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## EVALUATION OF EFFICIENCY OF APPLICATION OF GROWTH STIMULATORS AND MICROFERTILIZERS IN MAIZE CROPS

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**Abstract**

Maize varieties and hybrids are characterized by increased requirements for nutritional conditions and only with a full and balanced supply of nutrients can fully realize their genetic potential. An important measure of modern intensive technologies for growing high yields of corn for grain is the use of biologically active compounds that can affect the intensity of physiological processes and affect the production process of agricultural production. In addition to growth stimulants, much attention is paid to the use of trace elements that are active catalysts that accelerate biochemical reactions and affect their direction. Lack of micronutrients can adversely affect the growth and development of corn plants.

Treatment of corn seeds before sowing with growth stimulant Biolan, normal consumption of 15 ml/t, and during the growing season of corn plants in the phase of 6-7 leaves of foliar spraying with micronutrients Quantum Gold at a rate of 2 l/ha + Chelatin Zinc, 1 l/ha, will allow to obtain grain yield of maize hybrids at the level of 6,79-8,17 t/ha.

**Keywords.** corn, technology, seeds, growth stimulants, microfertilizers, yield.

**Formulation of the problem.**

Corn (species Zea maus L.) is one of the main crops of modern world agriculture. This is a culture of versatility and high yields.

Corn grain is an excellent fodder. 1 kg of grain contains 1,34 feed units and 78 g of digestible protein. This is a valuable component of feed. However, corn grain protein is poor in essential amino acids - lysine and tryptophan - and rich in low-value protein - zein. Among cereals, corn is the most valuable in terms of energy nutrition, characterized by a high content of starch and fat, low - fiber.

Ukraine has a great potential for grain production, because the climatic conditions of Ukraine sufficiently meet the biological needs of corn, so now an important area of scientific support of crop production is the creation of varieties and hybrids with high genetic resistance to biotic and abiotic environmental factors [4]. Thanks to the introduction of innovative hybrids and the expansion of sown areas under corn, Ukraine is among the six major producers of corn grain in the world and in the top five exporters [5]. This requires a reassessment of all elements of the technology of growing corn in order to significantly increase grain production in our country.

In modern socio-economic conditions, which have led to a decrease in the level of agricultural culture, agriculture is one of the main factors of negative impact on the environment and the productive potential of cultivated plants, including corn.

Fertilizers and growth stimulants are one of the most effective means of influencing plant productivity and quality. Due to the high cost of fertilizers, farmers face the task of minimizing their losses and rational use. Foliar fertilization is an effective way to fertilize and improve physiological processes, which makes it possible to increase the availability of nutrients for the plant and stimulate their better absorption from the soil.

**Analysis of recent research and publications.**

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 1,100 million tons [3]. Corn is the second largest crop in the structure of cereals after wheat, which directly forms the export potential of the country's agricultural sector and is the basis for its food and economic security. In terms of gross production, corn began to occupy a leading position among all other types of crops, outperforming even wheat, the undisputed and long-standing leader of the grain industry.

World production of corn grain annually reaches 550-580 million tons and is the largest in volume compared to other cereals, even with such leading crops as wheat and rice. The largest producer of corn grain is the United States, which annually receives 230-250 million tons from an area of 28-29 million hectares with a yield of not less than 7,9-8,0 tons/ha, in second place is China, which annually collects 120-130 million tons, EU countries produce 39 million tons of corn grain with an average yield of 8,8-9,0 t/ha [11, 14].

Obtaining consistently high yields of corn grain is extremely important for agricultural production in Ukraine. But the potential of modern hybrids is used only by 40-50%. The average yield is 5,02 t/ha, while zoned hybrids and varieties of corn have a potential productivity of 10-15 t/ha, and therefore agricultural producers in Ukraine have a task to significantly increase the productivity of corn for the needs of the national economy [10, 13].

