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The Use of the Growth-Regulating Substances in the Agrocenosis of Sunflower as the Factor of Ecologization in Plant Growing Technology.

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ABSTRACT

The system optimization problem of the sunflower mineral nutrition is important in determining the theoretical foundations of fertilizers and combined action substances. Foliar feeding is the most effective for soils with the high level of fertility, which is achieved with the introduction of intensive technologies in plant cultivation. As a limiting factor for crop yields increase can be one of macro- or microelements. This paper presents the results of analysis of environmental and economic efficiency of sunflower foliar feeding with the new multi-functional substance Helafit-Kombi® in agro-climatic conditions of the Southern steppe of Ukraine, using the research areas in Mykolaiv region as an example. The research has established that the application of the substance Helafit-Kombi® two times as a foliar feeding during the sunflower growing stage allows to prolong photosynthetic activity of plants for 5 – 10 days, to reduce the seed emptiness up to 10% and to increase the mass of seeds in one inflorescence up to 15%, leading to the stable growth of sunflower crop yield. The anti-stress effect of the substance substantially eliminates the adverse action of abiotic environmental factors and accelerates the process of plants coping with stress, which in turn affects the increase in productivity of oilseeds in 0.27 t/ha, reduces the negative impact on the ecological agrochemical state of soils and provides an ecologically-safe crop production.

Keywords: sunflower seeds, fertilizers, substances, research, productivity, leaf surface area, soil, environmentally safe production.

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INTRODUCTION

Recently, while implementing the intensifying elements in cultivation technology for basic plants in field crop rotation, the role of foliar fertilizing has grown in significance and requires special attention of agricultural producers and the scientific community. The optimization problem of the sunflower mineral nutrition is important for determining the theoretical foundations for application of fertilizers and combined action substances. Modern scientific literature insufficiently reflects the issues related with the consumption by plants of nutrition elements, including trace elements. There is almost no research on the application technology of modern substances, based on chelated forms of trace elements, microorganisms with fungicidal effect and stimulators of different origin.

The level of crop yields under conditions of Southern Steppe of Ukraine is determined primarily with natural soil fertility [1], which level in turn, has significantly decreased in recent years as a result of extensive maintenance of agricultural activities [2].

Thus, in years 1957 - 1961 the humus content in the plowed soil level remained on the level of 3.84%, and in 2001 – 2006 it decreased to 3.0% [3,4]. As a result, the neuro-forecast has determined that by 2025 the gradual process of dehumification of dryland soils in the Ssouthern steppes of Ukraine will reach the level of 0.01% per year. The index 0.03% per year for irrigated soils will be slightly higher, which is related with the intensive use of irrigated soils [5, 6].

Plants are able to consume nutrition elements in larger quantities only by means of root system. Foliar feeding is the most effective for soils with the high level of the soil fertility (агрофон), which is achieved through the introduction of intensive technologies for plants cultivation. As a limiting factor for the increase in yield can be one of macro- or microelements.

In stressful conditions (low temperatures, frost, drought etc.) consumption of nutrition elements by root system is slowing down, leading to a decline in growth and development of plants.

Under such conditions the increase in physiological development of plants is achieved through the foliar (leaf) feeding. This contributes to the significant increase in degree and speed of assimilation of nutrition elements from fertilizers through the assimilation system, what is more effective than the plant fertilization through soil. Therefore, foliar feeding is an effective auxiliary method of fertilization, but not the main [7].

Foliar feeding - is a recognized scientific method, which compensates quickly and focused the imbalance of nutrients in plants and presents itself as a tool for the rapid delivery of micronutrients during the stages of a plant growth and development [8,9].

The productivity level of plants has close correlation with photosynthetic potential, which in turn depends on the lifetime of leaf surface. That is why farmers achieve higher yields from late varieties and hybrids compared to early ones. If one maturity group is considered, the importance of increased period of the leaf surface functionality becomes evident. The ability of leaves to photosynthesis retains longer in natural conditions provided that there is effective interaction of three factors: the required level of water supply, optimum temperature regime and the increased soil fertility rate. The energetics of climate greatly influences the soil-forming process [10], which determines the capacity of soils to cultivate agricultural plants effectively [11]. Therefore, the researchers are in constant search of reliable and effective ways to prolong the leaf surface lifetime without using the methods of regulation of water and nutrient regimes [12-14].

