

EFFICIENCY OF THE USE OF THE COMPLEX BIOLOGICAL PREPARATION "MEGAVROZHAI" ON THE FORMATION OF THE YIELD AND QUALITY INDICATORS OF WINTER WHEAT GRAIN

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Abstract. It was established that foliar fertilization had a significant effect on the formation of elements of the crop structure. Thus, the highest indicator was formed with complex fertilization with nitrogen fertilizers and the biological preparation MehaVrozhai, namely, the number of grains from an ear was 32,6 and 29,4 pcs., the weight of grains from an ear was 1,0 and 1,3 g, and the weight of 1000 grains was formed at the level of 42,4 g.

Also, it has already been established that a higher level of yield is formed when sowing winter wheat on cereal precursors than when sowing on sunflower, and the highest level of yield is formed when complex foliar fertilizing with nitrogen fertilizers and the biological preparation MehaVrozhai at the level of 4,2 and 4,3 t/ha, which is 1,1 and 1,3 t/ha more than in the control when sowing on different predecessors.

The analysis of the conducted studies indicates a significant effect of the investigated factors, namely, the highest level of protein and a high increase in gluten content was observed when sowing winter wheat on a grain precursor and when feeding with a complex of fertilizers Urea-ammonia mix-32 + MehaVrozhai. Protein content increased by 6,3 %, and crude gluten increased by 15,6 %.

Keywords: foliar feeding, precursors, grain crops, crop structure, quality indicators, protein, crude gluten, fertilizers, bacteria.

The cultivation of winter wheat is one of the most important directions of the agricultural sector of Ukraine. Under modern realities, when almost all segments of the national economy are under the influence of crisis factors, farms receive record harvests of this crop. Which is of great interest to both manufacturers and consumers. On the one hand, farmers are trying to get a high yield, and on the other hand,

consumers set high demands for quality, and above all environmental friendliness, of raw materials and products³⁵⁹.

Preservation of positive trends in increasing gross grain production is possible both using high-quality seeds of high-yielding varieties of grain crops, and through the implementation of modern innovative approaches in the production of grain crops in compliance with global quality standards³⁶⁰.

As for environmental friendliness, the intensive use of chemical plant protection agents has a negative impact on the environment and the quality of the obtained products. The resistance of pathogens to chemicals is constantly increasing, and drugs lose their effectiveness over time. Fungicides of chemical origin often have a negative effect on plants and cause their growth to slow down, and sometimes lead to the cessation of their development. Obviously, a reliable guarantee of ecological safety can be the use of biological means of plant protection, which, unlike pesticides of chemical synthesis, after introduction into the agroecosystem lead to qualitative and quantitative changes among the components of the cenosis. However, many mechanisms of interaction between plants and biological preparations have not been studied in detail. The effect of drugs of different concentrations on the environment and the reaction of plants to their use in different soil and climatic conditions remains unexplored³⁶¹.

The aim of our research is to study the interaction of various precursors, feeding with nitrogen fertilizers and the new complex biological preparation "MehaVrozhai" on the formation of yield and quality of winter wheat grain.

These are field, laboratory, statistical. These are planning, conducting field experiments, observations and accounting carried out according to B.O. Dospekhov. Statistical processing of the results of the experiments was carried out using the dispersion method, using application program packages Microsoft Excel.

The issue of the influence of biological preparations on various crops is widely studied, namely: many scientists noted that pre-sowing treatment of cereal seeds with biological preparations containing bacteria of the genus *Azospirillum* helps to limit the development of root rot and increase the yield by 18-28 %³⁶². And a team of authors from the Institute of Agriculture of the National Academy of Agrarian Sciences conducted research with plants of different varieties of spring barley. They established that when using a mixture of micro fertilizers, bio preparations and humic acids, the number of species of micromycetes in the rhizosphere soil decreases (4-35 %). This shows that the drugs can significantly affect the number of

³⁵⁹ Karamushka O.M. (2016) *Pidvyshchennia konkurentospromozhnosti vyrobnykiv zernovykh kultur v Ukraini*, p.104-108.

³⁶⁰ Kovalenko O.A., Kliuchnyk M.A., Chebanenko K.V. (2015). *Zastosuvannia biopreparativ dlia obrobky nasinnievoho materialu pshenytsi ozymoi*, p.74-77.

³⁶¹ Mosiichuk I.I. et al. (2022). *Vplyv biolohichnykh preparativ na chyselnist mikromitsetiv ryzosferneho gruntu roslyn yachmeniu yarocho*, p.39-49.

