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Yield Capacity And Bioenergy Efficiency Of The Sunflower Cultivation Technology When Using Microelement Containing Preparations.

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ABSTRACT

The article deals with the yielding capacity data and bioenergy assessment of sunflower cultivation technologies depending on the application of various complex fertilizers containing microelements. It has been found that the application of preparations containing micro elements makes it possible to get rather a considerable rise of the harvest of sunflower seeds with rather small power consumption. The applied micro element fertilizers did not have an effect on the content of oil in sunflower seeds, however they considerably increased the oil yield from 1 hectare. The most energetically effective is the option with use of Mikromak preparation (energy coefficient – 3,80).

Keywords: yield capacity and quality of sunflower seeds, bio-energy evaluation, structure of technology-related energy consumption.

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INTRODUCTION

An urgent need of developing energy and resource saving systems of farming presupposes a multilateral evaluation of all elements of crops cultivation technologies. Bases of the bio-energy streams analysis in the natural and anthropogenically transformed systems were put by Odum H.T. [1]. Researches in this area became a frequent practice in some other countries [2, 3, 4]. A corresponding scientific approach including the theory and methodology of the problem, and corresponding research tools [5, 6] are necessary for the development of energy saving technologies. In this regard various methods of evaluating the energy efficiency of technological processes in agriculture [7, 8, 9], and also the techniques based on the principles and concepts of energetics in ecosystems are constantly being developed and improved.

One of the most important points of the energy consumption decrease in farming is researches on studying a physio-biochemical value of microelements and growth stimulators and development, features of their influence on exchange processes and formation of a crop as bases of rational regulation of the plant nutrition.

Technology-related energy costs of seed and crops treatment with microelements and microelement containing preparations in comparison with other elements of crops cultivation technologies are low, however these practices and techniques allow to increase considerably yielding capacity of crops and efficiency of agricultural production.

Calculation of energy costs per operation in the production of the agricultural produce and the energy which is accumulated with the yield serves as a basis for the evaluation of separate technological operations and the whole technology in general. Proceeding from the ratio of the energy obtained with the yield and the energy spent for the production of this yield determine the coefficient of energy efficiency.

The results of our calculations showed that the application of microelement containing preparations in cultivation technologies of the studied crops allows to get a reliable rise of a crop at a relatively low energy consumption. It is unambiguous that at present the energy equivalents presented in a technique require specifications and verification that take into account regional features, the improvement of automobile and tractor fleet and technologies.

Evaluation results of yielding capacity and bioenergetic efficiency of sunflower cultivation technologies are given below.

TARGETS AND METHODS OF RESEARCH

Targets of research were: average typical loamy black soil; sunflower; complex macro - and micro-fertilizers Micromak, Strada N, Mikroel.

The experiments were made in 2011-2013 at the JSC Novospassky grain elevator of the Novospassky district on the area of 12,4 hectares, the registered area of the plot - 120 sq.m, replication 3-fold, their lay-out - systematic.

The soil of the experimental plot - average typical loamy black soil was characterized by the following agrochemical indicators: humus content 5,5% (average), mobile phosphorus of 165 mg/kg (high), exchange potassium 188 mg/kg (very high), exchangeable indicators: calcium of 24,8 mg/kg (very high), magnesium 3,6 mg/kg (high); microelements: copper of 4,6 mg/kg (high), manganese 14,5 mg/kg (average), zinc 0,49 mg/kg (low).

The scheme of the experiment consisted of 4 options:

1. Control
2. Micromak (pre-sowing seed treatment, 2 l/t)

3. Strada N (pre-sowing seed treatment, 2 l/t)
4. Mikroel (pre-sowing seed treatment, 2 l/t)

In view of the average content of the soil with nutrient elements, the background fertilizer diammonium phosphate with the content of 17,7% of nitrogen and 46,0% of phosphorus was applied. The fertilizer was applied during the pre-sowing cultivation.

The sunflower sowing material (the variety “Oreshok”) was treated with complex fertilizers at the rate of 2 liters for 1 ton of seeds. The sowing is wide-row with a row-spacings width of 70 cm. The seeding rate was 3,5 kg/hectare, or 40 thousand pieces for one hectare. The content of productive moisture in the soil before the sowing in an arable layer (0 – 30 cm) was sufficient (32 mm), in a meter layer – 218 mm (optimum). During the sunflower vegetation period there was 253 mm of rainfall, the total number of average daily temperatures higher than 10 °C amounted to 2103,4 °C.

RESEARCH RESULTS

One of the reasons of low productivity of such major commercial crop as sunflower is an unbalanced nutrition of plants during vegetation. Pre-sowing seed treatment of sunflower with microelement containing fertilizers (2 l/t) promoted an essential increase of the crop productivity. Thus it should be noted that the experiment was being made on the soil with a high content of mobile compounds of nutritive elements and background fertilizer application in all options.

The results of our experiment on studying the efficiency of liquid complex microelement containing fertilizers in the sunflower cultivation technology are given in table 1.