MATERIALS AND RESEARCH METHODS

The purpose of the research is to study the effectiveness of foliar fertilization of sunflower with new multifunctional substance Helafit-Kombi® in modern agro-climatic conditions of the Southern steppe of Ukraine on example of the research area in Elanez district of Mykolayiv region. The areas for conducting experiments had leveled surface without slopes and erosive formations. Before using the areas for field experiments there was conducted the field leveling sowing with spring barley as a precursor of sunflower.
The areas for experiments were placed in series with the offset variants for repetition. The total area for researches was 330 m^2, the test area – 112 m^2. For experiments there was used the sunflower hybrid "Zaklik",

entered in 2004 into Ukrainian State Register of Plant Varieties. The hybrid originator is the agricultural company „Flora" (Odesa).

Phenological observations were carried out according to the methods of the state progeny test [15]. The cultivation of sunflower plants was conducted using the crop sprayer Helafit-Kombi® - in the stage 4 - 6 true leaves and bud-formation stage. The substance use norm was 1 l/ha, the working fluid norm – 250 l/ha. There were 4 repetitions in the research. The leaf assimilating surface area was determined by the method of A. Nichyporovycha [16].

Crop registration was carried out using combine threshing on the tested area. There was used combine "KLAAS" with a four-row attachment for sunflower. Actually, the obtained harvest was calculated taking into account the basis humidity (8%) and the presence of impurities. The experimental data was processed by means of multivariate analysis of variance by Dospyehova B.A. methodology [17]. Simulation of the yield formation was carried out with the use of the licensed software tool «Statistic 8.0».

THE MAIN PART

The first third of vegetation is characterized by the absence of significant difference between variants on dynamics of changes in the leaf surface area. Further can be observed the mentioned above pattern: the areas treated with the stimulating substances showed a clear trend towards the extension of the assimilation period in time. While determining the dynamics of sunflower leaf surface area there were found significant differences in the function of leaf apparatus in accordance with experiment variant (Table. 1).

It is established, that the application of Helafit-Kombi® as a foliar fertilizer leads to the elongation of photosynthetic activity in sunflower plants for 5 – 10 days, in 2015 as an arid year this difference was more obvious.

Table 1: Dynamics of change of the sunflower leaf surface area in relation to the dates of research, thous. m^2/ha

Test Date	2014 y.			2015 y.			2016 y.		
	Check	Treatment with Helafit-Kombi®		Check	Treatment with Helafit-Kombi®		Check	Treatment with Helafit-Kombi®	
		single	double		single	double		single	double
15.08	28,4	30,7	32,4	20,6	22,6	23,1	30,1	31,8	33,0
20.08	22,1	26,5	28,4	18,4	20,2	21,4	24,7	27,7	29,0
25.08	19,9	24,4	25,7	16,5	17,0	19,3	21,7	24,0	25,0
30.08	14,2	16,8	18,3	10,6	12,4	16,4	15,0	17,2	19,2
05.09	8,1	10,0	12,4	2,4	6,9	9,8	9,0	11,4	14,0
10.09	1,7	5,9	8,3	0	3,1	6,2	2,0	8,0	10,0
15.09	0,4	3,1	4,9	0	0	3,0	0	2,6	6,0
20.09	0	0	2,6	0	0	0	0	0	3,0

The calculation of the leaf surface area in percents in relation to its max value on Fig.1.

The obtained data demonstrates that at the beginning of vegetation stage the reduction in size of the assimilation system has a similar character in most cases, but after 15 - 20 days from the beginning of the observation there is significant difference.

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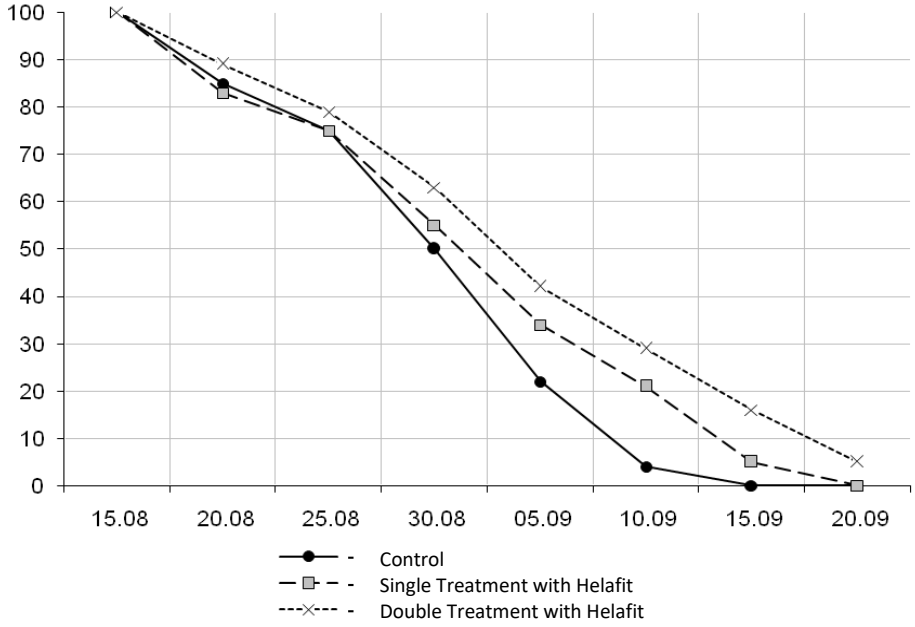

