Proceedings of the
10th International Symposium
Modern Trends in Livestock Production, October 2-4, 2013

ANALYSIS OF SOME OF THE TRAITS THAT DETERMINE THE PRODUCTIVITY OF OATS IN ORGANIC AND CONVENTIONAL PRODUCTION

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Original scientific paper

Abstract: In the period 2005-2007 trials with five oats populations (*krivogastani,trebenista,radolista,bulgaria, kuceviste*) and three oats varieties (*rajac,slavuj, lovcen*), were carried out. The experiments were set in conditions of organic and conventional production. The main goal was to determine the differences in some of the traits that determine the productivity of oats, as well as differences that arise as a result of growing systems. Number of oat stalks in 1 m^2 in organic production (449) is greater absolutely for 20, or relatively for 4.5% of the number of stalks in 1 m^2 in conventional production (428). The number of panicles in 1 m^2 in organic production (445) is greater absolutely for 21or relatively for 4.8% from the number of panicles (424) in conventional production. Statistically reliable difference in number of stalks and panicles in 1 m^2 in organic and conventional production was not obtained in the tested varieties and populations. The production system of oats did not show a particular increase in the number of stalks in a panicle, although there is some increase in organic production, which was not going after a certain legitimacy to draw the right conclusions.

Key words: oat, stalk, panicle, node, organic, conventional

Introduction

Oats (*Avena sativa* L.) is a crop grown primarily for grain and straw. Oats as culture was introduced in Europe more than 3500 years ago and is considered as "European grain." It is thought that originats mainly from two types: wild oats (*Avena fatua* L.) and red wild oats (*Avena sterilis* L.), *Suttie JM (2000).* Area under oats over the world have been decreasing steadily, mainly due to lower and unstable yields in comparison with wheat and barley. As reasons for the low

productivity of oats are growing poorly productive varieties and improper agrotechnics. Poor scientific research in oats contributes to a series of unsolved agro-technical issues that greatly affect low production potential and reduction of area. On the other hand, today oats is among the many important crops in the human diet, with increased demand in modern cooking and food technology. It contains, soluble dietary fiber, mainly ß – glucans whose content varies from 2,5 – 6,5 %, Przulj N. et al. (1998). According fat content in grain (4-7%), oats deviates only place of corn. Among cereals, oats is the richest source of minerals: Ca (57 mg/100 g fruit), P (520 mg/100g/zrno), K (384 mg/100g fruit) and Fe. It contains vitamins B1, B2, B6, K1, E, *Savova T. et al. (2005)*. Today, in the developed world, great attention is paid on the healthy food. World tends to produce healthy food imposes the need and the Republic of Macedonia to conduct investigations in this direction and gain additional knowledge about the reaction of oat genotypes to applied agrotechnics.

The main objective was to determine differences in some of the traits that determine the productivity of oats, differences that occur as a result of farming systems, and in particular to distinguish the best varieties or populations of both types of production.

Material and Methods

The tests were performed in field conditions on the experimental field of Faculty of agriculture - Strumica, at the University “Goce Delchev", Stip, during the period 2005 to 2007. The laboratory tests were performed in the laboratories of the Faculty of Agriculture.

Five oats populations, of which four were domestic and one was introduced from Bulgaria (*krivogastani, trebenista, radolista, bugaria, kuceviste*) and three oats varieties from Serbia (*rajac, slavuj, lovcen*) were analyzed. Two experiments were set up. In both all the above-mentioned genotypes of oats were present, except that in one experiment all variants were set in terms of conventional production, and the other in terms of organic production. The experiments consisted of 8 variants in four repetitions, divided by the method of random block system, with the dimension of basic parcel of 5 m^2. The distance between the variants was 0,50 m, and between repetitions 1,0 m. The distance between rows was 20 cm. The seeding rate was 550 grains per 1 m^2. In the three years of testing the soil was prepared in an identical manner. The main treatment was plowing at a depth of 35 cm, followed by fertilization in methodological principle. In all the years of experiments, sowing is performed during March: 17.3.2005; 28.03.2006 and 06.03.2007, ie. when there were optimal conditions. Sowing is performed manually, in rows, at a depth of 5-6 cm.

