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PECULIARITIES OF GROWTH AND DEVELOPMENT OF SUNFLOWER DEPENDING ON BIOPREPARATIONS

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Pre-sowing treatment of seeds with biological products is now one of the promising agricultural techniques in the technology of growing crops. Most seeds are treated before or just before sowing. The use of biological products, in the first place, increases the resistance of seedlings and plants against adverse environmental influences, diseases and pests, activation of plant growth and development, which in turn should lead to increased yields and product quality. Evaluation of the effect of the studied biological products on field germination showed that the biological products Flavobacterin and Mizorin, as in laboratory studies, had a more stimulating effect on the germination of sunflower seeds. As a result of pre-sowing treatment of sunflower seeds with these biological products, the field similarity over the years of research (2019–2021) was 92.0 and 93.7 %, respectively, for biological products, with 87 % under control. Pre-sowing treatment of seeds with other studied biological products also contributed to the increase of field germination against control: Albite – 89.2 %; Extrasol – 91.0 %. A slight effect on the effect on sunflower yield was in the version with the biological product Flafobacterin on all three methods of application. Thus, when using this biological product, the yield compared to the control increased by the methods of application of 0.03–0.23 t/ha. In addition, for each biological product, you can find the most effective way to use it, as a result of which it is possible to obtain the largest collection of oil per unit area. Thus, the biological product Albit worked most effectively with double treatment (pre-sowing seed treatment + spraying on vegetative plants), in this case the yield was 2.9 t/ha. The active substance of Albit is polybetahydroxybutyric acid from soil bacteria, the substance is more resistant to environmental factors than the living microorganisms. Therefore, there is also the effect of spraying vegetative plants, in contrast to biological products containing live microorganisms.

Keywords: *sunflower, pre-sowing treatment, biological preparations, seed treatment methods, sowing properties.*

ОСОБЛИВОСТІ РОСТУ ТА РОЗВИТКУ СОНЯШНИКА ЗАЛЕЖНО ВІД БІОПРЕПАРАТІВ

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Передпосівна обробка насіння біологічними препаратами є нині одним із перспективних агротехнічних прийомів у технології вирощування сільськогосподарських культур. В основному насіння обробляють заздалегідь або безпосередньо перед посівом. Застосування біологічних

препаратів, в першу чергу, впливає на підвищення стійкості проростків і рослин проти негативних впливів зовнішнього середовища, ураження хворобами та шкідниками, активацію процесів росту та розвитку рослин, що в результаті має призвести до підвищення врожайності та якості продукції. Оцінка впливу біопрепаратів, що вивчаються, на польову схожість показала, що біопрепарати Флавобактерін і Мізорін, як і в лабораторних дослідженнях, мали більш стимулюючу дію при проростанні насіння соняшника. Внаслідок передпосівної обробки насіння соняшнику даними біопрепаратами польова схожість у середньому за роки досліджень (2019–2021 рр.) склала 92,0 та 93,7 % відповідно за біопрепаратами, при 87 % на контролі. Передпосівна обробка насіння іншими досліджуваними біопрепаратами також сприяла підвищенню польової схожості проти контролю: Альбіт – 89,2 %; Екстрасол – 91,0 %. Незначний ефект щодо впливу на врожайність соняшника був у варіанті з біопрепаратом Флафобактерин на всіх трьох способах застосування. Так, при застосуванні даного біопрепарату врожайність порівняно з контролем зростала за способами застосування 0,03–0,23 т/га. Крім того, для кожного біопрепарату можна виявити найбільш дієвий спосіб його застосування, в результаті якого можливо отримати найбільший збір олії з одиниці площі. Так, біопрепарат Альбіт найбільш ефективно спрацював при дворазовій обробці (передпосівна обробка насіння + обприскування по рослинах, що вегетують), на даному варіанті врожайність склала 2,9 т/га. Діючою речовиною Альбіта є полібетагідроксимасляна кислота з ґрунтових бактерій, речовина більш стійка до факторів зовнішнього середовища, ніж самі живі мікроорганізми. Тому тут спостерігається також ефект від обприскування рослин, що вегетують, на відміну від біопрепаратів, що містять живі мікроорганізми.

