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HIGHER REDUCTION IN MAIZE CEREALS ON GRAIN

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ABSTRACT

The fertilizer system has the greatest impact on the formation of the future corn grain crop. Optimization of nutrition of maize plants, namely the use during the growing season of modern biologicals and trace elements contributes to the increase of corn grain yield. Carrying out foliar application of a tank mix of the microbiological preparation Azotofit in the rate of application of 0,5 l/ha and microfertilizer Quantum-Cereals with a standard consumption of 1,0 l/ha in the period of 3-5 leaves of corn, will allow to obtain the yield of corn seeds at the level of 8,73-9,47 t/ha, and the addition to the control will be 0,57-0,77 t/ha.

Keywords: Agrocenoses, technology, corn grain, biologicals, microfertilizers, yield.

Formulation of the problem. Corn (species Zea maus L.) is a crop of versatile use and high yield. Attention to the production of corn grain, as one of the main crops of modern world agriculture, due to the wide range of its use, as it is an important component of agricultural production in Ukraine.

There is a tendency in the world to increase the production of corn grain. Over the past 16 years, production has almost doubled - from 600 to 1100 million tons [3]. Currently in Ukraine, corn is grown on an area of 4.3 million hectares and ranks third in terms of sown area. In general, the potential of maize hybrids is not fully realized, and therefore the need to improve existing technologies is growing. for the introduction of new maize hybrids included in the Register of Plant Varieties of Ukraine [2].

Corn belongs to crops with high productivity potential, sales which depends on fertilizers and hybrids adapted to the conditions of the region of cultivation and climate change and able to generate high yields. Many farms receive 9-10 t / ha and more, including in new areas of corn sowing (Polissya of Ukraine). In some regions of Ukraine the yield is 5,5-6,0 t/ha.

Of the total world production of corn grain, 60% is used for livestock feed; more than 25% - for food - for the preparation of flour, cereals, cereals, canned food, confectionery; about 15% - for industrial processing - for the production of oil, starch, molasses, alcohol, glucose, sugar, etc [16]. High-calorie corn grain (in 100 g - 97 kcal); contains a lot of carbohydrates, fiber, protein, a large number of vitamins group B, vitamin E, potassium, phosphorus, magnesium, iron, zinc. Carbohydrates contained in corn provide the body with energy [10].

Recently, organic fertilizers are applied in very small quantities, and nitrogen fertilizers are applied nitrogen, phosphorus and potassium. However, these elements cannot fully compensate for the need of plants for nutrients. Increasingly, plants are beginning to show signs of micronutrient starvation, ie lack of the element which requires only a few grams per hectare, and this offsets all the efforts of the agronomist and the investment of the owner [9].

Improving the technology of growing corn for grain is an extremely important task, because in the current economic conditions, cheaper grain production and increase the profitability of its cultivation is possible only in case of introduction of new agrotechnical receptions which do not provide big expenses. It is known that the most valuable of the elements of technologies for growing crops are measures tillage and fertilizer application, the latter and especially in modern conditions farming, when soils are depleted of nutrients, is the most effective factor in increasing yields. Therefore, optimizing plant nutrition on a regular basis resource conservation, namely the use during the growing season of modern biological products and trace elements has significant prospects for widespread implementation.

Analysis of recent research and publications. There is an urgent need in Ukraine to increase the production of corn grain. All this stimulates the increase of sown areas and the improvement of cultivation technology [12].

Corn belongs to crops with high productivity potential, sales which depends on a number of factors, the most decisive of which are fertilizers and selection of hybrids adapted to the conditions of the region of cultivation and climate change and capable to form a high yield, stable over the years. Technological capabilities, modern hybrids and natural conditions make it possible to obtain grain yields at the level of world indicators (about 10,5 t/ha).

The use of microfertilizers and biological products in crop production is an integral part modern agricultural technologies, as they are important components in the system balanced plant nutrition. These drugs can significantly increase resistance plants to adverse weather conditions, diseases and pests of crops, increase yields and product quality.

A number of authors note that in the last century the main source of recovery trace elements were organic fertilizers, the application of which is currently greatly reduced due to decline of the livestock industry. Therefore, today the problem of deficit is acute trace

elements in the soil. The main way to solve this problem is the use of microfertilizers [4, 5].

