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STUDY ON THE IMPACT OF INNOVATIVE BIOFERTILIZERS ON PROSO MILLET (*Panicum miliaceum*) PRODUCTIVITY

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Abstract

During the period 2023-2025, at the Agricultural Institute - Shumen, millet genotype G2 was treated with innovative bioinoculants. Based on the obtained results, it was established that under carbonate chernozem soil conditions, the application of inoculants at different doses and using different methods, led to an increase in the grain yield of millet in all cases of application. The increase in yield also led to an increase in the coefficient of variation. Under the more favorable agrometeorological conditions of 2023, seven of the tested variants showed significantly higher yields. In conditions of water deficit in 2024 and 2025, significantly higher yields were observed only in the variants treated with Fosfatovit 0.5 l/ha, Azotovit 1 l/ha and Fosfatovit 1 l/ha. The aim of the study is to investigate underl field conditions the influence of innovative bioinoculants on grain yield in millet.

Key words*: fertilization, inoculants, millet, yield.*

INTRODUCTION

Millet (*Panicum miliaceum* L.) is one of the oldest cultivated cereals in the world and played a significant role in early agriculture in Eurasia. Although it is now cultivated on a limited scale, mainly in Central and East Asia, archaeobotanical evidence suggests that domestication of this plant occurred more than 10,000 years ago, in northern and northeastern China (Hunt et al., 2008; Crawford, 2009; Liu et al., 2009; Lu et al., 2009; Hunt, 2014). It is an important tetraploid cereal (2n=4 x=36; Hamoud et al., 1994). It has the shortest growing season of all cereals (60-90 days) and extremely low water requirements (Baltensperger, 1996; Baltensperger, 2002).

The high nutrient concentration of the grain is a prerequisite for its use for human consumption, as well as as poultry feed and ethanol production (Graybosch and Baltensperger, 2009; Habiyaremye et al., 2017).

Compared to other summer crops, millet has remarkable tolerance to drought and high temperatures and could be used to improve crop rotation and biodiversity (Antonacci el al., 2021; Palchetti et al., 2023). This drought tolerance is based on complex interactions between the rhizosphere microbiome and plant metabolism (Li et al., 2023).

Studies by Gupta et al. (2021) found that the bacterial community in the rhizosphere of two millet cultivars was resistant to drought stress, showing only minor changes in its diversity and composition. Instead, the growth phase of the plant appeared to be the main factor determining the structure of the microbial community. Specifically, bacterial diversity increased significantly from the germination to the tillering stage and decreased at full maturity. These dynamics indicate that the composition of the rhizosphere microbiome is more responsive to the physiological needs and exudate profiles of the plant than to water stress conditions. Despite these studies, the available information on how bacterial communities in the rhizosphere of different millet cultivars respond to drought is limited (Na et al., 2019).

Major bacterial taxa such as *Actinobacteria*, *Proteobacteria* and *Acidobacteria* remained dominant under different irrigation regimes, suggesting functional stability and potential symbiotic support under limited water availability. The results show that pansy (*Panicum miliaceum* L.), even under drought, maintains a relatively stable and functionally resilient microbiome in the rhizosphere, which

likely contributes to its exceptional drought tolerance compared to other cereals (Na et al., 2019).

The rhizosphere plays a key role in water and nutrient uptake and represents a dynamic interface between plant roots and the surrounding soil. Rhizosphere microorganisms, including fungi and bacteria, are an integral part of this zone and have a strong influence on plant growth under stressful environmental conditions. During the flowering phase of millet (*Panicum miliaceum* L.), drought significantly altered the presence of major fungal phyla such as *Ascomycota* and *Basidiomycota*, but the overall fungal diversity remained stable. This indicates that the rhizosphere fungal community functionally adapts to water deficit conditions, possibly supporting plant water balance through improved nutrient cycling, osmolyte synthesis, and signalling between roots and microorganisms. Such microbial adaptations may partially explain the ability of *P. miliaceum* to maintain productivity under prolonged drought (Liu et al., 2023).

Compared to monocultures, the alfalfa-millet intercropping system at different row ratios significantly increased the yield of feathery millet, with the reported yield advantage reaching 28.3%. Intercropping not only improves nitrogen fixation and soil fertility, but also stimulates the uptake of nitrogen, phosphorus and potassium by plants, mainly through increased activity of soil microorganisms (Liu et al., 2022). This can be partly explained by the additional symbiotic microbiome arising between the different symbionts of the two species.