Before harvest, material of 1 m^2 from each parcel is taken for laboratory analysis. In the laboratory the number of stalks and number of panicles in 1 m^2 were analyzed. The number of stalks in panicle and the number of nodes in panicle were analyzed on 30 plants of each parcel, ie. 120 plants of each variety.

The results are processed with statistical method for analysis of variance, and differences were tested by LSD-test.

Results and Discussion

Number of stalks in 1 m^2. When processing the results, we speak for the number of stalks in 1 m^2 because all plants are counted together, and are not counted separately with their tillers. The results for the number of stalks in the 1m^2 in conventional oats production are shown in Table 1, a in organic production in Table 2. When compared to the general averages of the number of stalks in 1 m^2 of both farming systems, regardless of years, genotype and climatic conditions, and depending on the applied agro-technical measures, it can be said that the number of stalks in 1 m^2 in organic production (449) is greater absolutely for 21 or relative for 4.9% than the number of stalks in 1 m^2 in conventional production (428). Increasing the number of stalks and the number of spikes in wheat affected by the fertilization has concluded *Vasilevski G. (1980).* Our results are consistent with results from the author. According*, Jevtić S. (1992),* during the growth of the stalk and in the tasseling stage, oats have the greatest need for nutrients. Regardless of year, climatic conditions and farming systems ie. applied agrotechnics, the best genotype of examined varieties and populations for the high number of stalks in 1 m^2 of oats is *radolista* population, which in the organic production system formed approximately 514 stalks in 1 m^2, and the system of conventional production 478.

Table 1. Number of stalks per 1 m^2 in conventional oat production

Variety/Population	Year			Average by variety/population 2005/07
	2005	2006	2007	
Krivogastani	429	417	419	422
Trebenista	472	384	474	443
Radolista	490	439	506	478
Bugaria	477	376	434	429
Kuceviste	464	368	455	429
Rajac	430	355	469	418
Slavuj	391	365	391	382
Lovcen	461	387	426	425
M	452	386	447	428
LSD 0,05	ns	ns	ns	
0,01	ns	ns	ns	

Table 2. Number of stalks per 1 m^2 in organic oat production

Variety/Population	Year			Average by variety/population 2005/07
	2005	2006	2007	
Krivogastani	479*	459	490	476
Trebenista	450	380	428	419
Radolista	516*	505	522	514
Bugaria	478*	440	469	462
Kuceviste	420	381	430	410
Rajac	358	416	458	411
Slavuj	393	445	432	423
Lovcen	461	450	505	472
M	444	435	467	449
LSD 0,05	108	ns	ns	
0,01	ns	ns	ns	

Number of panicles per 1 m^2. The results for the number 1 m^2 panicle in the conventional production of oats are shown in Table 3, and in organic production in Table 4. When compared to the general averages of number of panicles in 1 m^2 of both farming systems, regardless of age, genotype and climatic conditions, and depending on the applied agro-technical measures, it can be said that the number of panicles in 1 m^2 in organic production (446) is greater absolutely for 22 or relative for 5,2 % from the number of panicles in conventional production (424).

Table 3. Number of panicles per 1 m^2 in conventional oat production

Variety/Population	Year			Average by variety/population 2005/07
	2005	2006	2007	
Krivogastani	420	414	412	415
Trebenista	462	380	463	435
Radolista	482	430	500	471
Bugaria	475	375	430	427
Kuceviste	460	365	450	425
Rajac	430	352	468	417
Slavuj	390	360	390	380
Lovcen	455	384	422	420
M	452	386	447	424
LSD 0,05	ns	ns	ns	
0,01	ns	ns	ns	

Table 4. Number of panicles per 1 m^2 in organic oat production

Variety/Population	Year			Average by variety/population 2005/07
	2005	2006	2007	
Krivogastani	468*	450	504	474
Trebenista	435	380	488	434
Radolista	506*	497	515	506
Bugaria	470*	435	450	452
Kuceviste	412	380	430	407
Rajac	348	414	448	403
Slavuj	390	440	430	420
Lovcen	456*	447	501	468
M	436	430	471	446
LSD 0,05	104	ns	ns	
0,01	ns	ns	ns	

According to *Georgieva T. (1995),* the maximum general tillering at oats increases with increasing nitrogen fertilization, from 3.37 (at N_0), to 4.11 (at N_{18}), and productive tillers increase from 1.63 (at N_0), to 1.93 (at N_{18}). The highest percentage of the maximum established tillers develop into productive in the variant without nitrogen fertilization. According to the results obtained for the number of stalks and panicles in both farming systems can be stated that the number of panicles in all tested species and populations is proportional to the number of stalks in 1 m^2.