In the process of growth and development of cultivated plants it is important to receive them throughout the growing season, not only the basic nutrients, but also trace elements contained in plants in amounts less than one hundredth of a percent.

Now the market for microfertilizers is developing rapidly. According to international experts market growth will be 5,5% annually and in 2017 will amount to 1236,5 thousand tons. Another 10 years therefore, the use of microfertilizers was considered as additional fertilization. Many do not include trace elements in the law of dependence of the crop on the lack of an element whose content in the soil is in maximum shortage. Factors that limit the yield were considered humidity, NPK, solar radiation activity, soil acidity. Due to the numerous vegetation and field research has proved the importance of all possible nutrients. Now the use of microfertilizers is part of the main system of crop fertilization [7].

It is established that plants absorb only a small part of microelements from the soil, which are in a movable easily accessible form, and fixed gross reserves of trace elements may be available to plants after undergoing complex microbiological processes in soils with the participation of humic acids and root secretions. Therefore, the gross content of trace elements does not reflect the real picture of providing plants with trace elements [4].

The role of trace elements in the plant is multifaceted. They intensify the activities of many enzymes that increase the germination energy of seeds, reduce plant morbidity bacterial and fungal diseases. In addition, trace elements accelerate development of crops, their maturation, increase the resistance of plants to lack of moisture and low temperatures and absorption of nitrogen, phosphorus and potassium from the soil. The use of trace elements in agricultural production is based not only on their need for individual crops, but to a greater extent on the content of trace elements in the soil a it is on the insufficient number of forms available to plants. Positive effect on plants trace elements is also due to the fact that they participate in the oxidative regenerative processes of carbohydrates in the environment. Under the influence trace elements in the leaves increases the composition of chlorophyll, improves photosynthesis, increases the assimilative effect of the plant [11], improves plant respiration, increases them resistance to diseases, etc.

Traditionally, this culture is considered an "indicator" of the content of trace elements in the soil. Maize is sensitive to their use, especially zinc (Zn), manganese (Mn), copper (Cu) and boron (B). Lack of which inhibits plant growth and development, reduces productivity culture. Zinc (Zn) is involved in nitrogen metabolism, promotes amino acid synthesis tryptophan, which acts as a regulator of plant growth. Zinc is also an enzyme systems that regulate carbohydrate, fat, phosphorus metabolism and biosynthesis of vitamins. Application of high doses of phosphorus and potassium, lime fertilizers, low temperature soil, its compaction, low organic matter content, high phosphorus (P) content, calcium (Ca), magnesium (Mg) or copper (Cu) in it reduces the availability of zinc for plants.

Therefore, the technology of growing crops has long been involve the use of various trace elements, taking into account their content in the soil, as well taking into account the sortogenetic features of the cultivated plants themselves and, of course, the method introduction of these trace elements. Lack of micronutrients for plant nutrition is eliminated in different ways: by introducing into the soil modern macrofertilizers produced on the basis of natural raw materials that contain impurities of trace elements; application of microfertilizers to seeds or vegetative organs of plants [15].

In general, the use of microfertilizers is an important component of an effective system balanced nutrition of crop plants with a full set of elements [1, 6].

Important elements of agricultural technology include the rational use of fertilizers, growth regulators, biological products.

The biological system in the conditions of agrocenoses is subject to the action of both natural and anthropogenic factors in the form of various agricultural measures that change one or another to some extent soil ecosystems. One of the tasks of modern agriculture is the fuller use of nitrogen-fixing and phosphate-mobilizing ability of microorganisms. It now exists a lot of scientific work to study the problems of symbiotic and associative nitrogen fixation, phosphate and potassium mobilization. Pre-sowing inoculation of seeds with biological products, based on selected nitrogen-fixing and phosphate-mobilizing microorganisms, helps to increase productivity of crops by 10-30%. An important role among them play microbiological drugs to enhance nitrogen fixation from the air and mobilization phosphorus compounds in the soil, because due to this the cost of mineral fertilizers decreases and increases the realization of the genetic potential of plants.

In recent years in Ukraine considerable attention is paid to the scientific substantiation of effective application in technologies of cultivation of agricultural crops. biologicals of various spectrum of action, including phosphate-mobilizing. Pre-sowing inoculation of seeds with microbial preparations is an effective, ecologically safe means improving the conditions of mineral nutrition, growth and development of plants, phytosanitary condition of crops, increasing the productivity of crops [8].