Intercropping significantly alters the structure of rhizosphere microbial communities, often increasing the relative abundance of beneficial taxa such as Actinobacteria, Proteobacteria, and Firmicutes. These shifts are associated with enhanced soil enzyme activities, improved nutrient cycling, and increased crop yield and nutrient use efficiency (Zhang et al., 2019). Therefore, the interaction between legume root exudates and the microbiome in the rhizosphere of feathery millet plays a crucial role in increasing the yield and sustainability of terrestrial agroecosystems (Li et al., 2025).

The combination of organic nutrients and bioinoculants resulted in significantly higher grain and straw yield of feathery millet under field conditions in a semi-arid climate (Sharma et al., 2022).

The concentration of trace elements such as zinc, iron and manganese in millet grain also increased, indicating that the crop responded very well to microbial inoculation (Šenk, 2023).

Devasena et al. (2024) found that integrated nutrient management practice by applying vermicompost enriched with *Azospirillum* and *Phosphatobacteria* at a dose of 6 t/ha along with 100% recommended dose of nitrogen, phosphorus and potassium significantly increased plant physiological parameters (leaf area index, crop growth rate, chlorophyll index) and yield (grain yield and straw yield) of millet.

Other studies by Sridevi et al. (2020) on the inoculation of *Pseudomonas fluorescens* of millet seeds resulted in significant increase of germination percentage, vigor index and early growth. Bio-primed seeds showed higher chlorophyll content and enzyme activities, especially amylase and peroxidase, which helped in stronger root development and higher yields under field conditions.

Shishehbor et al. (2013) studied the effect of applying biofertilizers with vermicompost on yield components in millet. They reported a higher 100 seed weight, in plants inoculated with *Azotobacter chroococcum*, which was significantly higher than uninoculated plants. In addition, the effect of mycorrhiza and *Azotobacter* in the presence of vermicompost was greater. The biological yield was higher when mycorrhiza was applied together with Azotobacter and vermicompost. The grain yield of plants inoculated with *A. chroococcum* was significantly higher than that of uninoculated ones. Also, the effect of *Azotobacter* in the presence of vermicompost was enhanced.

Inoculation with *Rhizophagus fasciculatus* significantly increased the degree of root colonization and helped the absorption of essential nutrients (nitrogen, phosphorus and potassium) in millet (*Panicum miliaceum* L.). Even under fungicide stress, plants in symbiosis with mycorrhizal fungi showed better root morphology, higher chlorophyll content and increased dry matter accumulation compared to uninoculated controls. The study

demonstrated that arbuscular mycorrhizal fungi not only protect roots from chemical stress but also maintain soil enzymatic activity (dehydrogenase, phosphatase) and nutrient cycling, leading to sustainable growth and yield stability. This highlights the key role of microbial symbioses in maintaining millet productivity and soil health under intensive agronomic practices (Channabasava et al., 2015).

The aim of the current study is to investigate the impact of innovative microbial fertilizers on millet productivity in real field conditions.

MATERIALS AND METHODS

The experiments were conducted during the period 2023-2025 in the experimental fields of the Agricultural Institute - Shumen, Northeastern Bulgaria (GPS coordinates: 43°18'51.3"N 27°01'41.8"E). The soil is sandy, clay, leached chernozem. The chemical properties are provided in Table 1.

Table 1. Chemical properties of the soil

pH (H_2O)	6.66
Nutrient reserves	**Amount (ppm)**
NO_3	15.62
$+NH_4$	1.96
N	17.58
P_2O_5	40.94
K_2O	227.14
CaO	6,002.82
MgO	692.65
Na_2O	33.98
S	7.71
B	0.57
Cu	1.44
Fe	27.31
Mn	6.74
Zn	0.35

The preceding crop was wheat.

The experiments were set up using a block method in four replications with 10 m^2 of harvest area under non-irrigated conditions. The accepted technology for cultivation with narrow-row sowing was used, carried out at the end of April or the beginning of May, with permanent warming of the soil to 10 cm above 14°C. During the vegetation period, observations were made on morphological and economic indicators. Harvesting was carried out manually when 75% of the plants were fully mature.

For the purposes of the study, the millet genotype G2, developed in the breeding program of the Agricultural Institute - Shumen, was used, which in field tests has been distinguished by very good productivity so far. The applied doses, methods, and timing of inoculant application were in accordance with the instructions of the respective manufacturer. Due to the indication of different doses and methods of application, two of the products (Phosphatovit and Azotovit) were used both for surface treatment of the soil before sowing in different doses, and for seed coating, as well as a combination of them at the maximum recommended dose.