Number of stalks per panicle. The panicle in oats is composed of a central shaft (spindle) with an average of six nodes, *Vasilevski G. (2004)*. Lateral stalks of the panicle are developed on the nodes and on these panicles the spikelets are found. The results for the number of stalks per panicles in conventional oats production are shown in Table 5, a for organic production in Table 6. When compared to the general averages of the number of stalks per panicle in 1 m^2 of both farming systems, regardless of the year of production, genotype and climatic conditions, and depending on the applied agro-technical measures, it can be concluded that the number of stalks per panicle in 1 m^2 in organic production (22, 0) is higher absolutely for 0.7 or relative for 3,3 % than the number of of stalks per panicle in 1 m^2 in conventional production (21.3). The production system of of oats has not shown some increase in the number of stalks per panicle in 1 m^2, although there is some increase in organic production, but it does not go in a certain legitimacy to draw correct conclusions.

Table 5. Number of stalks per panicle in conventional oat production

Variety/Population	Year			Average by variety/population 2005/07
	2005	2006	2007	
Krivogastani	23.2	19.9	20.2*	21.1
Trebenista	21.6	22.2*	17.9	20.6
Radolista	22.6	20.1	19.1	20.6
Bugaria	22.5	21.3	18.7	20.8
Kuceviste	21.4	21.0	20.0	20.8
Rajac	23.0	22.4**	20.9	22.1
Slavuj	22.0	22.1*	21.5	21.9
Lovcen	23.4	22.9**	21.5	22.6
M	22.5	21.5	20.0	21.3
LSD 0,05	N.S.	1.77	1.72	
0,01	N.S.	2.56	2.49	

Regardless of year, climatic conditions and farming systems i.e applied agro-technical measures, the best genotype of examined varieties and populations for a number of of stalks per panicle in 1 m^2 of oats is variety *lovcen* which in the system of organic production reached an average number of of stalks per panicle in 1 m^2 of 23.6 and 22.6 in conventional production.

Table 6. Number of stalks per panicle in organic oat production

Variety/Population	Year			Average by variety/population 2005/07
	2005	2006	2007	
Krivogastani	23.3	21.8	21.5	22.2
Trebenista	23.1	20.2	17.9	20.4
Radolista	22.2	20.5	23.0**	21.9
Bugaria	22.7	22.1	19.5	21.4
Kuceviste	21.7	23.1	20.2	21.7
Rajac	23.3	24.0**	22.5**	23.3
Slavuj	22.1	224	21.6	22.0
Lovcen	25.4*	23.4*	22.2*	23.7
M	23.0	22.2	21.1	22.1
LSD 0,05	2.28	1.27	0.54	
0,01	ns	1.85	0.78	

Number of nodes per panicle. The results for the number of nodes per panicle in conventional oats production are shown in table 7, and in organic production in table 8.

Table 7. Number of nodes per panicle in conventional oats production

Variety/Population	Year			Average by variety/population 2005/07
	2005	2006	2007	
Krivogastani	5.6**	5.5**	5.1	5.4
Trebenista	5.3	5.1	4.9	5.1
Radolista	5.1	5.4	5.0	5.2
Bugaria	5.2	5.4	4.9	5.2
Kuceviste	5.3	5.3	5.2*	5.3
Rajac	5.6**	5.5**	5.1	5.4
Slavuj	5.5*	5.3	5.1	5.3
Lovcen	5.5*	5.5**	5.0	5.3
M	5.4	5.4	5.0	5.3
LSD 0,05	0.29	0.17	0.25	
0,01	0.42	0.24	ns	

