Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 20, Issue 2, 2020
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ECONOMIC RESULTS FROM THE APPLICATION OF FOLIAR TREATMENTS FOLUR, AMALGEROL AND LITHOVIT ON RICE PRODUCTION

Tonya GEORGIEVA, Vanya TOROMANOVA, Vasko KOPRIVLENSKI, Maya DIMITROVA, Plamen ZOROVSKI

Agricultural University, Plovdiv, Bulgaria,
Emails: tonia@au-plovdiv.bg, vania_toromanova@abv.bg, koprivlenski@au-plovdiv.bg, mayadimitrova30@yahoo.com, plizv@abv.bg

Corresponding author: tonia@au-plovdiv.bg

Abstract

One of the economically significant issues that accompany rice production is the increase of productivity through foliar treatments. The aim of the study is to evaluate the economic results from the application of foliar treatment in the production of 6 cultivars of rice - Bulgarian and introduced ones. The level of cost of rice production for 96 commonly tested variants has been established, including for 72 variants to which Folur, Amalgerol and Lithovit leaf treatments were applied. Performance indicators, cost-effectiveness thresholds and the factors that determine them are analyzed. All variants of paddy rice production, using foliar treatments have been found to provide positive economic benefits. Sufficient profit per unit area and profitability in the range of 10 to 18.40% was realized. The critical yield of production for them is 40-55% of the actual production per unit area.

Key words**:** *productivity, economic results, foliar treatment, rice*

INTRODUCTION

One of the key prerequisites for obtaining high and durable rice yields is the achievement of a balanced nutrition, appropriate irrigation regime and plant protection while implementing the technology used for its cultivation [2, 3, 7, 9, 10, 12]. In this regard, one of the economically significant problems which accompanies rice production is the possibility of enhancing the productive capacity of the plant through foliar treatment, which could replace some of the high expenses involved in growing and producing this crucial food crop [5, 6, 8]. The selection of the most appropriate foliar preparations, according to the conditions and technology of cultivation, leads to stable yields and, consequently, to high economic efficiency of produce [1, 4, 5].

Apart from high yields of supreme quality, the choice of rice cultivation technology should also take into account the level of production costs [3, 4]. Currently, one of the major problems in the production of this crop is the low yields during less favourable, in terms of climate, years and also labor productivity against the background of rising costs which are clearly technological by nature. They affect, on the one hand, the impact of factors such as irrigation, fertilization, weed control, mechanization, etc., and on the other, the economy and the management of the production processes.

The purpose of this research is to provide a summary assessment of the economic results of the application of the foliar treatment preparations Folur, Amalgerol and Lithovit and to establish their relationship with the yield in all experimental variants.

The accomplishment of the so-defined target will pass through the following four interrelated **tasks**:

1.Building of a set of economic tools for developing and evaluating the technological and economic calculations.

2.Accurate accounting of the production costs by constituents and by technological units.

3.Division of costs into fixed and variable ones on the basis of carefully selected evaluation criteria.

4.Determination of the critical level of average yield and cost-effectiveness of the rice production.

MATERIALS AND METHODS

Methodical lay-out of the experiment

During the period 2013-2015, in the land area of the town of Saedinenie, in a permanent rice cell was carried a two-factor field experiment on the method of fractional plots in four repetitions. The large plots accommodate the grades of factor A (variants) and the small ones - the grades of factor B (foliar preparations). When combining the two factors, 24 variations are derived. Each variant has a total area of 14.85 m^2 and a harvest area of 10 m^2. The agrotechnical activities have been carried out in accordance with the conventional technologies for rice cultivation.

Methodological and methodical issues and peculiarities in determining the amount of production costs for the cultivation of rice (paddy).

In the present study, ***the technological map*** was adopted as the fundamental, primary document in which the whole technology of the crop cultivation was developed and recorded, from the preparation of the areas for its sowing through the care during the growing season to the harvesting of the finished products. It reflects the main normative factors which influence the amount of production costs. The technological map sets out all those production and economic parameters which reflect the maximum manifestation of the biological potential of the rice crop and the potential opportunities of the technology applied for its cultivation [2, 3].

The economic part of the technological map reflects the physical and the value volume of all the necessary material and labor expenses for the cultivation and harvesting of rice. In essence, these are the direct variable costs which depend on production volume and can be managed and "dosed".

The expenses for raw and other materials (seeds, fertilizers, preparations, irrigation water, fuels and lubricants, electricity, etc.) are calculated on the basis of their amount and unit cost, on average for the period 2013-2019. The raw and other materials from own production, which are involved in the domestic turnover, are valued on the principle of *alternative costs*, ie. at the current market prices for them.

