

# The effectiveness of biologization in the cultivation of crops

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**Abstract.** The article presents data from field studies of the use of biological products and fertilizers with microelements in the cultivation of four crops: winter wheat, sunflower, grain corn, soybeans. Schemes for the introduction of drugs, indicators of the comparative economic efficiency of their use are presented. The results of the conducted studies have proved the effectiveness of the use of biological products and fertilizers with trace elements. For all crops, there was an increase in yields: winter wheat - by 1.2%, sunflower - by 7.5%, corn for grain - by 7.8%, soybeans - by 13.6%. The increase in profit from each hectare of crops was: for winter wheat - by 8.7%, sunflower - by 9.2%, corn for grain - by 6.9%, soybeans - by 17.9%.

## 1 Introduction

The currently used highly productive crop production technologies are usually based on the use of a large amount of mineral fertilizers and plant protection products, which leads to negative environmental consequences for the soil and the environment, as well as to high financial costs [1-2].

An urgent issue in the development of technologies is to reduce the doses of mineral fertilizers and the amount of pesticides used with a constant or increased level of productivity of cultivated crops. The use of biologically active drugs in plant growing technologies fully meets the solution of this problem [3-4].

One of the important directions in modern land use is an integrated system of crop protection, which is based on the joint use of biological and chemical agrochemicals, in the control of the phytosanitary situation in the fields and in the preventive impact on biogeocenoses [5-7].

Numerous experimental studies conducted in the cultivation of grain and row crops have shown that the use of biological products and microelement fertilizers contributed to

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an increase in plant survival, improved grain quality and, accordingly, an increase in yield, which ultimately led to an increase in the economic efficiency of crop cultivation [8-10].

## 2 Materials and methods

The studies were carried out in the conditions of the Krasnodar Territory in the zone of unstable moisture in industrial crops of winter wheat, sunflower, corn for grain and soybeans.

In this work, together with the preparations used in economic treatments for each of the crops, biological preparations of the AgroVerm trademark were used: AgroMaximum Antistress + Protection and Agro DV complexes, which are produced by BioEraGroup LLC (Moscow).

The three-component crop nutrition system - AgroMaximum Antistress + Protection is represented by the following preparations:

- AgroVerm Master is a biological preparation based on vermicompost and contains low molecular weight humic acids, fulvic acids and amino acids. It is an antidepressant, helps the plant recover from frost, drought, herbicide stress, pest damage, increases the immunity and resistance of plants to diseases, and also intensifies the physiological and biochemical processes in plants, allowing to accelerate the passage of phenological phases,

- AgroVerm Screen is a bacterial preparation containing live spore bacterium *Bacillus Subtilis*, which inhibits the reproduction of pathogenic fungi and bacteria by its metabolic products. It has the property of increasing immunity to the following diseases: seed mold, root rot, rhynchosporia, helminthosporia, brown rust, septoria, alternaria, powdery mildew, and reduces the risk of re-infection,

- AgroVerm Trichoderma is a preparation that contains living cells, spores and a complex of *Bacillus 5 Subtilis* metabolites  $1 \times 10^5$  CFU. It inhibits the development of phytopathogens by direct parasitism, competition for the substrate, the release of enzymes, antibiotics (gliotoxin, viridin, trichodermin) and other biologically active substances that suppress the development of many types of pathogens and inhibit their reproductive ability. In the soil, the fungus develops on various plant residues rich in cellulose, on mycelium, fruiting bodies of phytopathogens. Grows quickly in well-aerated soils rich in organic matter. It works in a wide range of soil pH, but its antagonistic properties are most active in soil with an acidity of 5.0 to 7.0 pH. The drug effectively suppresses pathogenic pathogens and protects against root rots (*pythium*, *rhizoconia*, *fusarium*), from wilting of various etiologies, diseases of leaves and stems (*astochitoses* and anthracnose, *alternariosis* and gray rot).

The two-component Agro DV system is used only in soybean crops in the phase of plant branching and has the following components:

- Component A - water-soluble powder with a complex of L-amino acids of plant origin. The drug optimizes the water balance, increases the resistance of plants during drought, activates photosynthesis, improves nitrogen and hormonal metabolism inside the plant, helps to relieve pesticide stress,

- Component C (universal) - to eliminate micronutrient deficiencies during the period of active plant growth. The drug contains in the composition: 15% iron, manganese, boron, magnesium, copper, zinc and 10% sulfur.

The seed material used in the studies was zoned for the central zone of the Krasnodar Territory: mid-early variety of winter soft wheat "Tanya" (selection of the Federal State Budgetary Scientific Institution "NTsZ named after P.P. Lukyanenko"), mid-early sunflower hybrid SUBERIC "Syngenta", mid-season hybrid of corn for grain P9241 from seed company "Pioneer" and mid-early, high-yielding soybean variety SK Veda (LLC Soy Complex Company) with oilseed use.