The largest areas under corn are allocated in the Forest-Steppe and Polissya – 1,52 million hectares or 68,2% against 31,8% in the Steppe zone of Ukraine. The first places in terms of the area of this crop for grain were taken by Poltava (306,7 thousand hectares), Dnipropetrovsk (2003), Cherkasy (188,9), Chernihiv (165) and Vinnytsia (144,3 thousand hectares) [1] .

The development of biologization of plant growing is an important scientific and industrial problem, the successful solution of which largely depends on the level of competitiveness of agricultural products in the world, European and domestic markets, the ecological state of the environment.

Scientifically based application of technologies or elements of technologies with the use of new liquid complex fertilizers allows not only to increase yields, improve its quality, but also to affect ripening, significantly increase plant resistance to diseases and stress factors, reduce fertilizers and pesticides, reduce content of heavy metals and nitrites in crop products.

In the current economic crisis in the agro-industrial complex due to a sharp reduction in the application of organic fertilizers and the high cost of mineral applications of humic, bacterial, phytohormonal drugs, trace elements in the technology of growing crops is becoming more common. These drugs promote the synthesis in plants of a full range of enzymes that allow more intensive use of energy, water and nutrients. Plants can be fed in two ways: from the air through the green leaves and from the soil - through the root system. Therefore, there are air and root nutrition of plants. Root nutrition of plants is possible not only through the soil, but also through other environments. Growing plants without soil in artificial nutrient media is called hydroponics. Water and mineral nutrients enter the plants during periodic automatic spraying with special nozzles. Great importance of plant nutrition is currently given to foliar plant nutrition. Mineral salts from weak solutions can penetrate into a plant through leaves, and at the same time exchange adsorption is shown. Therefore, foliar feeding has been used in many technologies for growing crops [12].

An important component of modern intensive technologies for growing high yields of agricultural plants is the use of biologically active compounds that can affect the intensity of physiological processes and change the desired direction of metabolism and accordingly affect the production process of agricultural production [10].

Foliar feeding provided an increase in chlorophyll content in the leaves by 5-36%, compared with the control (without fertilization). An important advantage of foliar fertilization is that they can be combined with pesticide treatment of crops, in addition, the dose of their costs is recommended to reduce by 20-30% [7].

Among the studied maize hybrids, the maximum indicators of leaf surface area were formed by hybrids DKS 3871, DK 391 and DKS 4964. During foliar fertilization, the leaf surface area increased by 0,6-5,6 thousand $m^2$/ha, compared with control (without fertilization). The maximum value of the total area of assimilation surface of leaves (28,9-41,9 thousand $m^2$/ha) was determined in the variant of application of double fertilization in phases 5-7 and 10-12 leaves of corn with microfertilizer "Ecolist monozinc", with the growth of the indicator relative to control was 2,4-5,0 thousand $m^2$/ha [6].

One of the promising ways to increase crop productivity and product quality is the use of growth regulators, which allows to realize the potential of plants inherent in nature and selection, to regulate ripening, improve product quality and increase crop yields. Plant organisms in natural conditions are exposed to various adverse environmental factors. The ability to resist extreme conditions is the basis of plant existence. The implementation of the mechanisms underlying the adaptation of plants to stressful conditions requires high energy costs and is accompanied by a simultaneous reduction in the energy supply of productivity processes. Therefore, the use of

endogenous growth regulators, in the spectrum of physiological action of which there is a clear anti-stress effect, to increase the stability and productivity of cultivated plants of the basic requirements for such means of protection include low loss rates, rapid disposal in nature, inability to accumulate in soil and food products [8].

To significantly improve the food problem, world agriculture desperately needs new high-efficiency, low-cost agrobiotechnologies, among which an important role belongs to the widespread use of plant growth regulators or so-called biostimulants.

