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ECONOMIC EVALUATION OF FORAGE PEA ORGANIC PRODUCTION

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Natalia GEORGIEVA*, Ivelina NIKOLOVA[1], Vladimir DIMITROV[2], Daniela DIMITROVA[2]

[1]*Institute of Forage crops, 5800–Pleven, Gen. V. Vazov Street, 89, Pleven, BULGARIA*
[2]*Institute of viticulture and enology, 5800–Pleven, Kala Tepe Street, 1, Pleven, BULGARIA*
**Corresponding author: E–mail: imnatalia @abv.bg*

Abstract. The presented evaluation provides an opportunity to be compared the economic results at different variants of forage pea organic production. From the recommended indicators in economic literature in the current evaluation are calculated following ones: total production (€/da), production costs (€/da), cost price (€/kg), net income (€/da) and rentability (%). In the organic production are used four products: foliar fertilizer Biofa, growth regulator and fungicide Polyversum, bioinsecticides Pyrethrum and NeemAzal which are applied alone and in combination. Comparisons are chemicals (regulator Flordimex, insecticide Nurelle D) that are used in the standard conventional technology. All variants of organic production are cost–effective and enable the realization of good economic results. With the highest economic effect is the application of organic fertilizer Biofa in combination with bioinsecticide Polyversum. In the production of hay, this combination provides profitability of 79.30 %, exceeding the profitability of the standard variant in conventional production (75.00 %); the profitability in grain production (137.05 %) is somewhat lower than that of the conventional variant (140.00 %). Overall, the profitability in different variants of pea organic production for grain and hay is with average values of 109.91 % and 51.67 %, as values for the conventional production are 128.905 and 68.43 %, respectively. Although the result of the economic evaluation is chosen a certain optimal variant of pea organic production, open to future studies remain questions concerning the effectiveness of various organic products in different forms of production organization.
Keyword*:* economic evaluation, rentability, organic production, pea.

Introduction

Organic agriculture is a system of production which combines the most beneficial practices for the environment, a high degree of biological variety, natural resource protection and production of products received through the use of natural substances and processes. It is the most environmentally friendly method of agricultural production [NOWAK and SZEWCZYK, 2015, BOSTAN *et al.,* 2013, BUTNARIU and CAUNII, 2013, RASHED and BUTNARIU, 2014].

By comparing organic and conventional production in global scale, Badgley and collab. [BADGLEY *et al.,* 2007] establish evidence that organic agriculture has the potential to contribute quite substantially to the global food supply while reducing the detrimental environmental impacts of conventional agriculture. The main objections to the proposition that organic agriculture can contribute significantly to the global food supply are low yields, insufficient quantities of organically acceptable fertilizers [BADGLEY *et al.,* 2007] and high production costs–higher costs for labour, biopesticides *etc*. [KOSTADINOVA and POPOV, 2012].

The introduction of organic production and increase consumer demand for organic products necessitates the development of new technologies and search for optimal variants that provide higher productiveness, successful pest control, and low cost price. This type of production imposes economic analysis in order to have a real evaluation of its effectiveness [BORISOV and DINTCHEVA, 2014, BUTNARIU *et al.,* 2012, PUTNOKY *et al.,* 2013. BAGIU *et al.,* 2012, BUTNARIU *et al.,* 2006]. Grain legumes, especially pea, play a very important role in organic cropping systems.

Pea provides nitrogen in the system through nitrogen fixation, grain and forage which are rich in protein, and improves the nitrogen content of soil for the next crop [CORRE–HELLOU and CROZAT, 2005, BUTNARIU and GIUCHICI, 2011]. Forage pea is an important annual legume crop in Bulgaria.

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Banat's Journal of Biotechnology
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Very few studies related to its cultivation in organic conditions are available in the literature [GERDZHIKOVA *et al.*, 2012; NIKOLOVA and GEORGIEVA, 2015].

The aim of this paper is on the base of a comparative analysis of economic results of the application of different variants of organic production in forage pea to determine economically effective ones for its cultivation.