Ключові слова: *соняшник, передпосівна обробка, біологічні препарати, способи обробки насіння, посівні властивості.*

Introduction

The formation of the crop and its quality is considered as a process that occurs on the basis of the plant's phenological phases and stages of growth and development. Phases of growth and development and stages of organogenesis are characterized by different requirements for environmental conditions. High yields of sunflower can be obtained with significant reserves of moisture in the soil, which are formed mainly due to autumn-winter precipitation in the root layer of the soil [1].

In recent decades, a fairly common measure in both intensive and adaptive technologies for growing crops is the use of microfertilizers and biologics, which increase the use of soil resources by plants, increase yields [2]. However, the development of such technologies requires research as close as possible to the conditions of production to determine the effectiveness of both individual drugs and their integrated use, to establish the characteristics of the reaction of varieties to each of the drugs. In the conditions of the left-bank Forest-Steppe of Ukraine such researches on sunflower culture were not carried out that testifies to their urgency [3–5].

The formation of the sunflower crop is a process determined, on the one hand, by the characteristics of plants, and on the other - a number of external factors, including those that are regulated to varying degrees by man [6]. Among the biological features the most important are the ability of hybrids to create a coenosis with a certain height and weight of plants, to form an area of leaves that would not limit the intensity of photosynthesis, to be resistant to adverse growing conditions due to different vegetation periods and individual interphase periods. nutrition and use them to form a crop of a certain quality [4, 7].

Sunflower is one of the most profitable field crops.

Obtaining low yields of this crop is largely due to the negative impact of diseases, pests and weeds. On the other hand, the growth and development of sunflower plants is influenced not only by biotic factors [8].

The work of many scientists has shown the great influence of physiologically active substances of synthetic or natural origin on metabolism in the plant, resulting in changes in the growth and development of the whole organism or its organs and increases resistance to stressors [9–11].

Growth regulators do not replace fertilizers, but supplement them in the system of crop nutrition, increase the utilization of nutrients from soil and fertilizers [12]. These drugs are usually used for seed treatment before sowing and in the phase of 3-5 pairs of sunflower leaves [13]. At the same time, the yield can increase by 0.22–0.31 t/ha, and the fat content by 0.3–0.5 % [14].

It was also effective to spray plants with solutions of these drugs in the phase of 4 pairs of leaves (yield increased by 0.42 t/ha, oil content – by 1.5–2.6 %) [15].

Climatic conditions play an exceptional role in this process, as they largely determine the nature of the relationship between all components of the agrocenosis. Therefore, an important problem is not only the fight against diseases and pests, but also with the full range of other environmental stressors [16].

In the current ecological situation, the use of highly effective plant growth regulators, safe for humans and the environment, is of great scientific and practical importance in the formation of high-yielding sunflower agrocenoses, as in a relatively short time a significant number of domestic microbial drugs were created. [17].

Proper use of biological products ensures high agronomic and economic results. In addition, they significantly improve the environmental and sanitary environment. Their use allows more efficient use of material and energy resources and to solve many issues caused by environmental pollution by agrochemicals and pesticides [18].

The aim of the research was to determine the impact of different variants of biological products and methods of their application on the growth, development and formation of elements of sunflower productivity in different weather conditions of the growing season.

Determining the best options for the use and implementation of biological products in the cultivation of sunflower will reduce the chemical load on soils and produce more environmentally friendly products, increase plant productivity and provide the processing complex with high quality raw materials.

Materials and methods of research

The research was conducted during 2019–2021 in the fields of Olimp - Agro LTD LLC, which is located in the village of Kruty Bereg, Lubny district, Poltava region, according to the generally accepted method. The soil of the research area is sod-podzolic chernozem, slightly humus. The content of humus in the arable layer is 2.4–2.8 %, mobile phosphorus (according to Chirikov) – 11.6 mg, potassium – 9.1 mg per 100 g of soil.

The absorbing complex is saturated with magnesium and to a lesser extent calcium, such elements as metabolic sodium and potassium contain a small amount.

The reaction of the aqueous suspension within the first meter is slightly alkaline. The total field moisture content of the soil, for a meter layer, is 204.6 mm, wilting moisture – 70.2 mm, the range of available moisture – 134.4 mm.

The use of biological products should be accompanied by numerous studies of their impact on plant growth and development, the formation of elements of crop yields. All this determined the choice of the direction of our research.

The research was conducted according to the following scheme:

Factor A. Biologicals:

1. Control (without treatment with biological products).
2. Albite (poly-beta-hydroxybutyric acid) – 0.35 l/t.
3. Extrasol (Bacillus subtilis Ch-13) – 1 l/t.
4. Misorin (Arthrobacter mysorens) – 0.3 kg per hectare of seeds.
5. Flavobacterin (Flavobacterium sp. JT 30) – 0.3 kg per hectare of seeds.

