UDC 633.11: 631.8: 632.51 https://doi.org/10.31867/2523-4544/0344

# INTEGRATED APPLICATION OF BIOLOGICALS FOR INCREASING THE PRODUCTIVITY OF WINTER WHEAT IN THE RIGHT-BANK FOREST-STEPPE OF UKRAINE

***L. S.Kvasnitska, H. P. Voitova, O. S.Vlasiuk***
*Khmelnytskyi State Agricultural Research Station of the Institute of Feed Research and Agriculture of Podillia NAAS, 1 Samchyky St., Samchyky village, Khmelnytskyi district, Khmelnytskyi region, 31182, Ukraine*

***Topicality.*** *Modern innovative approaches of winter wheat cultivation technology involve the use of biological products.* ***Purpose.*** *The aim of the research was to determine the impact of the integrated use of the plant residue biodestructor Organic-Balance (1 l/ha) and the multifunctional biological product Organic-Balance with the bioadhesive Liposam (1.0 l/t + 0.3 l/t) for seed treatment and crop spraying (0.5 l/ha and 0.3 l/ha) against different fertilizer backgrounds on the productivity of winter wheat crops in the conditions of the Right-Bank Forest-Steppe of Ukraine.* ***Materials and methods.*** *The research was conducted at the Khmelnytskyi State Agricultural Research Station of the Institute of Feed Research and Agriculture of Podillia NAAS in a temporary field experiment on crops of winter wheat variety Bohdana during 2021–2023. Research methods: field, laboratory, mathematical and statistical.* ***Results.*** *The effect of the combination of biologicals on increasing the density of productive stems from 4,878,000 to 5,240,000 stems/ha on the background without fertilisers and from 5,320,000 to 5,627,000 stems/ha with mineral fertilisation ($N_{90}P_{60}K_{60}$) was established. There was also an increase in the number of grains per spike – from 24.2 to 25.1 grains on the background without fertiliser and from 26.4 to 27.3 grains with mineral fertilisation, and the grain weight per spike – from 1.01 to 1.08 g and from 1.19 to 1.29 g, respectively. The integrated use of the plant residue biodestructor Organic-Balance (1 l/ha) and the multifunctional biological product Organic-Balance with the bioadhesive Liposam (1.0 l/t + 0.3 l/t) for seed treatment and spraying of crops (0.5 l/ha + 0.3 l/ha both on a non-fertilised and mineral background increased yields by 0.72 and 0.91 t/ha, gluten content by 2.4 and 2.8 %, and grain hardness by 6 and 7 %, respectively.* ***Conclusions.*** *The combination of biologicals had an effect on the formation of winter wheat yield with a significant increase in the number of productive stems by 7 % against non-fertilised background and 6% against mineral background, and in the grain weight per spike by 7 % and 8 %, respectively, which resulted in a yield increase of up to 16 %.*

***Key words****: fertilisation background, biodestructor of plant residues, biologicals with multifunctional action, yield, grain quality*

**Introduction.** Enhancing the winter wheat (*Triticum aestivum* L.) grain production is a key objective of the Ukrainian agro-industrial complex. Growing demand for wheat grain on the global market necessitates increasing the yield of this crop [1–3].

Today, there are well-established components of cultivation technology for each soil and climatic zone of Ukraine. Their strict adherence to the technology allows us to obtain high yields of all crops, including grain crops [4, 5]. At the same time, most agrotechnological practices are highly intensive and costly because they reduce soil fertility; deplete it of humus and nutrients content, etc. [6].

The problem of stable production of high yields of quality grain requires comprehensive efforts of breeders and producers, as the realisation of genotypically determined valuable economic traits is possible only if the requirements of modern cultivation technology are met. The fact that the material support for grain production varies significantly between farms of different ownership forms should also be taken into account [7].

