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UDC 504:631.881.98:635.112

<https://doi.org/10.33730/2310-4678.2.2020.208810>

## ECOLOGICALLY COMPARATIVE EFFECT OF BACTERIAL PREPARATIONS ON FIELD GERMINATION OF SUGAR BEETS

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*Intensive cultivation of sugar beets requires constant improvement of its components, the search for new reserves to increase yields and sugar content. Sowing to a stand is one of the important links of intensive technology. High field germination of seeds is its determining factor, which, it is a necessary condition for sowing to a stand. The use of plant growth regulators is one of the reserves for increasing the yield and sugar content of sugar beets. However, stimulating the growth, development and productivity of crops is provided at the appropriate doses, timing and methods of application of growth regulators. The synthetic drugs under certain conditions can be harmful to the environment, humans and animals. Inoculation of sugar beet seeds with bacterial preparations allows to realize the possibility of the biologically active substances effect on the plant during almost the entire growing season. According to the results of research, inoculation of sugar beet seeds by Polymixobacterin caused an increase by 9,6–13,9 % in field*

*germination, and joint inoculation of sugar beet seeds by Polymixobacterin and Agrofil increases field germination by 11,9–17,2 % in the area of insufficient moisture of the right bank forest-steppe of Ukraine under different systems of organic and mineral fertilizers. The application of such as bacterial preparations as Polymixobacterin and Agrofil can be recommended as an element of cultivation biologization for creating environmentally friendly technologies for sugar beets growing.*

**Keywords:** *sugar beets, field germination, pre-sowing inoculation, phosphorus fertilizers, nitrogen fertilizers, organic fertilizers, microorganisms, biologically active substances.*

## STATEMENT OF THE PROBLEM

Intensive technologies of sugar beets growing need constant improvement, i.e. reduction of energy consumption, more efficient use of organic and mineral fertilizers, and minimizing the impact on the agroecosystem. Therefore, the search for the latest methods aimed at improving the existing elements of technology in order to reduce the negative impact of agricultural production on the agricultural ecosystem is relevant.

## ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Nowadays the application of new generation growth regulators is becoming increasingly more important than the main traditional measures increasing the productivity of sugar beets. Their low doses are able to increase the potential of biological productivity of plants within the normal response of the genotype enhancing their adaptability to environmental stressors [1, 2].

It should be noted that the method of growth-promoting substances application is determined according to the goal and result because their effect extends to the plants development at the stage of organogenesis in which the treatment is carried out. Timely and full-fledged seedlings of optimal density are an important condition for growing high and stable yields of sugar beets with good product quality. That's why it is especially important to stimulate the process of seed germination and further development of seedlings [11, 18]. The concentration of restrictive substance, physiological, biochemical, morphological features of each development phase, the physiological state of the cell, their regulating effect on the physiological and biochemical processes of the plant organism and stressors protecting should be taken into account [3].

Soil for the sugar beets sowing is an open biologically active environment with billions of microorganisms, fungi, temperature, uneven oxygen supply, soil solution with different concentrations of nutrients and pH.

Oxygen lack in the soil delays the process of seed germination and leads to disproportionate

growth of seedlings, it also delays the growth of roots.

Field germination of seeds depends on its quality, growth strength, viability, i.e. laboratory germination, germination energy and other indicators. The process of seed germination is also influenced by its treatment with chemicals, trace elements, growth stimulants, which are used for inlay, wetting and other techniques activating the germination process [4].

Thus, seeds field germination is an integral combination of genetic, soil, hydrothermal, biotic and anthropogenic factors. Today, the germination of sugar beet seeds varies between 50–70%.

The use of plant growth regulators is one of the reserves for increasing the yield and sugar content of sugar beets. However, stimulating the growth, development and productivity of crops is provided at the appropriate doses, timing and methods of application of growth regulators, as well as weather conditions.

According to the literature review the action of plant growth regulators depends on organic and mineral nutrition.