Table 2 presents the microbial fertilizers used, the timing and method of their application.

Meteorological data, listed in Table 3 were collected starting from the post-harvest period of the previous year (2022) in order to assess the accumulation of soil moisture throughout the year. The agrometeorological conditions table shows a moisture deficit in all three years of testing, compared to the average norm for a 50-year period. 2022 had a deficit of 111 mm of precipitation, compared to the norm, whose lack was reflected in the following harvest year (2023). In 2023, the moisture deficit reached 70 mm., which was a prerequisite for a relatively good yield of millet grain. 2024 had a deficit of 173 mm, which adversely affected the yield, but also the amount of accumulated moisture. In 2025, the moisture deficit was very clearly expressed, although the precipitation in the months of April and May compensated to some extent the moisture deficit accumulated during the winter months.

During the first seven months, corresponding to the millet growing period, the moisture deficit reached 121 mm.

Despite the unfavorable values observed during all three years of research, we can note that millet managed to show its potential, under both high temperatures and water deficit conditions.

The data were processed using the method of variation statistics with the software product "Minitab". The significance of differences was determined using Student's *t*-test (Gosset, 1908) at a probability level of P=0.95, 0.99, 0.999.

Table 2. Microbial fertilizers used

Product name	Method of application	Product description
Biosplito	Surface (suspension) soil with incorporation	*Trametes versicolor, Pleurotus ostreatus, Cellulomonas uda, Cellulomonas gelida, Aspergillus awamori, and Trichoderma reesei* (in equal concentrations, total 1 x 10^9 ksv/g).
Biostart	Seed coating	*Bacillus subtilis, Paenibacillus azotofixans, Bacillus megaterium, Bacillus mucilaginosus, Bacillus mycoides, Trichoderma viride* (total more than or 1 x 10^9 cfu/g); mycorrhizal fungi 1 x 10^7 cfu/g.
Naturalis	Surface (suspension) soil with incorporation	*Beauveria bassiana*; strain ATCC 74040 0.185 g/kg
Microbtima protect	Seed coating	*Trichoderma koningii, Trichoderma viride, Trichoderma harzianum, Trichoderma asperillum, Pseudomonas putida, Pseudomonas chlororaphis*; Total CFU- up to 108 cells/ml
Biospectrum	Surface (suspension) soil with incorporation	*Paenibacillus azotofixans, Bacillus megaterium, Bacillus mucilaginosus, Bacillus mycoides.* Total 1 x 10^9 CFU*/g. Mycorrhizal fungi – Total 1 x 10^7 CFU*/g
Phosphatovit	Seed coating / Surface (suspension) soil with incorporation	Spores and living bacteria cells of *Paenibacillus mucilaginosus*
Azotovit	Seed coating / Surface (suspension) soil with incorporation	Living bacteria cells *Beijerinckia fluminensis*
Azotohelp	Seed coating	*Azotobacter chroococcu;* minimum 1.0 x 10^9 CFU*/cm^3
Utrisha N	Leaf in water suspension	*Methylobacterium symbioticum*; strain SB23 Total. 3 x 10^7 CFU*/g.

Table 3. Meteorological conditions in the area of the Agricultural Institute - Shumen