Material and methods

In scientific literature as main problems in pea organic production are indicated low productivity [KALAPCHIEVA *et al.*, 2010] and control of diseases and pests [FISCHL *et al.*, 1997; CROZAT, 2005; LESZNYÁK *et al.*, 2008, BUTNARIU, 2012, CAUNII *et al.*, 2015, BUTNARIU and CORADINI, 2012, PETRACHE *et al.*, 2013], because of which for the purposes of the experiment were chosen following four bioproducts: organic foliar fertilizer Biofa, organic growth regulator and fungicide Polyversum, bioinsecticides Pyrethrum and NeemAzal which are applied alone and in combination.

Comparisons were synthetic preparations (synthetic regulator Flordimex, insecticide Nurelle D) that are used in the standard conventional technology of forage pea growing.

Variants: I. Organic production:

1. Natural soil fertility, without use of products (K_0);
2. Biofa 0.5%;
3. Polyversum 10 g/da;
4. NeemAzal 0.5 %;
5. Pyrethrum 0.05 %;
6. Biofa 0.5%+NeemAzal 0.5 %;
7. Biofa 0.5%+Pyrethrum 0.05 %,
8. Polyversum 10 g/da+NeemAzal 0.5 %;
9. Polyversum 10 g/da+Pyrethrum 0.05 %;

Variants: II. Conventinal production:

10. Flordimex 0.05 %;
11. Nurelle D 40 mL/da;
12. Flordimex 0.05%+Nurelle D 40mL/da (K_1).

The experimental activity was conducted at the Institute of forage crops during 2011–2013. The sowing was done in March, after predecessor oats with a sowing rate of 120 seeds /m^2.

The preparing of the soil involved plowing (22–25 cm) in the fall and twice cultivation (15 cm) in spring.

The treatment with organic products and synthetics was applied at the stages of budding (once) and budding+flowering (twice). Pea for hay production was harvested at flowering–pod formation, and for grain–at technological ripeness.

The comparative analysis of economic results of the different variants was based on a comparison of a set of standard valuation metrics. They enable making economically justified decision when selecting a particular variant [POPOVA and TAHSIN, 2009, BUTNARIU *et al.*, 2013].

From the recommended indicators in economic literature [ANGELOVA, 1999; MIHAILOV *et al.*, 2002] for comparative analysis, in the current economic evaluation were used following indicators: total production (€/da), production costs (€/da), cost price (€/kg), net income (€/da) and rentability (%). Production costs were calculated on base the actual amount for the study period. Production costs and net income were calculated according to average market prices for the period 2011–2013.

The determination of cost price is useful for initial ranking of a wide range of products for application, which results in different levels of total costs, and net income and rentability are indicators with large estimated value in comparative analyses [POPOVA and TAHSIN, 2009].

Results and discussion

The rational organization of production processes requires achieving maximum economic results with minimum production costs [POPOVA and TAHSIN, 2009].

The amount of the expenditures can be a benchmark in choosing a concrete variant of growing a culture.

With the lowest production costs when growing forage pea for grain was the variant under natural soil fertility (47.96 €/da), followed by the variant with application of organic insecticide Pyrethrum (average 48.74 €/da), and with the highest costs was the combined treatment with Polyversum and NeemAzal (average 60.62 €/da) (Table 1).

In general, the costs of production for the variants with organic production of grain exceed by 10.4 % (on average) those under conventional cultivation.

According to Savov and collab. the main problem in organic farming is precisely the higher level of production costs compared with the conventional one [SAVOV *et al.*, 2011]. The authors point increment in production costs with 42 and 34 % respectively in organic production of wheat and corn. Gopinath and collab. also report higher costs under organic cultivation of pea with 172 US $/ha compared with an integrated management system [GOPINATH *et al.*, 2009].

Table 1.