Studies have shown that you can get additionally 10–20% of the sugar beet harvest due to high-quality sowing seeds preparation, i.e. pre-sowing treatment with protective and stimulating substances [5].

However, the pesticides application for pre-sowing seed preparation can have both positive and negative effects. There is phytotoxicity of drugs used for seed treatment, they reduce seed germination energy, field germination, plant density and their weight.

It should also be noted that the plants exogenous regulation by physiologically active substances of synthetic origin causes high results in case of their repeated application at different stages of organogenesis.

However, recently the new generation growth regulators application is becoming more important for sugar beets productivity. Their low doses increase the potential of biological productivity of plants within the genotype enhancing their adaptability to environmental stressors.

The growth regulators have a significant anti-stress effect proved by numerous experiments of domestic and international scientists.

Plant growth regulators are essential for modern No-Nill and Mini-Nill technologies, where accelerating seed germination, plant development, root system, removal of stress factors of pesticides are rather important.

Scientific research is increasingly focused on the creation of drugs regulating growth based on substances of natural origin because synthetic drugs can be harmful to the environment, humans and animals under certain conditions. Growth regulators of biological origin increase germination, the intensity of metabolic and growth processes in plants, the productivity of field crops and product quality are both effective and environmentally safe [6].

The stable interaction was formed between plants and microorganisms as a result of evolutionary development. Phytohormones and other biologically active substances are synthesized by plants and representatives of different groups of soil microorganisms [7].

The application of large amounts of pesticides has caused problems with the accumulation of plant residues and degradation of beneficial microflora, the accumulation of phytopathogens on plant residues and in the soil, inhibition of seed germination and the development of root rot products.

The inoculation of seeds of agricultural plants with microbiological drugs in the culture fluid containing a complex of biologically active substances can be solution to the problem [8, 9].

The aim of this research was to investigate the effect of inoculation of sugar beet seeds by bacterial drugs Polymixobacterin and Agrofil on field germination on different organic and mineral fertilizer systems.

### OBJECTS AND METHODS OF RESEARCH

The research was carried out at Vinnytsia Research Station on gray forest podzolic loam soils; its arable layer contains 2,2 % of humus, 0,12% of total nitrogen, 8,4 mg of hydrolyzed nitrogen, 22,2 mg of mobile phosphorus, 12,8 mg of exchangeable potassium per 100 g of soil, pH of the solva extract was 5,5 mg, hydrolytic acidity was 4,0 mg, the amount of absorbed bases was 13,0 mg per 100 g of soil. It was also carried out at the experimental field of VNAU on gray forest podzolic loam soils; its arable layer contains 2,2 % of humus, the reaction of the soil solution is weakly acidic with 5,8 pH; hydrolytic acidity was 4,1 mg. per 100 g of soil; the amount of

absorbed bases was 15,3 mg. per 100 g of soil; the saturation degree was 79%. Soils contain 8,8 mg of nitrogen available to plants (according to Cornfield), 21,2 mg of mobile phosphorus and 9,2 mg of exchangeable potassium per 100 g of soil.

- Scheme of the experiment
- Control (without treatment)
- Polymixobacterin
- Polymixobacterin + Agrofil
- Fertilizing
- Without fertilizers (control)
- $N_{160}P_{120}K_{160}$
- $N_{160}P_{120}K_{160}$  + Manure, 32 t/ha

Both cattle manure and mineral fertilizers were used for sugar beets cultivation. We have applied such mineral fertilizers as ammonium nitrate, double granular superphosphate, and potassium chloride.

We have taken seeds of such sugar beets hybrids as Lena, KV Ros, Vesto, and Kozak. Seeds were treated with 4 l/t of Royal Flo, 60 kg/t of Gaucho, they were inoculated by 0,5 l of Polymixobacterin per 100 kg of seeds, 0,5 l of Agrofil per 100 kg of seeds.

