committed to farm use.

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THE POTENTALS OF THE MUNICIPALITY OF PODGORICA IN AGRICULTURE AND TOURISM AND THEIR EVALUTION

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Abstract

Podgorica municipality covers a territory area of 144 100 ha and lies on the banks of the six rivers (Moraca, Ribnica, Zeta, Cijevna, Mareza and Sitnica). The borders of Podgorica are partly natural and relatively clearly differentiated in relation to the neighboring municipalities of Cetinje, Crikvenica, Kolasin and Andrijevica), borders to the Skadar Lake, and the border with Albania. Southern and southeastern border is to the Skadar Lake. Podgorica - the capital has a population of 180,132, with an average density of 117.4 inhabitants per km^2 (twice the average at the state level). The structure of land use in the area of Podgorica is dominated by agricultural land (42.9%), forest land (29.3%) and settlements, roads, rocks, water bodies (lakes and rivers) and other (27.8%). Podgorica has its tourist potential and the opportunity to enrich the tourist content, the commercial, transit, winter sports tourism (Veruša and Komovi), sightseeing (Gorica, Ljubovi) and recreationally - resort, tourism of Skadar Lake, hunting, sports, spa, shopping, wellness tourism.

The aim of this paper is to show the connection between tourism and agriculture in the area of Podgorica. Tourist valorization, as the process of evaluation and assessment of natural and anthropogenic values of importance for tourism, takes into account, among other things, agriculture and its potential. We performed an analysis of tourist traffic in Podgorica in 2011-2013. We analyzed the number of foreign and domestic tourists and the percentage increase, using statistical methods

Keywords: *land, city, agriculture, tourism*

Introduction

Podgorica municipality covers a territory area of 144 100 ha and lies on the banks of the six rivers (Moraca, Ribnica, Zeta, Cijevna, Mareza and Sitnica). The borders of Podgorica are partly natural and relatively clearly differentiated in relation to the neighboring municipalities of Cetinje, Crikvenica, Kolasin and Andrijevica), borders to the Skadar Lake, and the border with Albania. Southern and southeastern border is to the Skadar Lake. Podgorica - the capital has a population of 180,132, with an average density of 117.4 inhabitants per km^2 (twice the average at the state level). Podgorica is located in a spacious Zeta valley. (Baki , Doderovi , Mijanovi ; 2009) Zeta valley is elongated, about 18 km wide and about 23 km long. The land where Podgorica is makes a thick layer of fluviglacial materials that are brought from the northern mountain rivers Moraca and Cijevna. Prokletije, Komovi and Mora ke mountains were exposed to intensive glacier erosion. The material in the bottom of the basin contains clayey sand, sand, sand-gravel and pebbles, making conglomerate. The surrounding mountains have dinar direction of expanding from the northeast to the southwest. Quaternary deposits, represented by fluvioglacial sediment thickness below Momiši i 21m, and on the north shore of Lake Skadar 88m. The largest part of the basin covers 370km2 area of Skadar Lake. Since it is located in Zeta Plain Podgorica and its surroundings have favorable conditions for the development of agriculture and hence this city has agricultural function. The spatial coverage of the municipality of Podgorica significant areas of agricultural land is

located in altitude range of 4.6 m above sea level (right coast of Skadar Lake) to 2,000 m above sea level (high mountain pastures- meadows). The largest production resource is, of course, the coast of Skadar Lake, above the level of 10:44 mnm that, in intensive vegetable-crop production can provide significant productivity. Second, most potential height zonal region of agricultural land are height positions elevations between 20 and 70 m above sea level, or from Golubovci to Smokovac: of the country, Tuško field, Rogamsko field, emovsko field, Dinoško field, Kokotsko field, Lješkopolje, Momiši ko field (Sadine) Tološka field, Lješkopoljski, Vuk lug and Straganica. Next altitude land zone positions are between 70 and 250 m above sea-with dominating soil types such as red soil, renzini et al. The largest area of this zone can be found on river terraces of the Cijevna, Moraca, Zeta and the Matica river, which are the highest positions of the small plateau in Dinoša, Doljane, Rogami and Komane. Sub-Mediterranean agricultural species as a fig tree and the vine can be found between 250 and 500 m above sea level. The greatest potential of these areas are parts of Lješanska entity - Krusi, Draževina, Buronje, Podgorica Piper - Stanjevi a hole, Crnci, Radeca, Petrovici, Mrke, Bratonoži i - between Podkrš and Pelev Brijega; Kuci - villages below the level of 500 m above sea level, and Uble. From 500 to 1000 meters above sea level in the atmosphere of a special - geo cenosis, fertile soils are formed. These are of settled and anthropogenic terra rossa and buavica, which are increasingly becoming a forest, a small farm (classic phytocoenological succession). The largest areas within of this area are the fields - the plain Radov e and Trmanje that are best suited for growing potatoes, buckwheat, cabbage, etc.. The structure of land use in the area of Podgorica is dominated by agricultural land (42.9%), forest land (29.3%) and settlements, roads, rocks, water bodies (lakes and rivers) and other (27.8%).

Material and Methods

Tourist valorization, as the process of evaluation and assessment of natural and anthropogenic values of importance for tourism, takes into account, among other things, agriculture and its potential. Valorisation is a very important procedure because it has important application and is able to use those elements in the space of a whole range of other activities which do not represent a higher value. Significance in the tourist valorization of rural areas is reflected in the fact that it contributes to the recognition and individuality. In doing so, evolutionary information about a specific area (depending on the time of observation) and the one on which the emphasis was placed during the procedure must be considered. The only correct approach is the one that is based on the study of several aspects of the use and comparative results of several scientific disciplines.(Bakic, 2012) The successful development of the municipality will depend largely on its economic competitiveness and accessibility. The principle of economic competitiveness will be determined by the level of sustainable utilization of territorial capital and the potentials of the city, which will require the launch of all the power at the local and the city level. The principle of accessibility will be determined by the sustainable development (agriculture and tourism), reconstruction and modernization of the technical infrastructure, as well as their coordination, especially by planning and environmental argumentative development. The source of the publication of the Statistical Office of Montenegro in the field of tourism and agriculture were used, the statistics of the Podgorica municipality, as well as podcasts of the Ministry of Agriculture. Growth of tourist traffic we calculate so we followed its growth from 2011 to 2013. We calculated the average stay of tourists in Podgorica, as well as the number of tourist arrivals and overnight stays.

Results and discussion

Data on the use of agricultural land clearly illustrate the extensiveness of the current practice where: 1) currently is used only about one-third of the arable land, approximately 21,000 ha, involving about 10,000 ha of meadows, compared to about 62,000 ha of arable land; 2) used