Synthetic physiologically active growth regulators, together with their beneficial effects, can have a negative side effect on plants. Out of 60 plant growth regulators registered by the Ministry of Ecology and Natural Resources of Ukraine and included in the list of drugs permitted for use in agro-industrial production, 13 plant growth regulators are registered by the Institute of Bioorganic Chemistry and Petrochemistry. Under the influence of biostimulants, the adaptive capacity of plants to specific growing conditions is enhanced, and the influence of stress factors is reduced. In general, under the influence of biostimulants, the genetic potential of plants created by nature and selection work is more fully realized.

Biologically active substances (BAS), including phytohormones - regulators (stimulators) of growth and development of plants (PPP), in modern conditions are becoming increasingly important. Their application in agriculture, crop production and forestry gives results that cannot be achieved by other methods. The use of these drugs allows you to more fully realize the genetic potential, increase the resistance of plants to stressors of biotic and abiotic nature and ultimately increase yields and improve its quality. In view of this, the United Nations in 1973 recommended the use of PPPs worldwide to increase production in agro-industrial complexes. It is believed that, along with fertilizers and pesticides, they should play an important role in systems of improving plant production technologies.

According to scientific research, among the permitted for use of domestic growth regulators the most noteworthy are biostimulants of a wide range of applications, developed at the Institute of Bioorganic Chemistry and Petrochemistry and the state enterprise ISTC "Agrobiotech" NASU, in particular: Agrostimulin, for Radostim, Biostim individual cultures: Zeastimulin, Betastimulin, Poteitin and others.

According to the results of inspections in dozens of institutions and hundreds of leading and basic farms, these drugs help to increase crop yields by 14-21% at the cost of their acquisition and use in tens and hundreds of times less than the cost of yield gains from them. In many farms, the increase in grain yields from the best domestic biostimulants on winter wheat crops is 5-7 kg/ha, corn - 7-10, green mass of corn - 50-100 kg/ha [2].

Under the influence of biostimulants, the adaptive capacity of plants to specific growing conditions is enhanced, the influence of stress factors is reduced, and the genetic potential of plants created by nature and selection work is more fully realized. According to expert estimates, the use of growth regulators on one third of arable land in Ukraine (10 million hectares) will provide an additional 3 million tons of grain of improved quality.

New generation plant growth stimulators and developed technologies for their application for more than 50 crops are a world-class achievement. Field studies have shown that the created biologicals activate the main processes of plant viability, membrane processes, regulate cell division and function of photosynthesis systems, respiratory and plant nutrition processes by activating the rhizosphere of plants, which reduces negative processes.

Growth regulators are able to directly influence and regulate important processes of growth and development of plants, increase the efficiency of realization of potential productivity of varieties and hybrids, embedded in the structure of DNA by classical selection or by genetic engineering methods. A detailed study of the nature of the action of growth regulators on plants reveals their new properties. The use of growth regulators reduces the negative impact of the environment, helps to increase plant productivity and improve product quality.

In the current economic crisis in the agro-industrial complex due to a sharp reduction in the application of organic fertilizers and the high cost of mineral applications of humic, bacterial, phytohormonal drugs, trace elements in the technology of growing crops is becoming more common.

Thus, only through the balanced use of fertilizers containing trace elements and modern biostimulants can you get the maximum yield of proper quality, which is genetically embedded in corn seeds.

**The purpose** of the research is to scientifically substantiate the influence of growth stimulants and microelements on the yield of corn hybrids on grain in the experimental field of VNAU of Agronomichne village.

**Presenting main material.**

Not only nitrogen, phosphorus and potassium, but also micro- and mesoelements are necessary for normal development of corn plants: iron (Fe), copper (Cu), molybdenum (Mo), manganese (Mn), zinc (Zn), boron (B)., sulfur (S) and others, which are involved in all physiological processes of plant development, increase the efficiency of many enzymes in the plant body and improve plant absorption of nutrients from the soil. Most trace elements are active catalysts that accelerate biochemical reactions and influence their direction. That is why trace elements cannot be replaced by any other substances and their lack can negatively affect the growth and development of plants.

