https://www.sworldjournal.com/index.php/swj/article/view/swj28-00-014
DOI: 10.30888/2663-5712.2024-28-00-014

UDC 633.17:631.811.98

INFLUENCE OF BIOLOGICAL PRODUCTS ON THE YIELD OF SOWING MILLET IN ORGANIC PRODUCTION

Stoliar Svitlana
Candidate of Agricultural Sciences, Associate Professor
Head of the Department of Crop Production Technologies
ORCID ID: 0000-0001-5925-2008
Polissia National University, Zhytomyr, Ukraine
Trembitska Oksana
Candidate of Agricultural Sciences
Associate Professor of the Department of Soil Science and Farming
ORCID ID: 0000-0003-1152-0215
Polissia National University, Zhytomyr, Ukraine
Bilotserkivska Lilia
Teacher of the Novochortorii Technological and Economic College, Ukraine
Samkov Vladyslav
Master Student, Specialty 201 "Agronomy"
Polissia National University, Zhytomyr, Ukraine

Abstract. *The study considers the urgent problem of increasing the productivity of sowing millet under conditions of organic production. Theoretical analysis and experimental studies have shown that the use of biological products is an effective tool for achieving higher yields. The maximum grain yield of millet (1.73 t/ha) was obtained under the conditions of complex application of the biological product 'Fitotsid', including seed treatment and spraying of crops with a consumption rate of 1.5 + 0.6 l/ha. The study also revealed a significant correlation between the level of yield and the use of biological products, which is 61.73 %. This confirms the effectiveness of biological products in increasing yields, which is an important factor for organic farming, as it reduces dependence on synthetic chemicals and increases the environmental sustainability of production.*

Key words: *sowing millet, biological products, yield, grain quality.*

Introduction. In the context of climate warming, drought-resistant cereal crops such as sowing millet are of particular value. Adaptive responses of crop varieties contribute to sustainable productivity growth, resource and energy efficiency, environmental protection and profitability of production.

In the context of biologisation and greening of innovative processes in crop production, a special place is occupied by the use of biological products aimed at sustainable growth of the yield and quality of the crop. Broad-spectrum biological products with the functions of growth regulator, biofungicide, immunomodulator and fertiliser are gaining a significant role [1, 2, 5].

The use of multifunctional preparations is one of the ways to enhance plant growth and development, improve grain quality, increase productivity of sowing millet, and increase plant resistance to diseases and pests. In addition, these preparations, due to their versatile spectrum of action, can help reduce the use of chemical plant protection products [3, 4].

The aim of the research was to determine the effect of biological products on the yield and grain quality of sowing millet in the Forest-Steppe of Ukraine.

Material and Methods. Field research was conducted at Farmgate Ukraine LLC in Shepetivka district, Khmelnytskyi region, to study the complex treatment of sowing

millet with biological products to increase the yield and quality of grain products.

Laboratory research: phytopathological laboratory of the Department of Plant Protection and certified laboratory of Polissia National University.

The soils of the experimental plots are soddy podzolic.

From May to August 2023–2024, the Khmelnytskyi region experienced various weather conditions that affected agronomic indicators. In May 2023, the average temperature was around +16 °C, with precipitation of 60–70 mm, which was in line with seasonal norms. June was warm, with an average temperature of +19 °C and higher precipitation of 85 mm, which created favourable conditions for crop growth. In July, the temperature rose to +22 °C, and although it reached +30 °C in some places, precipitation was 70 mm, which was slightly below normal. August 2023 ended the season with an average temperature of +21 °C and 65 mm of precipitation, accompanied by short-term showers, while maintaining sufficient soil moisture.

In 2024, May saw slightly warmer weather, with average temperatures around +17 °C, but precipitation dropping to 55 mm, causing a moderate moisture deficit. June remained warm, with an average temperature of +20 °C and precipitation of 90 mm, which provided the necessary moisture for active plant growth. July 2024 was one of the warmest on record, with an average temperature of +23 °C, at times exceeding +30 °C, and precipitation of 75 mm, which was in line with the norm. August 2024 had an average temperature of +22 °C and 60 mm of precipitation, creating optimal conditions for crop ripening.

In general, in these two years, weather conditions were favourable for agriculture, although 2024 was characterised by slightly higher temperatures and uneven precipitation, which could affect the moisture supply of crops at different stages of their development.