areas, on average, have not been extensively discussed, in addition to some intensely treated viticultural areas and areas with prevalent greenhouse gas production. Due to the relatively low representation of arable land, the total consumption of fertilizers is not great, although there are areas that are intensively trash (especially in vegetables production). (Virtanen, 2009) Assessment of the use of excessive, improper, environmental irresponsible use of chemicals that significantly affect individual sites, confirmed by occasional reports of cases, does not exist. Toxicity is undervalued assets, and in particular the consequences for their own health. The amount of injected pesticides and fertilizers, especially if the price of products is not high is often exaggerated. Their use should be kept in a rational framework. With it goes relatively weak or complete absence of monitoring mechanisms. In terms of consumption of plant protection products, the area is considered low pollutant pesticides. However, it should be noted that the highest amount of pesticides is used in the cultivation of vegetables, orchards, vineyards, which are the basic culture of Podgorica, so special care supervision of the use of these funds is required. In addition to all the circumstances that enable tourism (leisure, learning, patriotism, internationalism) profit or economic effects have a special place.[1] As an important form of consumption occurs consumption of food beverages in places of tourist needs resolving. Since it has an excellent geographic location and abundant natural and anthropogenic tourist values, the area of Podgorica ha a significant place in an increasingly frequent tourist traffic in the wider area. Thanks to good infrastructure links to the coast and the northern part of Montenegro, Podgorica is placed in line of Montenegrin towns which more and more tourists choose to visit. The special attraction is the proximity to the National Park Skadar Lake. Podgorica has its tourist potential and the opportunity to enrich the tourist offer. The content of Montenegro, through business, transit, winter sports tourism (Veruša and Komovi), sightseeing (Gorica, Ljubovi) and recreationally - resort, tourism of Skadar Lake, hunting, sporting, convention, shopping, wellness tourism. The catering offer of Podgorica consists of 38 hotels and 2 hostels, possessing 2143 beds, 768 rooms and 207 suites. The hotels are equipped with modern European standards. The city has 80 restaurants and about 800 other similar facilities. It must be emphasized that the private households are not satisfactory. There is only six households with 29 rooms and 69 beds avaliable. The largest number is of bars - 448, followed by pizza huts - 62, 82 fast food outlets, 59 cafés, pastry shops, 18 sandwich shops, 31 dairy restaurants, and 18 steak house cafes. The capital has 66 categorized restaurants, eight of them have five stars, while 22 is a four star. When it comes to the categorization of the hotel, the total number of hotel 11 were categorized with four stars, 12 with three, two hotels are two-star hotel and there is one hotel with one star. For three hotels categorization is ongoing. According to the Ministry of Sustainable Development and Tourism in 2010. Five new hotels have been opened but two closed down. According to the Secretariat in the period from the first of January 2010 to 11 April 2011, 115 licenses for cafes were issued, of which 100 are legal entities and 15 entrepreneurs. In the same period 25 cafes were closed. (Virtanen, 2009) The number of tourists who visited Podgorica in 2008 was higher for the 10:54% compared to 2007. In 2007, the growth rate was 16.01% compared to the previous year. Percentage increasement in the number of tourists has marked 2006 compared to 2005. Tourism in 2009, expressed as the number of overnight stays and arrivals of domestic and foreign tourists, showed a negative trend. The decline in the number of visits and overnight stays of domestic tourists, was the result of the financial crisis. In 2010 it was recorded 112,569 overnight

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[1] Agriculture can be an important factor in reducing regional disparities. As well as agriculture and forestry can be a significant segment of the national economy and great potential security basic raw material for the development of fthe manufacturing industry. In addition to the implementation of strategic documents such as the "Strategy of development of food production and rural areas", "National program of food production and rural development", "Fisheries Development Strategy" and "National Policy of forests and forest land," it is necessary to adopt a number of principles and standards that will enable economic and social balance and sustainable development of this sector.

stays, ie, 8% more than in 2009, and 54 196 arrivals, an increase of 10.2%. Cumulative data of tourist traffic in 2013, indicate a continuation of the positive trends in this area. According to the Statistical Office of Montenegro - Monstat, Podgorica, in 2013 it was visited by 65136 tourists and there were 116,532 overnight stays, an increase of 23.16% and 13.27% compared to the 2012. Increase in tourist turnover in 2013 is the result of an increased number of arrivals (23.73%) and rates (11.66%) of foreign tourists and increasing number of tourist arrivals and overnight stays of 17.81% and 24.17% respectively.

Table 1: Tourism in the Capital City 2011 to 2013

	Podgorica 2011	Podgorica 2012	Podgorica 2013	13 Nov %	13 Dec %
Visitors					
Total	**53480**	**52889**	**65136**	**21.80**	**23.16**
-domestic	6516	5194	6119	-6	17.81
-foreign	46964	47695	59017	25.66	23.73
Overnight stays					
Total	**103636**	**102875**	**116532**	**12.44**	**13.27**
-domestic	**17616**	**13336**	**16559**	**-6**	**24.17**
-foreign	86020	89529	99973	16.22	11.66
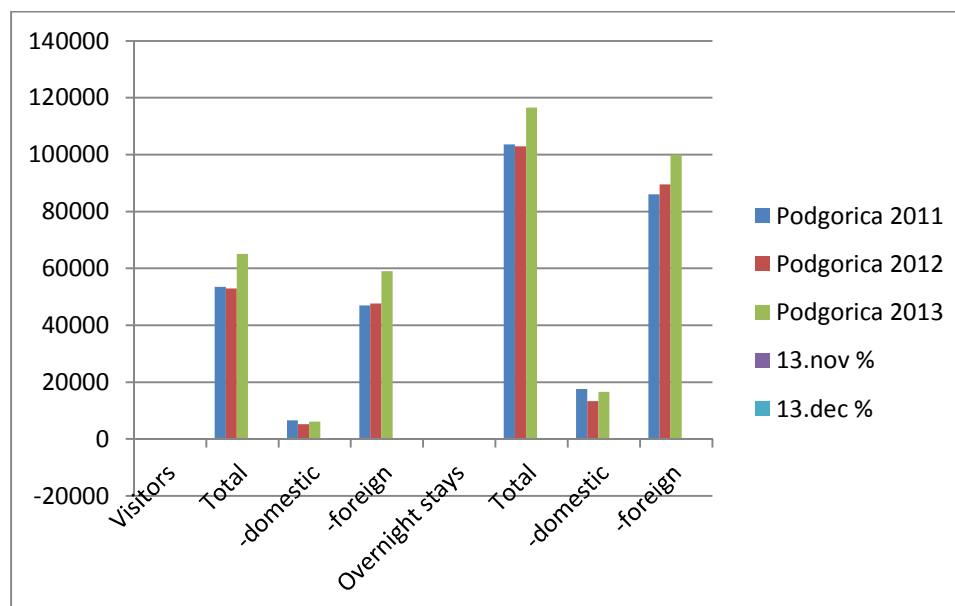
Chart 1 Tourism in the Capital 2011-2013

Broken down by month, the highest number of tourist arrivals was recorded in October, followed by September and July, while the lowest number of arrivals was recorded in January, February and December. Actual number of arrivals in the capital city in 2013 represents 4.4% of total arrivals in Montenegro, while the share capital to the total number of overnight stays by 1.2%. The structure of rates in 2013 were the most common tourists from Serbia (23 368), Croatia (9965), followed by Italy (6 035) and Slovenia (4 749). The average stay of tourists in the Capital was less than two days (1.8) and decreased compared to 2012 by 0.18 percentage points. In hotels with 4 and 3 stars, which dominate in accommodating the Capital recorded 91.4% of arrivals and 88.79% overnight stays. As in previous years in Podgorica in 2013, according to the number of arrivals is on the top 5 places in Montenegro, according to the number of overnight stays in the front of it are Budva, Herceg Novi, Bar and Ulcinj. (Jovicic, 2010) The reason for this is the seasonal nature of tourism in Montenegro. The fact that most of the tourist traffic is implemented in six coastal municipalities, which account for 83.6% of all overnight stays in the country and 81% of arrivals. However, if we look at the tourist trade by months, it is evident that the capital city shows the constancy of

tourist traffic during the year, in contrast to the highly seasonal component that characterizes the northern and coastal towns in Montenegro. In most months there are more visitors from the other towns in Montenegro. The capital is in a 2013 revenue of foreign tourists in the amount of €11,151,154, an increase compared to 2012 to 11.55%. The share capital to total income from foreign tourists at the level of Montenegro in 2013 amounted to 1.70 and is higher than the previous year by 0.12 points. However, as mentioned income from 2006 to today in Podgorica increasing share of total income is reduced. In 2006, the share was 2.50% in 2008 amounted to 1.95% and 1.70% in 2013 .(Lješevi , 2012)