Table 1: Influence of microelement containing fertilizers on yielding capacity of sunflower seeds

№	Option	Yield, t/ha	Deviation from control	
			t/ha	%
1	Control	2,40	-	-
2	Micromak	2,95	+0,55	23
3	Strada N	2,69	+0,29	12
4	Microel	2,63	+0,23	10
LSD 05		0,27		

Nevertheless, the increase of Micromak's application amounted to 0,55 t/hectare (23%), Strada N - 0,29 t/hectare (12%). A considerable increase of yielding capacity was also from pre-sowing seed treatment with Mikroel (0,23 t/hectare, or 10%), however the difference from control was insignificant in a LED 05 value.

High efficiency of Micromak in cultivating sunflower without any doubt is caused by the presence of zinc in this fertilizer in a significant amount (3,3%) exceeding Strada N by 27 times and Mikroel – by 2,4 times. The increase of yielding capacity of sunflower seeds from the use of Strada N though is almost twice lower, than with the application of Mikroel, but it is essential and amounts to 0,29 t/hectare. The latter, perhaps, is caused by the high content of nitrogen in Strada N (27%).

The value of fertilizers is not limited by the increase of crop productivity including sunflower. It is very important to obtain the seeds of high quality the main characteristics of which are the oil bearing capacity and acid number. The corresponding indicators of quality of sunflower seeds are presented in table 2.

Table 2: Quality of sunflower seeds depending on the sowing material treatment with microelement containing fertilizers

№	Option	Oil bearing capacity			Acid number	
		Oil content, %	Oil yield		mg POH/gr	Deviation from control
			t/ha	Deviation from control, t/ha		
1	Control	41,8	1,00	-	3,9	-
2	Micromak	41,6	1,23	+0,23	3,2	-0,7 (18 %)
3	Strada N	41,5	1,12	+0,12	3,6	-0,3 (8 %)

4	Microel	41,5	1,09	+0,09	3,1	-0,8 (21 %)
	LED ₀₅	3,1			0,5	

The provided data show that the applied microelement containing fertilizers had no influence on the oil content in sunflower seeds, however considerably increased an oil yield with the 1st hectare. It was determined by the crop yielding capacity and amounted while using Micromak to 1,23 t/hectare, Strada N - 1,12 t/hectare and Microel - 1,09 t/hectare. And also naturally the oil quality improved: the acid number with the application of Micromak decreased by 18%.

V. G. Sychev and others [10] in the review of references on studying the efficiency of microelements in sunflower cultivation technologies note that microfertilizers in all zones of the country raise not only yielding capacity, but also improve the quality of the obtained produce. Thus the most effective method of application of microfertilizers is pre-sowing seed treatment.

The analysis results of energy efficiency of sunflower cultivation showed that the application of complex microelement containing preparations for seed treatment allows to get a rather considerable rise of a crop at a relatively low energy consumption. Owing to insignificant energy consumption costs of seed treatment, technology-related energy consumption throughout the experiment options practically did not differ and was from 13,68 thousand MJ/hectare on control to 13,99 thousand MJ/hectare in option with use of preparation Micromak (table 3).

All options in which microelement containing preparations were applied differed in greater energy efficiency in comparison with control. However the option with the use of preparation Micromak should be mentioned in which the greatest energy coefficient was obtained – 3,80.

Bioenergy efficiency of sunflower cultivation depending on treatment of seeds with microelement containing preparations

Table 3

N	Option	Yielding capacity, t/ha	Technology-related energy consumption for grain production, thousand. MJ/ha	Energy accumulation in grain, thousand. MJ/ha	Bioenergy coefficient
1	Control	2,40	13,68	43,26	3,16
2	Micromak	2,95	13,99	53,17	3,80
3	Strada N	2,69	13,84	48,48	3,50
4	Microel	2,63	13,81	47,40	3,43
	LSD 05	0,27			

In efficiency the options with the use of the preparations Strada N and Mikroel are close to each other.

The analysis of the energy input structure allows to find out the most power-intensive operations of technologies and a share of this or that category of resources for the purpose of their subsequent optimization. The analysis of structure of energy inputs in sunflower cultivation technologies shows that the share of inputs when using microelement containing preparations does not exceed 0,03% of the general power costs in cultivation of this crop.

However the yielding capacity increase and consequently the energy efficiency of sunflower cultivation technologies allows to draw a conclusion on rather a high efficiency of their application.

In the analysis of the structure of costs the greatest specific weight occupies fuel – more than 54%, mineral fertilizers – about 28% and costs of farm vehicles and equipment – about 13%. Manpower and electric power in the total come to no more than 3,8% from the general energy costs of the crop cultivation.

CONCLUSIONS

The analysis of yielding capacity and bioenergy evaluation of sunflower cultivation technologies enables us to draw the following conclusions:

- the application of the microelement containing preparations allows to get rather a considerable rise of a crop with rather low energy costs;
- the applied microelement fertilizers did not render influence on the content of oil in sunflower seeds, however considerably increased an oil yield with the 1st hectare. And it was determined by the crop yielding capacity and was while using Micromak 1,23 t/hectare, Strada N - 1,12 t/hectare and Microel - 1,09 t/hectare;
- the most energetically effective is the option with the use of Mickromak preparation (energy coefficient – 3,80);
- the share of costs when using microelements and growth factors and developments does not exceed 0,03% of the general energy costs of cultivating this crop.

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