Fig. 1. Dynamics of operation of sunflower leaf apparatus during the vegetation stage in the years of research, %

Thus, if the control version from September 5 had only 22% of the active leaf surface, then, after double treatment with the substance Helafit-Kombi® this figure was twice as big. In the control version of the sunflower sowing from September 15th almost 100% of the assimilation substance were not involved in photosynthetic activity, after the treatment with Helafit-Kombi® additional 16% of the entire leaf surface became functional.

Under these conditions were formed more productive sunflower inflorescences (Table 2).

Table 2. Structural and morphological parameters of sunflower harvest depending on the treatment with Helafit-Kombi® (average during 2014 – 2016)

Ratio	Check	Treatment of sowings with Helafit-Kombi®	
		Single	Double
Basket diameter , cm	15,2	18,5	19,2
Seed emptiness, %	24	17	14
Number of full seeds in one basket, pc.	791	812	825
Weight of 1000 seeds, g	44	47	49
Weight of seeds in one inflorescence, g	35,1	38,2	40,5

This data covers three years of research on average, because during the whole period there was observed almost identical pattern, what confirms the reliability of results. The research has established that the treatment of sunflower with Helafit-Kombi® makes it possible to reduce the seed emptiness by 7 – 10%, and to increase the weight of seeds from one inflorescence by 8.8 – 15.4%, leading to the steady increase in the yield of sunflower (Table. 3). The double treatment of sunflower sowings with the substance Helafit-Kombi® has led to the increase in yield by 0.27 t/ha on average.

Table 3. The Productivity of certified sunflower seeds (sowing material) after the foliar feeding with Helafit-Kombi® during the years of research, t/ha

Variants of Research	Years			Average	
	2014	2015	2016	t/ha	% before check
Check	1,70	1,54	2,07	1,77	100,0
Helafit-Kombi® (1 treatment)	1,90	1,79	2,25	1,94	109,6
Helafit-Kombi® (2 treatments)	2,01	1,76	2,36	2,04	115,2
LSD05, t/ha	0,14	0,13	0,17	-	-

CONCLUSION

The research has established that the double application of multifunctional substance Helafit-Kombi® as a foliar fertilizer during the vegetation stage allows to prolong photosynthetic activity of plants for 5 – 10 days, to reduce the seed emptiness up to 10% and to increase the mass of seeds in one basket up to 15%, leading to the stable growth of sunflower crop yield. The anti-stress effect of the substance substantially eliminates the adverse action of abiotic environmental factors and accelerates the process of plants coping with stress. Paying attention to the fungicidal effect of the substance, the appropriateness of its application both separately and in combination with mineral fertilizers is even more effective.
It is determined, that the use of the substance Helafit-Kombi® in agro-climatic conditions of the Southern steppe of Ukraine provides additional revenue from the product sales by 15%/ha. The results obtained confirm the high efficiency of the substance as an element of the sunflower growing technology.

SUMMARY

The research has established that the application of the substance Helafit-Kombi® two times as a foliar feeding during the sunflower growing stage allows to prolong photosynthetic activity of plants for 5 – 10 days, to reduce the seed emptiness up to 10% and to increase the mass of seeds in one inflorescence up to 15%, leading to the stable growth of sunflower crop yield. The anti-stress effect of the substance substantially eliminates the adverse action of abiotic environmental factors and accelerates the process of plants coping with stress, which in turn affects the increase in productivity of oilseeds in 0.27 t/ha, reduces the negative impact on the ecological agrochemical state of soils and provides an ecologically-safe crop production.

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