Labor costs are established on the basis of the required number of norms and normshifts, for the implementation of the agro-technical activities and the tariff rate for the respective type of work. In the case of the mechanized works, the relevant vocational class-qualification of the sub-contractor, mechanic, was also taken into account.

The expenses of the mechanized activities (plowing, cultivating, harrowing, transporting, fertilizing, spraying, harvesting, etc.) incurred by rented machines, are calculated in the total cost of the value of the service actually paid. In the present study, in view of the current economic conditions, a new manner of reflecting machinery and transport works is adopted - as services.

Costs of manual labor, surcharges, mechanical, tractor and transportation costs are calculated on the basis of the estimates for them valid for the Agricultural University - Plovdiv and are equal to the actual labor remuneration.

The methodological notes outlined above concern the direct production costs which are fundamental to the production of rice.

The full cost per unit area is obtained by adding other additional costs, such as: insurance, interest on loans, security, management, unforeseen costs, land rent, taxes, fees, property maintenance costs, to the direct production costs.

In practice, the insurance per decare generally widely varies. This research uses averaged rice insurance of 3.40 BGN/da.

Interest, management and contingency costs are calculated as a percentage of the direct production costs, at 8%, 7% and 2%, respectively.

The finished production - rice (paddy), is valued at the average market price for the period 2013-2019.

Separation of costs into fixed and variable

The plan for the estimation of the production costs and their differentiation into Fixed (FC) and Variable (VC) includes the following more important **criteria**: management options, relation to changes in the production volume, relation to the ownership of the basic assets, duration of use, timing of performance, behavior in unit production, correlation possibilities.

Methodological toolkit for establishing the critical yield levels and the economic performance thresholds of efficiency within the variants of the experiment

The determination of the critical yield levels and the efficiency thresholds for rice production is made using a system of indicators [2, 3] as follows: Value of production costs - total, BGN/da; Value of fixed costs - total, BGN/da; Variable costs value - total, BGN/da; Average yield - by technology, kg/da; Cost of marketing, BGN/kg; Variable costs per unit of output, BGN/kg; Critical average yield level, kg/da; Value of total production, BGN/da; Net income of 1 da, BGN/da; Cost of production, BGN/kg; Rate of profitability, %.

The total production is valued at the market prices of the paddy rice for the period 2013 – 2019.

In the system of indicators for the economic efficiency of rice production, the Rate of profitability based on production costs is adopted as the main summary indicator. We believe that when measuring the effectiveness of a particular crop, such as rice, this indicator is sufficiently accurate and reliable.

The other indicators such as average yield, total production, cost and net income per unit area, are used as additional analytical indicators for measuring and 249nalysing the efficiency of rice production.

The efficiency thresholds, expressed by the critical level of average yield, for the individual variants, are calculated as the ratio of the total fixed cost per unit area to the difference between the average selling price and the variable production unit cost by the formula:

$$Q_{BEP} = \frac{FC}{p - VC_1},$$

where:

Q_{BEP} – critical level of average yield;

FC – total fixed cost;

p – average cost of marketing

VC_1 – variable cost per unit of output.

The critical level of average yield (BEP-break-even-point) determines at what volume of yield the rice production ends without profit and without loss (i.e. at "zero"), after which each kilogram of production, above the critical yield, begins to make a profit.

RESULTS AND DISCUSSIONS

The productive capacity of the rice is largely determined by the meteorological conditions of the year, with the flowering period being of particular importance to the crop. The lack of rainfall during this period, which is August (2013), creates favourable conditions for achieving good yields that same year. Subsequent years are defined as unfavourable and this accordingly reflects on the average yields obtained during the experiment period.

Table 1. Effect of the year, cultivars and foliar treatment on paddy yield, kg/ da

Factor (A) Year	Analysis of variance of the effect of the factor on the paddy yield		
	kg/da	**Evidence**	**%**
2013	1,112.6	A	100
2014	819	B	73.6
2015	750	C	67.4

Factor (B) Cultivars	Analysis of variance of the effect of the factor on the paddy yield		
	kg/da	**Evidence**	**%**
Osmanchik97	879.2	a	100
Gala	878.9	a	99.9
Linche	862.1	a	98.1
Kameo	954.5	a	108.6
Puma	839.5	a	95.5
Brio	949.1	a	108

Factor © Preparation	Analysis of variance of the effect of the factor on the paddy yield		
	kg/da	**Evidence**	**%**
Control	846	b	100
Folur	887	ab	101.3
Amalgerol	942	a	111.3
Lithovit	898.9	ab	102.5

Source: [11].