Without micronutrients, it is impossible to fully absorb basic fertilizers (nitrogen, phosphorus and potassium) by plants. Lack of trace elements disrupts metabolism and the course of physiological processes in the plant. Trace elements promote the synthesis in plants of a full range of enzymes that allow more intensive use of energy, water and trace elements. Only through the balanced application of fertilizers containing trace elements, you can get the maximum

yield of proper quality, which is genetically laid down in the seeds of crops. Lack of trace elements in an accessible form in the soil leads to a decrease in the speed of the processes responsible for plant development. Ultimately, this leads to crop losses, its class and unsatisfactory organoleptic properties [9].

Today, Ukraine has a significant shortage of micronutrients in the soil, as in recent years, agronomists have followed intensive technologies for growing crops, and the supply of micronutrients in the soil has been significantly reduced due to a significant reduction in cattle. Lack of micronutrients in the soil causes a decrease in yield, its quality, damage to plants by pests and diseases.

Foliar fertilization is an effective way to fertilize crops, including corn. It should be noted that this method of plant nutrition has long been known, but has become widespread in recent years. Leaf (foliar) application of microelements is especially effective. The effectiveness of foliar application of trace elements is many times higher compared to the introduction into the soil.

The efficiency of assimilation of microelements is especially influenced by the form in which they are. Thus, it is generally known that the most effective is a chelated, ie organic, form in which the trace element (preferably a metal) is in contact with a chelating agent (preferably an organic acid). The effectiveness of dressing gowns in foliar feeding, according to various studies, is 5-10 times better compared to salt forms. Despite the small amount of micronutrient consumption by plants, they play no less important role in crop formation than micronutrients. The lack of any element can be a limiting factor. It is known that the utilization rate of soil nutrients is low: for nitrogen and potassium fertilizers it is from 30 to 60%, for phosphorus on different soils - from 15 to 40%, and for trace elements - less than 1% of mobile forms of trace elements. in the soil. These facts allow us to draw certain conclusions about the effective organization of plant nutrition.

Even with a sufficient number of trace elements in the soil, plants can not always absorb them. In fact, any weather and soil conditions significantly affect the availability of trace elements for plants.

The microelements applied on a leaf surface easily get into plants, are well assimilated, give fast effect. In foliar nutrition, macro and micronutrients are directly involved in the synthesis of organic matter in the leaves or transferred to other plant organs and used in metabolism.

Foliar feeding, in which nutrients in mobile forms enter plants, is usually much more effective than fertilizing the soil. Timely foliar fertilization makes it possible to provide plants with macro- and microelements in critical phases of development when they need them most, reduce stress due to adverse environmental factors, prevent disease due to lack of certain elements, create optimal conditions for plant growth and development.

Analysis of the results of the experiment to study the duration of the period "sowing-seedlings" was different. It is known that this period depends on the temperature of the soil, the reserves of productive moisture in the seed layer, and in our case, and the treatment of corn seeds with growth stimulant Biolan. Thus, in the variants where the PR39D81 maize hybrid was sown and the seeds were not treated, the sowing-germination period lasted 12 days, and in the areas where the maize seeds were treated with a growth stimulant, this period lasted 10 days. Accordingly, in these variants there was a better field germination of corn seeds and was 90,5%, while in areas without treatment with growth stimulant, this figure was 87,6% (Table 1.).

Thus, the best conditions for the formation of grain productivity of corn have developed when processing seeds before sowing growth stimulant Biolan at a rate of 15 ml/t.

