The effect of the biopreparation of LPB on the yield of vegetable crops

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Abstract. At the All-Russian Research Institute of Reclaimed Lands - a branch of the Federal Research Center "Soil Institute named after V.V. Dokuchaev" LPB biological product containing agronomically significant microflora, macro- and microelements, and physiologically active substances has been developed. LPB was diluted with water at a ratio of 1:200 and doses of 0.1, 0.2, and 0.3 l/m^2 were used for three root feeding of vegetable crops with an interval of two weeks. For each vegetable crop, the optimal dosage of the drug used was established, which contributes to the formation of the maximum yield. The results obtained indicate that the biological preparation of LPB is the most effective in growing root crops. It was facilitated by the active development of agronomically significant microflora, the number of which, on average, almost doubled over the season. In the future, it is necessary to check the results obtained on other varieties and vegetable crops.

1 Introduction

Vegetables play an important role in the human diet. They belong to dietary products, have a therapeutic and prophylactic effect. At the same time, vegetables can be consumed both fresh and serve as raw materials for the production of a variety of food products, including baby food [1].

Due to the wide demand for vegetables, agricultural producers strive to provide the market with vegetable products to the maximum, resorting to improving the agricultural technology of their cultivation. Currently, there is a wide range of fertilizers, biological products, dressings for vegetable crops. All of them have their own original composition, depending on the raw materials used and production technology, as a result of which they have either a directed or complex effect.

Bacterial preparations play a special role in the technology of cultivation of various agricultural crops. Once in the soil, the microorganisms of biological products begin to feed and actively multiply, as a result of which they create a "biological shield" for plants, protecting them throughout the entire growing season and even during storage [2]. It has been established [3] that microorganisms of various physiological groups can participate in a wide variety of biochemical and physiological soil processes, affecting the growth and development of cultivated plants.

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A number of bacterial preparations based on strains of nitrogen-fixing bacteria, in particular, Agrofil, Flavobacterin, Agrika, Rizoagrin, Extrasol, and others, have been created at the Federal State Budgetary Scientific Institution VNIISKhM (St. Petersburg), the effectiveness of which was evaluated in the Penza region when growing various vegetable crops [4]. It has been established that as a result of the use of Flavobacterin, the yield of marketable roots of table beets of the Bordeaux 237 variety increased by 17%; when Mizorin was introduced into the wells when planting potatoes, the yield of marketable tubers exceeded the control by 13.3%; when using Agrofil for growing table carrots of the Shantane 2461 variety, its yield increased by 26%.

In recent years, the creation of new biopreparations of complex action based on microbial associations has become increasingly important [5]. For example, the biological preparation microbiovit (MBV) provided an increase in the yield of various vegetable crops by 36-56%. The drug provided the formation of larger root crops of carrots, beets, radishes (1.4-1.6 times compared to the control), increased the number of ovaries on cucumber plants.

The use of the microbiological preparation Baikal-EM1, created on the basis of a consortium of lactic acid, photosynthetic, nitrogen-fixing bacteria, yeasts and their metabolic products, for soaking seeds and treating vegetative tomato plants grown in a film greenhouse, contributed to an increase in their productivity by 13.5% on average over two years [6].

In spring film greenhouses at St. Petersburg State Agrarian University, the effectiveness of Extrasol, Bisolbicide, Baikal EM-1 preparations was tested on seed germination, plant growth and development, yield and quality of sweet pepper fruits of the Tenderness variety [7]. The use of drugs contributed to an increase in the growth of leaf area, productivity and quality of sweet pepper fruits. The greatest increase in the yield of sweet pepper of the indicated variety was obtained when using the Extrasol preparation - 28.2% compared to the control.

At the All-Russian Research Institute of Reclaimed Lands - a branch of the Federal Research Center "Soil Institute named after V.V. Dokuchaev" a method for obtaining a liquid-phase biological product of LPB from the fermentation product of a peat-manure mixture was developed [8]. Currently, a comprehensive approbation of LPB is being carried out in the cultivation of various crops.