Construction of new hotels of high standards contributed to the increase in tourism traffic. Positive trends in the tourism capital in the previous period are the result of intensive cooperation with countries in the region and beyond, the greater presence of the administration and the economy of these countries, building new and increasing the quality of hotels and tourism as well as catering facilities that meet high standards and the urban development of Podgorica, as modern European center. In the coming period, it is necessary to strive to change the structure of production and redirect it toward cultures that carry potentially higher profit, as well as the cultivation of early fruits and vegetables and increase production in greenhouses. Of great importance is also the implementation of international standards in this area, because without them is not possible performance in the markets of EU member states. It is necessary to create a new generation of young farmers, who would remain in the country. It is necessary to invest in agricultural infrastructure, roads and their maintenance in order to further encourage the development of the village. (Jovicic, 2010) Also of utmost importance is the appropriate use of funds MIDAS (Montenegro Institutional Development and Agriculture Strengthening) project, which should be focused on strengthening agriculture and rural development to promote the improvement of environmental protection in accordance with EU standards. This measure would affect the reduction of the depopulation of rural areas, contributing to the conservation of natural resources and the support to economic diversification (development of eco - tourism). (Ljesevic, 2012)

It is necessary to develop market infrastructure in the areas of crop production in Montenegro in order to use quality products from primary plant production in the higher stages of processing and to achieve higher value finished goods manufacturing industry (olive oil, wine, fruit juice, etc..). (Virtanen, 2009) At the same time, we should support all forms of investment, which are related to storage, preservation and processing of fresh products to meet the standards of today's market in terms of quality, quantity and safety. Montenegro is a major importer of meat, despite the excellent conditions for the development of animal husbandry. Thus, in the structure of agricultural production, an important place is given to meat production, and continuous need to work on the expansion of the livestock, parallel with the adoption of EU standards in order to facilitate the export of meat to the EU market. It is necessary to encourage the development of production on family farms through various investment support to create a healthy competition in the domestic market, higher quality, preservation of traditional products, which also can enrich the tourist offer. The tourist industry should count on those items that best represent and highlight locally and nationally, with both quality and appearance. (Ljesevic, 2012) Development plans must emphasize the concept of healthy food and its products that reflect the local climate, a special way of processing and preparation. The concept of healthy food often has a number of similarities with the concept of active protection of nature. They need to be more in the area of nutrition, preferential those products with geographical origin and superior quality, and avoid imitations. It is important to emphasize the local, traditional and national, as opposed to the global import and leading globalization and uniformity. It is possible to achieve only a deliberate policy that leads connecting food producers and packaging on the one hand, and the tourism and hospitality industry on the other. (Fušti , ureti ;2000)

Conclusion

Podgorica municipality covers a territory area of 144 100 ha and lies on the banks of the six rivers (Moraca, Ribnica, Zeta, Cijevna, Mareza and Sitnica). The borders of Podgorica are partly natural and relatively clearly differentiated in relation to the neighboring municipalities of Cetinje, Crikvenica, Kolasin and Andrijevica), borders to the Skadar Lake, and the border with Albania. Southern and southeastern border is to the Skadar Lake. Podgorica - the capital has a population of 180,132, with an average density of 117.4 inhabitants per km^2 (twice the average at the state level). The structure of land use in the area of Podgorica is dominated by agricultural land (42.9%), forest land (29.3%) and settlements, roads, rocks, water bodies (lakes and rivers) and other (27.8%). From the perspective of the financial impact 2013 was more successful than the previous year, considering that according to the Central Bank of Montenegro, the capital city in 2013 generated revenues of foreign tourists in the amount of € 11,151,154, an increase compared to 2012 of 11.55 %. The share capital to total income from foreign tourists at the level of Montenegro in 2013 amounted to 1.70 and is higher than the previous year by 0.12 points. Cumulative data of tourist traffic in 2012, indicate a continuation of the positive trends in this area. According to the Monstat, Podgorica, in 2013 was visited by, 65,136 tourists and recorded 116,532 overnight stays, an increase of 23.16% and 13.27% compared to the 2012. Increase in tourist turnover in 2013 is the result of an increased number of arrivals (23.73%) and overnight stays (11.66%) of foreign tourists and increasing number of tourist arrivals and overnight stays for 17.81% and 24.17% respectively. The catering offer of Podgorica consists of 38 hotels and 2 hostels , possessing 2143 beds, 768 rooms and 207 suites. The hotels are modernly equipped and meet European standards. City has 80 restaurants and about 800 other similar facilities. It must be emphasized that the private accommodation households are not satisfactory. There is only six households with 29 rooms and 69 beds. While in 2000 the main holder of hospitality area was UTIP company "Montenegro", 4 hotels ("Montenegro", "Podgorica", "Ljubovi " and "Zlatica"), which are disposed of 780 beds and three private hotel with 67 beds, today in the capital city there are 41 hotels with 2 143 beds, 768 rooms and 207 suites. Meeting the needs of business and tourists, accommodation offer is better and more diverse, from exclusive hotels, to the most favorable at hostels and private accommodation. Tourism and agriculture are carried out according to the research activities with high potential for development.

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EVALUATION OF KASTAMONU VILLAGE DEVELOPMENT AND OTHER AGRICULTURAL COOPERATIVE ASSOCIATION'S (VDACA): ORGANIZATION, OPERATION MODE AND IMPACT ASSESSMENT

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Abstract

Only dairy cooperatives among the fields which VDACA carries out studies have been included in the research. The purpose of the research is to perform impact assessment of VDACA management and studies by cooperative members. For this purpose, cooperatives and subjects present in three districts of Kastamonu province have been selected using random sampling method. Face to face interviews were conducted with a total of 116 cooperative partners among 21 cooperatives selected. Survey results were assessed with the SPSS program and their significant situations were examined through Anova analysis. The subjects' individual characteristics, the education, size of the enterprise, number of milch cows and their distribution to the districts have been interpreted by examining them. The ANOVA test was applied related to these aforementioned 4 characteristics. However, any statistical significant value couldn't be found.

Keywords: *Impact assessment, agricultural cooperative, evaluation, Kastamonu*

Introduction

It should be especially stated that this study was realized upon a civil society organization VDACA's application to our faculty for revealing the impact of studies carried out by itself. The subject of this study is the evaluation of the impact of studies conducted by VDACA. The research covers only the assessment of VDACA'S management and study by dairy cooperatives partners. The subject of the research includes 3 main features. These can be listed as follows:

The assessment of VDACA management services by cooperative members and the impact assessment were determined as the purpose of this research.

The researches on agricultural cooperatives up to the present have mainly addressed cooperative activities in terms of agricultural economy. Meanwhile in this study, the organization impact assessment was conducted for VDACA which is an upper organization.

Theoretical Foundations of the Research

In the research, the approach which was developed by Albrecht (1974) was modified according to the conditions of VDACA and a kind containing the knowledge of self experiment acquired from previous assessment studies (1976;2000;2005a,b.) by the project manager was applied. The essence information regarding this approach was presented below.

The concept of assessment is used as the self-criticism of the action to be researched, the result of the program implemented, the proof and control of the impact reached and finally the determination of effective factors, scientific solution of the cause-effect relationship. In this study, the evaluation process was barely conducted in three stages. Firstly, information was gathered through observations. Secondly, certain criteria and assumptions were identified on the basis of observations conducted. In the last stage, some judgments in relation to the impact of VDACA were expressed and conclusions were drawn. This research is a process evaluation (Post-hoc-evaluation). Because, the VDACA'S studies are still continuing. Thus

the impacts and responses arising out during the implementation period could be obtained directly. Thus the findings obtained during the research process can contribute to enhance the success of VDACA'S studies.

The Research Question and Hypotheses
Just one of each research questions and hypotheses has been included herein due to page limitation. The research question:
"After the cooperative partners become members to the VDACA, what is the situation regarding the satisfaction for the rise of income and VDACA'S activities and management?"
Hypothesis:
"VDACA management is regarded as successful by the subjects because the construction of milk collection centers by VDACA is effective in marketing of milk, the rise of milk prices.