2022									
Month	Temperature - °C				Precipitations – mm				
	Ten-day periods			Mean	Ten-day periods			Sum	Norm
	I	II	III		I	II	III		
VI	23.5	22.9	26.1	24.2	0.6	0.0	3.7	4.3	64.0
VIII	25.1	24.4	24.8	24.8	0.0	27.6	3.0	30.6	42.0
IX	20.0	19.0	16.2	18.4	28.9	9.6	16.7	55.2	53.0
X	14.7	12.5	14.2	13.8	11.7	0.5	0.3	12.5	51.0
XI	13.0	10.1	6.1	9.7	0.0	19.4	32.1	51.5	51.0
XII	4.9	4.6	4.2	4.6	13.9	9.2	0.6	23.7	28.0
Total:								177.8	289.0
2023									
Month	Temperature - °C				Precipitations - mm				
	Ten-day periods			Mean	Ten-day periods			Sum	Norm
	I	II	III		I	II	III		
I	7.0	7.1	2.3	5.4	2.1	30.4	7.0	39.5	35.0
II	2.9	7.0	5.1	5.0	12.3	0.0	14.2	26.5	28.0
III	8.2	6.9	8.5	7.9	6.9	11.0	20.9	38.8	31.0
IV	8.5	11.2	11.8	10.5	13.0	45.3	27.2	85.5	41.0
V	13.8	15.0	17.9	15.6	13.3	11.4	44.7	69.4	64.0
VI	19.9	20.4	23.2	21.2	6.9	17.6	1.9	26.4	41.0
VII	23.8	27.5	25.3	25.5	34.6	3.1	0.0	37.7	64.0
VIII	24.0	24.9	20.8	23.1	0.0	6.7	0.6	7.3	42.0
IX	22.0	20.4	21.3	21.2	0.9	47.8	0.0	48.7	53.0
X	16.7	14.3	18.6	16.6	0.5	0.0	0.0	0.5	51.0
XI	13.5	8.1	4.6	8.7	12.3	20.5	46.1	78.9	51.0
XII	4.6	3.8	6.5	4.9	0.0	2.0	1.1	3.3	28.0
Total:								462.5	529.0
2024									
Month	Temperature - °C				Precipitations - mm				
	Ten-day periods			Mean	Ten-day periods			Sum	Norm
	I	II	III		I	II	III		
I	4.1	2.0	0.3	2.1	8.0	0.3	3.7	12.0	35.0
II	8.2	7.3	9.5	8.3	0.0	0.0	2.6	2.6	28.0
III	7.3	8.0	11.5	9.0	1.1	18.9	8.0	28.0	31.0
IV	15.6	16.2	12.9	14.9	4.5	20.9	45.7	71.1	41.0
V	15.0	14.5	18.3	16.0	13.4	13.5	10.3	37.2	64.0
VI	25.3	24.8	25.2	25.1	0.0	33.3	0.0	33.3	75.0
VII	25.2	24.8	24.0	24.6	15.0	20.0	12.6	12.6	60.0
VIII	25.2	26.9	23.7	25.2	5.1	0.0	5.2	10.3	42.0
IX	22.3	17.4	18.7	19.5	0.0	0.5	15.7	16.2	28.0

X	17.1	11.4	9.9	12.7	6.7	8.3	0.3	15.3	53.0
XI	7.0	5.0	4.1	5.4	14.2	21.0	2.4	37.6	51.0
XII	5.2	4.7	2.9	4.2	30.9	0.8	79.0	110.7	51.0
Total:								416.9	559.0
2025									
Month	Temperature - °C				Precipitations - mm				
	Ten-day periods			Mean	Ten-day periods			Sum	Norm
	I	II	III		I	II	III		
I	5.9	1.1	7.3	4.9	1.2	2.4	3.2	6.8	35.0
II	0.1	-1.4	-2.7	-1.2	0.6	11.2	6.0	17.8	28.0
III	7.5	11.3	11.6	10.2	1.0	15.6	9.2	25.8	31.0
IV	6.5	10.4	13.4	10.1	28.4	1.0	5.4	34.8	41.0
V	16.0	13.5	16.3	15.3	15.0	15.2	37.8	68.0	64.0
VI	21.7	21.7	24.5	22.6	8.0	5.2	0.4	13.6	75.0
VII	25.0	22.2	26.5	24.6	0.0	34.6	11.8	46.4	60.0
Total:								213.2	334.0

RESULTS AND DISCUSSIONS

Table 4 shows the results of the test for 2023. The control variant yielded 1,759 kg/ha of grain. The application of Phosphatovit as a seed coating and at the minimum dose of 0.5 L/ha resulted in a statistically significant increase in yield ($P < 0.05$) corresponding to increases of 15% and 12%, respectively. At doses of 1.0 and 1.5 L/ha, the yield increase averaged 600 and 500 kg/ha, respectively, corresponding to 24.4% and 22.4% increases ($P < 0.01$). The application of Azotovit at doses of 0.5 and 1.0 L/ha also resulted in a significant yield increase ($P < 0.05$), of 221 and 407 kg/ha, corresponding to 19% and 23.1%, respectively.