The effectiveness of complex treatment of sowing millet with biological preparations was studied according to the scheme:

Variant	Consumption rate of the preparation, kg, l/t, l/ha
Zapovitne variety	
Seed treatment and crop spraying	
Control (water treatment)	–
Nitrogen, p.	0,1+0,5
Biophosphorus, p	0,2 + 1,0
Organic-Balance, p	2,5 + 2,5
Phytocide, p	1,5+0,6

The area of the accounting plot was 10m^2, replication was four times, the placement of variants in the experiment was randomised. Seed treatment with biological products was carried out 1–2 hours before sowing by the method of moistening (working solution at the rate of 10 l/t of seeds). Plants were sprayed at the 31st and 60th stages of plant organogenesis (according to the international BBCH) (working solution consumption – 300 l/ha).

Harvesting was carried out by harvesting the grain (SAMPO-500 combine) and

subsequent weighing in terms of 14 % moisture content and 100 % purity. Samples were taken from each threshed area for laboratory tests to determine the quality of the grain.

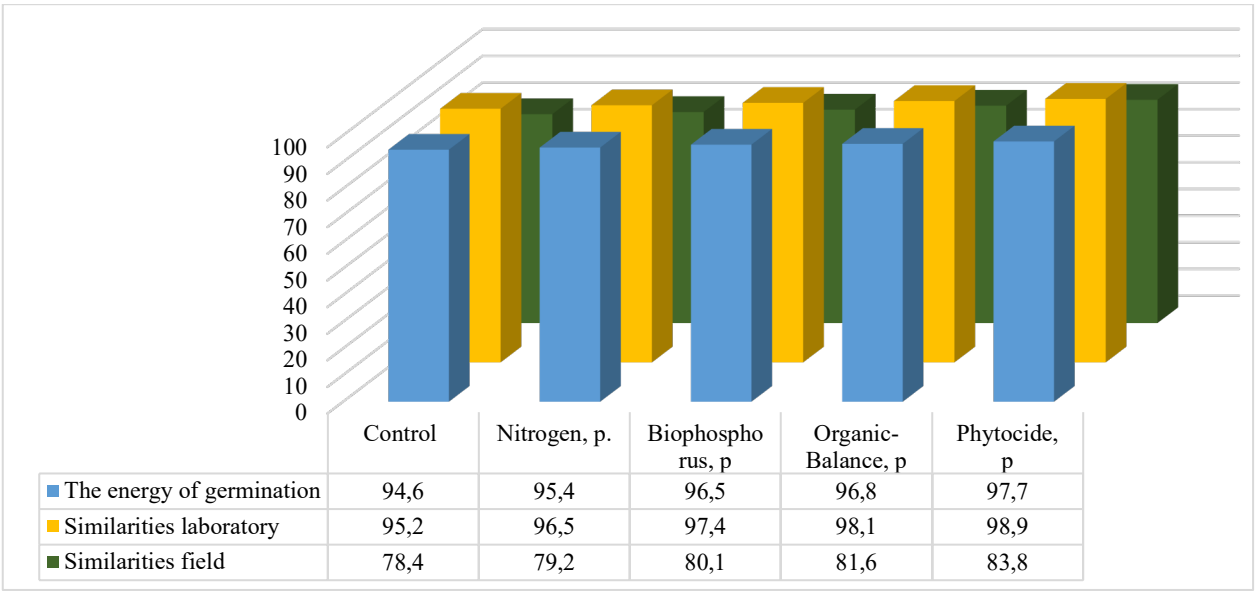
The mass fraction of protein, fat and starch in the grain (%) was determined using infrared spectroscopy, using the methodology for determining the quality of crop production. The data was statistically processed using computer software.

Results. Proso millet goes through different stages of development during the growing season (from seed germination to maturity). The process of plant growth and development is crucial for yield. Numerous factors that determine the growth and development of vegetative and generative organs of cereals need to be regulated to ensure high crop productivity (Fig. 1).

a – seed **b – agrocenosis**

Figure 1 – Proso millet variety Zapovitne

Germination is one of the main indicators of seed quality. It is characterised by the number of normally germinated seeds over a set period of time and under the conditions necessary for germination (optimal temperature, light, humidity) (Fig. 2).



	Control	Nitrogen, p.	Biophosphorus, p	Organic-Balance, p	Phytocide, p
The energy of germination	94,6	95,4	96,5	96,8	97,7
Similarities laboratory	95,2	96,5	97,4	98,1	98,9
Similarities field	78,4	79,2	80,1	81,6	83,8

Figure 2 – Sowing qualities of millet depending on seed treatment with biological preparations (Zapovitne variety, 2023–2024)

Studying the sowing qualities of seeds, it was found that the energy of grain germination ranged from 94.6 % to 97.7 %. The highest rate (97.7 %) was recorded after seed treatment with the biological preparation Phytocid, p. with a consumption rate of 1.5 l/t. Laboratory germination varied between 95.2–98.9 % when using biological products. Field germination differed from the laboratory and was significantly lower and ranged from 78.4 to 83.8 %. The maximum value was observed when seeds were treated with the biological preparation Phytocid, p.