Table 1

The effect of growth stimulants on the duration of emergence and field germination of corn seeds average (2019-2020)

| Experiment options | Duration of the period "sowing-seedlings", days | +/- to control days | Field similarity,% | +/- to control % |
|---|---|---|---|---|
| PR39D81 (FAO 260) | | | | |
| Control (without processing) | 12 | - | 87,6 | - |
| Biolan 15 ml/t | 10 | - 2 | 90,5 | +2,9 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha | 10 | - 2 | 90,5 | +2,9 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha + Chelatin Zinc, 1 l/ha | 10 | - 2 | 90,5 | +2,9 |
| PR38D89 (FAO 330) | | | | |
| Control (without processing) | 12 | - | 88,5 | - |
| Biolan 15 ml/t | 11 | - 1 | 90,7 | + 2,2 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha | 11 | - 1 | 90,7 | + 2,2 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha + Chelatin Zinc, 1 l/ha | 11 | - 1 | 90,7 | + 2,2 |

An important factor that ensures high productivity of crops is the density of its plants. It creates a significant impact on the growth, development and formation of productivity elements in corn. At the optimal density of standing corn plants grow better without competing with each other for nutrients and moisture. They do not overshadow each other, which creates favorable conditions for development.

Calculations of the density of standing corn plants in the experiment, conducted in the phase of full

germination and before harvest, showed that these indicators did not differ much from each other. Thus, in crops where no growth stimulants were used (control variant), the crop density of maize hybrid PR39D81 (FAO 260), in the phase of full germination, was 67,5 thousand units/ha, and before harvest – 65,5 thousand units /ha.

In areas where corn seeds were treated with Biolon growth stimulant, at a rate of 15 ml/t of both maize hybrids, the density of maize crops in the phase of full germination was higher and amounted to 68,3 thousand units/ha. Before harvesting corn, the density of crops in the control plots of corn hybrids was in the range of 65,5 thousand units/ha. The application of growth stimulants and microfertilizers also affected the crop density before harvest.

Thus, when applying Biolan 15 ml/t + Quantum Gold 2 l/ha, the crop density of the hybrid PR39D81 was 67,8 thousand units/ha, which is more than the control plots by 2,3 thousand units/ha, and the hybrid PR38D89 67,6 thousand pieces/hectare that is more than control sites on 2,1 thousand pieces/hectare. The highest density of maize crops before harvest was observed in areas where maize hybrid PR38D89 was sown and maize seeds before sowing were treated with growth stimulant Biolan, and during the growing season microfertilizers were applied + Quantum-Gold 2 l/ha, Chelatin Cylatin at the level of 68,0 thousand units/ha, which is more than the control plots by 2,5 thousand units/ha.

In areas where growth stimulants Biolan and quantum-Gold microfertilizer were used during the period of vase of full seedlings of PR39D81 hybrid corn, this figure was 68,3 units/ha, and for the harvest period, respectively, 67,8 units/ha, which is 2,3 thousand units/ha more than in the control (Table 2).

Due to favorable conditions of moisture supply, corn plants were noted in the phase of ejection of panicles. 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 conditions for accelerating the linear growth of plants [1].

Table 2

The effect of drugs on the density of standing corn plants, average (2019-2020)

| Experiment options | Density of corn crops, thousand pieces / hectare | | |
|---|---|---|---|
| | Phase of full shoots | Before harvesting | +/-, to control before harvesting |
| PR39D81 (FAO 260) | | | |
| Control (without processing) | 67,5 | 65,5 | - |
| Biolan 15 ml/t | 68,3 | 67,1 | +1,6 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha | 68,3 | 67,8 | +2,3 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha + Chelatin Zinc, 1 l/ha | 68,3 | 68,1 | +2,6 |
| PR38D89 (FAO 330) | | | |
| Control (without processing) | 67,5 | 65,5 | - |
| Biolan 15 ml/t | 68,3 | 67,0 | +1,5 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha | 68,3 | 67,6 | +2,1 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha + Chelatin Zinc, 1 l/ha | 68,3 | 68,0 | +2,5 |

The use of Biolan growth stimulant before sowing and foliar application of 4-6 leaves of corn microfertilizer Quantum Gold, both individually and jointly, had a positive effect on the height of corn plants during the harvest and the number of cobs on the stems. Thus, the height of maize plants of hybrid PR39D81 in the control areas was on average 189,5 cm, and in areas where the growth stimulant Biolan and microfertilizers were used, the height of plants for the period of harvesting corn cobs was 197,0-198,5 cm, which is more than in the control option at 5,4-12,1 cm