General information on the research area
Kastamonu province takes place between 41 degrees 21 north latitude and 33 degrees 46 east longitudes in the Western Black Sea region. Its altitude above sea level is 775m. Its area is 13.108,1 km². It comprises 1,7% of Turkey's lands. Kastamonu province mostly consists of rugged terrains. The surface area of Kastamonu is comprised of 74,6% mountains and forests, 21,6% plateaus and 3,8% plains. These data shows that the arable areas are limited in the Province. But however, its structure is suitable for animal husbandry.
Kastamonu province ranks 51st among 81 provinces according to the "Provinces' Development Level Performance"[1] study carried out in 2003 by State Institute of Statistics. When the education indicators are examined, it is seen that the ratio of literate population is 80%, the proportion of literate female population in total women population is 72.3%.
The population of Kastamonu as of the end of 2012 was found as 359 thousand 808. The number of people living in the city center is 98 thousand 775, total number of people living in city and district centers is 202 thousand 006 and total number of people living in villages is 157 thousand 852.

Materials and Methods

The information available regarding the subject was obtained from VDACA, Provincial Directorate of Agriculture, Chamber of Agriculture. The primary data of the research was acquired through the research conducted.
VDACA covers Kastamonu, Çankırı, Bartın provinces with respect to the region. The cooperatives in Çankırı and Bartın provinces were excluded from sampling due to two reasons. First, the cooperatives in these provinces have more recently become members to VDACA. Second, the cooperatives in Kastamonu province are more intense numerically than the aforementioned provinces.
The cooperatives are working in four areas of specialization. Dairy products, dairy-forestry products, forestry products and irrigation. According to the 2014 figures, there're 313 member cooperatives to VDACA. The first cooperative has been established in 1977. There are 107 cooperatives operating in dairy products, 133 in forestry products, 55 in dairy and forestry areas. A total of 17333 partners are members to these cooperatives. In the research, only dairy cooperatives were included in the assessment. Because VDACA'S intense working areas is intended for dairy cooperatives. Two layers were determined in selection of cooperatives within the sampling. The distribution of cooperatives by districts, the distribution of cooperatives by founding years. However, this layer separation was not taken into account in statistical assessment due to lack of any difference in evaluation criteria for VDACA by the
distribution.

Purpose-sampling method was used in the selection of cooperatives. A total of 22 cooperatives were included in the sampling. The distribution of selected cooperatives by districts, number of selected cooperatives and subjects were illustrated in the following tab. 2.

The Selection of Subjects

The number of subjects to be surveyed was determined as follows with stratified random sampling. At least five members were surveyed among each cooperatives selected. Even though priority was given to make surveys with female cooperative partners, in real terms female cooperative members couldn't be found. A total of 105 subjects were envisaged.

However, a spare of 11 subjects with a proportion of 10% were included in the sampling in order to avoid the situation of not able to find subjects or not want to make interviews. Briefly, a total of 116 subjects were surveyed with face-to-face interviews. Only 4 of them were not taken into the consideration due to the information given was contradictory.

Table:1 Selection criteria of cooperatives

BY DISTRICTS	Number of Dairy Cooperatives		NUMBER OF SELECTED COOPERATIVES		Number of Selected Subjects		FOUNDING YEARS (Of the Selected Cooperatives)			
							BEFORE 1998		1998 AND AFTER	
	NO	%	NO	%	NO	%	NO	%	NO	%
CENTER	28	26,2	8	38,1	39	34,8	3	33,3	5	41,7
TAŞKÖPRÜ	43	40,2	9	42,9	65	58,0	5	55,6	4	33,3
DADAY	8	7,5	4	19,0	8	7,1	1	11,1	3	25,0
TOTAL	107	100,0	21	100,0	112	100,0	9	100,0	12	100,0

The assumptions were identified based on the information obtained through observations, as mentioned above, which were performed prior to the main survey application and accordingly the survey questions were prepared. Trial surveys were conducted with a total of five cooperative partners selected with random sampling for understandability of these questions and for preventing similar problems that may arise. The main survey questions were given their final forms on the basis of the conclusions acquired from here. The subjects to be surveyed in each cooperative were determined according to age, gender, education, size of the enterprise. Thus, the assessments were compared according to different education, size of enterprise, number of milch cows. For this, the information belonging to cooperative partners were ascertained prior to the main survey.

The data obtained were explained by means of a statistical software (SPSS) and were interpreted. The ANOVA test was applied. Additionally, the situation was watched in the place by attending cooperative general assemblies.

The researchers focused mainly their attention on observations in the villages and pollsters were not used, as mentioned above, because of the information obtained from survey applications doesn't always reflect the actual situation. The research was carried out on site by two researchers.

Results and Discussion

The research findings will be handled in two main chapters including VDACA data and survey application results. In the first chapter the services offered to member cooperatives will be evaluated on the basis of VDACA data and in the second chapter VDACA will be evaluated with respect to success on the basis of research data.

The evaluation of success on the basis of VDACA data

Meanwhile on the basis of VDACA data, two properties will be examined. The first one is the services offered to member cooperatives; the second one is the assessment according to the tenure of VDACA chairmen of the executive boards.

While there were 2 milk collection centers in 1998, this number rose to 30 in 2013. As understood from this data, a great boom happened in the number of milk collection centers. Milk collection centers have increased by 15 times. In addition to these, VDACA has two important services like input supply, technical knowledge and education. Furthermore, while the turnover of VDACA was 181.082,23 TL in 1998, it became 15.791.604,57 TL in 2013. In short, a 87-fold increase was realized in respect of the turnover. While the shareholders' equity was 3.110,75 TL in 1998, it became 2.874.303,82 TL in 2013. The shareholders' equity rose 924-fold in 16 years.

While the tenure of VDACA chairmen was between 3 and 5 years at most until 1998, the present chairman has been uninterruptedly performing the task of presidency for 16 years.

It can be said that the realization of these services by VDACA is directly connected with the democratic and participatory organizational management. As the VDACA management became professionalized and the partners' existing problems were solved, so the service offering activities' contribution to the partners increased. The VDACA activities presented above have only become possible with a professional, effective management policy oriented to the interests of members. VDACA can increasingly solve the current problems because of implementing the cooperative principles (participation in decisions, volunteering, and democratic management).

    The evaluation of success according to the opinion of cooperative partners

The subjects' educational status with "income" and "satisfaction" assessments was compared in table 2. When those who graduated from secondary school, high school and university are combined in respect of the distribution and interpreted, such a conclusion emerges: As seen in the table, when the subjects are asked "Was there any increase in your income after being members to VDACA? 97,3% of the subjects graduated from primary schools stated their income increased. Only 2.7% of them said nothing changed. This ratio is 97,05% for those who have education at a level of secondary school, high school and university. Briefly, the difference between the evaluations of those who are primary school graduates and those who are secondary school, high school and university graduates is 25%. In other words, the educational status plays no role in assessment of VDACA. Those who said nothing changed in incomes are very few.

When asked about the satisfaction from the activities and management of VDACA, it can be said that there's almost no difference with respect to educational status of those who say "Very satisfied". The enterprises with a size of between 1 and 50 were united. Likewise, those over 51 decares were gathered in a single segment.

The size of enterprise doesn't also show a difference with respect to the "income" assessment of VDACA. While the small enterprise owners (small holders) said "very satisfied" with a ratio of 58,8% about "satisfaction" status, the owners of larger enterprises answered as "very satisfied with a ratio of 40,2%. So this indicates that VDACA has a better communication with small enterprise owners.

When the milch cow options are also dealt in two options including 1-10 and 11 and over, the emerging situation is as follows: While 98,3% of the owners of enterprises having less than eleven milch cows expressed an increase in income; 95,15% of those having 11 and over cows said that the income increased. The difference between them is a mere trifle. When asked about the satisfaction from VDACA, 50% of the owners of enterprises having 1-10 milch cows said "very satisfied". This ratio is 49,2% for the subjects having more than 11 milch cows. The situation for the subjects who expressed only "satisfied" is as follows: the ratio for the owners of enterprises having 1-10 cows is 50%, and this ratio for the owners of enterprises having 11 and over cows is 51,7%.

