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COMPARATIVE COST ANALYSES OF PEPPER PRODUCTION UNDER CONVENTIONAL AND INTEGRATED CROP MANAGEMENT METHODS: THE CASE OF STRUMICA REGION IN REPUBLIC OF MACEDONIA

P. Kletnikoski, E. Sofijanova, D. Jovanov, V. Dimovska

University „Goce Delcev", Faculty of agriculture, „Krste Misirkov" b.b, 2000 Stip, Republic of Macedonia

Abstract

Pepper is an important export crop in Macedonia. Demand for ICM grown food has been increasing in the last decade. Production costs have been analyzed in several studies using methods as budgeting and approaches as estimation of production, cost, or profit functions. In this study budgeting methods are used in order to analyze the costs and benefits of pepper production under conventional versus integrated crop management (ICM) methods. Data were collected using field studies, applying face– to–face interview method, conducted at the region of Strumica. Time and motion study techniques were used to record machinery use and labor quantities. Records of production inputs and yields were also collected. Results show that ICM systems are more profitable than conventional. Net returns were fairly close to those for conventional and ICM systems.

Key Words: Pepper, Conventional methods, Integrated crop management methods (ICM), Production costs, Profitability, Net returns.

Introduction

Pepper (Capsicum spp.) is one of the leading vegetable crops grown in Macedonia. It is the most important lowland vegetable, in terms of cultivated area and net returns. From the total area under vegetables in Macedonia, 8.626 hectares (18 %) are allocated for pepper production. Pepper production is varying from about 140-168 thousand tons, and the yields from 17 - 20 t per ha., depending on the year and weather conditions in Macedonia (table 1).

Demand for ICM grown food has been increasing in the last decade. The concept of ICM is new. Aware of the negative side effects of pesticides, the Western world began a search for pest control practices with reduced chemical inputs, such as supervised control and biological control by means of natural enemies. The concept of integrated crop management (ICM) has been developed from the more commonly applied concept of integrated pest management (IPM). ICM tends to focus on the crop and to maintain its health. ICM includes management practices such as minimum tillage, nutrient balancing and integrated pest management (IPM).

The IACPA (Integrated Arable Crop Protection Allianc) describes ICM as: "a whole farm policy aiming to provide the basis for efficient and profitable production which is economically viable and environmentally responsible. It integrates beneficial natural processes into modern farming practices using advanced technology and aims to minimize the environmental risks while conserving, enhancing and recreating that which is of environmental importance" (IACPA, 1998,)

ICM are distinctive from conventional farming practice in that sustainability is at the core of the objectives, as is the case in organic systems. However, unlike organic farming ICM still rely upon the use of inorganic inputs, albeit at more appropriately targeted levels than those of conventional systems to achieve environmental benefits and cost savings. ICM thus represent a "middle course between the extreme constraints of organic farming standards and the increasingly unacceptable pursuit of intensive cereal monocultures" (Wibberley, 1995, p.48). The key to ICM is that it is not a prescriptive approach, but involves a set of principles and procedures (incorporating chemical, biological and cultural farm management methods) which have to be applied, taking account of the specific circumstances of the farm and its surroundings. (IACPA, 1996)

The aim of this study was to analyze the costs and benefits of pepper production under conventional versus integrated crop management (ICM) methods in the region of Strumica in Macedonia. In the study,

usage of physical input, production costs, yields, of pepper production under conventional and ICM methods and productivity, gross margin and net profit per unit area have been examined in comparative way.

Table 1. Production of pepper in Macedonia

	2006	2007	2008	2009	2010	2011	2012
Area of pepper (ha)	8.313	8.331	8.199	8.438	8.474	8.465	8.626
Production (t)	140.905	140.558	141.729	154.771	168.150	153.842	166.247
Yield (t/ha)	16,9	16,9	17,3	18,3	19.8	18,2	19,3

Materials and Methods

This study was mainly based on primary information collected from the pepper producers in Strumica region of Macedonia. The data is collected from 20 pepper producers that are producing pepper under conventional methods, and 15 pepper producers that are producing pepper under ICM methods, determined through the random sampling method. Primary information was collected by using pre-tested interview schedule, applying face– to–face interview method. Time and motion study techniques were used to record machinery use and labor quantities. The collected information was first tabulated, coded and entered into computer. The data necessary for the study has been collected through the survey of sample farms.

All the local measurements were converted into standard unit and final analysis was done by using computer software packages: Microsoft Excel and Statistical Package for Social Science (SPSS).

Physical data related to pepper production practices, costs, and yield, use of physical input and sale quantity and selling prices has been collected in 2012 production year.

The results, calculated in the national currency unit, have been converted to EU-€ at the Macedonian Central Bank`s middle rate of exchange of the production years.