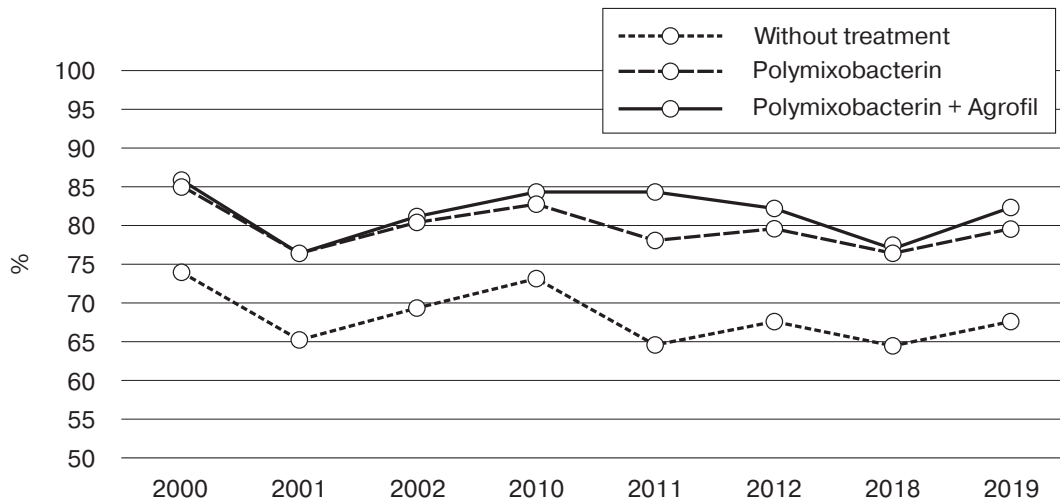
Experimental farming techniques are generally accepted for the sugar beet growing zone. The estimated area of the site is 50 m<sup>2</sup>, 24 m<sup>2</sup>, and 12 m<sup>2</sup>; the frequency is three times.

Field germination of sugar beet seeds was determined according to the methodology of the Institute of Sugar Beets [10]. Statistical processing was performed by the method of analysis of variance [11].