Table 4. Average millet yield t/ha under different microbial fertilizer application options, 2023

2023 average yield of millet, grain - t/ha					
Microbial agent	Method of application	Application dose	$\bar{x}$	SE	CV
Biosplito	soil surface application	1.5 kg / ha	1.761	9.0	8.1
Biostart	seed coating	200 g / 100 kg seeds	1.761	14.7	10.0
Naturalis	soil surface application	2l / ha	1.893	7.4	8.7
Microbtima	seed coating	500 ml / 100 kg seeds	1.767	7.7	9.9
Biospectrum	soil surface application	250 g / ha	1.763	14.1	15.2
Phosphatovit	seed coating	1,5 l / ha	*2.055	9.2	10.0
Phosphatovit	soil surface application	0.5 l / ha	*1.995	6.7	7.9
Phosphatovit	soil surface application	1 l / ha	**2.357	8.8	8.3
Phosphatovit	soil surface application	1,5 l / ha	**2.265	7.7	7.6
Phosphatovit + azotovit	soil surface application	1.5 l / ha + 1.5 l / ha	1.843	18.1	15.0
Azotovit	soil surface application	1.5 l / ha	2.075	14.4	15.5
Azotovit	soil surface application	1 l / ha	*2.166	10.6	10.9
Azotovit	soil surface application	0,5 l / ha	*1.973	8.0	9.1
Azotovit	seed coating	1,5 l / ha	1.987	14.4	16.2
Azotohelp	seed coating	2 l / ha	1.888	13.7	9.3
Utrisha N	leaf application (third-fourth leaf)	330 g / ha	*2.046	13.0	14.2
Control	-	-	1.759	3.7	4.7

$\bar{x}$ - Mean; SE – Standard error; CV – Coefficient of variation
*- Statistically significant difference at $p < 0.05$
**- Statistically highly significant difference at $p < 0.01$

The experimental year 2024 was characterized by temperatures above normal and precipitation well below normal for the region, although the precipitation that fell in the months of April and May accumulated moisture, which helped the initial development of the plants. Logically, as shown in Table 5, the yields obtained from the experimental fields were the lowest of the three years of study. The control yielded 1,514 kg/ha. Due to the unfavorable conditions, the differences between the control and the experimental plots were small and insignificant. A proven positive difference $P<0.05$ was observed with the application of Phosphatovit 0.5 l/ha and Azotovit 1 l/ha, respectively by 9% and 19%, and with Phosphatovit 1 l/ha the increase in yield increases with a proven $P<0.01$, with the difference being 19% and 354 kg/ha in absolute value. With other microbial preparations and

applied doses, although there is a positive difference, it has not been proven due to significant variation between yields in the experimental plots.

Table 5. Average millet yield t/ha under different microbial fertilizer application options, 2024

2024 average yield of millet, grain - t/ha					
Microbial agent	Method of application	Application dose	x̄	SE	CV
Biosplito	soil surface application	1.5 kg / ha	1.534	4.5	5.1
Biostart	seed coating	200 g / 100 kg seeds	1.491	6.4	5.1
Naturalis	soil surface application	2l / ha	1.532	10.1	14.7
Microbtima	seed coating	500 ml / 100 kg seeds	1.497	5.7	8.5
Biospectrum	soil surface application	250 g / ha	1.540	8.7	7.3
Phosphatovit	seed coating	1,5 l / ha	1.722	12.5	16.2
Phosphatovit	soil surface application	0.5 l / ha	*1655	5.7	7.7
Phosphatovit	soil surface application	1 l / ha	**1.953	8.2	9.4
Phosphatovit	soil surface application	1,5 l / ha	1.892	10.4	12.3
Phosphatovit + azotovit	soil surface application	1.5 l / ha + 1.5 l / ha	1.560	5.5	8.1
Azotovit	soil surface application	1.5 l / ha	1.808	12.6	15.5
Azotovit	soil surface application	1 l / ha	*1.868	10.8	13.0
Azotovit	soil surface application	0,5 l / ha	1.513	6.4	9.5
Azotovit	seed coating	1,5 l / ha	1.773	9.3	11.7
Azotohelp	seed coating	2 l / ha	1.625	5.6	7.7
Utrisha N	leaf application (third-fourth leaf)	330 g / ha	1.794	7.1	10.2
Control	-	-	1.514	5.3	5.8

x̄ - Mean; SE – Standard error; CV – Coefficient of variation
*- Statistically significant difference at $p < 0.05$
**- Statistically highly significant difference at $p < 0.01$

Table 6 shows the grain yield of millet for the 2025 harvest year. The lack of precipitation in the first half of the year, compared to the average precipitation for the region, reached 121 mm. The drought, which was observed in the months of June and July, at a time when millet lays reproductive organs and forms seeds, had a particularly adverse effect on grain production. In this situation, 1.557 t/ha of grain was obtained from the control variant. In all experimental settings, the positive influence of microbial fertilizers was demonstrated, with a proven difference $P<0.05$ being recorded in the variants with Phosphatovit 0.5 l/ha and Azotovit 1 l/ha, representing 10% and 21%, respectively. The application of Phosphatovit at a dose of 1 l/ha leads to the proven positive difference $P<0.01$, representing 410 kg/ha or 24.3% compared to the control variant.