The highest height of maize plants was observed in areas where maize seeds before sowing were treated with growth stimulant and during the growing season foliar fertilization was carried out with microfertilizer Quantum Gold + Chelatin Zinc at a rate of 1,0 l/ha, the height of corn plants of the hybrid PR39D81 was 198,5 cm, and the hybrid PR38D89 – 210,5 cm, which is more than the control areas by 9,0-16,8 cm. Accordingly, in these areas there were more cobs - per 100 plants of the hybrid corn PR39D81 – 146,1 pcs. cobs, which is more than the control by 12,1 pcs. cobs per 100 plants of this crop, and on the maize hybrid PR38D89 the number of cobs per 100 plants was 152 pieces, which is more than the control plots by 16 pieces (Table 3).

Table 3

Plant height and number of corn cobs average (2019-2020)

| Experiment options | Plant height, cm | +/- to control days | Number of cobs per 100 plants, pcs | +/- to control % |
|---|---|---|---|---|
| PR39D81 (FAO 260) | | | | |
| Control (without processing) | 189,5 | - | 134,0 | - |
| Biolan 15 ml/t | 192,8 | 3,3 | 136,6 | 2,6 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha | 197,0 | 7,5 | 139,4 | 5,4 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha + Chelatin Zinc, 1 l/ha | 198,5 | 9,0 | 146,1 | 12,1 |
| PR38D89 (FAO 330) | | | | |
| Control (without processing) | 193,7 | - | 136,0 | - |
| Biolan 15 ml/t | 197,4 | 3,7 | 139,3 | 3,3 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha | 203,4 | 9,7 | 143,7 | 7,7 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha + Chelatin Zinc, 1 l/ha | 210,5 | 16,8 | 152,0 | 16,0 |

Thus, we can conclude that the action of plant growth stimulants and foliar application of micronutrients has a positive effect on the development, growth and number of cobs of corn when growing it for grain. The effect of biostimulants and microfertilizers on the growth of corn crop productivity is due to the fact that they intensify the activity of membranes and accelerate biochemical processes in them, which leads to increased processes of nutrition, respiration and photosynthesis. Thanks to these drugs, the resistance of crops to adverse weather conditions and to their damage by pests and diseases increases. In general, under the influence of biostimulants, the genetic potential of plants created by nature and selection work is more fully realized.

Energy-saving technologies of application, both for seed treatment and crop spraying, have been developed. Biostimulants promote the development of a strong and branched root system with the formation of a healthy microbiological environment in the rhizosphere with enhanced development of phosphate-mobilizing and nitrogen-fixing bacteria. Under the influence of biostimulants, the adaptive capacity of plants to specific growing conditions is enhanced, and the influence of stress factors, both natural and anthropogenic, is reduced.

Thus, on average, the grain yield of corn in variants where corn seeds were not treated before sowing and during the growing season with a growth stimulant, the average yield of hybrids for the years of research was 5,06 – 6,32 t/ha, 5,96-6,93 t/ha. In areas where maize seeds were treated with growth stimulant Biolan and during the growing season of maize plants foliar fertilization was carried out with microfertilizers Quantum Gold, 2 l/ha and Chelatin Zinc, 1 l/ha grain yield of hybrid corn maize control3 compared with t / ha and amounted to 6,79 t/ha, and the grain yield of maize hybrid PR38D89 on average for two years of research was in the range of 8,17 t/ha (Table 4).