When the "question about income increase" according to the districts is considered, the following situation appears. Ta köprü is 100%, the central district is 94,9%, Daday district is 87,5%. When the satisfaction status is considered, this result is seen. The ratio of "very satisfied" in Ta köprü district is 55,4%, it is 41% in the central district, 12,5% in Daday district. Its reason can be explained as follows: There was no significant change in the previous situation due to milk collection centers have recently established in these cooperatives and those who are buying and marketing milk are members of the cooperative. The ANOVA test was applied, however a significant situation couldn't be found out. Because the subjects' assessment ratio for the criteria is very close to each other.

Table 2. The Evaluation of VDACA According to the Breeders' Properties

EDUCATIONAL STATUS	INCOME				SATISFACTION						TOTAL	
	INCREASED		NOT CHANGED		VERY SATISFIED		SATISFIED		LESS SATISFIED			
	SAYI	%	SAYI	%	SAYI	%	SAYI	%	SAYI	%	SAYI	%
PRIMARY SCHOOL	71	97,3	2	2,7	34	46,6	39	53,4	0	0	73	100
SECONDARY SCHOOL	16	94,1	1	5,9	4	23,5	13	76,5	0	0	17	100
HIGH SCHOOL AND UNIVERSITY	22	100	0	0	15	68,2	7	31,8	0	0	22	100
TOTAL	109	97,3	3	2,7	53	47,3	59	52,7	0	0	112	100
THE SIZE OF ENTERPRISE	INCREASED		NOT CHANGED		VERY SATISFIED		SATISFIED		LESS SATISFIED			
	SAYI	%	SAYI	%	SAYI	%	SAYI	%	SAYI	%	SAYI	%
1-30 DÖNÜM	10	100	0	0	7	70	3	30	0	0	10	100
31-50 DÖNÜM	20	95,2	1	4,8	10	47,6	11	52,4	0	0	21	100
51-100 DÖNÜM	57	98,3	1	1,7	29	50	29	50	0	0	58	100
101 VE YUKARISI	22	95,7	1	4,3	7	30,4	16	69,6	0	0	23	100
TOPLAM	109	97,3	3	2,7	53	47,3	59	52,7	0	0	112	100
NUMBER OF MILCH ANIMALS	INCREASED		NOT CHANGED		VERY SATISFIED		SATISFIED		LESS SATISFIED			
	SAYI	%	SAYI	%	SAYI	%	SAYI	%	SAYI	%	SAYI	%
1-10 PCS	59	98,3	1	1,7	30	50	30	50	0	0	60	100
11-20 PCS	37	97,4	1	2,6	15	39,5	23	60,5	0	0	38	100
21 AND OVER	13	92,9	1	7,1	8	57,1	6	42,9	0	0	14	100
TOTAL	109	97,3	3	2,7	53	47,3	59	52,7	0	0	112	100
THE DISTRICT IN WHICH THE	INCREASED		NOT CHANGED		VERY SATISFIED		SATISFIED		LESS SATISFIED			

COOPERATIVE IS PRESENT	SAYI	%	SAYI	%	SAYI	%	SAYI	%	SAYI	%	SAYI	%
CENTER	37	94,9	2	5,1	16	41	23	59	0	0	39	100
TAŞKÖPRÜ	65	100	0	0	36	55,4	29	44,6	0	0	65	100
DADAY	7	87,5	1	12,5	1	12,5	7	87,5	0	0	8	100
TOTAL	109	97,3	3	2,7	53	47,3	59	52,7	0	0	112	100

Conclusion

The incomes of the union partners have risen with an increasing rate. The subjects' satisfaction from the VDACA varies between "very satisfied" and "satisfied". There are no subjects who are less satisfied or not satisfied. VDACA has a say and effective in local milk market and marketing. The services provided to the partners by VDACA have increasingly risen. In summary, the subjects' educational status, the size of enterprises, number of milch cows, on the basis of districts shows no difference regarding the "Satisfaction" and "Income", the assessment criteria for VDACA". The services provided by VDACA also indicate that the expectations of the cooperatives were satisfied increasingly when they're becoming members to the VDACA. And this demonstrates the democratic and effective management of VDACA. As the members of VDACA are increasing, so the quality and quantity of the services offered by the union are rising and VDACA is appearing as a power across Turkey and Kastamonu in production and marketing process.

Acknowledgement

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ECONOMIC EVALUATION OF CLIMATE INFORMATION IN SAHEL: CASE OF FARM HOUSEHOLDS IN BURKINA FASO

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Abstract

This study highlights the perception and the option value of climate information in the sahelian and sudano-sahelian agro-climatic zones of Burkina Faso. It shows that the climate information is asymmetrically distributed to a minority (21.78 %) of the sampled farmers. The analysis reveals that the majority (93%) of the farmers need climate information to guide their decision in planning agricultural activities. Option value shows the interest granted by farmers using climate information. 64% of the farmers willing to pay would pay an average of CFA 546.34 Francs to obtain climate information. The willingness to pay is determined by the ability of the farmers to predict the climate, to use radio as a means of information, awareness of farmers on the previous forecast and early onset of the rainy season. While farmers considered benefit from the use of climate information, it is clear that its contribution to farm income remains a field of research to explore. Thus it is necessary to experiment with individual farms and to evaluate the contribution of climate information to the added value of different crops and farmers' income.

Keys words: *farmers, climate information, willingness to pay, Burkina Faso.*

Introduction

The use of seasonal climate forecasts based on indigenous knowledge is a traditional strategy of West African farmers to reduce climate risk on their crop yields (Roncoli, 2006; Nyong et al., 2007). Forecast guides their decision making for the choice of fields, crop varieties, crop rotation, sowing date and precautions to maintain the crop production. The main indicators of endogenous seasonal climate forecasts are environmental (moon, cloud, wind), biological (animals, plants), magic and religious (Phillips et al., 2002). They are transmitted from one generation to another by oral tradition (Zuma-Netshiukhwi et al., 2013).

Despite their importance, these forecasts are becoming less reliable because of climate change over the past four decades (Ingram et al., 2002; Roncoli et al., 2008). The distortions in the transmission of indicators from one generation to another question the reliability of these forecasts (Risiro et al., 2012). Therefore, farmers are looking for new strategies for seasonal climate forecasts to better plan production of seasonal crops (Ingram et al., 2002).

Climate information is one possible way to mitigate the adverse effects of climate change on agricultural productivity (Hansen, 2002). It consists of publishing seasonal forecasts from climate models to farmers (Klopper et al., 2006). The seasonal predictions usually provide information about the probability of the starting and ending dates of the rainy season, the length of the season, the number of rainy days, the annual cumulative rainfall, the average and maximum duration of dry spells during the rainy season.

The purpose of this paper is to analyze the perception of farmers on climate information in Burkina Faso and to identify the determinants of their option value. We formulated two research hypotheses. First, we assume that the majority of farmers perceive

climate information as probative adaptation strategy to climate change. Second we expect that the willingness to pay of farmers for climate information depends on their ability to conduct seasonal forecasts on climate change.