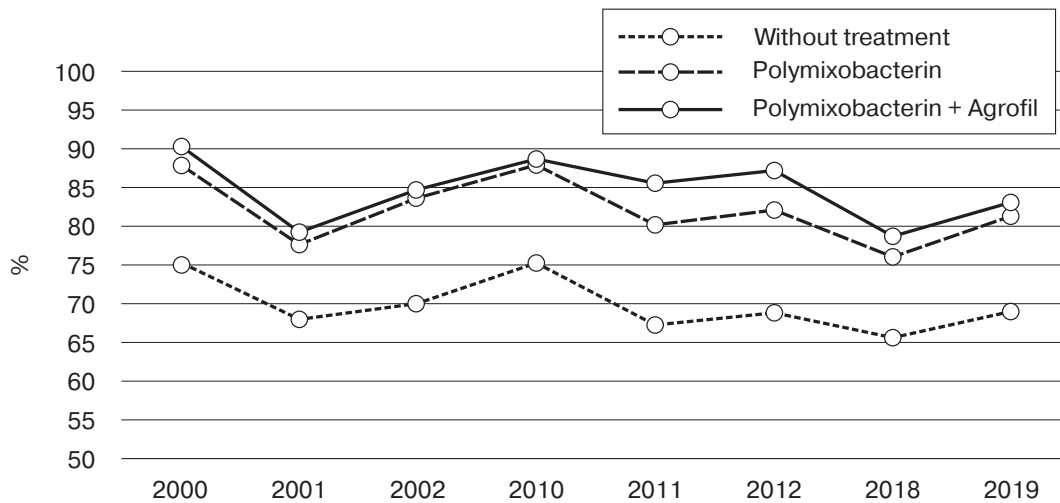
### PRESENTING MAIN MATERIAL

The results of research at Vinnytsia research station (2000–2002) were greatly influenced by weather conditions. Thus, we had favorable hydrothermal conditions in 2000, the field germination of sugar beet seeds inoculated by Polymixobacterin, was 84,9% without fertilizers; it was by 11,1% more than in the control; being inoculated with both Polymixobacterin and Agrofil it increased by 11,9%. In case of fertilizing by  $N_{160}P_{120}K_{160}$  germination increased by 13,5% when inoculated by Polymixobacterin and by 15,1% when inoculated with Polymixobacterin and Agrofil. In case of fertilizing by Manure (32 t per ha) +  $N_{160}P_{120}K_{160}$  and inoculation by Polymixobacterin, the germination was 88,8%; it was by 13,5% more than in the control, and when inoculated with Polymixobacterin and Agrofil it increased by 15,1% (Fig. 1–3).

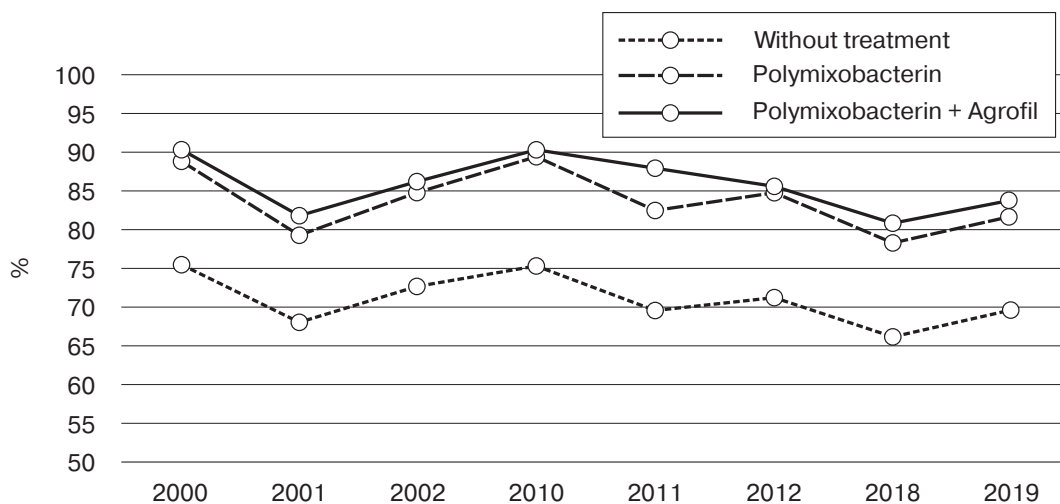
In 2001 the research took place under adverse weather conditions. Intense rains and downpours in mid-April after sowing caused the formation of soil crust, which negatively affected



**Fig. 1.** Field germination of inoculated sugar beets seeds without fertilizers application



**Fig. 2.** Field germination of inoculated sugar beets seeds with mineral fertilizers application



**Fig. 3.** Field germination of inoculated sugar beets seeds with organic and mineral fertilizers application



the field germination of seeds. The field germination of inoculated by Polymixobacterin sugar beet seeds was 76,2% without fertilizers; it was by 10,3% more than in the control; being inoculated with Polymixobacterin and Agrofил it increased by 10,6%. In case of fertilizing by  $N_{160}P_{120}K_{160}$  germination increased by 9,6 % when inoculated by Polymixobacterin and by 10,3 % when inoculated with Polymixobacterin and Agrofил. In case of fertilizing by Manure (32 t per ha) +  $N_{160}P_{120}K_{160}$  and inoculation by Polymixobacterin, the germination increased by 9,6 %, and when inoculated with Polymixobacterin and Agrofил it increased by 11,8%. Lower seed germination rates are due to the formation of soil crust, which negatively affected soil aeration and reduced oxygen concentration (Fig. 1–3).