There were no proven differences in yield between the variants tested. In the three years of the study, they achieved productivity between 839.5 kg/ da of the Puma and 949 kg of the Brio one (Table 1).

However, proven differences were noted in the treatment with different preparations.

The main results of the economic evaluation of the foliar treatments tested for the cultivation of rice (paddy) are summarized in Tables 2, 3 and 4.

Table 2. Operating production costs for the cultivation of Rice (paddy) according to variants, in BGN/da

Types of expenses	**Controls**	**Variant 1 Folur**	**Variant 2 Amalgerol**	**Variant 3 Lithovit**
Labor costs - total	**12.51**	**12.51**	**12.51**	**12.51**
Incl. 1. Permanently employed	11.45	11.45	11.45	11.45
2. Temporarily hired	0.55	0.55	0.55	0.55
Material costs - total	**331.99**	**353.39**	**345.39**	**341.89**
Incl. 1. Seeds	37.05	37.05	37.05	37.05
2. Fertilizers	37.05	37.05	37.05	37.05
3. Plant protection products	34.71	34.71	34.71	34.71
4. Leaf treatment preparations	-	21.4	13.20	9.9
- Folur 2 liters/ da	-	21.4	-	-
- Amalgerol 1.2 l/ da	-	-	13.2	-
- Lithovit 0.300 kg/ da	-	-	-	9,90
5. Water	62.50	62.50	62.50	62.50
6. Mechanized services	126.01	126.01	126.01	126.01
- basic urea fertilization	4.27	4.27	4.27	4.27
- plowing	18.51	18.51	18.51	18.51
- discing	7.19	7.19	7.19	7.19
- current leveling	4.61	4.61	4.61	4.61
- pre-sowing fertilization with carbamide	4.27	4.27	4.27	4.27
- chiseling with harrowing	7.40	7.40	7.40	7.40
- transportation of seeds	0.10	0.10	0.10	0.10
- sowing	6.95	6.95	6.95	6.95
- spraying with herbicides	2.24	2.24	2.24	2.24
- water transportation and solution	2.51	2.51	2.51	2.51
- nourishment	4.64	4.64	4.64	4.64
- corrective spraying with herbicides	4.64	4.64	4.64	4.64
- dehulling sector 20%	23.11	23.11	23.11	23.11
- harvest with a combine harvester	27.76	27.76	27.76	27.76
- loading a vehicle with a crane loader	0.38	0.38	0.38	0.38
- transportation of arpa	1.31	1.31	1.31	1.31
- transportation to a purchase center	1.48	1.48	1.48	1.48
- drying in a grain dryer	4.64	4.64	4.64	4.64
Costs Total	**344.50**	**365.90**	**357.90**	**354.40**

Source: The economic indicators are calculated on the basis of current market prices for Bulgaria on average for the period 2013-2019.

The size and structure of production costs by items vary within a relatively narrow range for all variants of the experiment (Table 2). A minor exception are the Controls and Variant 3, which differ from the others in terms of both total production costs and cost per item. At the Controls foliar treatments are not applied, and in Variant 3, the cost of the Lithovit and the amount of its application are the lowest. This is what influences the amount of material costs as well as the value of the direct production costs. The data in Table 2 show that the amount of these costs is, respectively, by 4 to 7% lower than that of Variants 1 and 2.

The main factors which influence the amount of the costs are: the chosen technological option and the volume of the finished production. The larger the latter, the greater the machinery and transport costs associated with the harvest. The technological and economic calculations made in Table 2 reveal that the highest production cost is accounted in the variants in which the Folur and Amalgerol preparations are used. They have total material costs of 353.39 BGN/da and 345.39 BGN/da, respectively, and the value of the total maintenance amounts to 365.90 BGN/da and 357.90 BGN/da respectively.