The main advantage of microbiologicals in comparison to other products is their low cost per unit of additional output, low consumption

**Author information:**
**Larysa S. Kvasnitska**, *Candidate of Agricultural Sciences, Senior Researcher, Senior Researcher at the Laboratory of Innovative Technologies in Agriculture, Plant Production and Animal Husbandry*, e-mail: larusa7215@ukr.net, https://orcid.org/0000-0002-7925-2299
**Oksana S. Vlasiuk**, *Candidate of Agricultural Sciences, Senior Researcher, Senior Researcher at the Laboratory of Innovative Technologies in Agriculture, Plant Production and Animal Husbandry*, e-mail: vlasukoksana293@ukr.net, https://orcid.org/0000-0001-7500-4119
**Halyna P. Voitova,** *Researcher at the Laboratory of Innovative Technologies in Agriculture, Plant Production and Animal Husbandry*, e-mail: larusa7215@ukr.net, http://orcid.org/0000-0001-6152-5677

rate, and environmental safety [8]. The use of biologicals to restore soil fertility and produce environmentally safe and high-quality crop production is one of the strategic directions of modern agriculture. Microbial agents for biological nitrogen fixation, phosphate mobilisation, growth stimulation in the plant rhizosphere and bio-protective action to protect crops from pathogens and phytophages are of great importance in implementing this approach. [9]. Plant protection products include biologicals with multifunctional action, which contain living microorganisms: representatives of natural plant and soil microflora, as well as their physiologically active substances. These biologicals are developed according to special formulations to meet the biological requirements of each agricultural crop [10]. Microbial destructors of plant residues also play an important role among biologicals in technologies for preparing soil for winter crops [11–13]. The composition of biodestructors includes microorganisms, enzymes-destructors, biologically active substances, the synergy of which accelerates the decomposition of plant residues [14]. In the face of rising climate aridity, biologically based farming systems are an element of sustainable crop production [15, 16]. Therefore, one of the priorities of the modern strategy is the application of biologicals as an integral technological component in the cultivation of grain crops in ecological farming systems [17]. Given that biologicals help to increase the productivity of winter wheat crops, the issue of their impact on yield and grain quality prompted us to conduct research in this area.

The research was aimed at determining the effect of integrated use of a biological agent with multifunctional action and a biodestructor of plant residues on different fertilisation backgrounds on the grain yield and quality of winter wheat in the conditions of the Right-Bank Forest-Steppe of Ukraine.

**Materials and Methods.** The studies were conducted in a temporary field experiment of the Khmelnytskyi State Agricultural Research Station of the Institute of Feed Research and Agriculture of Podillia NAAS during 2021–2023. The research object was the processes of formation of winter wheat crop productivity under the application of biologicals.

The research methods were as follows: field, which involved the study of the effect of the interaction of the studied factors on the grain yield of winter wheat; quantitative and weighing method – for accounting of weeds in crops; mathematical and statistical method – for analysing and establishing the reliability of the results.

The soil of the experimental plot was slightly podzolised medium loamy, medium-powerful, low-humus chernozem on brownish-pale loam. Plot area was 32 $m^2$; repetition was four times; plots were placed systematically. Humus content (according to Tyurin) – 2.8–3.0 %, pH – 5.8–6.2; hydrolytic acidity 1.9–2.3 mg/equiv. per 100 g; total nitrogen reserves 0.153–0.163 %, phosphorus – 0.136–0.149 %; alkaline hydrolysable nitrogen 17–19.3 mg, mobile forms of phosphorus and potassium (according to Chirikov) 20.8–22.6 and 8–12 mg per 100 g, respectively.

In the experiment, the cultivation technology components were studied: the application of plant residues biodestructor Organic-Balance (1.0 l/ha) and biological agent of multifunctional action Organic-Balance with Liposam bioadhesive (1.0 l/t + 0.3 l/t) for seed treatment and spraying of crops (0.5 l/ha + 0.3 l/ha) on a background without fertilisers and mineral background $N_{90}P_{60}K_{60}$. Before ploughing the crop residues of the predecessor (sunflower), a compensatory rate of mineral nitrogen $N_{10}$ per tonne of by-product was introduced. The see-ding rate of winter wheat of Bohdana variety was 4.5 million seeds/ha. Observations and records were carried out in accordance with generally accepted methods of research in agriculture [18–20].

In our research, we used the Organic-Balance biodestructor on the residues of sunflower (predecessor). This biological agent contains potassium and phosphorus-mobilising bacteria, natural saprophytic fungi, organic stabilising agents, biologically active substances, vitamins, enzymes for decomposition of plant residues, and a concentrate of viable microorganisms: cells of bacteria *Bacillus subtilis, Azotobacter chr., Paenibacillus polymyxa*, titer 1×108–1×109 CFU/$cm^3$. We also used Organic-Balance, a multifunctional biological product containing nitrogen-fixing, phosphorus- and potassium-mobilising bacteria, bacteria with fungicidal and bactericidal properties, and biologically active substances: phytohormones, amino acids and vitamins, inactivated microorganism cells and their fragments, titre – 1×109 CFU/$cm^3$,

combined with the Liposam bioadhesive, the active ingredient of which is a water-soluble composition of naturally occurring biopolymers with adhesive properties.