The use of rhizosphere microorganisms for the fixation of biological nitrogen from the atmosphere by diazotrophic bacteria in the cultivation of crops is of particular importance for overcoming nitrogen deficiency in plant nutrition, increasing the efficiency of arable land use, increasing soil fertility, reducing money the cost of purchasing synthetic fertilizers, etc. Biologization of the crop industry provides an environmentally friendly, economically reasonable amount high-quality plant products, strengthens the ecological sustainability of agricultural landscapes, contributes to the preservation of soil fertility.

In recent years, significant progress has been made in the development of biological products based on associative microorganisms of complex action. Microor-

ganisms included in the composition biological products capable of performing a number of functions that increase crop yields.

When growing corn, it is advisable to use agricultural techniques, including bacterization of seeds and surface treatment of plants during the growing season in the phase of 7-9 leaves Polymyxobacterin - a plant growth stimulant, the bioagent of which is the phosphate-mobilizing bacteria Paenibacillus polymyxa KB, which affects the strengthening assimilation of phosphorus by plants and contributes to the increase of its content in the leaf-stem mass and grain of corn and, as a consequence, increases the removal of this element with the yield of the crop, which indicates an increase in the efficiency of phosphorus nutrition of corn plants. At the present stage of development of agriculture the direction of researches acquires urgency soil microbiological processes, where soil microorganisms are an important component of the biological cycle of substances. The study of soil biological activity allows scientists more widely understand and identify patterns in the processes of conversion of organic matter, given the anthropogenic impact on soil and its properties [14].

Therefore, the use of trace elements and microbiological preparations of plants is an integral part of intensive technologies for growing corn due to which it is possible to increase gross grain production, increase profitability and improve the economic condition of agricultural production.

The purpose of the study is to scientifically substantiate the impact of the use of biological products and microfertilizers on the productivity of corn on grain.

Presenting main material.

Modern fertilizers for foliar feeding are fertilizers with a high degree of grinding, low humidity, trace elements in chelated form, stabilizers, adjuvants (adhesives).

When choosing a sheet fertilizer, you should pay attention to its composition. Simpler fertilizers have a rather poor chemical composition, a low degree of purity, quite low solubility and poor wettability of the sheet surface. After their use, salt leaves may appear on the leaves of cultivated plants, in particular corn. Using them justified only on cultures of the extensive type, when under any circumstances it is not possible expect to get a very large harvest, but still have to provide plants with the appropriate element.

One of the most effective forms of fertilizers is the chelated form, which provides stability in solution and a high degree of absorption by plants. Sometimes a cheaper form of complexones (organic acid complexes) is used instead of chelates. Such compounds are less stable and slightly less digestible, but in many cases can help adjust plant nutrition. The latest developments are polymer chelate complexes and compounds based on amino acids. These substances practically do not lose efficiency at processings at very low or very high temperatures, besides, high degree of purity of connections provides their greater efficiency.

In this context, it is becoming increasingly important to study the effects of highly effective polymeric chelated fertilizers, biologicals, growth regulators, etc. in combination with other agrotechnical elements for the formation of biometric indicators of plants, yield and product quality [13].

In 2018-2019, an experiment was conducted to study the effectiveness microbiological preparation Azotofit-universal and micronutrient Quantum-grain, which were studied separately and in a tank mixture on corn crops for grain of different hybrids.

The composition of Azotofit - universal includes living cells of the natural nitrogen-fixing bacterium Azotobacter chroococcum and their active metabolites: amino acids, vitamins, phytohormones, fungicides, macro- and microelements. This biological fertilizer should be applied in the evening, as it contains live microorganisms that die from sunlight in the early stages of application.

The growth and development of plants is one of the main features that indicates the peculiarities of the conditions for growing crops. Growth processes are a direct relationship between yield, vegetative mass and plant height, as the stems and leaf surface are organs of transportation of organic minerals.

