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Influence of organic fertilization on the economic efficiency of field lettuce production

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Abstract: In our country lettuce is widely cultivated as a field and greenhouse crop. A significant part of the production during the autumn-winter and winter-spring period takes place in unheated polyethylene greenhouses. An important factor in the choice of variety is, on the one hand, the quality indicators in line with market requirements, which have been the subject of a number of studies at home and abroad, and, on the other, the possibility of achieving high profitability of production. The aim of the study is to evaluate the economic effects of the application of organic fertilizers in the production of field lettuce. The comparative economic evaluation of different fertilizer options is carried out using the ranking method. The most attractive fertilizers for practice are Italpolina and Lumbicompost.

Keywords: lettuce varieties; organic fertilization; economic efficiency; economic evaluation

INTRODUCTION

Lactuca sativa is an annual plant from *the Asteraceae family.* It includes three varieties – *Lactuca – sativa var. romana Lam.* – lettuce; *Lactuca – sativa var. capitata L.* – head lettuce and *Lactuca – sativa var. secalina Aleph.* – leafy salad. In our country, lettuce is widely grown as a field and greenhouse crop. The changed agro-climatic conditions require the use of suitable varieties and fertilization schemes. When growing and outdoors, it is important to choose a variety of lettuce, on the one hand, the quality indicators are consistent with market requirements, which are the subject of a number of studies at home and abroad (Aleksiev, 1982), (Barov, 1982), (Neikov, 1989), (Neykov, 1997), (Neykov and Todorova, 1997), (Cools and Stratsma, 1996), (Koopman, Jong, De Vriues, 1993), (Maaswinkel and De Visser, 1986), (Stoyanova and Neykov, 2001) and (Straatska and Jansen, 1996), and on the other hand, the possibility to achieve high profitability of production, while protecting the health of the user and the environment (Alieva, 2022). In recent years, organic fertilization has improved its economic indicators and even the economic effect of its application has surpassed that of conventional fertilization (Alieva and Garabedian, 2022). Organic fertilizers are increasingly gaining popularity among the farming community, as the main factors for this phenomenon are: ecological subsidies aimed at limiting the pressure on the environment that farmers exert (Alieve, 2022); market demands – consumers are becoming more and more demanding of the vegetables offered on the market and last but not least the aggressive marketing

of fertilizer distributors for vegetable production (Kolaj, Borisov, Arabska and Radev, 2023).

The aim of our study is to perform an economic evaluation of the effects of the application of organic fertilization in the production of field lettuce and to make recommendations to farmers to optimize costs when organizing fertilization.

MATERIAL AND METHODS

Setting up the experience and research material

The experimental work was carried out in the period 2019 – 2020 in the experimental field of AU – Plovdiv on alluvial-meadow soil (Mollic fluvisol, FAO, 2006). Three types of lettuce were used for cultivation with spring planting in March – Leaf lettuce-type Batavia variety "Maritima" (variety A), Leaf lettuce-type Lolo Rosa variety "Tuska" (variety B), Head lettuce variety "Winter Butterhead" (variety C).

Seedling production. For the purposes of the experiment, organic seeds of the three varietal types of the above-mentioned varieties were purchased. A total of 3,000 plants (1,000 plants of each cultivar type) were grown using container technology using 150-hole Styrofoam sheets. An organic seedling mixture was used – 80% Perlite:20% Lumbricompost, developed by us for bioproduction of seedlings (Kostadinov and Filipov, 2013).

Planting. The plants were planted in the 4 – 5 leaf phase in March in the experimental field of AU – Plovdiv in a 4 row strip according to the scheme 70 + 30 + 30 + 30/30 cm with a profile of the soil surface high level bed with parameters 100 + 60 cm. The experiment was based on the block method in four replications with 28 plants per replication and the size of the experimental plot 3.36 m^2 (Barov, 1982). Internal guards are 8 pcs./repetition. The front and rear guards have 12 pcs. each plants. The reporting parcels include 20 units each plants in repetition. The experiment was started with 6 options with a total area of 450 m^2, of which 375 m^2 with organic fertilization. Watering was carried out with a drip system.

The following options were explored:

1. Control – unfertilized
2. Control – MT (mineral fertilization – NPK)
3. Italpolina
4. Arcobaleno
5. Lumbricompost
6. Eco prop NX

The area after being plowed and milled is shaped into a high flat bed. According to a previously developed scheme, two organic fertilizers applied in practice in organic vegetable production (Italpolina and Lumbrikompost) and two less known but promising organic fertilizers – Arkobaleno and Eco prop NX were imported.

The granular fertilizers were introduced as the main fertilization with the pre-planting soil treatment in the following rates: N – 12.5 kg/da, P_2O_5 – 1.25 kg/da, + K_2O – 4.75 kg/da, Italpolina – 25 kg, Arkobaleno – 100 kg/da, and Lumbricompost – 400 l/da. Eco prop NX is applied by two treatments at a dose of 100g/da – the first in the seedling phase, the second after planting and trapping the plants.