Spraying crops with the multifunctional biological product Organic-Balance with Liposam bioadhesive (1.0 l/t + 0.3 l/t) was carried out at the third organogenesis stage of winter wheat.

**Results and Discussion.** Crop yield formation is the result of complex interaction between productivity elements, such as the number of productive stems, grain weight per spike, grain content per spike, and 1,000-grain weight. Yield is determined by its attributes, which are quantitative characteristics. Each yield attributes is the result of the interaction of many factors and agroecological conditions. The optimal structure of the crop agrocenosis creates high yields of winter wheat. The grain quality of this crop is also determined by specific weather conditions.

The results of the studies showed an increase in the competitiveness of winter wheat when using a combination of biologicals. It was established that on both backgrounds without fertilisers and on mineral one ($N_{90}P_{60}K_{60}$), the number of weeds decreased by 17 % at the time of growth resumption, and the biomass of weeds decreased by 32 % and 39 % at the end of the growing season, as well as the spread of powdery mildew decreased by 22 % and 19 %, respectively (Table 1).

This study showed that integrated use of

***Table 1. Phytosanitary condition of winter wheat crops, 2021–2023***

| Nutrition background | Indicator | Period | No treatment with biologicals | Plant residue biodestructor + seed and crop treatment with a multifunctional biological product |
|---|---|---|---|---|
| No fertilisers | Weed infestation, pcs/m$^2$ | growth resumption | 52 | 43 |
| | Weed biomass, g /m$^2$ | harvest | 38.6 | 26.1 |
| | Infection of powdery mildew, % | stem elongation | 48 | 26 |
| | Development of powdery mildew, % | | 12.1 | 6.5 |
| | Development of Septoria disease, % | | 26 | 24 |
| Mineral ($N_{90}P_{60}K_{60}$) | Weed infestation, pcs/m$^2$ | growth resumption | 47 | 39 |
| | Weed biomass, g /m$^2$ | harvest | 35.5 | 21.7 |
| | Infection of powdery mildew, % | stem elongation | 88 | 69 |
| | Development of powdery mildew, % | | 23.1 | 17.2 |
| | Development of Septoria disease, % | | 34 | 31 |

biologicals had a positive effect on the formation of productive stems of winter wheat plants on the studied backgrounds (Table 2). The application of a plant residue biodestructor and the treatment of seeds and crops with a multifunctional biological product against a background without fertilisers contributed to an increase in the density of productive stems from 4,878,000 to 5,240,000 pcs/ha, the productive tillering coefficient – from 1.57 to 1.62, and a decrease in the percentage of unproductive stems – from 9 to 5 %; on a mineral background ($N_{90}P_{60}K_{60}$) – an increase in the density of productive stems from 5,320,000 to 5,627,000 pcs/ha, the productive tillering coefficient – from 1.71 to 1.74, and a decrease in the percentage of unproductive stems from 6 % to 4 %.

Analysis of the yield attributes showed that the integrated use of biologicals (the plant residue biodestructor with a multifunctional biological product for seeds and crop treatment) against a background without fertilisers contributed to an increase in plant height from 88 to 98 cm, the spike length – from 6.4 to 7.6 cm, the number of grains per spike – from 24.2 to 25.1, and the grain weight per spike – from 1.01 to 1.08 g; on a mineral background ($N_{90}P_{60}K_{60}$) – plant height increased from 96 to 102 cm, spike length – from 7.7 to 8.4 cm, number of grains per spike – from 26.4 to 27.3, grain weight per spike – from 1.19 to 1.29 g (Table 3).