The experimental plots were laid out within one field for each of the presented crops (winter wheat, sunflower, corn for grain and soybeans), in compliance with the recommendations for the cultivation of field crops for the zone with unstable moisture according to the scheme and methodology developed jointly with a representative of the manufacturing company taking into account the recommended doses and terms of treatments (Table 1) and in compliance with the basic rules and requirements for field experience Dospekhova B.A. [11].

**Table 1.** Variants of experience in experimental crops.

<b>Plant phase</b>	<b>Option number 1 (control)</b>	<b>Option number 2 (experiment)</b>
<b>Winter wheat</b>		
tillering	Status Grand (35 g/ha) + Novus-F (0.8 l/ha) + Bioton (50 g/ha) + Potassium Humate (0.5 l/ha)	Status Grand (35 g/ha) + Bioton (50 g/ha) + AgroMaximum Antistress + Zashchita
start of the call	Therapeutic Pro (0.7 l/ha) + Micro Complex (0.7 l/ha) + Urea (20 kg/ha)	
heading	Input (1 l/ha) + Clonrin (0.15 l/ha) + Urea (10 kg/ha) + Potassium Humate (0.5 l/ha)	
<b>Sunflower</b>		
2-3 sheets	Status Grand (40 g/ha) + Bioton (50 g/ha) + Potassium Humate (0.5 l/ha)	Status Grand (40 g/ha) + Bioton (50 g/ha) + AgroMaximum Antistress + Zashchita
<b>Corn for grain</b>		
3-5 leaves	Modern, EC (0.5 l/ha) + Potassium Humate (0.5 l/ha)	Modern, EC (0.5 l/ha) + AgroMaximum Antistress + Zashchita
5-7 leaves	Extra Zn (1.0 kg/ha) + Potassium Humate (0.5 l/ha)	
<b>Soya</b>		
1st sheet	Global, BP (1.0 l/ha)	
1-2nd sheet	Extra Molybdenum / Cobalt (0.4 l/ha)	AgroMaximum Antistress + Zashchita
branching	-	Agro DV

Thus, the experimental schemes differed from the economic treatments by crops as follows:

- In the experimental sowing of winter wheat in the tillering phase, the chemical fungicide Novus-F and the organomineral fertilizer Potassium Humate were replaced by the three-component nutrition system AgroMaximum Antistress + Zashchita (AgroVerm Master 1 l/ha + AgroVerm Screen 0.5 l/ha + AgroVerm Trichoderma 0.5 l/ha),
- In crops of sunflower and corn for grain in foliar treatments, Potassium Humate was also replaced by the AgroMaximum Antistress + Zashchita complex (AgroVerm Master 1 l/ha + AgroVerm Screen 0.5 l/ha + AgroVerm Trichoderma 0.5 l/ha),
- In experimental soybean crops, foliar treatments were completely different in preparations: in the phase from 1 to 2 true trifoliolate leaves in the control variant, treatments were carried out with organomineral fertilizer with trace elements Extra Molybdenum / Cobalt (0.4 l/ha), and in the experimental one - with the AgroMaximum Antistress + complex Protection; in the phase of branching of plants in the control crops, no treatments were carried out, but in the experimental ones they were treated with the Agro DV complex (component A (0.04 g/ha) + universal component (0.12 g/ha)).

### 3 Formatting the title, authors and affiliations

Affiliations Let us analyze the economic efficiency indicators of the use of AgroVerm biological preparations in the production of winter wheat, sunflower (Table 2) and in the technologies for growing grain corn, soybeans (Table 3).

**Table 2.** Efficiency of using AgroVerm preparations on winter wheat, sunflower.

Indicators	The value of the indicator by culture			
	winter wheat		sunflower	
	No. 1 (control)	No. 2 (AgroVerm)	No. 1 (control)	No. 2 (AgroVerm)
Productivity, t/ha	6.893	6.979	3.220	3.463
Profit, rub./ha	48 912	53 186	49 054	53 604
Cost reduction, rub./ha	-	3 129	-	-
Additional costs, rub./ha	-	-	-	553
Additional profit, rub./ha	-	4 274	-	4 550

**Table 3.** The effectiveness of the use of AgroVerm preparations on corn for grain, soybeans.

Indicators	The value of the indicator by culture			
	corn for grain		soy	
	No. 1 (control)	No. 2 (AgroVerm)	No. 1 (control)	No. 2 (AgroVerm)
Productivity, t/ha	10.232	11.038	3.017	3.430
Profit, rub./ha	56 418	62 462	58 031	68 419
Cost reduction, rub./ha	-	629	-	1 176
Additional costs, rub./ha	-	6 044	-	10 388

With the use of biological preparations for all four crops, the following increase in yield is noted: for winter wheat - by 1.2%, sunflower - by 7.5%, corn for grain - by 7.8%, soybeans - by 13.6%. The growth in crop yields ultimately led to an increase in profits: for winter wheat - by 4,274 rubles/ha, for sunflower - by 4,550 rubles/ha, for corn for grain - by 6,044 rubles/ha, for soybeans - by 10 388 rubles/ha.