Material and method

The study was conducted in the sahelian and Sudano-sahelian agro-climatic zones of Burkina Faso, a landlocked country in West Africa (Figure 1). The sudano-sahelian zone is characterized by rainfalls ranging between 600 and 900 mm during a 4 to 5 months rainy season. In the sahelian zone annual rainfalls range between 300 and 600 mm and are characterized by a more irregular spatial and temporal distribution. This area is the driest of the country sometimes with less than three months rainy season.
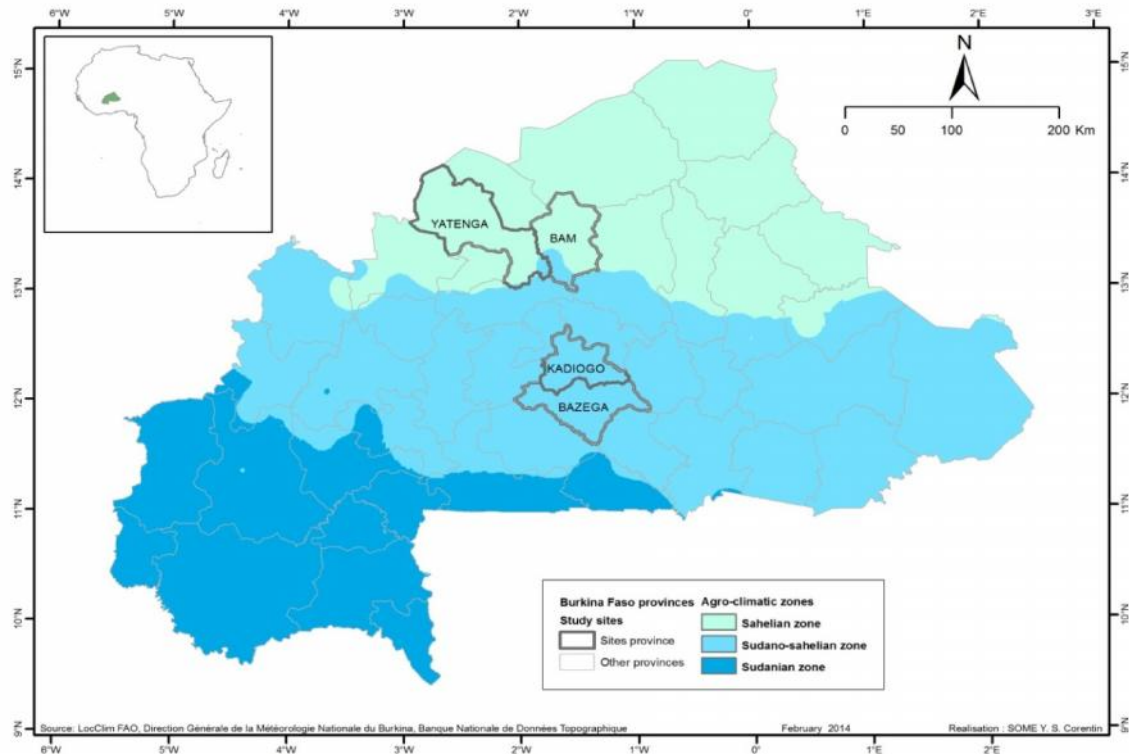
Figure 10. Location of study sites in agro-climatic zones of Burkina Faso

The data collection was performed on the basis of a stratified sampling at three levels identified in collaboration with the team of the project of *supplemental irrigation and climate information* and with the Provincial Directorates of the Ministry of Agriculture and Water Resources. The different levels are the provinces, villages and farmers (Figure 1). The number of farmers per village was obtained on the basis of updated data from permanent agricultural survey made by the Ministry of Agriculture and Water Resources. From this basis, 629 farmers spread over eleven villages were surveyed from January to February 2013 in the provinces of *Yatenga*, *Bam*, *Kadiogo* and *Bazega*. In each village, a third of the farmers were surveyed randomly.

Data were collected using a structured questionnaire referring to socio-economic characteristics of farmers and planted crop during the year 2012-2013. They were also related to endogenous seasonal forecasts of farmers and their perception of climate information. Afterwards farmers were questioned about their willingness to pay (WTP) to benefit from good quality IC using the contingent valuation method.

The approach of contingent valuation method (CVM) is to construct a hypothetical market on goods or service proposed for economic agents (Randall et al., 1974). The objective of CVM is to reveal the marginal willingness to pay of an individual by simulating operation of a market (Ami and Desaigues, 2000). To comply with the principle of this

method, the advantages and limitations of the use of climate information were first explained to farmers. After ensuring that farmers have understood the challenges of using the climate information, we asked them to comment on their need for climate information.

The Chi-square test was used to compare the perception of farmers for seasonal climate forecasts and socioeconomic characteristics of potential users at significance level p = 5%. Analysis of variance and the Kruskal-Wallis test were used respectively to compare the average and median income in grain production and farmers' WTP threshold of significance p = 5%. Average and median WTP were calculated excluding the true zeros.

The estimated true zeros are null of WTP given by farmers because their agricultural productivity will not be improved even if they benefit from the climate information. On the contrary false zeros are null WTP by farmers when they need the climate information to guide their decision making to plan agricultural production.

Results and discussion

Table 1 shows that a minority of farmers in the sample (21.78%) had access to seasonal forecasts prior to the agricultural campaign of 2012/2013. An asymmetry of information exists within and between climate zones (p < 0.001). Compared to other provinces, farmers in the *Yatenga* province (40.48%) were aware of climate forecasts. This asymmetry of information could derive from the presence of other projects experimenting climate information with some farmers in the *Yatenga* province. These results are consistent with the findings of Churi et al. (2012) who found asymmetric climate information among farmers in the villages of the semi-arid region of Tanzania.

Despite this asymmetry, the sources of information are not significantly different among farmers (p > 0.000). Nearly 65.85% of the farmers in the sample received the seasonal forecasts prior to the agricultural campaign of 2012/2013 by listening to the radio. Farmers also have similar behavior towards the use of seasonal forecasts (p > 0.000). Approximately, 76% of them have taken into account the seasonal forecasts in their decision making. They recognize that seasonal forecasts have supported their decisions in planning and implementing of agricultural activities. Seasonal forecasts facilitate choice of crop rotation, crop varieties and soil type (Klopper et al., 2006).

Table 1. Differential dissemination of seasonal forecasts

Characteristics of the access and use of the current forecasts	Sahelian provinces		Sudano-sahelian provinces		Total	p-value
	Yatenga	*Bam*	*Kadiogo*	*Bazega*		
Access to seasonal climate forecasts climate information						0.000
No (%)	59.52	89.50	82.35	88.89	78.22	
Yes (%)	40.48	10.50	17.65	11.11	21.78	
Information sources						0.104
Radio (%)	58.72	90.00	82.35	66.67	65.85	
Other farmers	41.28	10.00	17.65	33.33	34.15	
Taking seasonal climate forecasts to make decision						0.874
No (%)	22.35	33.33	27.78	25.00	24.19	
Yes (%)	77.65	66.67	72.22	75.00	75.81	

Table 2 shows that 93% of farmers needing climate information. This fraction is equitably distributed within and between the two agro-climatic zones (p > 0.05). The need expression of farmers for climate information shows they are well aware of climate risks on agricultural production (Tarhule and Lamb, 2003; Roncoli et al., 2008). Farmers' need relates to the beginning of the rainy season (74.95%), its length (19.52%) and the end of the rainy season (5.52%). Strong aversion of sowing plants on drought risk may justify the choice of

the beginning of the rainy season by the majority of farmers (p < 0.001). According to Hammer et al. (2001), nearly a quarter of farmers' planting failures are due to poor rains start. The perception of farmers for rainfall changes may explain the differences observed in their needs for climate information within and between agro-climatic zones. For example the decrease in rainfall is perceived by 28.2% of farmers in the Sahelian zone and 45.6% in the Sudano-Sahelian zone (Ouédraogo et al., 2010).

Radio is the most used channel for the dissemination of climate information according to 60.96% of farmers. Although all provinces are covered by the national radio. Radio stations are also located in provinces (*Bam* and *Yatenga*). Differentiated choice of radio (p < 0.000) as a means of information on climate information within and between provinces is related to the rate of possession of radios by farmers and their purchasing power to purchase rechargeable batteries (Roncoli et al., 2008).

According to 55.54% of farmers surveyed, April is the suitable period for getting climate information. This month is the start of agricultural activities: *zaï*, bunds, application of organic manure in the fields. The heterogeneity (p < 0.001) choices of broadcasting periods on climate information derives from farmers' agricultural practices and the beginning of the rainfall of the previous campaign within and between agro-climatic zones (Ingram et al. 2002).