Table 3. Amount and structure of fixed and variable costs of Rice cultivation (paddy) in BGN/da

Types of expenses	**Controls**	**Variant 1 Folur**	**Variant 2 Amalgerol**	**Variant 3 Lithovit**
Fixed costs – Total	**46.16**	**46.16**	**46.16**	**46.16**
1. Salaries of permanent employees	11.45	**12.51**	**12.51**	**12.51**
2. Land rent	34.71	11.45	11.45	11.45
Variable cost – Total	**298.34**	**319.74**	**311.74**	**308.24**
1. Temporarily hired	0.55	0.55	0.55	0.55
2. Seeds	37.05	37.05	37.05	37.05
3. Fertilizers	37.05	37.05	37.05	37.05
4. Plant protection products	34.71	34.71	34.71	34.71
5. Leaf treatment preparations	-	21.4	13.20	9.9
- Folur 2 liters/ da	-	21.4	-	-
- Amalgerol 1.2 l/ da	-	-	13.2	-
- Lithovit 0.300 kg/ da	-	-	-	9.9
6. Water	62.50	62.50	62.50	62.50
7. Other expenses	126.01	126.01	126.01	126.01
- basic fertilization with phosphorus	4.27	4.27	4.27	4.27
- plowing 23-25	18.51	18.51	18.51	18.51
- discing	7.19	7.19	7.19	7.19
- current leveling	4.61	4.61	4.61	4.61
- pre-sowing fertilization with carbamide	4.27	4.27	4.27	4.27
- chiseling with harrowing	7.40	7.40	7.40	7.40
- transportation of seeds	0.10	0.10	0.10	0.10
- sowing	6.95	6.95	6.95	6.95
- spraying with herbicides	2.24	2.24	2.24	2.24
- water transportation and solution	2.51	2.51	2.51	2.51
- nourishment	4.64	4.64	4.64	4.64
- corrective spraying with herbicides	4.64	4.64	4.64	4.64
- dehulling sector 20%	23.11	23.11	23.11	23.11
- harvest with a combine harvester	27.76	27.76	27.76	27.76
- loading a vehicle with a crane loader	0.38	0.38	0.38	0.38
- transportation of paddy yields	1.31	1.31	1.31	1.31
- transportation to a purchase center	1.48	1.48	1.48	1.48
- drying in a grain dryer	4.64	4.64	4.64	4.64
Costs Total	**344.50**	**365.90**	**357.90**	**354.40**

Source: The economic indicators are calculated on the basis of current market prices for Bulgaria on average for the period 2013-2019.

In Table 3, the production costs of rice cultivation are grouped into two other large groups - Fixed and Variable. The aim is that they can be used to calculate the key economic indicators and performance thresholds for the developed experiment. In this connection, the average rice yields by variants are also indicated. The structure of total production costs is dominated by the variable costs. In the individual variants, they range from 298.34 BGN/da at the Controls to 319.74 BGN/da at the use of the preparation Folur. The fixed costs amount to 46.16 BGN/da for all variants. This cost structure is typical of crops with a high degree of mechanization of production processes, such as rice. At the expenses thus incurred, the highest average yields are provided by the variants with the application of the foliar treatment preparations - Amalgerol - 941.83 kg/ da and Lithovit - 897.66 kg/da, followed by Folur - 893.50 kg/da. The lowest average yield is provided by the Controls variant - 842.83 kg/da, which does not use foliar treatment.

It is noteworthy that the largest increase in the total production costs - 6.21%, which is between the Controls and Variant 1 (with the application of Folur), caused almost the same increase in the average yield between them. For the other variants, this increase is more significant, and for the variant with the application of Amalgerol, it is almost two times greater. In other words, the rate of increase of additional production per unit area exceeds twice the rate of the investments made. This positive trend, though less so, is also noticeable in the other variations. In absolute value, their yields increased by 50-55 kg/ da compared to the control.

The amount of the production costs and the level of average yields are the main factors which influence the economic efficiency of rice production (paddy) in the different variants of the experiment hereby developed (Table 4).

Table 4. Economic parameters for determining the critical level of average yield and the efficiency of Rice production (paddy)

	Indicators	**Measure**	**Controls**	**Variant 1 Folur**	**Variant 2 Amalgerol**	**Variant 3 Lithovit**
1.	Production costs - total	BGN/da	344.5	365.9	357.9	354.4
2.	Fixed costs per 1 decare	BGN/da	46.16	46.16	46.16	46.16
3.	Variable cost per 1 decare	BGN/da	298.34	319.74	311.74	308.24
4.	Average yield by technology	kg/da	842.83	893.5	941.83	897.66
5.	Cost of marketing	BGN/kg	0.45	0.45	0.45	0.45
6.	Variable costs in unit of output	BGN/kg	0.35	0.36	0.33	0.34
7.	Critical level of average yield	kg/da	461.6	512.89	384.67	419.63
8.	Value of total output	BGN/da	379.27	402.08	423.82	403.95
9.	Net income per 1 decare	BGN/da	34.77	36.18	65.92	49.55
10.	Cost of production	BGN/kg	0,41	0.41	0.38	0.39
11.	Rate of profitability	%	10.09	9.89	18.4	13.98

Source: The economic indicators are calculated on the basis of current market prices for Bulgaria on average for the period 2013-2019.