As a result of the research, a phytopathological examination of millet grain was carried out to identify pathogens that, under favourable conditions, cause plant damage throughout the growing season, which affects the level of yield and its quality (Fig. 3).

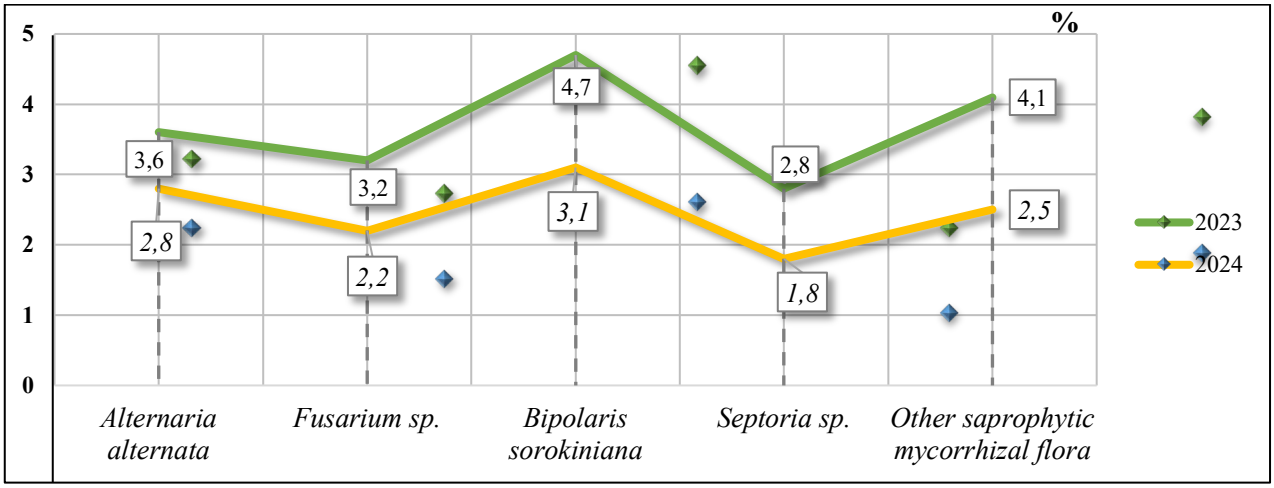


Figure 3 – Seed millet grain damage by fungal pathogens

Pathogens of fungal etiology were found on the seeds of sowing millet: *Alternaria alternate, Fusarium* sp., *Bipolaris panici-miliacei, Magnaporthe grisea and* other saprophytic mycorrhizal flora. During the grain harvest in 2023, there was excessive precipitation in August, which led to more seed infection than in 2024. The most common pathogen was *Bipolaris panici-miliacei* , which causes root rot, black germ, and brown leaf spot.

It should be noted that the use of biological preparations has a significant impact on the formation and development of the main elements of the structure of the millet yield (Table 1)

Table 1 – Sowing millet yield structure depending on the complex use of biological products, 2023–2024

Variant	Plant height, cm	Panicle length, cm	Number of grains per panicle, pcs.	Grain weight per panicle, g	Weight of 1000 grains, g
Control (water treatment)	110,0	26,2	438,7	3,29	7,10
Nitrogen, p.	107,8	27,3	441,1	3,31	7,15
Biophosphorus, p	109,5	26,8	443,7	3,32	7,17
Organic-Balance, p	112,2	27,4	446,3	3,34	7,19
Phytocide, p	115,6	28,0	448,5	3,39	7,23
HIP05	*3,49*	*1,12*	*5,25*	*1,04*	*1,63*

Having analysed the indicators of the structure of the millet crop depending on the complex application (seed treatment and spraying of crops) of biological products, it was found that the maximum parameters were recorded when using Phytocid, p. with a consumption rate of 1.5 l/t + 0.6 l/ha. Thus, the height of the plants reached up to 115.6 cm, the length of the panicle – 28.0 cm, the number of grains per panicle – 448.5 pcs, the weight of grains per panicle – 3.39 g and the weight of 1000 grains – 7.23 g.

The result of the complex process of plant organogenesis is a crop that shows the effectiveness of all methods of crop cultivation (Fig. 3.4).

It was found that as a result of the integrated use of biological products, namely the treatment of seeds and vegetative plants, the grain yield ranged from 1.35 to 1.73 t/ha. The maximum value was reached when using Phytocide, p. and was 1.73 t/ha.