Economic effect at different variants of forage pea production for grain

Variant	Stage of treatment	Total production €/da	Production Costs €/da	Net income €/da	Rentability %	Cost Price €/kg
organic production						
	b	100.57	47.96	52.20	108.80	0.17
Natural soil fertility (K_0)	b+f	100.16	47.96	52.61	109.60	0.17
	average	**100.37**	**47.96**	**52.40**	**109.20**	**0.17**
	b	108.23	51.67	56.56	109.50	0.17
Biofa	b+f	112.09	52.59	59.50	113.10	0.17
	average	**110.16**	**52.13**	**58.03**	**111.30**	**0.17**
	b	105.52	52.75	52.77	100.00	0.18
Polyversum	b+f	108.39	57.17	51.22	89.60	0.19
	average	**106.95**	**54.96**	**51.99**	**94.80**	**0.19**
	b	104.68	51.80	52.88	101.70	0.19
NeemAzal	b+f	108.54	55.64	52.91	95.10	0.19
	average	**106.61**	**53.72**	**52.89**	**98.40**	**0.19**
	b	106.55	48.48	58.08	119.80	0.17
Pyrethrum	b+f	110.29	49.00	61.29	125.10	0.16
	average	**108.42**	**48.74**	**59.68**	**122.45**	**0.17**
	b	112.41	52.72	59.69	113.20	0.17
Biofa+NeemAzal	b+f	117.41	57.48	59.93	104.30	0.18
	average	**114.91**	**55.10**	**59.81**	**108.75**	**0.18**
	b	116.01	49.40	66.61	134.90	0.16
Biofa+Pyrethrum	b+f	121.60	50.83	70.77	139.20	0.15
	average	**118.80**	**50.11**	**68.69**	**137.05**	**0.16**
	b	113.36	56.40	56.95	100.90	0.18
Polyversum+NeemAzal	b+f	119.42	64.84	54.57	84.20	0.20
	average	**116.39**	**60.62**	**55.76**	**92.55**	**0.19**
	b	116.07	53.08	62.99	118.80	0.17
Polyversum+Pyrethrum	b+f	122.52	58.21	64.31	110.50	0.17
	average	**119.29**	**55.64**	**63.65**	**114.65**	**0.17**
conventional production						
	b	111.04	50.94	60.10	118.00	0.17
Flordimex	b+f	116.93	51.12	65.81	128.70	0.16
	average	**113.98**	**51.03**	**62.96**	**123.35**	**0.16**
	b	111.57	50.11	61.45	122.60	0.16
Nurelle D	b+f	117.09	52.26	64.83	124.10	0.16
	average	**114.33**	**51.19**	**63.14**	**123.35**	**0.16**
	b	118.10	50.30	67.80	134.80	0.16
Flordimex+Nurelle D (K_1)	b+f	128.58	52.43	76.15	145.20	0.15
	average	**123.34**	**51.36**	**71.97**	**140.00**	**0.16**

Legend: b–budding, b+f–budding and flowering

The amount of production costs and the level of average yields determine the cost price. These two factors to greatest extent define the possibilities for lowering the price cost [BORISOV and DINCHEVA, 2014].

Because of the high grain yields which were delivered after using Biofa + Pyrethrum and lower prices of these products, this variant had the lowest price cost (an average 0.15 € / kg) which was equal to the price cost in conventional production.

Utilization of the possibilities for reducing the price cost of production is a base for obtaining a higher net income.

According to the values of this indicator between the variants of organic production first place took the combined use of Biofa and Pyrethrum, respectively with 68.69 € / da on average.

High net income was realized also in variants Polyversum + Pyrethrum and Biofa + NeemAzal.

Through net income is obtained an idea for achieved effect by choosing a variant of growing, but the measurement of economic effectiveness requires a comparison of the effect of the inputs made to achieve it.

This defines profitability as a resumptive indicator in the economic assessment of different variants [BORISOV and DINCHEVA, 2014].

The profitability of organic production of grain had a maximum at combined treatment with Biofa and Pyrethrum (137.05 %), followed by the variant with alone application of bioinsecticide Pyrethrum (122.45 %).