Table 2. Farmers' need for climate information

Characteristics of the need of climate information	Sahelian provinces		Sudano-sahelian provinces		Total	p-value
	Yatenga	*Bam*	*Kadiogo*	*Bazega*		
Farmers needing climate information						0.451
No (%)	5.24	6.50	8.82	9.40	7.00	
Yes (%)	94.76	93.50	91.18	90.60	93.00	
Types of climate information						0.000
Start of rainfall (%)	58.29	86.63	93.55	65.63	74.95	
End of rainfall (%)	2.01	2.14	4.30	28.13	5.52	
Duration of season (%)	39.70	11.23	2.15	6.25	19.52	
Broadcasting						0.000
Radio (%)	52.76	75.40	40.86	73.44	60.96	
Other (%)	47.24	24.60	59.14	26.56	39.04	
Broadcasting period						0.000
April (%)	21.39	87.36	59.14	62.30	55.34	
May (%)	62.03	12.64	40.86	36.07	38.45	
June (%)	16.58	0.00	0.00	1.64	6.21	

The analysis shows that the majority of the farmers are ready to contribute financially to benefit from the climate information to reduce climate risks on agricultural productivity. About 64% of the farmers showed a strictly positive WTP. However 29% of the farmers need climate information but are not willing to pay for. Only 7% of farmers don't want to integrate climate information in their decision process for agricultural production. These behaviors are recurrent within and between climate zones (p > 0.000). The mean of WTP is estimated CFA 546.34 Francs per farmer. The median WTP shows that 50% of farmers in Yatenga, Bazega and Bam are willing to pay CFA 200 Francs to benefit from the climate information compared to CFA 300 Francs in *Kadiogo*. Although they are not significantly different within and between agro-climatic zones (p > 0.000), the average and median WTP reveal the interest of farmers for using climate information (Kenkel and Norris, 1995). Hanemann (1984) recommended using median WTP to measure the economic level because average WTP can

be very sensitive for small changes in the distribution of WTP, while the median is much more robust to these effects.

Table 3. Farmers' willingness to pay for climate information

Farmers' willingness to pay	Sahelian provinces		Sudano-sahelian provinces		Total	P-value
	Yatenga	*Bam*	*Kadiogo*	*Bazega*		
Farmers needing climate information						0.316
True zeros	5.24	6.50	8.82	9.40	7.00	
False zeros	33.81	26.50	23.53	27.30	28.59	
WTP > 0	60.95	67.00	67.65	63.30	64.41	
Central values						
Average WTP	659.05	525.50	450.78	463.25	546.34	0.137
Median WTP	200	200	300	300	200	0.235

Conclusion

This study highlights the perception and the option value of climate information in the sahelian and sudano-sahelian agro-climatic zones of Burkina Faso. It shows that the climate information is asymmetrically distributed to a minority (21.78 %) of the sampled farmers. The analysis reveals that the majority (93%) of the farmers need climate information to guide their decision in planning agricultural activities. The determining factors of the demand for climate information are the age of heads of the household, their literacy level, marital status, their maize and sorghum production and also the added value of grain production. Option value shows the interest granted by farmers using climate information. 64% of the farmers willing to pay would pay an average of CFA 546.34 Francs to obtain. While farmers considered benefit from the use of climate information, it is clear that its contribution to farm income remains a field of research to explore. Thus it is necessary to experiment with individual farms and to evaluate the contribution of climate information to the added value of different crops and farmers' income.

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THE MAIN DIRECTIONS OF SCIENCE AND TECHNOLOGY DEVELOPMENT IN AGRIBUSINESS SECTOR OF THE REPUBLIC OF SERBIA

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Abstract

Recent history has shown that a nation's investment in science and technology development of the agribusiness sector is closely connected to its production power and efficiency. But at the local - national circumstances we are facing many unclear questions which are crucial to the future of science and technology development in agribusiness sector. What will be our science and technology basis in the future? What are the directions of science research and how we are going to organize science and technology development in the field of agribusiness activities? How can we reconcile agribusiness sector development and respect for the environment? What will our sources of energy be in the future? Those are the questions we are discussing in the paper and trying to find out.

Key words: *agribusiness, science, technology, strategy, efficiency, corporation*

Introduction

Theoretical and empirical analysis of economic development, covered with literature (Baptist and Teal, 2014; Teixeria and Fortuna, 2010; Cameron et al, 2005; Fagerber, 2000), indicates the important impact of new knowledge and technology to production and productivity factors increase. It is believed that the most important factors are innovation of local companies and that their results are the fastest to expand into other businesses. In support of this - three arguments are presented. First, it is necessary to dispose with domestic research knowledge to be able to exploit new innovative knowledge. Second, due to various barriers (geographic, cultural, etc.) to diffusion, the research results are hardly implemented. Third, the domestic research form an important component of the increase in the quality of human capital, all of which shows that technology transfer is not the only way of manifestation of technological progress. In formulating the basis of scientific and technological policies of Serbia, we must bear in mind the empirical fact confirmed in the case of many countries.

Agro-complex as the area of production and human activity is gradually changing so that the predominant effect of the basic factors of development and growth is replaced with increasing impact of scientific and technical achievements. In agricultural production it can be observed that science and technology are gradually substituting land and labor.

The essence of this shift is reflected in the increase in profitability; improvement of the process of energy conversion of agrosector as co-producers and consumers of energy; improved quality of natural resources management - water, land; development of biotechnology; development of the necessary scientific and professional human resources; development of the information system to support the human potential and the improvement of human nutrition and understanding about the importance of nutritional/health.

Technological developments in the Republic of Serbia - current trends and limitations

Previous trends in the field of scientific and technological development in the Republic of Serbia are characterized by the following:

- Development is accomplished by imported technology, which in early stages of development is undoubtedly necessary; however, a high degree of direct technological

and economic dependence on foreign countries is continuing;

- Import of technology was broad and indiscriminate pushing the economy into a growing dependence and slowing growth dynamics;
- Purchase of licenses, brands, models and samples, transfer of know-how, technical assistance, long-term alliances, joint ventures, and so on is often at the expense of domestic partner as a deteriorating import-export relationship because of the practice of restrictive clauses (import materials, components, etc., on the one hand and on the other export restrictions) and prevent the greater international affirmation of local companies;
- Forms and terms of cooperation between local companies usually took on the role of transmission through which the competitive struggle was passed;
- An objective need for the development of domestic technology is set to a minimum; therefore, the economic power of most local companies is not based on its own R&D efforts, but foreign.

The possibilities that modern technology and technological processes involve middle-income countries such as the Republic of Serbia, would require, above all, the orientation towards the modernization of existing technological units and acceptance of innovative trends to a wide segment of the scientific and technical achievements that are related to economic development. This would provide appropriate interrelationships between the following processes: the generation of new knowledge and new technologies, the rapid and efficient transfer of new technologies and modernization of existing ones, the expansion of human resources base in science and technology.

It is very important that users of scientific and technological achievements are trained as active participants. Such a relationship requires some knowledge and appropriate technology culture in order to fully appreciate the benefits of technology. Under the conditions of the Republic of Serbia, this is a very important aspect given the widespread perception that only those who create technology have to be active. The active approach requires a constant orientation to monitor new developments, the measurement results of their application and measurement of their rationality in the relationship between inputs and outputs. Such a system is not easy but it is imperative to establish a modern development trends in the field of technological development.

To achieve scientific and technological development, it is necessary to overcome the difficulties in the process of transformation of total economic trends and apply them to transfer of scientific research and technological achievements. A necessary condition for this is a sufficient number of qualified staff and adequate information logistics, the existence of managerial techniques and practices, and of course, appropriate financial environment. Of particular importance is the aspect that represents the process of strengthening the intergovernmental coordination of scientific and research centers. On the other hand, the efficient transfer of technology assumes strong professional - advisory services organized in such a way that enhances the overall value and develop all aspects of work and life.

Generating new knowledge in our conditions appears as a problem but also as an opportunity. As a problem it occurs in the following forms:

- With regard to the level and competence of existing scientific and technical personnel and institutions;
- In terms of their interconnectedness and interdependence;
- In terms of tangible opportunities for investment in the creation and growth of new general and specific knowledge of the staff.