Maize is a crop with a much higher need for fertilizer than other cereals. Depending on the level of yield, different amounts of nutrients are absorbed, including a large number of macro- and microelements. The main ones are potassium, copper, iron and zinc. Quantum-grain fertilizer is a multi-component combined organomineral, microbiological-synthesized fertilizer that can provide corn plants with these elements. Due to its properties and component composition can increase the productivity of corn by increasing the intensity photosynthesis of plants, better fixation of solar energy in the form of carbon compounds, increasing the leaf surface area of the culture by 30-50% and the size and mass of the root system of plants, its vegetative and generative mass, increasing the resistance of maize plants to stress factors.

Observations of the growth processes of corn on grain indicate differences in the dynamics of the influence of the studied factors on the parameters of growth processes. In the course of research, biometric indicators were analyzed: plant height, leaf surface area, elements of crop structure: grain size of the cob and the weight of 1000 grains. Weather conditions in the corn period contributed to the active growth of plants almost to the flowering phase, after which the intensive growth processes are significantly slowed down, and usually almost stop.

The height of the stem is determined by the number of nodes and the length of the internodes and depends on the genotype (precocity) and growing conditions.

Precocious hybrids are usually short, and late ripening have a higher stem.

The highest height on average for two years of research was characterized by medium-ripe hybrid corn 4490, the height in the control areas was within 213 cm, and in the areas where biological preparations and microfertilizers were applied foliarly, the height of plants was in the range of 218-233 cm, which is 5-20 cm

higher than the control areas. It should be noted the areas where foliar spraying with the microbiological drug Azotofit was used. The leaves and the plants themselves had a beautiful appearance, a strong root system. The best, respectively, the highest maize plants were in areas where the tank mixture was applied Nitrogen - universal + Quantum - Cereals at the rate of consumption (0,5 l/ha + 1,0 l/ha). These plants DKS 3705 had a height of 221 cm, and corn plants DKS 4490 had a height of 233 cm. The general trend in the growth response of maize to the types of drugs is that each element of the plant nutrition system creates integrated, favorable conditions for accelerating the linear growth of plants.

The most effective factor in regulating the height of plants was the diet of microbiological preparation and micronutrients for plants that were applied in phase 3-5 of corn leaves, so as a result of foliar application of Azotofit at a rate of 0.5 l / ha and microfertilizers Quantum grain at a rate of 1 l / ha height of corn plants hybrid DKS 3705 (FAO 300) on average for two years was within 221 cm, which is more than in the control areas by 12 cm The height of the plants of the maize hybrid DKS 4490 (FAO 370) with foliar feeding of these drugs was 233 cm, which is more than in the control areas by 20 cm (Table 1).

Table 1

Influence of foliar fertilization with drugs on height corn plants

Experiment options	Plant height, cm			+/- to control
	2018 yr.	2019 yr.	average	
DKS 3705 (FAO 300) medium early				
Control (without feeding)	213	205	209	-
Azotophyte is universal, 0,5 l/ha	215	210	213	+ 4
Quantum - Cereals, 1,0 l/ha	216	211	214	+ 5
Azotophyte - universal + Quantum - Cereals (0,5 l/ha + 1,0 l/ha)	224	217	221	+ 12
DKS 4490 (FAO 370) is medium ripe				
Control (without feeding)	215	210	213	-
Azotophyte is universal, 0,5 l/ha	220	215	218	+ 5
Quantum - Cereals, 1,0 l/ha	225	217	221	+ 8
Azotophyte - universal + Quantum - Cereals (0,5 l/ha + 1,0 l/ha)	238	227	233	+ 20

The formation of a high yield of agricultural plants is the result increase in photosynthesis, in the process of which from simple substances are formed rich in energy complex and chemically diverse organic compounds.

An important role in the cultivation of corn for grain is played by photosynthetic activities by various measures using intensive technologies with elements of biologization. Photosynthesis as the main process occurring in plants, provides quantitative and qualitative parameters of the crop, so the data on the elements of photosynthetic activity allow determine the effectiveness of measures taken in the formation of a unit of production. It is known that the best use of climatic, soil resources, as well as measures of agro-technical impact occurs in crops with optimal leaf surface.

Creating optimal, ecologically adapted conditions for the operation of the photosynthetic apparatus during the growing season is a necessary component of the formation of high and high quality crops. The productivity of corn plants is determined by the size and duration of the leaf apparatus, the net productivity of photosynthesis, the nature of use its products for growth processes, for the formation of the economically valuable part of the grain harvest. In this regard, the development of separate measures for foliar application of microbiological drugs and micronutrients, their reasoned use in cultivation technologies corn for grain, requires data on the elements of photosynthetic activity of plants.