The high profitability is determined by the high value of net income realized in these variants, result of comparatively lower production costs.

Economic indicators in organic production of hay generally followed the trends in grain production (Table 2), but with significantly lower values: average level of production costs of 37.04 € / da, net income–18.63 € / da and profitability–51.67 %.

Table 2.

Economic effect at different variants of forage pea production for hay

Variant	Stage of treatment	Total Production €/da	Production Costs €/da	Net Income €/da	Rentability %	Cost Price €/kg
organic production						
	b	48.66	31.73	16.93	53.30	0.07
Natural soil fertility (K_0)	b+f	49.41	31.73	17.68	55.70	0.07
	average	**49.04**	**31.73**	**17.30**	**54.50**	**0.07**
	b	53.27	32.93	20.34	61.80	0.06
Biofa	b+f	55.23	33.92	21.31	62.80	0.06
	average	**54.25**	**33.42**	**20.83**	**62.30**	**0.06**
	b	51.36	36.48	14.87	40.80	0.07
Polyversum	b+f	53.86	41.22	12.65	30.70	0.08
	average	**52.61**	**38.85**	**13.76**	**35.75**	**0.07**
	b	51.58	35.77	15.81	44.20	0.07
NeemAzal	b+f	53.08	39.67	13.42	33.80	0.08
	average	**52.33**	**37.72**	**14.61**	**39.00**	**0.07**
	b	52.13	32.47	19.66	60.60	0.06
Pyrethrum	b+f	54.71	33.07	21.64	65.40	0.06
	average	**53.42**	**32.77**	**20.65**	**63.00**	**0.06**
	b	55.82	36.85	18.97	51.50	0.07
Biofa+NeemAzal	b+f	58.33	41.82	16.52	39.50	0.07
	average	**57.08**	**39.33**	**17.74**	**45.50**	**0.07**
	b	59.37	33.77	25.59	75.80	0.06
Biofa+Pyrethrum	b+f	63.89	34.96	28.94	82.80	0.06
	average	**61.63**	**34.37**	**27.26**	**79.30**	**0.06**
	b	57.62	40.69	16.93	41.60	0.07
Polyversum+NeemAzal	b+f	61.74	49.38	12.36	25.00	0.08
	average	**59.68**	**45.03**	**14.65**	**33.30**	**0.08**
	b	59.04	37.43	21.61	57.70	0.07
Polyversum+Pyrethrum	b+f	62.96	42.79	20.17	47.10	0.07
	average	**61.00**	**40.11**	**20.89**	**52.40**	**0.07**
conventional production						
	b	54.68	32.23	22.45	69.7	0.06
Flordimex	b+f	57.66	32.61	25.05	76.8	0.06
	average	**56.17**	**32.42**	**23.75**	**73.25**	**0.06**
	b	53.74	34.16	19.58	57.3	0.07
Nurelle D	b+f	57.32	36.56	20.77	56.8	0.07
	average	**55.53**	**35.36**	**20.17**	**57.05**	**0.07**
	b	60.33	34.74	25.60	73.7	0.06
Flordimex+Nurelle D (K_1)	b+f	65.92	37.40	28.53	76.3	0.06
	average	**63.13**	**36.07**	**27.06**	**75.00**	**0.06**

Legend: b – budding, b+f – budding and flowering

The highest economic effect was achieved again under application of Biofa + Pyrethrum where production costs are relatively low (37.34 € / da), and net

income and profitability were the highest (27.62 € / da and 79.30 %).

The results in regard to the indicated combination showed that it was economically expedient and profitable to implement in practice.

More than that, the economic effect was higher than the one of treatment with the combination Flordimex and Nurelle D (K_1), used in conventional technology of growing.

Pandey and collab. also reported for a variant of biologically grown pea where the application of composted manure provides a greater economic effect than using inorganic fertilizers [PANDEY *et al.*, 2006].