Harvesting performed in phenophase consumptive maturity in May. The total yield was reported by replicates.

The performed economic evaluation of the effects of the application of the different fertilization options is based on the economic efficiency of the cultivated crop.

Economic efficiency was determined using the indicators: total yield (kg/da), production costs (BGN/da), net income (BGN/da), profitability based on production costs (%). The total yield of the different varieties of lettuce was established based on data derived from field experience. The production costs were determined on the basis of detailed organizational and technological maps developed for each variety, valued according to standards and prices of labor, materials and production as of 2020 (Zhivondov, Manolova, 2004); (Ivanova, Tahsin, 2005). Thus, the influence of other factors is eliminated, and only the type of fertilizer affects the level of efficiency, through the different level of total yields obtained.

The economic assessment of the effects of the application of the different fertilization options is determined on the basis of average values of the indicated indicators (average results achieved from the cultivation of all three varieties of lettuce). The dynamics of the indicators for analysis and assessment of the economic effect was determined by applying the method of the single base index, using the control, that is, the variant without fertilization, as a base.

Each fertilization option is ranked in descending order according to the value of performance indicators. In this way, it is determined which organic fertilizers have the greatest importance for practice (Borisov and Kostadinov, 2007).

RESULTS AND DISCUSSION

As a result of the analysis of the collected data, the main economic indicators were determined, which are presented in the following Figure 1. According to the total production indicator, it can be seen that when fertilizing with different organic fertilizers, the same effect is achieved in terms of the total production, which is generates from a unit of area (this indicator is 6 550 BGN/da). The main factor for this uniform effect is the total yield, which is the same for all variants of fertilization with organic fertilizers. The production costs for the different fertilizing options show that the highest costs are the application of the preparation Arkobaleno, respectively 1361.30 BGN/da, followed by the option with the application of the Lumbicompost preparation, with production costs reaching 1 329.30 BGN/da.

The net income is the next indicator, through which a comparative economic assessment of the application of the different options of fertilizing with organic fertilizers is made. According to the indicator, the highest profitability is achieved with the use of the preparation Eco prop, with this version of fertilization, the net income reaches a value of 5 282.6 BGN/da. The next relatively more profitable fertilizing option is the one in which it is fertilized with Lumbicompost, correspondingly the value of the net income is 5 220.70 BGN/da. The net income evaluates the effect of the investment made in absolute terms, the comparative evaluation of the different fertilization options according to the profitability indicator based on the production costs is of interest. Through this indicator, it is easy to compare the different options of fertilizing with organic fertilizers, at different levels of technical treatment of the crop and applied production technology. According to the results obtained from the conducted experience, the variant in which it is applied is determined with the greatest cost effectiveness is Italpolina. The reason is that the maximum effect of the application of this fertilizer lies in the fact that with the use of Italpolina, the costs are lower and thus profitability is allowed to increase, other conditions being equal.

The following Figure 2 provides information on the dynamics of production costs, expressed using the no-fertilization option as a baseline. The graph clearly shows that production costs are highest when using the Akrobaleno, respectively, in this variant, production costs increase by 10.4% compared to the control. With the application of the Eco prop, the costs increase most insignificantly, namely only by 2.85% compared to the control.

The following figure 3 shows the dynamics of the net income in the researched fertilization options. With this indicator, it can be seen that when using the Italpolina, the relatively highest net income is achieved. When using this fertilizer, the net income increased by 159.33% compared to the control.

The dynamics of profitability on the basis of production costs is shown in the following Figure 4. In this graphical analysis of the data, it is clearly seen that profitability is maximized in the version of fertilization in which the preparation Italpolina is used, respectively, the indicator has a value of 423.3%, immediately after it is the fertilization option, where Eco prop is used – 418.3% profitability of production costs.

The summary evaluation of the economic efficiency of the application of the different fertilization options in the derived experience is placed on the following Table 1. This evaluation was