The information in Table 4 show that, in accordance with the size of production costs and the level of average yield, the lowest cost efficiency is at Variant 1 followed by the Controls. The low level of yield at the Controls, and the relatively high cost of production, are the reason for the unsatisfactory value of the total production of BGN 379.27 BGN/decare. For Variant 1, the high impact on production costs reflected negatively on the efficiency, which increased the level of variable costs per unit of output and the cost of production. The latter is the highest at Variant 1 and at the Controls, which is why these variations show
the lowest levels of profit margin per unit area and a rate of return of 9.89% - 10.09%.

Although with relatively high production costs, Variant 3 provides a sufficient level of average yield (897.66 kg/da), so that the resulting production has a sufficiently low cost (0.39 BGN/kg), compared to the cost of marketing of the paddy (0.45 BGN/kg). This provides a profit margin of BGN 49.55 BGN/da, and the profitability rate of 13.98% is sufficient for its extended reproduction.

Variant 2 is distinguished with the highest economic efficiency, in which the cost of production is the lowest - 0.38 BGN/kg, the rate of profitability is 18.40%, and the net income per unit area is 65.92 BGN/da.

CONCLUSIONS

The results of the study give rise to the following important conclusions:

The use of foliar treatment preparations for rice production is only economically feasible when it leads to outstripping rate of revenue increment, resulting in a total revenue which is higher or, at least equal, to the variable costs.

All variants at which foliar treatment is applied provide positive economic results from the production of rice (paddy), a sufficient profit margin per unit area and a profitability of between 10 and 18.40%. The critical level of

yield for them is 40-55% of the actual production per unit area.

The efficiency thresholds indicated, in all variants using foliar treatments, ensure good competitiveness of the rice, sufficient profitability per unit area and a rate of return allowing for reinvestment in the production.

REFERENCES

[1]Angelova, S., 1999, Testing of introduced varieties of rice. Soil Science, Agrocemistry and Ecology, Vol. XXXIV, № 4-5, 158-162.

[2]Georgieva, T., Toromanova I., 2018, Formation of panicle basic elements with urkish and italian rice cultivars grown in Bulgaria, Agriculture & Forestry, Vol. 64 Issue 1: 97-104, 2018, Podgorica, 97-104.

[3]Koprivlenski, V., 1997, Problems of Grain Production and Optimization of Economic Factors for its Development, Economics and Management of Agriculture, N 7-8, 1997, pp. 27-29.

[4]Koprivlenski, V., 2011, Production Costs and Efficiency Thresholds in Plant Production, Academic Publishing House of Agrarian University, Plovdiv.

[5]Pan, S., Rasul, F., Li, W., Tian, H., Mo, Z., Duan, M., & Tang, X., 2013, Roles of plant growth regulators on yield, grain qualities and antioxidant enzyme activities in super hybrid rice (Oryza sativa L.). Rice, 6(1), 9.

[6]Richards, D., King, K., Ait-ali, T., & Harberd, N., 2001, How gibberellin regulates plant growth and development: a molecular genetic analysis of gibberellin signaling. Annual review of plant biology, 52(1), 67-88.

[7]Russo, S., Callegarin, A., 2007, Rice production and research potential in Italy. Cahiers Options Méditerranéennes, 24(2).

[8]Tamanna, S., Parvin, S., Kumar, S., Dutta, A. K., Ferdoushi, A., Siddiquee, M. A., ... & Howlader, M., 2013, Content of some minerals and their bioavailability in selected popular rice varieties from Bangladesh. Int J Curr Microbiol Appl Sci, *2*(7), 35-43.

[9]Todorov, M., Angelova, S., 1998, Rice protein quality and factors influencing its development. Plant Science, Sofia, 35, 830-833.

[10]Toromanova, I., Georgieva, T., 2015, Research on some grain quality characteristics of Turkish and Italian rice varieties grown in Bulgaria. Book of Proceedings, Sixth International Scientific Agricultural Symposium "Agrosym 2015", Jahorina, October 15-18, pp. 142-147.

[11]Toromanova, I., Georgieva, T., 2017, Impact of foliar fertilization on productivity of new introduced cultivars of paddy rice, AGROFOR International Journal, Vol. 2(2), 92-98.

[12]Tosheva, S., Kamishev, K., 2013, Biochemical and Phytopathological Characterization on Bulgarian and Introduction Rice Varieties. Plant Science, Sofia, 50, 94-96.