Overall, the profitability of different variants of pea organic production for grain and hay was with average values of 109.91 % and 51.67 %, as values for the conventional production were 128.905 and 68.43 %, respectively.

These findings confirmed studies of other authors [ŽIVELĚLOVÁ *et al.*, 2003; RUSSO and TAYLOR, 2006, BUTNARIU et al., 2014] where a greater economic efficiency was reported for conventionally produced crops than for organic crops.

Anonymous (2016) pointed out profitability of 68.2 % for organic production of pea, 62.7 % for rye, 52.9 % for barley, 48.2 % for soybeans and 40.0 % for oats.

The lower levels of net income and profitability in organic production were offset by the higher prices of organic products [RUSSO and TAYLOR, 2006; KULSHRESHTHA and KLEMMER, 2011], which for organic pea were within 15–30 % [GOPINATH *et al.*, 2009].

The values of economic indicators depending on the phenological stages of application for the different organic products and combinations were not unidirectional.

The treatment at budding and flowering (twice) was an economically more effective activity only for the products Biofa, Pyrethrum and their combining. In Polyversum and NeemAzal as well as in their combinations (Biofa + NeemAzal, Polyversum + NeemAzal, Polyversum + Pyrethrum) the twice treatment had a lower net income and profitability compared to a single treatment since the implemented additional costs did not generate high enough volume of production per unit area, respectively income and profitability.

The economic evaluation as regards the way of application (alone or combined) of organic products showed that the most effective under alone use was the Pyrethrum treatment (with a rate of profitability 122.45 and 63.00 %, respectively for production of grain and hay), while at the combined use–Biofa + Pyrethrum (with a rate of profitability of 137.05 and 79.30 % respectively).

The results from multiple comparative analysis (each variant compared to variant K_0) [BORISOV and DINCHEVA, 2014] showed interesting trends in regard to economic indicators (Figure 1).

High levels of fluctuation of the studied indicators in comparison with those under natural soil fertility (K_0) were achieved with the combination Biofa+Pyrethrum.

In this variant of pea cultivation for hay, the expenses increased by 8.29 % compared to variant K_0, the price cost decreased by 14.3 %, and the net income and profitability increased by 57.58 and 45.50 %.

The achieved economic effect was greater than that of the variant with conventional production K_1 (Nurelle D + Flordimex).

A similar dependence was observed in grain production: the economic impact of the application of Biofa + Pyrethrum was close but slightly lower than in conventional combination K_1.

It should be noted that in some variants of organic production (Polyversum, NeemAzal and their combinations) the economic effect was lower than that under natural soil fertility (without using products).