The influence of complex application of

***Table 2. Plant density of winter wheat on different nutrient backgrounds, 2021–2023***

| Nutrition background | Indicator | No treatment with biologicals | Plant residue biodestructor + seed and crop treatment with a multifunctional biological product |
|---|---|---|---|
| No fertilisers | Density of productive stems, thousand pcs/ha | 4878 | 5240 |
| | Productive tillering coefficient | 1.57 | 1.62 |
| | Unproductive stems, % | 9 | 5 |
| Mineral ($N_{90}P_{60}K_{60}$) | Density of productive stems, thousand pcs/ha | 5320 | 5627 |
| | Productive tillering coefficient | 1.71 | 1.74 |
| | Unproductive stems, % | 6 | 4 |

***Table 3. Individual productivity of winter wheat on different nutrient backgrounds, 2021–2023***

| Nutrition background | Indicator | No treatment with biologicals | Plant residue biodestructor + seed and crop treatment with a multifunctional biological product |
|---|---|---|---|
| No fertilisers | Plant height, cm | 88 | 98 |
| | Spike length, cm | 6.4 | 7.6 |
| | Number of grains per spike, pcs | 24.2 | 25.1 |
| | Grain weight per spike, g | 1.01 | 1.08 |
| Mineral ($N_{90}P_{60}K_{60}$) | Plant height, cm | 96 | 102 |
| | Spike length, cm | 7.7 | 8.4 |
| | Number of grains per spike, pcs | 26.4 | 27.3 |
| | Grain weight per spike, g | 1.19 | 1.29 |

biologicals on the yield and grain quality of winter wheat was also studied against the backgrounds without fertilisers and with mineral fertilisation ($N_{90}P_{60}K_{60}$) (Table 4).

***Table 4. Yield and grain quality of winter wheat under different nutrient conditions, 2021–2023.***

| Nutrition background | Indicator | No treatment with biologicals | Plant residue biodestructor + seed and crop treatment with a multifunctional biological product |
|---|---|---|---|
| No fertilisers | 1,000 grain weight, g | 41.6 | 42.9 |
| | Yield, t/ha | 4.39 | 5.11 |
| | Gluten content in grain, % | 14,8 | 17,2 |
| | Grain hardness, % | 47 | 53 |
| Mineral ($N_{90}P_{60}K_{60}$) | 1,000 grain weight, g | 45,5 | 47,3 |
| | Yield, t/ha | 5,83 | 6,74 |
| | Gluten content in grain, % | 18,8 | 21,6 |
| | Grain hardness, % | 64 | 71 |

It was established that the winter wheat yields varied depending on the applied biologicals. The variant with the introduction into the soil of plant residue biodestructor + treatment of seeds and crops with the multifunctional biological product Organic-Balance against the background without fertilisers provided an increase in yield by 0.72 t/ha (16 %), gluten content – by 2.4 %, grain hardness – by 6 %; on a mineral background ($N_{90}P_{60}K_{60}$) – an increase in yield – by 0.91 t/ha (16 %), gluten content – by 2.8 %, grain hardness – by 7 %.

**Conclusions.** Therefore, the application of the plant residue biodestructor in combination with a multifunctional biological product for the treatment of seeds and crops on a background

without fertilisers and under mineral fertilisation ($N_{90}P_{60}K_{60}$) resulted in an increase in winter wheat yield by 0.72 and 0.91 t/ha, gluten content – by 2.4 and 2.8 %, grain hardness – by 6 and 7 %, respectively.

We recommend for agricultural enterprises in the Right-Bank Forest-Steppe of Ukraine that they implement a combination of these environmentally safe biologicals in intensive and biological cultivation technologies to increase the yield and grain quality of winter wheat.