In 2002 the results of the research were affected by rainfall, it caused the formation of soil crust and the deterioration of soil aeration, it affected the field germination of sugar beet seeds. The field germination of inoculated by Polymixobacterin sugar beet seeds was 80,2% without fertilizers; it was by 11,2% more than in the control; being inoculated with Polymixobacterin and Agrofил it increased by 11,9%. In case of fertilizing by  $N_{160}P_{120}K_{160}$  germination increased by 13,9% when inoculated by Polymixobacterin and by 14,7% when inoculated with Polymixobacterin and Agrofил. In case of fertilizing by Manure (32 t per ha) +  $N_{160}P_{120}K_{160}$  and inoculation by Polymixobacterin, the germination increased by 11,9%, and when inoculated with Polymixobacterin and Agrofил it increased by 13,0% (Fig. 1–3).

Similar results were obtained in three-year research at the experimental field of VNAU. Thus, in 2010 we had favorable hydrothermal conditions, the field germination of inoculated sugar beet seeds by Polymixobacterin was 82,5% on the unfertilized variant, which is 9,5% higher than the control. Co-inoculation of sugar beet seeds by Polymixobacterin and Agrofил caused an increase of field germination by 11,1%.

The inoculation of sugar beet seeds by Polymixobacterin caused field germination increase by 12,7%, co-inoculation of sugar beet seeds with Polymixobacterin and Agrofил caused an increase of field germination by 13,5%. with the mineral fertilizer system of  $N_{160}P_{120}K_{160}$ .

The inoculation of sugar beet seeds by Polymixobacterin increases field germination by 14,3 %, inoculation of sugar beet seeds by Polymixobacterin and Agrofил increases field germination by 15,5% with organic and mineral fertilizer system consisting of  $N_{160}P_{120}K_{160}$  + Manure (32 t per ha).

In 2011, sunny windy weather caused the soil drying; lack of precipitation and low humidity caused the evaporation of soil moisture, which negatively affected the field germination of sugar beet seeds was 64,3% without fertilizer, inoculation by Polymixobacterin increased germination by 13,5% and Polymixobacterin and Agrofил increased germination by 16,8%.

The germination of inoculated sugar beet seeds by Polymixobacterin increased by 12,7%, and when inoculated by Polymixobacterin and Agrofил increased by 16,1% compared to the control within the mineral fertilizing by  $N_{160}P_{120}K_{160}$  nutrition. The germination of inoculated sugar beet seeds by Polymixobacterin increased by 12%, when inoculated with Polymixobacterin and Agrofил increased by 17,2 % with organic and mineral fertilizer system consisting of  $N_{160}P_{120}K_{160}$  + Manure (32 t per ha).

In 2012, sowing took place under favorable hydrothermal conditions, they were replaced by intense heat, no precipitation, low relative humidity, contributed to the intensive evaporation of soil moisture, negatively affected the field germination of sugar beet seeds.

The germination of sugar beet seeds inoculated by Polymixobacterin without fertilizers was 79,4%, it was by 8,9% more than in the control, when inoculated by Polymixobacterin and Agrofил it increased by 14,5% compared to the control. The germination of sugar beet seeds inoculated by Polymixobacterin increased by 13,5%, when inoculated by Polymixobacterin and Agrofил it increased by 15,3% relative to control. The germination of sugar beet seeds inoculated by Polymixobacterin increased by 13,9%, when inoculated by Polymixobacterin and Agrofил it increased by 14,3% with organic and mineral fertilizer system consisting of  $N_{160}P_{120}K_{160}$  + Manure (32 t per ha) (Fig. 1–3).