Factor B. Methods of treatment with biological products:

1. Seed treatment before sowing.
2. Spraying crops in the budding phase.
3. Seed treatment before sowing + spraying crops in the budding phase.

In all years of research, the predecessor of the studied crop was spring wheat. The President cultivated the sunflower variety in experiments. The repetition of field experiments was four times, the location of sites is systematic. The analysis of plant samples was performed in the grain quality laboratory of the Department of Plant Breeding of PSAU.

The following records, observations and laboratory analyzes were performed to evaluate the obtained results:

1. Laboratory experiments were conducted to establish the effectiveness of biological products before the field experiments with biological products on sunflower. Laboratory studies have identified indicators such as germination energy, laboratory seed germination, root and sprout length, and seedling weight.

When taking into account the germination energy, only seeds that germinated normally and clearly rotted were counted and removed, and when germination was taken into account, normally germinated, swollen, hard, rotten and abnormally germinated seeds were counted separately. Measurements of linear indicators of seedlings (length of sprout and root, mass of seedlings) were performed after 5 days of supply for germination.

2. To assess the impact of biological products on plant development, phenological observations were conducted, which consisted in the registration of phases of sunflower development. The individual phases differ in appearance of plants.

The beginning of the phase was considered the period when it entered 10–15 % of plants, if it entered 70–75 % of plants, the phase was considered complete. Phenophases were determined visually, simultaneously throughout the experiment.

3. Biometric observations and records were performed on 25 fixed plants and in the same sequence of rows as in phenological observations.

Research results and their discussion

Evaluation of the effect of the studied biological products on field germination showed that the biological products Flavobacterin and Mizorin, as in laboratory studies, had a more stimulating effect on the germination of sunflower seeds [19–21].

As a result of pre-sowing treatment of sunflower seeds with these biological products, the field similarity over the years of research (2019-2021) was 92.0 and 93.7 %, respectively, for biological products, with 87 % under control. Pre-sowing treatment of seeds with other studied biological products also contributed to the increase of field germination against control: Albite – 89.2 %; Extrasol – 91.0 %.

Increased field germination with biological products is associated with the positive effects of Arthrobacter mysorens, strain 7 and Flavobacterium sp. (strain JT 30) which are part of the drugs Misorin and Flavobacterin.

The positive effect of pre-sowing seed treatment does not end with an increase in field germination, it lasts throughout the growing season, which can be seen in the analysis of the preservation of plants before harvest.

Under the preservation of plants is the number of preserved plants before the harvest from the number of seedlings.

According to the years of research, the preservation of sunflower plants before the time of harvest in the control version was 89 % (42.6 thousand plants per hectare).

The results obtained on the preservation of sunflower plants on the options of experience, with the use in the preparation of seeds and spraying of vegetative plants with Extrasol and Misorin indicates their positive effect on this indicator in all study areas compared to control. Thus, seed treatment increased plant safety with Misorin to 93.4 %, and double treatment with Extrasol to 92.9 %. There was a slight decrease in plant safety with the use of biological products Albit and Flavobacterin, which is associated with the loss of plants during the growing season.

In this case, for both biological products, the greatest loss of plants was during seed treatment before sowing. Treatment of seeds and plants with biological products contributed to the increase of biometric indicators. In our studies, the most significant indicators were for the use of biologicals Extrasol and Misorin. In the case of double treatment with these biological products (treatment of seeds and vegetative plants), the height of plants on average over the years of research was 169.0 and 166.4 cm, respectively, for biological products, while in the control – 160.0 cm (Tabl. 1).