According to the results of our research, it is proved that the indicators of the leaf surface area of corn crops for grain during its cultivation with elements of biologization fluctuated significantly depending on the studied factor in different phases of plant development. Studies have shown that the growth of the leaf surface of plants of maize hybrids increased significantly with the growth and development of plants and maximum values reached the flowering phase with a subsequent slight decrease in the area of the leaf apparatus in subsequent vegetation periods. This dependence is clearly observed when spraying plants with solutions of complex microfertilizers and growth regulators.

The minimum leaf surface area of one plant in the flowering phase of panicles was in the variant without foliar fertilization in the middle-early hybrid of corn DKS 3705 – 0,411 m^2/per plant. When using the microbiological drug Azotofit at a rate of 0,5 l/ha, this figure increased by an average of two years of research by 0,006 m^2/per plant compared to control areas. The largest indicators of leaf surface area were observed in areas where they were applied foliarly in phase 3-5 corn leaves with microbiological preparation Azotofit and micronutrients Quantum - Cereals at a rate of 1,0 l/ha. Thus, the leaf surface area of the medium-early hybrid DKS 3705 maize averaged 0,429 m^2/plant per two years, which is more than in the control plots by 0.018 m^2/per plant.

Accordingly, the leaf area of the medium-ripe hybrid DKS-4490 was at the level of 0.473 m^2/per plant, which is greater than the control plots by 0,037 m^2/per plant. Therefore, the joint application of the microbiological drug Azotofit on micronutrients Quantum-Grain in the phase of 3-5 leaves of corn contributed to an increase in the area of leaves of corn of both hybrids (Table 2).

Table 2

Influence of foliar fertilization of growth stimulants and microfertilizers on the leaf surface area of corn

Experiment options	Leaf surface area, m^2/per plant			+/- to control
	2018 yr.	2019 yr.	average	
DKS 3705 (FAO 300) medium early				
Control (without feeding)	0,416	0,405	0,411	-
Azotophyte is universal, 0,5 l/ha	0,423	0,411	0,417	+ 0,006
Quantum - Cereals, 1,0 l/ha	0,429	0,418	0,424	+ 0,013
Azotophyte - universal + Quantum - Cereals (0,5 l/ha + 1,0 l/ha)	0,430	0,427	0,429	+ 0,018
DKS 4490 (FAO 370) is medium ripe				
Control (without feeding)	0,447	0,424	0,436	-
Azotophyte is universal, 0,5 l/ha	0,458	0,445	0,452	+ 0,016
Quantum - Cereals, 1,0 l/ha	0,467	0,451	0,459	+ 0,023
Azotophyte - universal + Quantum - Cereals (0,5 l/ha + 1,0 l/ha)	0,478	0,468	0,473	+ 0,037

According to the results of the research, there was an increase in the leaf surface area by groups of maturity of maize hybrids for treatment with drugs, compared with options without their use. The positive effect on plants of biological products and trace elements is due to the fact that they participate in the redox processes of carbohydrates in the environment. Under the influence of microorganisms and microelements in the leaves, the composition of chlorophyll increases, photosynthesis improves, and the assimilative effect of the plant increases. The introduction of the microbiological drug Azotofit strengthens the immunity of plants, increases their resistance to disease, accelerates and prolongs the phases flowering, increases yield and grain quality, improves mineral nutrition of plants, reduces the amount of mineral fertilizers (macronutrients), including nitrogen, rejuvenates the soil and improves its natural fertility.

Thus, the application of biological products and microfertilizers significantly improves the growth and development of corn plants, which further affects the quality and increase in corn grain yield.

Maize as a crop is characterized by high biological adaptability, but has certain requirements for growing conditions.