## References


1. Kernasiuk, Yu. V. (2020). Global wheat market: situation and trends. *Ahrobiznes sohodni* [Agribusiness today], *22 (437*). 12–16. [in. Ukrainian].
2. Kozak, O. A. & Hryshchenko, O. Yu. (2016). Development of the grain industry of Ukraine at the current stage. *Ekonomika APK* [*Economy of agro-industrial complex*], *1*. 38–47. [in. Ukrainian].
3. Prokopenko, O. M. (Ed.). (2019). Silske hospodarstvo Ukrainy. *Statystychnyi zbirnyk* [Agriculture of Ukraine. Statistical collection]. Kyyiv, 235 p. [in Ukrainian].
4. Bilousova, Z., Klipakova, Yu., Kenieva, V. & Priss O. (2020). Forecasting of winter wheat (*Triticum aestivum* L.) yield for the Southern Steppe of Ukraine using meteorological indices. *Ukrainskyi ekolohichnyi zhurnal* [Ukrainian Journal of Ecology], *10 (3).* 36–43.
5. Panchenko, T., Lozinskyi, M., Hamaiunova, V., Tsentilo, L., Khakhula, V., Fedoruk, Yu., Pokatylo, I. & Horodetskyi O. (2019). Change of yield and baking gvalities of winter wheat grain depending on the year of growing and predecessor in the central forestry of Ukraine. *Plant Archives journal, 1 (19).* 1107–1112.
6. Hamaiunova, V., Khonenko, L., Korkhova, M. & Smirnova, I. (2022). The importance of selection of varietal composition in obtaining high yield and grain quality of winter wheat when grown after sunflower in the conditions of the Southern Steppe of Ukraine. *Scientific bases of agriculture, development of ways of its effective development: collective monograph. International Science Group*. 144–161. [in Ukrainian]
7. Shevchenko, O. O., Vashchenko, V. V. & Lobko, T. K. (2023). Degree of plasticity of soft winter wheat varieties of different ecotypes. *Zernovi kultury* [Grain Crops], *7 (1).* 37–42. doi: 10.31867/2523-4544/0256 [in Ukrainian].
8. Kaminskyy, V. F. (2017). Biologization of agriculture as a component of the biosphere. *Posibnyk ukrainskoho khliboroba* [*Ukrainian farmer's guide*], *1*. 28–31. [in Ukrainian].
9. Volkohon, V. V., Zaryshniak, A. S., Hrynyk, I. V., Berdnikov, O. N., Tsentylo, L. V., Nadkernychna, O. V., Murach O. M. (2011). *Metodolohiia i praktyka vykorystannia mikrobnykh preparativ u tekhnolohiiakh vyroshchuvannia silskohospodarskykh kultur* [Methodology and practice of using microbial preparations in technologies of growing crops]. Volkohon V. V. (Ed.). Kyiv: Ahrarna nauka. [in Ukrainian].
10. Kataloh produktsii kompanii «BTU-TsENTR» [Catalogue of products of the company "BTU-CENTER"]. (2022). Retrieved from https://www.btu.center.com. [in Ukrainian].
11. Kovalenko, A. M., Novokhyzhnii, M. V., Tymoshenko H. Z. & Serhieieva, Yu. O. (2020). Features of application of destructors of stubble in the steppe zone. *Visnyk ahrarnoi nauky* [Bulletin of Agricultural Science], *2*. 44–51. doi: 10.31073/agrovisnyk202002-07 [in Ukrainian].
12. Tokmakova, L. M. & Trepach, A. O. (2022). Microbiological destruction of organic matter in agrocenoses. *Visnyk ahrarnoi nauky* [Bulletin of Agricultural Science], *2.* 19–26. doi: 10.31073/agrovisnyk202202-03 [in Ukrainian].
13. Shaharooma, B., Naveed, M., Arshad, M. & Zahir, Z. A. (2008). Fertilizer-dependent efficiency of *Pseudomonads* for improving growth, yield, and nutrient use efficiency of wheat (*Triticum aestivum* L.). *Appl. Microbiol. Biotechnol., 79.* 147–155. doi: 10.1007/s00253-008-1419-0
14. Kushnarov, A., Kravchuk, V. & Bobrovnyi E. (2012). The influence of the degree of grinding and the depth of straw embedment in the soil on the intensity of its decomposition using the Sternifag biodestructor. *Tekhnika i tekhnolohii APK* [Agricultural machinery and technologies], *12.* 24–27. [in Ukrainian].
15. Isbell, F., Craven, D., Connolly, J., Loreau, M., Schmid, B. & Beierkuhnlein, C. (2015). Biodiversity increases the resistance of ecosystem productivity to climate extremes. *Nature, 526.* 574–577. doi: 10.1038/nature15374
16. Mandic, V., Krnjaja, V., Tomic, Z., Bijelic, Z, Simic, A., Muslic, D., Gogic, M. (2015). Nitrogen fertilizer influence on wheat yield and use efficiency under different environmental conditions. *Chilean journal of agricultural research, 75 (1).* 92–97. doi: 10.4067/S0718-58392015000100013
17. The concept of organic farming (soil and agrochemical supply). (2017). *Posibnyk ukrayinskoho khliboroba [Ukrainian farmer's guide], 1*. 63–80. [in Ukrainian].
18. Moiseichenko, V. F., Yeshchenko, V. O. (1994). Osnovy naukovykh doslidzhen v ahronomii [Basics of scientific research in agronomy]. Kyiv: Vyshcha shkola. [in Ukrainian].
19. Volkohon, V. V., Zaryshniak, A. S., Hrynyk, I. V., Berdnikov, O. N., Tsentylo, L. V., Nadkernychna, O. V. Murach, O. M. (2011). *Metodolohiia i praktyka vykorystannia mikrobnykh preparativ u tekhnolohiiakh vyroshchuvannia silskohospodarskykh kultur* [Methodology and practice of using microbial preparations in technologies of growing crops]. Volkohon V. V. (Ed.). Kyiv: Ahrarna nauka. [in Ukrainian].
20. Tsykova, V. S. & Pykush, H. R. (Ed.). (1983). Metodicheskiye rekomendaciyi po provedeniyu polevykh opytov s zernovymi, zernobobovymi i kormovymi kulturami (issledovaniya, uchety i nablyudeniya) [Methodological recommendations for conducting field experiments with grain, leguminous and fodder crops (research, records and observations)]. Dnepropetrovsk: VNIIK. 49 p. [In Russian].