In order to determine the profitability of pepper production under conventional and integrated crop management methods, budgeting model was established. The budgeting model used in this study is an enterprise budget, defined as an estimate of the average annual costs and returns for the enterprise.

The model calculates variable and some of the fixed costs. These costs are summed to derive the total cost of production on a per hectare basis. Variable costs refer to those costs which vary directly according to the level of production of grown crop. These costs include seed, hired labour, fertilizers, pesticides, machinery operating costs, and hired machinery. Fixed costs are defined as costs that do not change with the level of production. These costs include depreciation and interest and, repair and maintenance and insurance. The model will calculate machinery depreciation and interest on machinery and repair and maintenance. Taxes and other overhead, such as landownership are not taken into consideration.

In the cost analysis, data related to labor demand and machine power in the production activities of the farms, production practice, input usage, quantity of production and selling prices have been taken as a basis. Costs have been determined on the basis of the quantity of input used by the pepper producers. In the determination of the gross production value, main and by-product sale prices received by the farmers and the average amount of pepper have been taken into consideration.

The cost, productivity and profitability levels of wheat farming using certified and uncertified seeds are examined in the comparative analysis.

The gross margin is the difference between the gross return and the total variable cost:

(1)

Gross margin = Gross return – Total variable cost

Net profit has been calculated by subtracting the total production costs from the total financial output:

(2)

Net return = Total financial output – Total production costs

Results and Discussion

Economy data are compiled in three main sections: 1) Yields and prices; 2) Production costs; and 3) Output returns.

Table 2 shows yields and average prices for the peppers under conventional and ICM systems.

Prices for peppers were based primarily on the prices received from peppers producers in the Strumica region. Monthly price data from Agricultural Market Information System were also used to compute average, maximum and minimum prices. The prices for pepper produced under conventional methods and pepper produced under integrated crop management methods are same. (Table 2).

Table 2. Average marketable yield per decare and price per kg for pepper under two cropping systems

Indicators	Conventional system	ICM[a] system
Pepper yield (kg/da[b])	8.000	8.400
Average price per kg (€/kg)	0,8	0,8

[a]ICM - integrated crop management
[b]da (decare) - 1da= 0,1 ha

Average marketable yields were computed as simple averages for two cropping systems. The marketable yield for pepper was higher under integrated crop management. The average pepper yield per decare is 8.000 kg in pepper produced under conventional system, and 8.400 kg/da pepper produced under integrated crop management methods The average productivity in pepper produced under integrated crop management methods is 5 % higher than pepper produced under conventional system. (Table 2).

Table 3 is the partial budget for the pepper producing under conventional and ICM systems. The budgets include average costs of materials, labor, machinery and equipment, and all other expenses for pepper producing under conventional and ICM systems. The cost of production per unit of pepper was compared for two types of production systems (Figure 1). Variable costs in pepper producing under conventional system has been calculated as 1.715 €/da, and in pepper producing under ICM system has been calculated as 1.725 €/da. The total variable cost is 0,5 % lower in pepper producing under conventional system in comparison to pepper producing under ICM system. This difference comes from using Integrated pest management (IPM) practices in ICM system.

Total production costs in pepper producing under conventional system is 1.825 €/da, and in pepper producing under ICM system is 1.855 €/da. The total production costs in pepper producing under conventional system are 1,6 % lower compared to the pepper producing under ICM system.

Table 3.Average cost per decare of pepper producing under conventional and ICM systems

Costs	Conventional system	ICM[a] system
Total variable costs (€/da[b])	**1.715**	**1.725**
Plowing and disk (€/da)	10	20
Seed (€/da)	250	250
Transplanting (€/da)	25	25
Fertilize (€/da)	325	300
Integrated pest management (IPM) (€/da)	0	100
Irrigation (€/da)	90	90
Spray pesticides (€/da)	200	125
Harvest (€/da)	165	165
Package charges (€/da)	455	455
Delivery charges (€/da)	195	195
Total fixed costs (€/da)	**110**	**130**
Depreciation and interest (€/da)	90	100
Repair and maintenance (€/da)	20	30
Total production costs (€/da)	**1.825**	**1.855**