These conditions directly affect the rate of growth, development of corn, and as a result, the crop itself. The size of the grain yield reflects the quantitative values of the obtained grain per hectare and varies significantly depending on plant life, as well as the intensity of absorption of nutrients, water from the soil and the synthesis of organic matter under the action of solar energy. To reduce the chemical load on the soil and for better plant growth, biological preparations based on nitrogen-fixing bacteria are used. In this way the seeds receive additional nitrogen nutrition from the soil, production processes are improved, grain yield and quality are increased. The competitive advantages of grain seeds are determined by their ability to form valuable features of marketable grain and, accordingly, its potential for competitiveness. Such features are yield, moisture yield of grain during ripening, which reduces the cost of drying marketable grain, resistance to adverse weather conditions, diseases and pests in the cultivation of commercial grain, the duration of grain ripening, which opened up the possibility of growing corn in areas with a lower amount of active average daily temperatures.

According to the results of the study, hybrids of corn of foreign selection in comparison with domestic in the cultivation of marketable grain provide less moisture, the difference in the figure reaches 4-10%. The moisture factor is important depending on the specialization of agricultural enterprises.

It is possible to increase the efficiency of corn production on the farm by growing several hybrids with different lengths of the growing season, adapted to the conditions of the farm and other factors. That is, the selection of seeds should take place in different groups of maturity. At the same time there is an opportunity to reduce the tension during the care and harvesting of commercial corn and optimize the use of material and technical resources of the economy.

It also provides full ripening of corn, which makes it possible to reduce energy consumption during harvesting and post-harvest processing of wet grain. The use in the production of the existing range of biological groups of maturity of maize hybrids and their rational ratio within a particular farm is an important reserve for increasing yields. It should be noted that before the full ripeness of the grain, the processes of moisture transfer were almost independent of the use of foliar fertilization. During harvesting, the moisture content of the grain in all variants of the experiment varied insignificantly and was equal to 14,0-14,6%, while the grain did not require drying. The level of corn grain yield was a natural consequence and a derivative result of the formation of biometric indicators of plants.

The available hydrothermal resources and their distribution during the growing season of corn on average over the years of research have contributed to a high return on grain yield. At this level of moisture intensive type of nutrition with biological drugs and microfertilizers caused an increase in corn grain yield (by 0,40-0,94 t/ha) in comparison with control areas where foliar fertilization with drugs was not carried out. The highest yield of maize hybrids was recorded in 2018 DKS 3705 – 8,73 t/ha, DKS 4490 – 9,47 t/ha in areas where in the phase of 3-5 leaves of corn was carried out

foliar fertilization with microbiological preparation Azotofit at the rate of consumption of 0,5 l/ha and micronutrient Kvantum-Zernovi at the rate of consumption of 1,0 l/ha. A characteristic feature of maize hybrids is the ability to dry the grain during ripening, which is largely depends on the efficiency of their cultivation, which, of course, is negatively affected by additional costs for drying in case of exceeding the normalized conditions of condition. In our study, all investigated variants of the hybrid DKS 3705 had a humidity of 14% and almost reached the root, and the hybrid DKS 4490 – 14,5% (Table 3).

Table 3

Influence of foliar fertilization of growth stimulants and microfertilizers for corn yield

Experiment options	Humidity grains,%	Grain yield, t/ha			+/- to control
		2018 yr.	2019 yr.	average	
DKS 3705 (FAO 300) medium early					
Control (without feeding)	14,0	7,80	6,63	7,22	-
Azotophyte is universal, 0,5 l/ha	14,0	8,24	7,00	7,62	+ 0,40
Quantum - Cereals, 1,0 l/ha	14,0	8,35	7,10	7,73	+ 0,51
Azotophyte - universal + Quantum - Cereals (0,5 l/ha + 1,0 l/ha)	14,0	8,73	7,24	7,99	+ 0,77
NIR_{05}		0,21	0,22		
DKS 4490 (FAO 370) is medium ripe					
Control (without feeding)	14,6	8,38	8,00	8,19	-
Azotophyte is universal, 0,5 l/ha	14,5	9,16	8,16	8,66	+ 0,47
Quantum - Cereals, 1,0 l/ha	14,5	9,24	8,27	8,76	+ 0,57
Azotophyte - universal + Quantum - Cereals (0,5 l/ha + 1,0 l/ha)	14,5	9,47	8,79	9,13	+ 0,94
NIR_{05}		0,24	0,25		

Thus, the comprehensive improvement of morphological and reproductive parameters of maize plants due to foliar application of biological preparations and micronutrients had a positive effect on corn grain yield.