As an option, the creation of new knowledge occurs in the form of three types of effects:

- As a result of the intention to ensure suitable technological effect or so-called planned technical and technological advancement;
- As an unintended consequence (by product) in the process when the research efforts were focused on a completely different objective, and
- As intended social effect, ie as a result of organized change in social and work

activities that results in new knowledge.

As a consequence the development and transfer of agricultural knowledge and technology in Serbia represents very important factor in the development of agro and thus economic and social progress. It would be no exaggeration to say that the Serbian agro-complex is on a kind of technological crossroads. However, in order to achieve further scientific and technological development it is necessary to overcome the difficulties in the process of transformation of overall economic trends and apply them into successful innovations, and then faced with international competition (Njegovan et al., 2009). In doing so, it should be borne in mind that some states differ in many aspects. First, it should be noted the size of the economy, then the achieved level of economic and social development, economic structure, geo-strategic position, the organization of the state (unitary or federal structure), and so on. Hence there is a very strong influence of socio-economic environment on forms, limitations and perspectives of technological development viewed globally as well as in certain economic segments, such as the segment of agro-complex.

A few basic parameters can be emphasized as the foundation upon which this claim rests:
- The nature of knowledge that is developed or being promoted in society,
- Economic ethos that emphasizes individualism or cooperation,
- The place and the role of government in society, and
- Openness of the economy.

Based on this approach, national priorities in technological development should take into account the following factors:
- National goals,
- Need to address acute problems,
- Realization of scientific posibilities, and
- Local availability of strong research schools.

However, it immediately raises the question whether in countries such as Serbia an applied or strategic research should be developed. In response, it may be noted that recent experience supports the fact that the smaller and less developed countries present orientation on certain technological niches, internationalization and international coordination of research.

Since Serbia is a small country, proportionally more attention should be focused on the processes of transfer and then to international cooperation and coordination of scientific and technological efforts. Thus, an essential element is the construction and establishment of the network on which cooperation may be based, above all in the relationship between the company, and then between research and education centers in developed countries and international - governmental organizations in this field.

Technological Policy of the Republic of Serbia

In a global assessment, development of Serbian agro model, that was early released of collectivization and had open space for rapid productivity growth of private sector, had chance for significant achievements in scientific research and technical-technological orientation. These chances are still present but, however, the absence of an adequate macroeconomic policy has made these development opportunities in the current period to be only partially utilized.

It is known that in addition to macroeconomic and development policy, technological development policy is an important determinant of greater international competitiveness. The politics of technological development is an important role of the state (Njegovan et al, 1996). Regardless of the fact that investing in R&D is widespread in market economies, trends indicate that the market does not lead to optimal results. In addition, knowledge market either does not exist or it is imperfect.

A further problem is the cumulative nature of knowledge, and the impossibility of strict separation of innovation from their diffusion; then insufficient definition of the concept of the best techniques, given the need of adaptation to local conditions. It follows that the best imitation is not always the best way to succeed. On the other hand, since without new

technology one can not survive in the market, it is necessary to develop own technological capacity. It seems that in such circumstances the optimal strategy is adoption of existing technologies while developing new approaches.

Regarding the role of the state, it is essential in the following three areas of technological development:

(1)   education (formal),
(2)   the process of increasing knowledge, and
(3)   development of technological capabilities.

It is known that less developed countries and countries in transition, do not have large funds for expenditure on research and development, which indicates that it is necessary to pursue a policy of imitation and adaptation. This policy would be based on the demand for innovation, as opposed to the traditional approach based on the offer (the establishment of the Institute for R&D, etc.). During the time of the adoption and adaption of technologies to local conditions certain innovations appears as a result of those processes. The solution of this problem can stimulate efficient adaptation of foreign technology.

A separate issue is technology policy in countries in transition, especially if one takes into account the long-term decline in labor productivity and inefficiency of previous systemic solutions related to the development of science and technology. The problem is heightened by the fact that the models of Western countries can not be directly applied. While the solution of some less important issues in this domain can take on strategic issues, such as size of the funds earmarked for the development of science there is no concrete answer. In Western countries the largest part of the fundamental research is carried out in laboratories and research and development departments of large companies. It is also known that budgetary resources in that area are insufficiently transparent. Even if these experiences are quite positive the capacity of countries in transition to implement such policies would be questionable (Cvetanovi , 2007).

A common phenomenon in European countries in transition represents an absolute decline in the size of the funds earmarked for the development of science and technology. The macroeconomic problems that these countries face in the first phase of transition, influenced on the governments of these countries to drastically reduce funding in R&D.

At the same time, it can be seen the reduction of assetss that was set aside to fund the development of new technologies, and significantly decreased rate of investment. In addition to the need to reduce fiscal deficits, macroeconomic instability has led to a decline in investment and innovative activity (Njegovan, 1996). This indicates the great importance of stability in development. In a situation characterized by reduced funds for financing the sector of science and technology and the fact that the big companies do not have sufficient resources to research and development, due to the difficulties they face in transition, it is recommended that measures of economic policy as much as possible encourage the establishment and development SME-oriented towards transfer of existing technologies. This would contribute to a relatively small decline in employment in transition. For this purpose it is necessary to economic and political measures stimulate the development of these enterprises. In a situation where the country is in transition, instead of conventional technology imports government should insist on the use of complex forms of international cooperation as a way to import new technologies. This form of cooperation includes joint ventures, free zones, import through international leasing and franchise. It should, in addition, create conditions for foreign direct investment.

It is undeniable that success in scientific research and the creation of new technology is a requirement for a secure future. However it is necessary to ensure the fulfillment of the following requirements:

1. Research in the agro-complex should be based on the strategic orientations, clear ownership concept and with the necessary de-politicization of the one, and strengthening the presence of the profession, on the other hand,
2. The constant comparison of domestic to international research systems,
3. The removal of artificial barriers between the various scientific disciplines, ie

strengthening the overall interactivity of scientific research system,
4. Increase in the quality of management and decision-making procces to the food system, as well as within the scientific research system,
5. The presence of the most creative thoughts and achievements (in scientific research and the creation of technology other scientific fields must be included),
6. Increased financial investments in human resources and scientific research infrastructure with mandatory rationalization of the existing scientific and research networks, and
7. Widely publicizing the importance of the results achieved in agricultural research to all segments of society.

In doing so, must not be forgotten that the different social segments have different requirements in relation to research in agro-complex. They are conditioned by their goals for which they are related to this activity.

Conclusion

The main practical issue that the agro-complex in Serbia faces is the issue of choice of alternative strategies and models of investment in scientific and technological development. In doing so, we must bear in mind, first of all currently available factors of production which is estimated to be available in sufficient quality for the execution of a comprehensive development program, and of course, the existing agrarian structure. This, because the growth of the agricultural sector if it is set as a goal, means increasing the volume of economic activity that can be realized in the framework of the unchanged economic structure.

During the period of application of the concept of broad industrialization development policies intensive were focused on imports of foreign technology. This concept is realized development of a significant number of enterprises of the private sector, especially agro-industry. Hence, it is widely believed that the decisive nucleus of retrograde development trends and trade balance deficit of agrarian economy sprung from its technological development.

The process of finding the right solutions bears in mind a number of factors, ranging from those conditioned both internally and externally. So, in addition to national objectives it is necessary to take into account the strategies of multilateral alliances and individual countries, the achievements in scientific and technological development, which poses the orientation of the international co-operation and integration of scientific and technological efforts to develop the agricultural economy and building its competitive position in the international level.

This orientation places an emphasis on modern company of agrarian economy as a support to agricultural development and the holder of scientific and technological results. On the other hand, this orientation requires the construction of a new strategy for the development of science, or at least its fundamental reorganization, in order to create an efficient R&D system, able to support the technological development of agricultural economy.

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AUTHOR INDEX