[a]ICM - integrated crop management
[b]da (decare) - 1da= 0,1 ha

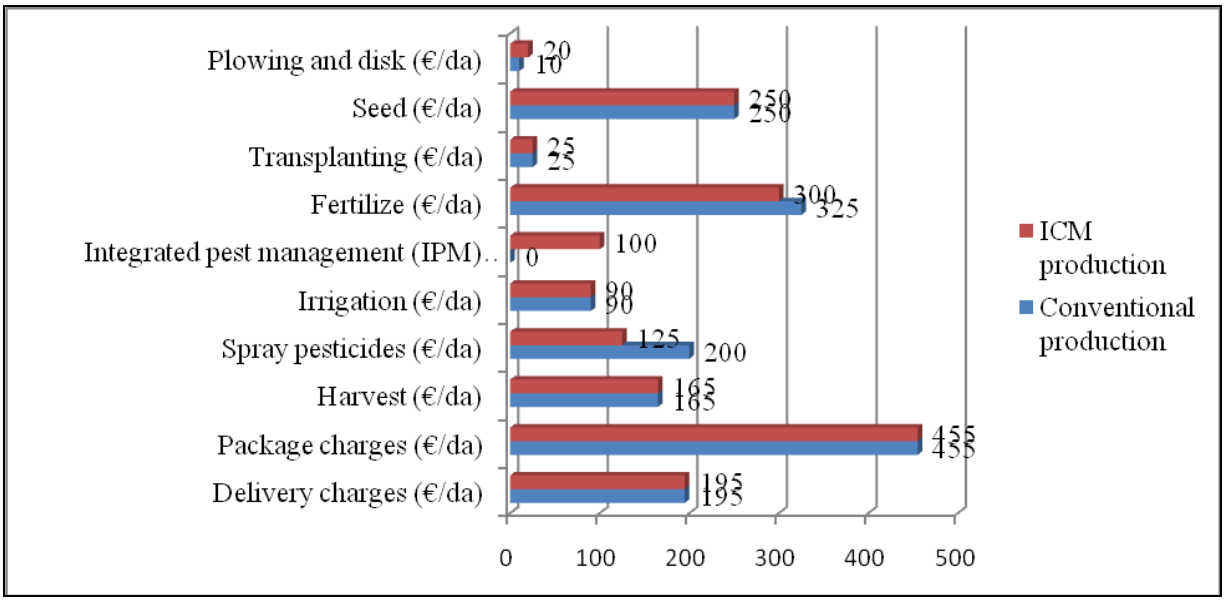

Figure 1. Comparison of average cost per decare of pepper producing under conventional and ICM systems

Table 4. Summary of per unit cost of production and per unit net return

Indicators	Conventional system	ICM[a] system
Pepper yield (kg/da[b])	8.000	8.400
Average price per kg. (€/kg)	0,8	0,8
Average cost per kg. (€/kg)	0,2	0,2
Gross production value (€/da)	6.400	6.720
Gross margin	**4.685**	**4.995**
Net return	**4.575**	**4.865**

[a]ICM - integrated crop management
[b]da (decare) - 1da= 0,1 ha

Gross production value (€/ha) has been calculated by multiplying the pepper yields with their selling price.Total financial output in pepper producing under conventional system is 6.400 €/da, and in pepper producing under ICM system is 6.720 €/da. The total financial output in pepper producing under ICM system is 5 % higher compared pepper producing under conventional system. This comes as a result of the higher yields in pepper producing under ICM system. (Table 4)

To measure economic efficiency, gross margin (total output value minus variable cost) was used to

assess profitability in pepper production. Gross margin in pepper producing under conventional system is 4.685 €/da, and in pepper producing under ICM system is 4.995 €/da. (Table 4)

Gross margin in pepper producing under ICM system is 6,5 % higher compared to pepper producing under conventional system. Accordingly, pepper producing under ICM system provides the highest contribution to the welfare of the producer.

Net return is calculated as 4.575 €/da in pepper producing under conventional system and 4.865 €/da in pepper producing under ICM system. Net return per hectare in pepper producing under ICM system is 6,2 % higher compared pepper producing under conventional system. Accordingly, pepper producing under ICM system provides the highest contribution to the welfare of the producer. Also, it provides a higher net economic benefit and contributes more to a higher living standard for the producer. (Table 4)

Conclusions

The average productivity in pepper produced under integrated crop management methods is 5 %

higher than pepper produced under conventional system.

The total variable cost is 0,5 % lower in pepper producing under conventional system in comparison to pepper producing under ICM system. This difference comes from using Integrated pest management (IPM) practices in ICM system

The total production costs in pepper producing under conventional system are 1,6 % lower compared to the pepper producing under ICM system.

The total financial output in pepper producing under ICM system is 5 % higher compared pepper producing under conventional system. This comes as a result of the higher yields in pepper producing under ICM system.

Gross margin in pepper producing under ICM system is 6,5 % higher compared to pepper producing under conventional system.

At the farm level the increase in net return per unit was 6,2 % under ICM systems compared to conventional systems. It was important to notice that change in net returns for ICM after switching from conventional systems was positive for pepper producers . For ICM systems this positive change is attributed to a increase in yields.

Accordingly, pepper producing under ICM system provides the highest contribution to the welfare of the producer. As contribution of pepper producing under ICM system to the welfare of the producer is higher than the contribution of pepper produced under conventional system, pepper producing under ICM system is becoming widespread.

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