Table 8. Number of nodes per panicle in organic oats production

Variety/Population	Year			Average by variety/population 2005/07
	2005	2006	2007	
Krivogastani	5.2	4.9	5.1	5.1
Trebenista	5.3	5.2	5.1	5.2
Radolista	5.4	5.3	5.2	5.3
Bugaria	5.3	5.2	5.0	5.2
Kuceviste	5.3	5.4*	5.1	5.3
Rajac	5.6*	5.3	5.0	5.3
Slavuj	5.7*	5.4*	5,3	5.5
Lovcen	5.6*	5.4*	5.1	5.4
M	5.4	5.3	5.1	5.3
LSD 0,05	0.34	0.34	ns	
0,01	ns	ns	ns	

The production system of oats showed no increase in the number of nodes per panicle, meaning this property showed high stability. Regardless of year of production, climatic conditions and farming systems i.e. applied agrotechnic, the best genotype of examined varieties and populations for the number of nodes per panicle is the variety *rajac*, which in organic and conventional production reached an average of 5.4 nodes per panicle. According to Finker et al. (1973) quoted by Milnar R. et al (1996), the lower and early maturing oat varieties often have fewer nodes per panicle (fertile layers), which reduces the number of spikelets and yield of grain by panicle.

Conclusion

Based on three years of research, the following conclusions can be drawen: The number of stalks in 1 m^2 in organic production (449) is greater absolutely for 21or relative for 4.9% of the number of stalks in 1 m^2 in conventional production (428). The best genotype of examined varieties and populations for the high number of stalks in 1 m^2 of oats is *radolista* population, which in both farming systems reached the highest number of stalks per 1 m^2 (514 in organic production and 478 in conventional production). Population in organic production reached an average number of 506 panicles and in conventional production 471. The number of stalks per panicles does not depend on the length of the panicle, but the density of the panicle and the number of the nodes per panicle, on which the lateral stalks are developed. Varieties with condensed panicle have many stalks in the panicle. The most stalks per panicle in both farming systems made variety *lovcen*, which in organic production reached an average number of stalks per panicle of 23.6 i.e. 22.6 in conventional production. All varieties grown in the organic production system had higher average number of spikelets, absolutely for 1.5 or relatively for 2.1% than the number of spikelets in conventional production. The production system of of oats has not shown some increase in the number of stalks per panicle in 1 m^2, although there is some increase in organic production (22.0) absolutely for 0.7 or relatively for 3.3% than the number of stalks per panicle in conventional production (21.3). The number of nodes per panicle is a variety characteristic, but it depends on the climatic conditions of the year. Lowest number of nodes per panicle in both farming systems were obtained in the year of 2007, as the most arid in thein the initial stages of development of oats. Best genotype of the tested varieties and populations for a number of nodes per panicle is variety *rajac*, which in organic and conventional production reached an average number of nodes per panicle of 5.4

Analiza nekih osobina koje određuju produktivnost ovsa u organskoj i konvencionalnoj proizvodnji

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Rezime

U periodu 2005-2007, postavljeni su ogledi sa pet populacija ovsa (krivogastani, trebenista, radolista, bugarska, kučevište) i tri sorte ovsa (Rajac,

Slavuj, Lovćen), su sprovedene. Eksperimenti su postavljeni u uslovima organske i konvencionalne proizvodnje.Osnovni cilj je bio da se utvrde razlike u nekim od osobina koje određuju produktivnost ovsa, kao i razlike koje se javljaju kao rezultat rastućih sistema. Broj ovsenih stabljika u 1 m^2 u organskoj proizvodnji (449) je apsolutno veći za 20, ili relativno za 4,5% od broja stabljika u 1 m^2 u konvencionalnoj proizvodnji (428). Broj metlica u 1 m^2 u organskoj proizvodnji (445) veći apsolutno za 21 ili relativno za 4,8% od broja metlica (424) u konvencionalnoj proizvodnji. Statistički pouzdane razlike u broju stabljika i metlica u 1 m^2 u organskoj i konvencionalnoj proizvodnji nije utvrđena u ispitivanim sortama i populacijama. Sistem proizvodnje ovsa nije pokazao određeni porast broja stabljika i metlica, iako postoji povećanje u organskoj proizvodnji.

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