УДК 633.11: 631.8: 632.51
***Квасніцька Л. С., Войтова Г. П., Власюк О. С. Комплексне застосування біопрепаратів для підвищення продуктивності пшениці озимої в умовах Правобережного Лісостепу України.*** *Зернові культури. 2024. 8 (2). 283–288.*
*Хмельницька державна сільськогосподарська дослідна станція Інституту кормів та сільського господарства Поділля НААН, вул. Самчики, 1, с. Самчики, Хмельницький район, Хмельницька область, 31182, Україна*

**Актуальність.** Сучасні інноваційні підходи в технології вирощування пшениці озимої передбачають застосування біопрепаратів. **Метою досліджень** було встановити вплив комплексного застосування біодеструктора рослинних решток Органік-баланс (1 л/га) та біопрепарату поліфункціональної дії Органік-баланс з біоприлипачем Липосам (1,0 л/т + 0,3 л/т) для обробки насіння і об-прискування посівів (0,5 л/га та 0,3 л/га) за різних фонів удобрення на рівень продуктивності посівів пшениці озимої в умовах Правобережного Лісостепу. **Матеріали та методи.** Дослідження проводились впродовж 2021–2023 рр. на Хмельницькій державній сільськогосподарській дослідній станції Інституту кормів та сільського господарства Поділля НААН у тимчасовому польовому досліді на посівах пшениці озимої сорту Богдана. Методи дослідження: польовий, лабораторний, математично-статистичний. **Результати.** Встановлено вплив поєднання біопрепаратів на збільшення густоти стояння продуктивних стебел з 4878 до 5240 тис./га на фоні без добрив та з 5320 до 5627 тис./га – за мінерального удобрення ($N_{90}P_{60}K_{60}$). Також відбулося зростання кількості зерен у колосі – з 24,2 до 25,1 шт. на фоні без добрив та з 26,4 до 27,3 шт. – за мінерального удобрення, маси зерна з одного колоса – з 1,01 до 1,08 г і з 1,19 до 1,29 г відповідно. Комплексне застосування біодеструктора рослинних решток Органік баланс (1 л/га) та біопрепарату поліфункціональної дії Органік-баланс з біоприлипачем Липосам (1,0 л/т + 0,3 л/т) для обробки насіння і обприскування посівів (0,5 л/га + 0,3 л/га) на фоні без добрив та мінеральному забезпечило збільшення показників урожайності на 0,72 і 0,91 т/га, вмісту клейковини – на 2,4 і 2,8 %, склоподібності зерна – на 6 і 7 % відповідно. **Висновки.** У досліджуваних агроценозах поєднання біопрепаратів мало вплив на формування врожаю пшениці озимої із суттєвим зростанням кількості продуктивних стебел на 7 % – фон без добрив і 6 % – за мінерального удобрення, маси зерна колоса – на 7 і 8 % відповідно, що забезпечило приріст урожайності до 16 %.

***Ключові слова:*** *фон удобрення, біодеструктор рослинних решток, біопрепарат поліфункціональної дії, урожайність, якість зерна*