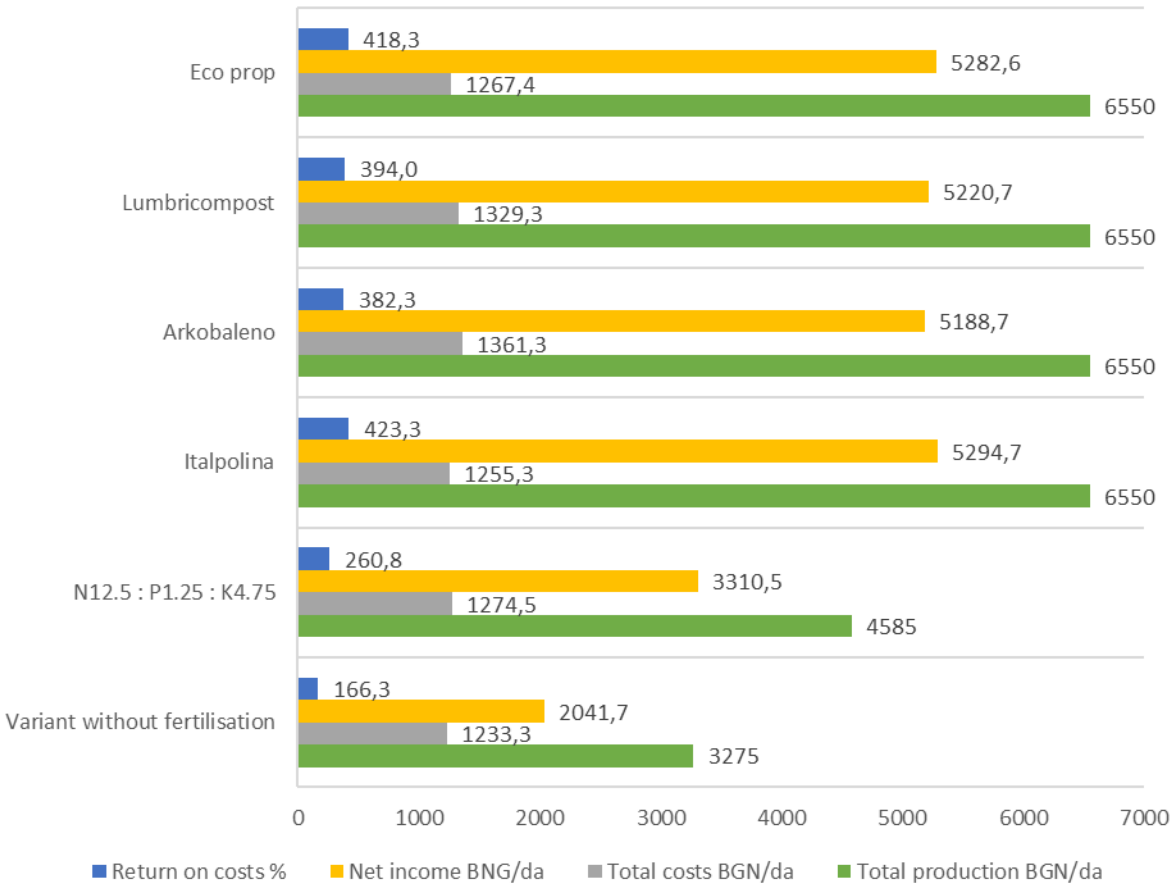

Fig. 1. Value of economic indicators for analysis and evaluation of the effects of different fertilization warrants

Source: Data from the experience conducted in AU – Plovdiv for the period 2019 – 2020.

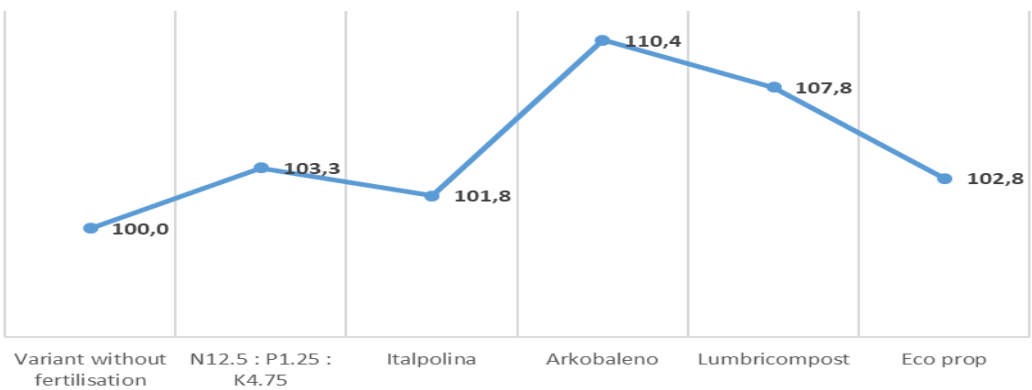

Fig. 2. Dynamics of production costs for different fertilization options

Source: Data from the experience conducted in AU – Plovdiv for the period 2019 – 2020.