Table 6. Average millet yield t/ha under different microbial fertilizer application options, 2025

2025 average yield of millet, grain - t/ha					
Microbial agent	Method of application	Application dose	x̄	SE	CV
Biosplito	soil surface application	1.5 kg / ha	1.616	6.7	7.3
Biostart	seed coating	200 g / 100 kg seeds	1.570	6.6	6.9
Naturalis	soil surface application	2 l / ha	1.561	9.1	12.8
Microbtima	seed coating	500 ml / 100 kg seeds	1.596	5.8	8.2
Biospectrum	soil surface application	250 g / ha	1.580	5.1	7.2
Phosphatovit	seed coating	1.5 l / ha	1.713	8.1	10.2
Phosphatovit	soil surface application	0.5 l / ha	*1.722	7.0	9.1
Phosphatovit	soil surface application	1 l / ha	**2.056	8.6	6.4
Phosphatovit	soil surface application	1.5 l / ha	1.992	10.9	12.3
Phosphatovit + azotovit	soil surface application	1.5 l / ha + 1.5 l / ha	1.601	6.3	8.7
Azotovit	soil surface application	1.5 l / ha	1.904	13.2	15.5
Azotovit	soil surface application	1 l / ha	*1.967	11.4	13.0
Azotovit	soil surface application	0.5 l / ha	1.610	4.5	6.3
Azotovit	seed coating	1.5 l / ha	1.823	9.2	10.2
Azotohelp	seed coating	2 l / ha	1.696	6.1	8.0
Utrisha N	leaf application (third-fourth leaf)	330 g / ha	1.733	10.5	9.0
Control	-	-	1.557	4.7	6.8

x̄ - Mean; SE – Standard error; CV – Coefficient of variation
*- Statistically significant difference at $p < 0.05$
**- Statistically highly significant difference at $p < 0.01$

From the data obtained during the three years of testing of the various biofertilizers, it can be summarized that in conditions of mild to moderate soil moisture deficiency and higher temperatures than the average for the region, a positive effect on grain yield was observed in all test variants. The independent application of bioinoculants has been proven to increase millet yields, and treatment in combination does not accumulate its effect on grain productivity. This may be due to both the specific abiotic conditions and the antagonistic effect between them. It is concluded that the application of biopreparations, in addition to increasing yield, also leads to an increase in variation. This is also confirmed in the studies of Leggett et al. (2015) and Overbeek et al. (2021).

In conditions of water deficit in 2024 and 2025, proven higher yields were observed in the variants treated with Fosfatovit 0.5 l/ha, Azotovit 1 l/ha and Fosfatovit 1 l/ha. During the more favorable agrometeorological conditions of 2023, seven of the tested variants showed significantly higher yields.

CONCLUSIONS

The new economic realities (expensive nitrogen and phosphorus fertilizers, extreme drought and high temperatures) can be overcome with new methods of farming and fertilizing crops.

Under unfavorable agrometeorological conditions - high temperature and water deficit, microbial fertilizers prove their effectiveness and increase the adaptability of plants to adverse abiotic factors of the environment, however, the highest percentage increase in yield is in the year with more precipitation - 2023. During the three years of research, the preparations Azotovit and Fosfatovit have given a proven increase in yield. From our research, we cannot conclude why high doses of application, as well as the combination of the two products, do not give a cumulative effect. When studying the impact of the aforementioned microbial fertilizers, the results obtained showed a positive effect on increasing millet (*Panicum miliaceum* L.) grain yield with up to 24,4%. Regardless of the composition of the microbial inoculants (spores, live bacteria, fungal strains or combinations thereof), they all show an increase in yields, although in some of the variants the increase is not statistically proven, but nevertheless higher yields have been registered.

The economic justification for the application of the studied biofertilizers is the subject of another study and the recommendation for their application can be made only after a careful economic analysis.

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