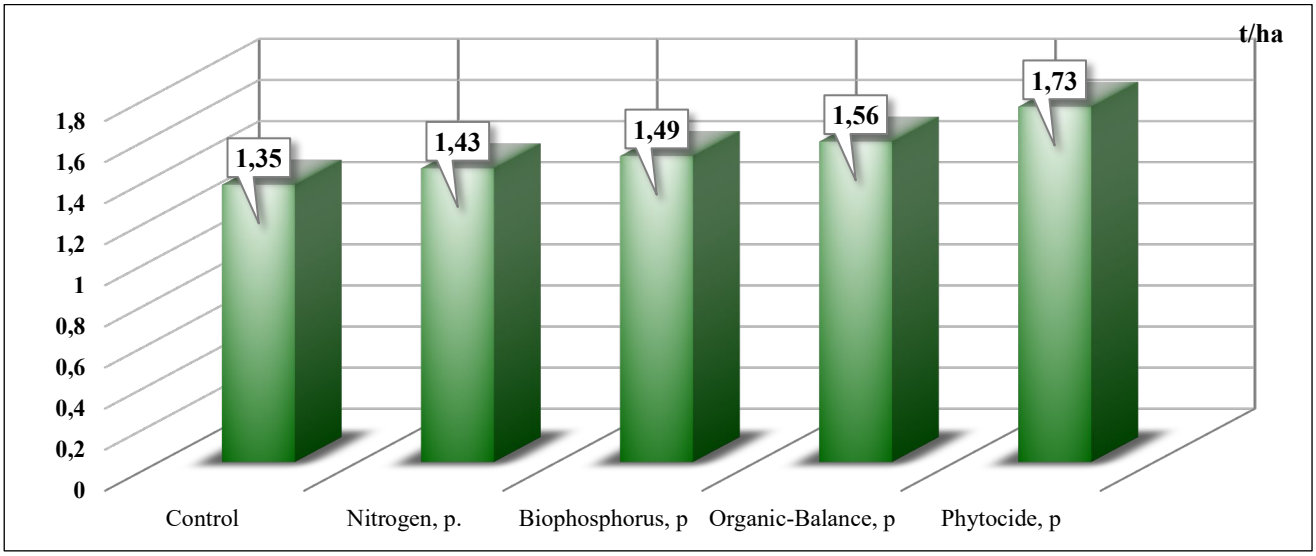


Figure 4 – Sowing millet grain yield under complex treatment with biological preparations, 2023-2024

To determine the dependence of grain yield on environmental factors and the use of biological products, a dispersion analysis of the interaction of these factors was conducted (Table 2).

Table 2 – Analysis of variance of sowing millet yield, 2023–2024

Variant	Sum of squares of deviation of yield level values from the mean, *SS*	Degrees of freedom, *df*	The share of influence, %
Year	0,42	2,01	29,15
Biological products	0,88	7,00	61,73
Unaccounted for factors	0,25	14,00	9,12
Total	1,55	24,00	100,00

It was found that the level of yield also depended on weather conditions by 29.15 % and the use of biological products by 61.73 %, as can be seen from the fact that the actual level of Fisher's F-criterion is higher than the critical one.

Conclusion. As a result of theoretical analysis and experimental studies, the urgent problem of increasing productivity in organic production was solved. The maximum level of grain yield of sowing millet (1.73 t/ha) was obtained under the

complex application (seed treatment and spraying of crops) of the biological preparation Phytocid, p. (with a consumption rate of 1.5+0.6). A close relationship between the level of yield and the use of biological products was established, which amounted to 61.73 %.

References

1. Svitlana, S., Oksana, T., & Tetiana, K. (2023, November). Effectiveness of complex biological protection for sorghum against the development of brown leaf spot in the Polissia of Ukraine. In *The 12 th International scientific and practical conference "Innovations and prospects in modern science"(November 20-22, 2023) SSPG Publish, Stockholm, Sweden. 2023. 912 p.* (p. 17).

2. Stoliar, S. H., Trembitska, O. I., & Klymenko, T. V. (2022). Effectiveness of complex biological protection of proso millet against the development of Bipolaris panici-miliacei (Y. Nisik) Shoemaker in Polissia, Ukraine. *Publishing House "Baltija Publishing"*.

3. Ключевич, М. М., & Столяр, С. Г. (2016). Розвиток хвороб проса в агроценозах Полісся та Лісостепу України. *Сільське господарство та лісівництво*, (4), 72.

4. Ключевич, М. М., Столяр, С. Г., & Дмитренко, О. О. (2019). Вплив регуляторів росту рослин на продуктивність проса посівного в Поліссі України.

5. Thakur, R. P., Sharma, R., & Rao, V. P. (2011). *Screening Techniques for Pearl Millet Diseases* (Information Bulletin No. 89, pp. 15–19). Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid.