

# Impact of different technologies in application of microbial compounds on number of micromycetes and cellulose-destroying microorganisms on ordinary chernozem of the Central Ciscaucasia

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**Abstract.** The aim of this work is to test the technology of application of multifunctional microbial compounds on corn in the zone of unstable moistening of the Central Ciscaucasia. The object of research are microbial complex composites. The studies were conducted on ordinary chernozem soil. According to the traditional technology we treated the seeds before sowing and corn plants in the phase of 3-4 leaves and flowering, and for the further improvement we treated the soil before sowing. It was revealed that the smallest number of micromycetes and cellulolytics appears in the phase of 3-4 leaves. The use of bioproducts had no significant effect on the number of microorganisms during this period. The number of the studied microorganisms has increased in the flowering and milky stages, and especially due to the use of compounds. The study of corn yield revealed that the least yield was in the control experiment and made up 4.07 t/ha. Application of the CBC-Standard product increased the yield by 0.98 t/ha in traditional technology. The lowest increase of 0.43 t/ha was observed on the variant with application of "CMC-92". On the proposed technology with the variant with application of "CMC-92", the corn yield was the highest and amounted to 5.35 t/ha. It is higher than in the control experiment by 1.28 t/ha.

## 1 Introduction

At the present stage of development of agriculture conducted a lot of research and practice proved that with the help of living microorganisms to control the fertility and productivity of soils [1]. This direction is an alternative to the use of fertilizers and pesticides. At the same time, there is a need to fully explore the conditions for the effective functioning of the microbiota in specific soil-climatic zones and development of evidence-based recommendations [2]. This is due to the fact that the soil

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demonstrates the incredible biodiversity of the soil community and is the source of many microorganisms including bacteria, fungi, nematode, actinomycetes, viruses, etc. [3-4]. Attempt using numbers to characterize these organisms or their activity requires understanding of the spatial and temporal distribution of microorganisms within the soil environment. The fact that the microbes in the soil are rarely in the same quantities or have stable activity is a problem for the characteristics of the population [5-6]. Many researchers believe that the use of biological compounds in agricultural production of southern Russia give good results and have a positive effect on plant growth, soil fertility and environmental quality. Since the production of corn for grain in the Central Ciscaucasia is one of the priority areas, it is important to increase grain production of corn and improve its quality through the development and application of new technologies of its cultivation [7-10]. The purpose of the research is the development and testing of new application technology of multifunctional microbial compounds on corn.

## 2 Materials and methods

The experiment was planned according to the following scheme: 1. control experiment (without treatment); 2. CBC-standard - complex of biological compounds on the basis of nitrogen-fixing and phosphate solubilizing microorganisms; 3. CBC – innovative complex of biological compounds based on nitrogen-fixing, phosphate solubilizing and bioprotect microorganisms; 4. MCM – multi-strained complex based on microbial antagonists of phytopathogens with a growth-stimulating effect; 5. CMC-92 – complex of microbial compounds based on nitrogen-fixing, phosphate solubilizing and poststimulus microorganisms. The observations were carried out in 2017-2019 year on the ordinary Chernozem rich low-humic, loam on loess-like loam. The corn has been sown for grain hybrid Mashuk 355. According to the traditional technology was carried out treatment of seeds before sowing and corn plants in the phase of 3-4 leaves and flowering. The proposed technology included, in addition to the treatment of seeds and vegetative plants, pre-sowing tillage.

Soil samples were taken from the rhizosphere of corn plants from a layer of 0–20 cm according to the generally accepted technique. In the phases of 3-4 leaves, flowering, and wax ripeness, 5–7 point samples comprised the middle sample. The number of micromycetes (the total number of colony forming units — CFU) was studied by plating a soil suspension in a dilution of 10<sup>-2</sup> on Czapek – Dox medium followed by direct counting of colonies. For cellulose-destroying microorganisms, a selective Hutchinson medium was used.

## 3 Results and discussion

As a result of the studies, it was found that in the phase of 3-4 leaves the number of micromycetes in the control was 91 thousand CFU / g (table 1). The use of microbial compounds by traditional technology did not significantly affect the change in the number of the studied group of microorganisms, since it was below the smallest significant difference. As a result of cultivating the soil and seeds using the proposed technology, the number of micromycetes also did not undergo significant changes in all variants.

In the flowering phase, the number of micromycetes was the smallest in the control and amounted to 337 thousand CFU/g. The largest increase in the number of microorganisms of this physiological group with traditional technology was observed as a result of the use of MCM. The difference compared with the control was 165 thousand CFU/g. The smallest

increase in the number of micromycetes was found when using the compound CBC-Standard. The difference with control was only 124 thousand CFU/g. Nevertheless, this difference can be considered significant since it is higher than the HCP. Therefore, in the active phase of the growth and development of corn for grain, the multi-strain complex of microorganisms is most effective due to its complex microbial composition.

**Table 1.** The number of micromycetes in the soil, depending on the use of biological products, thousand CFU/g.

№	Experiment options	3-4 leaves		Flowering		Wax ripeness	
		Traditional technology	Proposed technology	Traditional technology	Proposed technology	Traditional technology	Proposed technology
1	Control (without treatment)	91	91	337	337	144	144
2	CBC-Standard (complex of biological compounds)	90	91	<b>461</b>	<b>590</b>	<b>197</b>	<b>305</b>
3	CBC-Innovative (complex of biological compounds)	92	94	<b>495</b>	<b>637</b>	<b>231</b>	<b>362</b>
4	MCM (multi-strain complex of microorganisms)	85	90	<b>502</b>	<b>664</b>	<b>282</b>	<b>399</b>
5	CMC-92 (complex of microbial compounds-92)	79	88	<b>464</b>	<b>672</b>	<b>222</b>	<b>442</b>
	HCP <sub>05</sub> thous. CFU/g	12		<b>36</b>		<b>27</b>	

According to the proposed technology, there was general increase in the number of microscopic fungi. However, unlike traditional technology, the highest increase in the number of this group of mikroorganizmov was observed when using CMC-92. The difference compared with control was 2.0 times. Least vozrastaniya the number of micromycetes on the proposed technology was through the use of the CBC-Standard, as well as on traditional technology. The difference with control reliable and substantial and is 1.8 times. Therefore, introduction of microbial compounds in addition to the soil significantly affects the development of micromycetes.

To the phase of wax ripeness on controlling the number of microscopic fungi decreased to 144 thousand CFU/g. Treatment of microbial compounds in the traditional technology increased the number of microorganisms physiological groups of 2.0 times in the application of MCM and 1.4-1.6 times under the influence of other compounds used. According to the proposed technology, the number of microorganisms compared to the control increased from 2.1 times when using the CBC-Standard and to 3.1 times in the application of CMC-92.

It is revealed that in the phase of 3-4 leaves cellulose-destroying the number of microorganisms in the control was 73 thousand CFU/g (Table 2). When using compounds according to the traditional technology, the number of studied microorganisms in relation to the control did not change significantly. Apparently, the compounds will be delayed through the corn by increasing their biomass and the degree of development of the

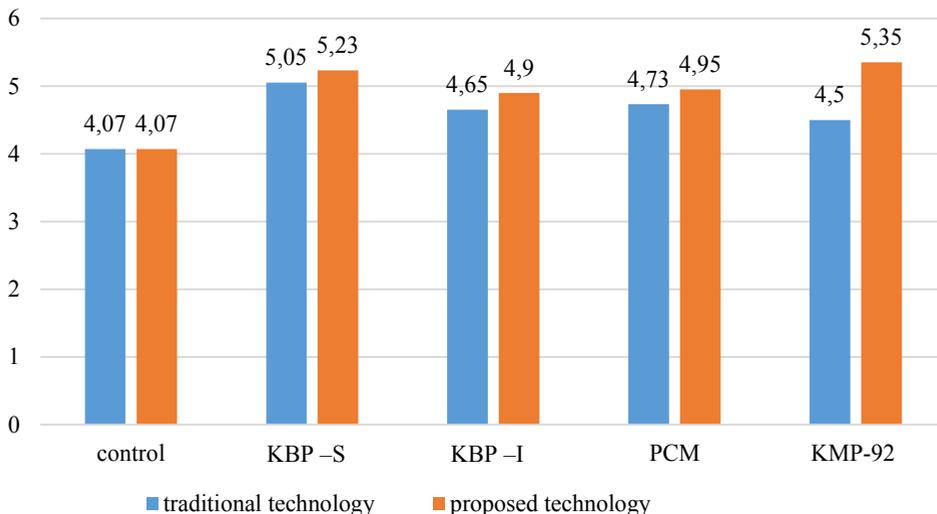
root system. According to the proposed technology, the number of cellulolytic also did not exceed the HCP.

**Table 2.** The number of cellulose-destroying microorganisms in soil depending on the use of bioproducts, thousand CFU/g.

№	Experience options	3-4 leaves		Flowering		Wax ripeness	
		Traditional technolog	Proposed technology	Traditional technolog	Proposed technology	Traditional technolog	Proposed technology
1	Control (without treatment)	73	73	192	192	224	224
2	CBC-Standard (complex of biological compounds)	89	90	336	416	431	565
3	CBC-Innovative (complex of biological compounds)	68	67	256	386	397	458
4	MCM (multi-strain complex of microorganisms)	67	66	273	359	388	457
5	CMC-92 (complex of microbial compounds-92)	68	66	340	445	400	590
	HCP <sub>05</sub> thous. CFU /1g	17		35		41	

In the flowering stage, the number of microorganisms in the control amounted to 192 million CFU/g. When using traditional technology, the smallest increase in the number of microorganisms of studied physiological groups relative to the control occurred in variants with applying CBC-Innovative and MCM 1.3 and 1.4 times, respectively. The difference is significant and higher HCP. When applying CBC-Standard and CMC-92 cancelled the greatest increase in the number of cellulolytics 1.8 times for both options. On options with the proposed technology, the smallest increase in the number of cellulose-destroying of microorganisms relative to the control (by 1.9 times) was observed when using the MCM, and the highest (by 2.3 times) by treatment with CMC-92.

In the phase of wax ripeness in the control study the indicator the indicator amounted to 224 thousand CFU/g. A number of cellulolytics was greatest during the use of the compound CBC-Standard, and exceeded the control by a factor of 1.9, and the lowest when using the MCM with a substantial excess control 1.7 times. On the proposed technology using the compounds CMC-92 has the highest increase in the number of cellulose-destroying microorganisms (by 2.6 times), whereas the smallest increase of the studied parameter (by 2.0 times) marked with using the MCM.



**Fig. 1.** The yield of hybrid corn Mashuk 355, depending on the application of biological products and application method

In the study of the yield of grain corn revealed that the least she was in control and made up 4.07 t/ha (figure). In traditional technology the use of the MCM - Standard gave the greatest increase to 0.98 t/ha, and the smallest - by 0.43 t/ha observed on the variant with application of CMC-92. According to the proposed technology the situation is quite different. On the variant with application of CMC-92 corn yield was the highest and amounted to 5.35 tons/ha. It's higher than control by 1.28 t/ha.

## 4 Conclusion

Thus, in the result of the research revealed that the application of multifunctional microbial compounds CBC-Standard of the CBC-Innovative, MCM and CMC-92 – change the number of fungal and cellulose-destroying microflora.

The number of micromycetes in the control at the flowering stage c 337 thousand CFU/g, and in a phase of wax ripeness c 144 thousand CFU/g maximum increased with the application of MCM on traditional technologies and the CMC-92 using the proposed one. The lowest values have a phase of 3-4 leaves. The use of biologics had no significant effect on the number of microorganisms during this period. A number of cellulose-destroying microorganisms on control in phase 3-4 leaves were amounted to 73 thousand CFU/g. and were not significantly changed as a result of the application of biocompounds. In the flowering phase, the number of cellulolytics in the control increased to 192 thousand CFU/g and increased in various variants from 1.3 to 1.8 times. In the phase of wax ripeness, the number of microorganisms in the control increased to 224 thousand CFU/g, and in various cases from 2.0 to 2.6 times and especially when using the CMC-92 compound according to the proposed technology.

The yield of corn on the smallest grain was on the control (4.07 t/ha), it increased on traditional technology most of all with the use of CBC-Standard, and according to the proposed technology with the use of CMC-92. Thus, the introduction of biological compounds into the soil gives an additional effect.

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