The quantitative characteristics of maize hybrids include the main economic and valuable characteristics. Therefore, the analysis of simple traits along with productivity is appropriate, because they are considered as influential elements of crop structure. Previous research has found that some of the signs of potential productivity (number of rows of grains cobs) are more stable in reproduction in offspring than yield, due to the determination of these traits in the early stages of morphogenesis. In this case, the environmental conditions during the formation and filling of grain do not have a significant impact. Among the significant number of economically important features of maize hybrids that have a significant impact on the formation of actual and potential yields, such as grain size and weight 1000 seeds. The study of the correlation between them and between the main economic and valuable traits is of practical importance for determining the optimal parameters in the development of models of maize hybrids for specific agroclimatic zones of cultivation.

Hybrids of different maturity groups studied showed individual features of the formation of structural elements of the crop depending on micronutrients and growth regulators. The grain size of the cob in the control areas averaged 562-604 pieces in two years of research. The grain size of the cob in the control areas averaged 562-604 pieces in two years of research.Thus, in these areas of the experimental maize hybrids, the grain size was at the level of 574-623 units, which is more than in the control areas by 12-19 units. The weight of 1000 grains, as an indicator of grain size formed on the cobs, under the influence of biological product and microfertilizers in the experiment varied from 216 to 231 g depending on the application of drugs is insignificant. Slightly higher than in other variants of the experiment, this figure was against the background of foliar application of Azotophyte at a rate of 0.5 l / ha and microfertilizers Quantum-Grain at a rate of 1.0 l / ha. The weight of 1000 seeds of the hybrid DKS 3705 was at the level of 219 g, the hybrid DKS 4490 - 231 g (Table 4).

Table 4

Influence of foliar fertilization on structural elements corn harvest (average for 2018-2019)

Experiment options	Graininess head, pcs.	+/- to control	Mass of 1000 grains, g	+/- to control
DKS 3705 (FAO 300) medium early				
Control (without feeding)	562	-	212	-
Azotophyte is universal, 0,5 l/ha	567	+ 5	216	+ 4
Quantum - Cereals, 1,0 l/ha	569	+ 7	217	+ 5
Azotophyte - universal + Quantum - Cereals (0,5 l/ha + 1,0 l/ha)	574	+ 12	219	+ 7
DKS 4490 (FAO 370) is medium ripe				
Control (without feeding)	604	-	218	-
Azotophyte is universal, 0,5 l/ha	610	+ 6	221	+ 3
Quantum - Cereals, 1,0 l/ha	616	+ 12	224	+ 6
Azotophyte - universal + Quantum - Cereals (0,5 l/ha + 1,0 l/ha)	623	+ 19	231	+ 13

Thus, foliar feeding of corn for grain in the phase of 3-5 leaves with the biological drug Azotofit and microfertilizer Quantum-Grain helps to increase the structure elements of the corn crop.

Conclusions

1. The highest height on average for two years of research was characterized by medium-ripe hybrid corn 4490, the height in the control areas was within 213 cm, and in areas where foliar application of biological products and microfertilizers plant height was in the range of 218-233 cm, which is more than the control areas by 5-20 cm. The best, respectively, the highest maize plants were in areas where the tank mixture was applied Nitrogen - universal + Quantum - Cereals at the rate of consumption (0,5 l/ha + 1,0 l/ha). These plants DKS 3705 had a height of 221 cm, and corn plants DKS 4490 had a height of 233 cm.

2. The leaf area of the medium-ripe hybrid DKS-4490 was at the level of 0,473 m^2/per plant, which is greater than the control plots by 0,037 m^2/per plant. Therefore, the joint application of the microbiological drug Azotofit on micronutrients Quantum-Grain in the phase of 3-5 leaves of corn contributed to an increase in the area of leaves of corn of both hybrids.

3. The highest yield of maize hybrids was recorded in 2018 DKS 3705 – 8,73 t/ha, DKS 4490 – 9,47 t/ha in areas where in the phase of 3-5 leaves of corn was carried out foliar fertilization with microbiological preparation Azotofit at the rate of consumption of 0,5 l/ha and micronutrient Kvantum-Zernovi at the rate of consumption of 1,0 l/ha.