The results of the research showed that in 2018 the field germination was influenced by the increased temperature, the deficit of precipitation caused unfavorable conditions for the growth and development of sugar beets. The germination of sugar beet seeds inoculated by Polymixobacterin was 75,2% without fertilizers, it is 10,3% more than in the control, and when inoculated with Polymixobacterin and Agrofил it increased by 12,8%. The germination of sugar beet seeds inoculated by Polymixobacterin increased by 11,5%, and sugar beet seeds inoculated by Polymixobacterin and Agrofил increased by 13,1% compared to the control with the mineral fertilizer system of  $N_{160}P_{120}K_{160}$ . The germination of sugar beet seeds inoculated by Polymixobacterin, increased by 12,7%, when inoculated

by Polymixobacterin and Agrofil it increased by 14,5% with organic and mineral fertilizer system consisting of  $N_{160}P_{120}K_{160}$  + Manure (32 t per ha) (Fig. 1–3).

In 2019 researches were conducted under favorable hydrothermal conditions, field germination of sugar beet seeds inoculated by Polymixobacterin was 79,4% without fertilizers, it was 11,9% more than in the control, and when inoculated with Polymixobacterin and Agrofil it increased by 13,7%. The germination increased by 12,5% when inoculated by Polymixobacterin and by 14,3% when inoculated with Polymixobacterin and Agrofil with the mineral fertilizer system of  $N_{160}P_{120}K_{160}$ , when inoculated by Polymixobacterin the germination was 12,7% more than in the control, and when inoculated by Polymixobacterin and Agrofil increased by 15,0%

with the mineral fertilizer system of  $N_{160}P_{120}K_{160}$  (Fig. 1–3).

## CONCLUSIONS

According to the results of research, inoculation of sugar beet seeds by Polymixobacterin caused an increase by 9,6–13,9% in field germination, and joint inoculation of sugar beet seeds by Polymixobacterin and Agrofil increases field germination by 11,9–17,2% in the area of insufficient moisture of the right bank forest-steppe of Ukraine under different systems of organic and mineral fertilizers.

The application of such as bacterial preparations as Polymixobacterin and Agrofil can be recommended as an element of cultivation biologization for creating environmentally friendly technologies for sugar beets growing.

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#### ЕКОЛОГО-ПОРІВНЯЛЬНИЙ ВПЛИВ БАКТЕРІАЛЬНИХ ПРЕПАРАТІВ НА ПОЛЬОВУ СХОЖІСТЬ ЦУКРОВИХ БУРЯКІВ

Вирощування цукрових буряків за інтенсивною технологією вимагає постійного вдосконалення її складових, пошуку нових резервів підвищення врожайності та цукристості. Однією із важливих ланок інтенсивної технології є сівба на кінцеву густоту стояння. Визначальним фактором цієї ланки є висока польова схожість насіння, яка, насамперед, є необхідною умовою реального прийняття терміну — «сівба на кінцеву густоту». Одним із резервів підвищення врожайності і цукристості цукрових буряків є використання регуляторів росту рослин. Але слід враховувати, що стимулювання росту, розвитку та підвищення продуктивності сільськогосподарських культур забезпечується при відповідних дозах, строках і способах застосування регуляторів росту, а також те, що синтетичні препарати за певних умов можуть бути шкідливими для довкілля, людини і тварин. Інокуляція насіння цукрових буряків бактеріальними препаратами дозволяє реалізувати можливість впливу комплексу біологічно-активних речовин на рослину на протязі майже усього періоду вегетації. За результатами досліджень установлено, що в зоні недостатнього зволоження Правобережного Лісостепу України за різних систем органо-мінерального удобрення інокуляція насіння буряків цукрових Поліміксобактерином сприяла підвищенню польової схожості на 9,6–13,9%, а сумісна інокуляція насіння буряків цукрових Поліміксобактерином і Агрофілом сприяє підвищенню польової схожості на 11,9–17,2%. Використання бактеріальних препаратів Поліміксобактерином і Агрофілом можна рекомендувати як елемент біологізації землеробства та для створення екологічно безпечних технологій вирощування цукрових буряків

**Ключові слова:** буряки цукрові, польова схожість, передпосівна інокуляція, фосфорні добрива, азотні добрива, органічні добрива, мікроорганізми, біологічно активні речовини.

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