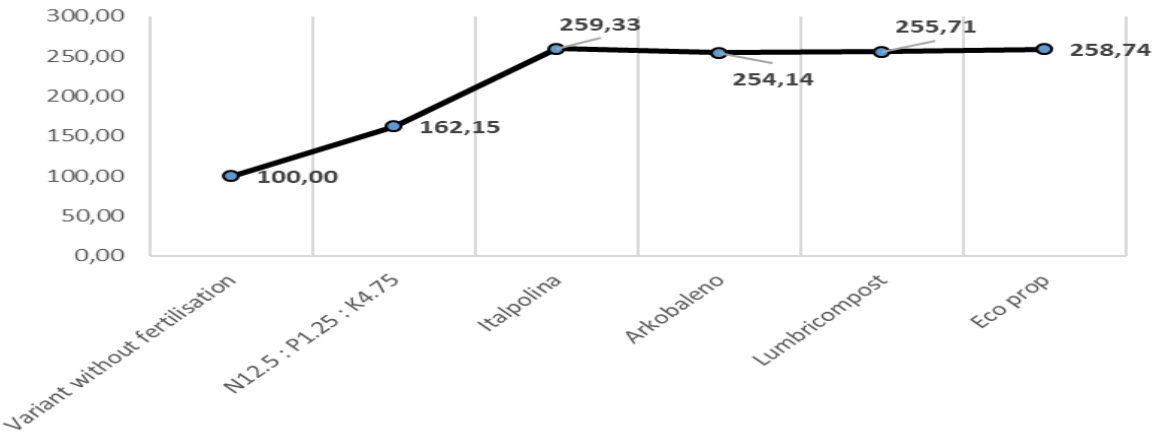

Fig. 3. Dynamics of net income for different fertilization options

Source: Data from the experience conducted in AU – Plovdiv for the period 2019 – 2020.

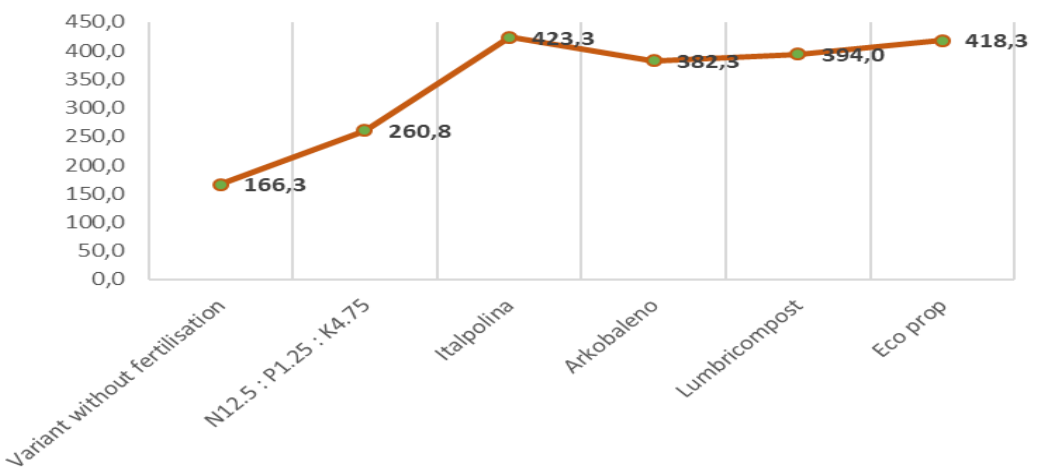

Fig. 4. Cost-effectiveness dynamics for different fertilization options

Source: Data from the experience conducted in AU – Plovdiv for the period 2019 – 2020.

Table 1. Ranking of fertilization options according to the main indicators used in the evaluation of the economic efficiency of organic fertilizers

Variants:	**Ranking according to "Total costs"**	**Ranking according to "Net income"**	**Ranking according to "Return on costs"**	**Final ranking**
Variant without fertilization	1	6	6	4
N 12.5:P 1.25:K 4.75	4	5	5	5
Italpolina	2	1	1	1
Arcobaleno	5	4	4	4
Lumbricompost	3	3	3	2
Eco prop	6	2	2	3

Source: Own.

carried out using the method of ranking the options according to the value of the main economic indicators used in the analysis. According to the obtained results, the option of fertilizing with Italpolina stands out with the highest economic efficiency. When using this fertilizer for plant nutrition, the highest net income and normal profitability is achieved. The second economically advantageous option is the use of Lumbricopost. Immediately after it is the fertilizer – Eco prop.

The level of net income and profitability is most strongly influenced by the factors – the level of production costs and the market prices of the used preparations for organic fertilizing. The use of the preparation Italpolina makes it possible to achieve the maximum effect in terms of yield and profitability from the applied fertilization system in the farm, by means of a slight increase in the cost of production.

CONCLUSION

The results of the experience and their economic evaluation determine all preparations for organic fertilization as an attractive form of fertilization in the farm. It should be noted that these results were obtained in an experimental farm. Here, the influence of the crop rotation system, the amount of production (the possibility of realizing economies of scale), the way of organization of production and the influence of soil and climatic conditions on the productivity of the crop in the long term are not taken into account. However, the research carried out within the limitations set, determines organic fertilization as a cost-effective system. All studied preparations achieve high profitability when they are used.

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