The purpose of the work is to study the effect of the biological product LPB on the yield of vegetable crops.

2 Materials and methods

LPB biological product is a brown liquid, pH - 7.5-8.5. LPB has a complex composition: it contains agronomically significant microorganisms (ammonifying, amylolytic, mobilizing organophosphates, etc. - not less than n × 109 CFU/ml), nutrients (total nitrogen - not less than 0.2 g/l, P2O5 - up to 11.0 g/l, K2O - up to 9.5 g/l), trace elements (copper, zinc, manganese, iron, etc.) and physiologically active substances (sugars, amino acids, enzymes, etc.). LPB is environmentally safe - it does not contain heavy metals and pathogenic microflora.

The influence of the LPB biological product was studied when growing cucumbers of the Bidretta variety, sweet pepper of the Bogatyr variety, and table beet of the Pablo F1 variety. The LPB biological product was diluted with water in a ratio of 1:200 and doses of 0.1, 0.2, and 0.3 l/m2 were used for three root feeding with an interval of two weeks. The control was the corresponding variant without the use of the LPB biological preparation.

Experiments with the cultivation of cucumbers were carried out in a greenhouse farm on the basis of the Municipal Unitary Enterprise "Zelenstroy", sweet pepper and table beet - on the basis of a personal subsidiary farm, with pepper plants growing in a glass greenhouse, and beet plants in open ground. During the experiments, we evaluated:

- biometric indicators of plants,
- the number of soil microorganisms by the method of limiting dilutions with inoculation on solid nutrient media: meat-peptone agar (ammonifying microorganisms), starch-ammonia agar (amylolytic microorganisms), Menkina (phosphomobilizing microorganisms).
- accounting for productivity.

3 Results and discusson

3.1 Cultivation of Bidretta cucumbers

As a result of root dressing of cucumber plants with LPB biological product, it was noted that cucumber lashes are more massive and bushy compared to the control variant. The data in Table 1 indicate that as the volume of LPB application increased, cucumber stems elongated and wider leaf blades were formed, which is of great importance for photosynthesis processes.

Table 1. Influence of LPB on the biometric parameters of cucumber plants of the Bidretta variety.

Indicator	Control	LPB dose		
		0.2 l/m^2	0.3 l/m^2	0.4 l/m^2
Average length of the central stem, m	1.15	1.30	1.39	1.53
Average leaf width, cm	17.1	20.2	22.1	25.3

Accounting for the yield of cucumbers showed that all doses of LPB had a positive effect on the formation of the crop, but the greatest effect was obtained when using the average dose of the biological product - the increase in control was 12.6% (Table 2). Despite the fact that the highest dose of LPB contributed to the most active development of the green mass of plants, the yield in this variant was almost at the control level.

Table 2. Influence of LPB on the yield of cucumber of Bidretta variety.

Variants	Yield, kg/m^2	± to control, %
Control	2.91	-
LPB 0.2 l/m^2	3.15	+ 8.2
LPB 0.3 l/m^2	3.28	+ 12.7
LPB 0.4 l/m^2	3.03	+ 4.1

3.2 Cultivation of Bogatyr varieties sweet pepper

A positive effect from the use of the LPB in the cultivation of sweet pepper was obtained in all variants, but the most significant effect was obtained with a minimum dose of LPB of 0.2 l/m^2 (Table 3). In this variant, more active development of the plants themselves was observed and the maximum yield was collected. It should be noted that as the dose of the applied product was increased, plant height and yield decreased.

Table 3. Influence of LPB on plant height and productivity of sweet pepper variety Bogatyr

Variants	Average plant height		Yield	
	cm	± to control, %	kg/m^2	± to control, %
Control	23.8	-	3.12	-

LPB 0.2 l/m^2	30.8	+ 29.4	3.69	+ 18.3
LPB 0.3 l/m^2	27.8	+ 16.8	3.51	+ 12.5
LPB 0.4 l/m^2	26.2	+ 10.1	3.38	+ 8.3

3.3 Cultivation of Pablo F1 beet variety

The LPB biologic product had a more significant effect on beet. With an equal number of root crops per 1 m^2, the maximum yield in the experimental variant of applying the biological product at a dose of 0.4 l/m^2 exceeded the control variant by 29.4%, and the weight of each root crop was 50 g higher on average. This fact, apparently, was facilitated by the high content in in the composition of LPB of mobile forms of phosphorus and potassium, which favorably affect the processes of tuberization.