Table 4

Influence of growth stimulants and microfertilizers for grain yield of maize hybrids

| Experiment options | Grain yield, t / ha | | | +/- to control |
|---|---|---|---|---|
| | 2019 | 2020 | average | |
| PR39D81 (FAO 260) | | | | |
| Control (without processing) | 6,12 | 4,00 | 5,06 | - |
| Biolan 15 ml/t | 7,33 | 4,58 | 5,96 | + 0,90 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha | 7,84 | 5,00 | 6,42 | + 1,36 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha + Chelatin Zinc, 1 l/ha | 8,23 | 5,35 | 6,79 | + 1,73 |
| $NIR_{05}$ | 1,21 | 1,22 | | |
| PR38D89 (FAO 330) | | | | |
| Control (without processing) | 7,72 | 5,06 | 6,32 | - |
| Biolan 15 ml/t | 8,36 | 5,50 | 6,93 | + 0,61 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha | 8,85 | 5,95 | 7,40 | + 1,08 |
| Biolan 15 ml/t + Quantum Gold 2 l/ha + Chelatin Zinc, 1 l/ha | 9,57 | 6,77 | 8,17 | +1,85 |
| $NIR_{05}$ | 1,22 | 1,23 | | |

It should be noted the peculiarity of medium-ripe and medium-early-ripening hybrids, which had slow growth in the early stages of development to respond to the action of growth-stimulating drug Ratchet. Grain yields for these hybrids were significantly higher in the variants where the growth stimulator Ratchet was used. This feature has a clear expression in the years of spring cold stress for corn plants. At the same time, the best the result (5,90 t/ha of grain) was observed in a hybrid of domestic selection Khorol SV [15].

Thus, the use of growth stimulant Biolan at a rate of 15 ml/t and foliar application of quantum fertilizer Quantum Gold at a rate of 2,0 l/ha and Chelatin Zinc, 1 l/ha promotes better development of maize plants and increases the productivity of its photosynthesis, which ultimately reflected in an increase in corn grain yield.

**Conclusions**

1. Analysis of the results of the experiment to study the duration of the period "sowing-seedlings" was different. It is known that this period depends on the temperature of the soil, the reserves of productive moisture in the seed layer, and in our case, and the treatment of corn seeds with growth stimulant Biolan. Thus, in the variants where the PR39D81 maize hybrid was sown and the seeds were not treated, the "sowing-germination" period lasted 12 days, and in the areas where the corn seeds were treated with a growth stimulant, this period lasted 10 days. Accordingly, in these variants there was a better field germination of corn seeds and was 90,5%, while in areas without treatment with growth stimulant, this figure was 87,6%.

2. Calculations of the density of standing corn plants in the experiment, conducted in the phase of full germination and before harvest, showed that these indicators did not differ much from each other. Thus, in crops where no growth stimulants were used (control variant), the crop density of maize hybrid PR39D81 (FAO 260), in the phase of full germination, was 67,5 thousand units/ha, and before harvest – 65,5 thousand units/ha.

3. The highest height of corn plants was observed in areas where corn seeds before sowing were treated with growth stimulant and during the growing season foliar fertilization was carried out with microfertilizer Quantum Gold + Chelatin Zinc at a rate of 1,0 l/ha, the height of corn plants of the hybrid PR39D81 was 198,5 cm, and the hybrid PR38D89 – 210,5 cm, which is more than the control areas by 9,0-16,8 cm. Accordingly, in these areas there were more cobs - per 100 plants of the hybrid corn PR39D81 – 146,1 pcs. cobs, which is more than the control by 12,1 pcs. cobs per 100 plants of this culture, and on the maize hybrid PR38D89 the number of cobs per 100 plants was 152 pieces, which is more than the control plots by 16 pieces.

4. In areas where corn seeds were treated with growth stimulant Biolan and during the growing season of corn plants was carried out foliar fertilization with microfertilizers Quantum Gold, 2 l/ha and Chelatin Zinc, 1 l/ha grain yield of hybrid corn control 1 corn compared to 81 corn, 73 t/ha and amounted to 6,79 t/ha, and the grain yield of maize hybrid PR38D89 on average for two years of research was in the range of 8,17 t/ha.

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