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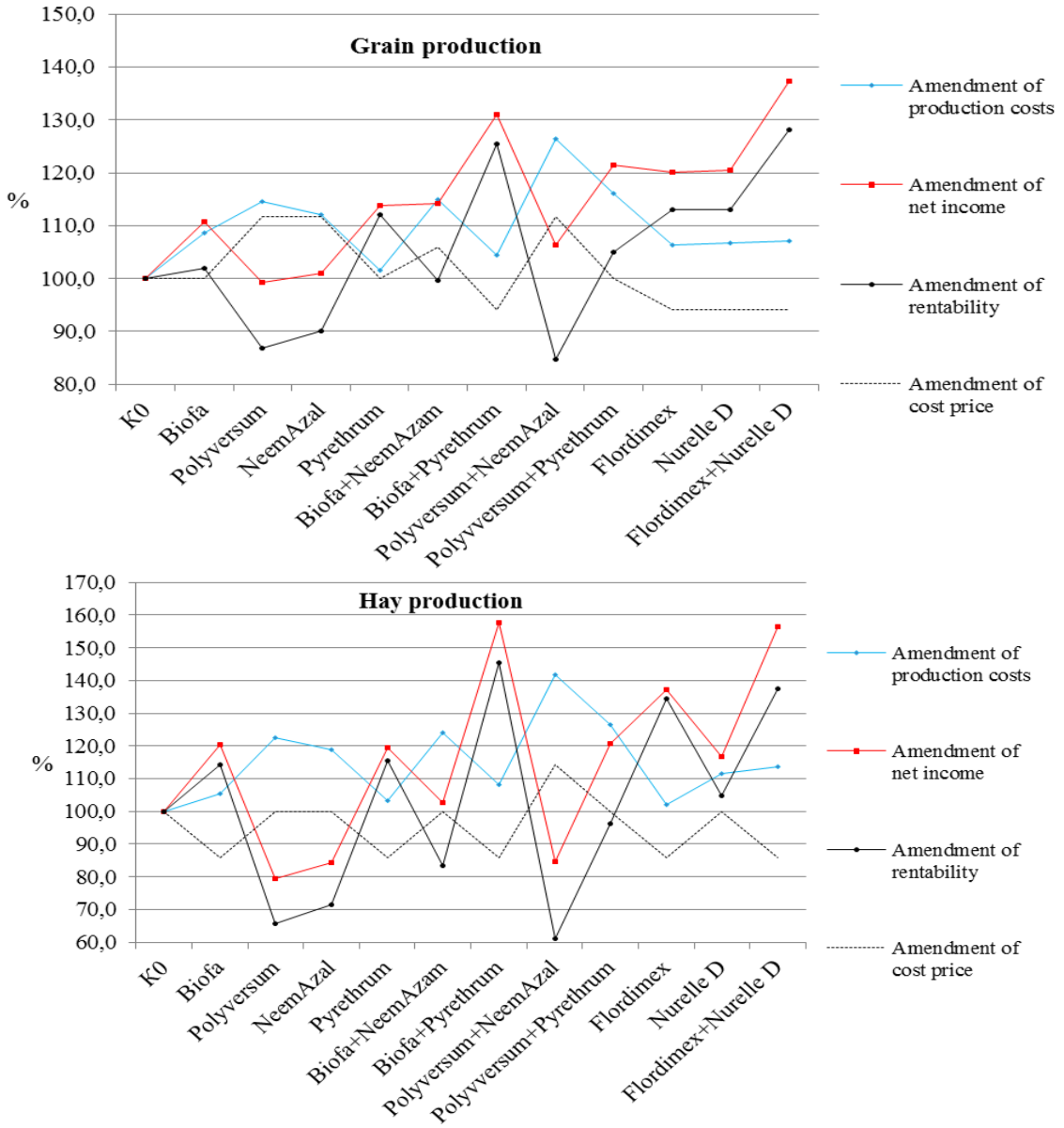
Banat's Journal of Biotechnology
2016, VII(14)



Benchmark is variant without use of organic products (variant K0 = 100%)

Figure 1. Amendment of economic indicators in forage pea production

This is due to considerably higher prices of organic products Poliversum NeemAzal compared to the prices of the other products, which increases production costs and consequently leads to the formation of lower net income and profitability.

Of course, the results of such studies are objective only in the conditions of the experiment, since the economic efficiency of production is influenced by a number of other factors (which here are not taken into account): production scale, which largely determines the level of production costs; natural soil fertility, specific climatic conditions; organization of production which also determines the production cost and *etc*. [BORISOV and DINCHEVA, 2014].

Conclusions

In conclusion of the conducted evaluation, all variants of organic production of forage pea are cost–effective and enable the realization of good economic results.

With the highest economic effect is the application of organic fertilizer Biofa in combination with bioinsecticide Polyversum.

In the production of hay, this combination provides profitability of 79.30 %, exceeding the profitability of the standard variant in conventional production (75.00 %); the profitability in grain production (137.05 %) is somewhat lower than that of the conventional variant (140.00 %).

Overall, the profitability in different variants of pea organic production for grain and hay is with average values of 109.91 % and 51.67 %, as values for the conventional production are 128.905 and 68.43 %, respectively.

Although the result of the economic evaluation is chosen a certain optimal variant of pea organic production, open to future studies remain questions concerning the effectiveness of various organic products in different forms of production organization.

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