1. Field germination and preservation of sunflower plants before harvest (2019–2021)

Factor A	Factor B	Number of plants on the stairs, thousand pcs/ha	Field germination, %	Number of plants before harvest, thousand pieces / ha	Preservation of plants%
Control	without processing	47,85	87,0	42,6	89,0
Albit	seed treatment before sowing	48,95	89,0	42,8	87,4
	spraying in the budding phase	47,96	87,2	43,7	91,1
	seed treatment before sowing + spraying in the budding phase	49,06	89,2	43,4	88,5
Extrasol	seed treatment before sowing	50,05	91,0	45,9	91,7
	spraying in the budding phase	48,07	87,4	42,4	88,2
	seed treatment before sowing + spraying in the budding phase	50,05	91,0	46,5	92,9

Misorin	seed treatment before sowing	51,48	93,6	48,1	93,4
	spraying in the budding phase	47,96	87,2	43,8	91,3
	seed treatment before sowing + spraying in the budding phase	51,53	93,7	46,6	90,4
Flavobacterin	seed treatment before sowing	50,43	91,0	43,14	86,2
	spraying in the budding phase	47,85	87,0	42,1	88,0
	seed treatment before sowing + spraying in the budding phase	50,71	92,0	44,3	87,3

According to the results of research, it was found that, depending on the use of biological products, the linear growth of sunflower plants increases. Thus, in the control variant, the linear gain was 1.68 cm/day. When using the biological product Extrasol – 1.85 cm/day, an increase over the control of 10.1 %. For other biological products, there is also an increase in linear growth (Tabl. 2).

2. Influence of biological preparations on the height of sunflower plants

Factor A	Factor B	Height of plants in the phase of full flowering, cm			Average 2019–2021, cm
		2019	2020	2021	
Control	without processing	158,5	170,3	151,3	160,0
Albit	seed treatment before sowing	164,2	176,1	152,1	164,2
	spraying in the budding phase	161,9	176,2	153,9	164,0
	seed treatment before sowing + spraying in the budding phase	164,0	176,2	156,5	165,6
Extrasol	seed treatment before sowing	165,1	178,6	158,9	167,6
	spraying in the budding phase	159,2	171,9	154,0	161,7
	seed treatment before sowing + spraying in the budding phase	167,6	180,2	159,2	169,0
Misorin	seed treatment before sowing	164,0	178,3	155,4	165,9
	spraying in the budding phase	158,9	171,1	153,3	161,1
	seed treatment before sowing + spraying in the budding phase	164,8	178,7	155,8	166,4
Flavobacterin	seed treatment before sowing	160,0	172,5	153,6	162,0
	spraying in the budding phase	159,0	171,0	152,8	160,9
	seed treatment before sowing + spraying in the budding phase	160,1	173,0	153,9	162,3

According to the results of our research, it was found that the treatment of sunflower seeds and plants with biological preparations led to a significant activation of growth and reproductive processes, resulting in a significant increase in yield compared to the control option [12].

On average, over the years of research (2019–2021), the largest yield of sunflower seeds was formed on the variants with pre-sowing seed treatment and treatment of both seeds and vegetative plants with Extrasol bioreparate. In these variants, the yield was 3.1 and 2.8 t/ha, respectively, by type of cultivation, the excess over the control variant was 0.78 and 0.71 t/ha, or 38.0 and 35.0 % more. Also high yields were in the version with the biological product Mizorin, in addition to spraying from the growing season. The excess over control in seed treatment and double treatment with Misorin was 0.61 and 0.62 t/ha or 30 %.

At the same time, biologicals Extrasol, Mizorin, Flavobacterin did not show high results when sprayed during the growing season of sunflower. Thus, for all drugs in this method of application, the yield was higher than the control variant by only 0.03–0.08 t/ha, which is probably due to the content of drugs in its basis of living microorganisms, which are released into the environment. actions of various environmental factors, especially the action of sunlight.

Conclusions

The use of biological products Albit and Extrasol reduces the growing season of sunflower by 4–5 days (control 125 days). Treatment of seeds with biological products Flavobacterin and Mizorin increases the field

germination of sunflower seeds from 87 % in control to 92.0 and 93.7 %, respectively, for biological products. When seed treatment with Extrasol, the field germination of seeds was 91 %; Albite–89.2 %. Preservation of sunflower plants before harvest in the control version was 89 % (42.6 thousand plants per hectare). Seed treatment increased plant safety with Misorin to 93.4 %, and double treatment with Extrasol to 92.9 %.

Prospects for further research. Given the high efficiency of biological products in sunflower research and taking into account the trend of deteriorating weather conditions, primarily – reducing rainfall and increasing temperatures, a promising area of research is to study the effectiveness of biological products in crops. It is also promising to compare the effectiveness of different biological products that have different composition and are represented by a wide range on the market. It is also advisable to conduct research on the effectiveness of biological products in combination with other technological factors, in particular, with mineral fertilizers, pesticides, sowing dates, features of varieties and hybrids, etc.

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