### 4 Discussion

Analyzing the results of the conducted research based on the data of field experiments in the cultivation of four agricultural crops, we can draw the following conclusions:

- The use of biological preparations AgroVerm led to an increase in the yield of all studied crops by 1.2-13.6%. The largest increase in yield was observed for soybeans.
- On winter wheat during tillering, the silicone adjuvant Bioton and the fertilizer Potassium Humate were replaced by the antidepressant Master and the biological product Trichoderma. Profit increased by 4,274 rubles/ha.
- On sunflower during foliar treatment in the phase of 2-3 leaves, the Potassium Humat fertilizer was replaced with a three-component preparation AgroMaximum + Zashchita, including the antidepressant Master, biofungtctd Screen and the biological product Trichoderma. Profit increased by 4,550 rubles/ha.
- On corn for grain during foliar processing in the phase of 3-5 leaves, additional application of the three-component preparation AgroMaximum + Zashchita. Profit increased by 6,044 rubles/ha.

- On soybeans during foliar processing in the phase from 1 to 2 leaves, the fertilizer Extra Molybdenum / Cobalt was replaced with a three-component biological product AgroMaximum + Zashchita; a technological operation of sheet processing in the branching phase with Agro DV was added. Of the four studied crops, the highest profit growth was noted - by 10,388 rubles/ha.

## 5 Conclusion

The results of the study of the use of biological preparations (fertilizers and microelement complexes) of the AgroVerm line from BioEraGroup LLC in the cultivation of four crops: winter wheat, sunflower, grain corn, soybeans confirm the effectiveness of their use, which was reflected in the following positive changes:

- Growth in crop yields amounted to: for winter wheat 0.86 c/ha or 1.2%, for sunflower 2.43 c/ha or 7.5%, for grain corn by 8.06 c/ha or 7, 8%, for soybeans by 4.13 c/ha or 13.6%.
- Profit per 1 ha increased for all crops: for winter wheat - by 4,274 rubles/ha or 8.7%, for sunflower - by 4,550 rubles/ha or 9.2% for corn for grain - by 6,044 rubles/ha or 6.9%, for soybeans - by 10,388 rubles/ha or 17.9%.

## References

1. A.A. Tarasov, S.A. Tarasov, *Implementation of the Concept of the Biologization of Agriculture Through the use of Microbial Preparations*, Materials of the International Scientific and Practical Conference "Shock Scientific support of agro-industrial production-2018", Kursk, **126-131** (2018)
2. I.I. Novikova, E.V. Popova, I.L. Krasnobaeva, N.M. Kovalenko, *Biological justification of the use of chitosan-based resistance inducers to increase the effectiveness of biofungicides*, Agricultural biology 3(56), **511-522** (2021)
3. *Biological protection of plants is one of the main directions of reducing the pesticide load on agroecosystems*, Retrieved from: <https://research-journal.org>
4. V.A. Babaev, *Agrotechnologies of the XXI century: the experience of Azerbaijan*, Perm Agrarian Bulletin 4, **41-47** (2019)
5. E.G. Prudnikova, P.S. Prudnikov, *The use of biologically active substances in agriculture*, Materials of the International Scientific and Practical Conference on topical issues in the field of biotechnology "In Rational use of raw materials and creation of new", Oryol, **119-122** (2018)
6. S.A. Vasilchenko, G.V. Metlina, Yu.V. Laktionov, *The Effect of Biological Products and Microelement Fertilizer "Organomix" on Maize Productivity in the Southern Part of the Rostov Region*, Grain farming of Russia 5, **81-85** (2021)
7. R.L. Akchurin, R.S. Bagautdinov, R.R. Mirsayapov, *The influence of environmentally friendly technologies for the use of plant protection products on the productivity of spring wheat*, Bulletin of the Bashkir State Agrarian University 4, **6-12** (2020)
8. L.V. Igolnikova, *Application of biotechnologies in production experiments*, Scientific and Agronomic Journal 1, **42-48** (2020)
9. M.A. Belik, S.A. Sviridova, T.A. Yurina, *The Effectiveness of Biological Products and Micronutrient Fertilizers use in Row Crops Cultivation*, XIV International Scientific and Practical Conference "State and Prospects for the Development of Agribusiness - INTERAGROMASH 2021" (E3S Web of Conferences), Rostov-on-Don 273, **01002** (2021)

10. A.K. Apazhev, K.G. Kurzhev, Yu.A. Shekikhachev, L.M. Khazhmetov, L.Z. Shekikhacheva, *Efficiency of the application of biological preparations in the cultivation of corn in the conditions of the Kabardino-Balkarian Republic*, International Agricultural Journal 6(64), **49** (2021)
11. B.A. Dospekhov, *Metodika polevogo opyta*, Moscow: Book on Demand, **352** (2012)