4. The highest yield of maize hybrids was recorded in 2018 DKS 3705 – 8,73 t/ha, DKS 4490 – 9,47 t/ha in areas where in the phase of 3-5 leaves of corn was carried out foliar fertilization with microbiological preparation Azotofit at the rate of consumption of 0,5 l/ha and micronutrient Kvantum-Zernovi at the rate of consumption of 1,0 l/ha.

5. The mass of 1000 grains, as an indicator of the size of the grain formed on the cobs, under the influence of biological product and microfertilizers in the experiment varied from 216 to 231 g depending on the introduction of drugs is insignificant. Slightly higher than in other variants of the experiment, this figure was against the background of foliar application of Azotophyte at a rate of 0,5 l/ha and microfertilizers Quantum-Grain at a rate of consumption of 1,0 l/ha. The weight of 1000 seeds of the hybrid DKS 3705 was at the level of 219 g, the hybrid DKS 4490 - 231 g.

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THE INFLUENCE OF HYDROTHERMAL CONDITIONS ON THE CULTIVATION OF SPRING BARLEY IN THE RIGHT-BANK FOREST-STEPPE OF UKRAINE

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ABSTRACT

The article reflects the results of the research and reasonably obtained indicators on the effect of hydrothermal conditions on the formation of spring barley yields in the conditions of the right-bank Forest-steppe of Ukraine. Climatic conditions put us severe obstacles in obtaining the yield of spring crops. Against the background of the beginning of desertification, we may think that this concept applies only to the southern regions, however, this is not true, the climate is changing much faster than we assumed. In general, the assessment of soil and climatic conditions of the VNAU research field indicates that they are sufficiently favorable for the formation of high and sustainable yields of major crops, and above all - spring barley, as evidenced by the data we obtained. On average for two years of spring barley cultivation after sunflower predecessor without using mineral fertilizers spring barley yield was 33.7 c/ha of grain. Upon application of $N_{60}P_{60}K_{60}$ barley yield increased up to 46.0 c/ha. It was highest when 90 kg of nitrogen fertiliser was applied on a phosphorous-potassium background and amounted to 53.9 cwt/ha.

Keywords: spring barley, forecrop, fertiliser, climate, yield.

To quote the head of the Sokolov Institute of Soil Science and Agrochemistry. Sokolovsky, it is worth noting that Ukrainian soils are dying due to lack of moisture and nutritional deficiencies. The content of humus, which primarily determines the fertility of soils, is decreasing. In the last 130 years our Ukrainian lands have lost 30% of their humus content.

Olga Babayants adds that an interesting fact is that rainfall during the year remains almost at the same level as before, i.e. in the range of 390-420 mm. But due to the acceleration of evaporation, only about 100 mm remains in the soil instead of the required half. And the increased winds, blow away the remaining moisture. Another of the problems we are hard pressed to face in 2019 is the almost total lack of moisture in the arable soil layer almost everywhere. The terrible rains, increasingly heavy rainfall, well as a consequence, of course, were not productive, but rather stripped away the top humus layer of the soil. Yes, it is a challenge of nature, and a very tough one, but a man should be smart and should find a way out of any situation.

It should also be noted that winter crops, namely wheat, barley and rapeseed still grow and survive in the absence of moisture, but the ending may be unpredictable. The start of 2020 provides us with clues as to the urgency of deciding what to sow, how to protect and shape the future crop. Unfortunately, the range of options for spring crops is very small. However, the search for crops that can do a bit of protecting and harvesting must be urgent. Therefore, in such cases, we increasingly turn to spring barley [1].

Researches on studying of technology models of spring barley growing for grain were conducted during 2019-2020 on the research field of Vinnitsa National Agrarian University.

Research was supposed to study the action and interaction of such factors: A - precursor; B - levels of mineral nutrition.

Gradation of factors 3x3. Repetition of experience three times. Placement of the variants is systematic. Area of the study plot is 30 m^2.

Spring barley precursors - winter rape, corn, sunflower.

Soil preparation during the pre-sowing period depended on the predecessor and was aimed at maximum conservation and accumulation of moisture in the soil and elimination of weeds. Soil treatment included: after the harvesting of the previous crop, discing with BDT-7 heavy harrows and later ploughing with PLN-5-35 plough to a depth of 25 cm with further application of

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