Table 4. Influence of LPB on the yield of Pablo F1 beet variety

Variants	Yield		The number of soil microorganisms	
	kg/m^2	± to control, %	mln/g	± to control, %
Control	3.61	-	35.1	-
LPB 0.2 l/m^2	4.08	+ 13.0	50.2	+ 43.0
LPB 0.3 l/m^2	4.36	+ 20.8	55.8	+ 59.0
LPB 0.4 l/m^2	4.67	+ 29.4	68.7	+ 95.7

In the soil of each variant, the number of ammonifying, amylolytic, and phosphate mobilizing mycoorganisms was determined. Their average total number for the season is presented in Table 4, from which it can be seen that this indicator is significantly higher as a result of three-time root feeding of beet plants with LPB biological product. It should be noted that phosphate mobilizing microorganisms dominated among these microorganisms, the active development of which is an indirect factor in the formation of the root system.

4 Conclusion

In the experiments carried out, the effect of LPB biological product on the yield of greenhouse cucumbers of the Bidretta variety, sweet pepper of the Bogatyr variety and beet of the Pablo F1 variety was shown. For each vegetable crop, the optimal dosage of the drug used was established, which contributes to the formation of the maximum yield: when growing cucumbers, the maximum yield increase of 12.7% was obtained as a result of applying LPB at a dose of 0.3 l/m^2, for sweet pepper, a dosage of 0.2 l/m^2 contributed to an increase in yield of 18.3%, and in the case of root feeding of beets with a biological product at a dose of 0.4 l/m^2, the maximum yield increase was 29.4%. The results obtained indicate that LPB biological product is the most effective in growing root crops. This was facilitated by the active development of agronomically significant microflora, the number of which, on average, almost doubled over the season. In the future, it is necessary to check the results obtained on other varieties and vegetable crops.

References

1. S. S. Litvinov, *Scientific foundations of modern vegetable growing* (M.: VNIIO, 2008).
2. R.P. Ibatullina, F.K. Alimova, A.P. Kozhemyakov, I.Yu. Kroshechkina, F.M. Menlikiyev, *Recommendations on the use of biological preparations of LLC "NPI*

"Biopreparaty" in crop production, fodder production and animal husbandry (Kazan: Center for Innovative Technologies, 2017)

3. M.G. Sokolova, G.P. Akimova, Sh.K. Khusnidinov, Agrochemistry **7** 54-59 (2009).
4. A.P. Shakin, V.N. Khryanin, A.I. Saltanova, G.A. Razorenova, Application of bacterial fertilizers in the cultivation of agricultural crops *Proceedings of the Penza State Pedagogical University* **5** 71-73 (2006).
5. G.A. Mikheeva, L.A. Somova, Agrochemistry **5** 66-72 (2013).
6. A.V. Yurina, T.V. Kiveleva, L.G. Mamonova, V.I. Zimina, V.K. Kostenko, Gavrish **5** 15-18 (2005).
7. V.L. Gaidov, Influence of biologically active substances on the yield and quality of sweet pepper in spring greenhouses *Proc. of intl. scientific and practical. conf. young scientists and students "The intellectual potential of young scientists as a driver for the development of the agro-industrial complex."* (St. Petersburg: St. Petersburg State Agrarian University, 2022) pp. 124-127.
8. G.Yu. Rabinovich, N.V. Fomicheva, Yu.D. Smirnova, *New polyfunctional liquid-phase biological agents (drugs) VNIIMZ for plant growing and agriculture* (Tver: Tver State University, 2022).