³⁶² Ishchenko V.A., Kozelets H.M. (2021). *Formuvannia produktyvnosti yachmeniu zvychainoho yarocho zalezho vid inokuliatsii nasinnia biopreparatom ta pozakorenykh pidzhyvlen v Stepu Ukrainy*, p.180-186.

phytopathogenic micromycetes³⁶³. Dumych V. in his works established that the introduction of bio preparations on sowing of spring grain crops provides an increase in yield by 12.3-19.9 %³⁶⁴. The research of Shevchuk M. Y. and Didkivska T. P. established that the incrustation of seeds with Baikal-EM-1 preparations increases the yield of spring barley by 5.1 c/ha³⁶⁵. The positive effect of drugs based on biological organisms has also been established, not only on increasing yield, but also on grain quality. Thus, Odesa scientists determined that the cultivation of winter wheat using biological technology gives an increase in yield up to 10 % and grain quality of 2-3 class³⁶⁶.

Studies conducted on leguminous crops also give high results. Thus, Horodyska I. M. and Chub A. O. established that the use of biological preparations in the planting of leguminous crops has a positive effect on the quantitative and qualitative indicators of the yield of experimental crops (soybeans, peas and beans): the sowing qualities of the seed material of leguminous crops grown by organic technology using biological preparations; an increase in the yield of peas, soybeans and beans relative to the control at the level of 16.5, 7.5 and 7.4 %, was noted respectively³⁶⁷.

In addition, many studies aimed at studying the effect of biological preparations in a complex with mineral fertilizers have been conducted. Thus, Chaikovska L. O. found that the use of bio preparations based on phosphate-mobilizing bacteria and mineral fertilizers in agricultural technologies for growing grain crops gives the greatest effectiveness in the pre-sowing bacteriization of winter wheat and spring barley seeds with the use of Phosphoenterin or Polymyxobacterin in the background for winter wheat – P₃₀, spring barley – against the background of N₃₀P₃₀ and the estimated dose of fertilizers (N₅₃)³⁶⁸. Uman scientists studied the reduction of herbicide pressure on plants and established that the most active synthesis of chlorophylls in spring wheat leaves occurs with the combined use of the herbicide Lintur 70 WG (120 g/ha) and Emistyn C (10 g/ha), such an interaction of drugs gives more favourable conditions for crop growth and activates physiological

³⁶³ Kozar S.F. (2005). Biologichna efektyvnist kompleksnoho zastosuvannya mikrobykh preparativ, p.86-94.

³⁶⁴ Dumych V. (2018). Doslidzhennia efektyvnosti zastosuvannya biopreparativ u tekhnolohiiakh vyroshchuvannya yarykh zernovykh kultur, p.232-236.

³⁶⁵ Shevchuk M.Y., Didkovska T.P. (2007). Efektyvnist zastosuvannya bakterialnykh preparative, p.129-135.

³⁶⁶ Smetanko O.V., Zorunko V.I. (2018). Zastosuvannya biologichnykh preparativ pry vyroshchuvanni pshenytsi ozymoi na riznykh fonakh mineralnoho zhyvlennia ta poperednykiv v umovakh pivdennoho stepu Ukrainy, p.111-119.

³⁶⁷ Horodyska I.M., Ternovyi Yu.V., Chub A.O. (2018). Rol biologichnykh preparativ u orhanichnomu zemlerobstvi, p.54-58.

³⁶⁸ Chaikovska L.O. (2011). Efektyvnist poiednanoho vykorystannia biopreparativ na osnovi fosfatmobilizovalnykh bakterii ta mineralnykh dobryv pry vyroshchuvanni zernovykh na pivdni Ukrainy, p.52-58.

processes and reduces the effect of herbicides on plants and the natural environment³⁶⁹.

The list of biotechnological products – bacterial preparations has significantly expanded in recent years and includes preparations created based on free-living, associative, symbiotrophic, nitrogen-fixing, phosphate-mobilizing microorganisms, as well as preparations of binary action. Therefore, the study of this issue has wide boundaries, and the topic is very relevant.

The purpose of our research was to study the interaction of various precursors, fertilization with nitrogen fertilizers and the new complex biological preparation "MegaVrozhai" on the formation of the yield and grain quality of winter wheat.

Field research was conducted in 2022 on the fields of the limited liability company "ORHANYTSIA", which are located in the north-eastern part of the Cherkasy region in the village of Bohdanivka. The experiment with winter wheat was laid according to generally accepted methods. The research was carried out in triplicate, the placement of the plots was randomized. The total sown area was 60 hectares, the registered area was 360 m². The soils of the research plots are sod-gley, rich meadow and sod-podzolic. The growing season of winter wheat was favourable for the formation and development of winter wheat plants. At the beginning of the growing season, a low level of moisture was observed, but the subsequent conditions were favourable.

The Bohdana winter wheat variety was used in the research. Originator: Institute of Plant Physiology and Genetics of the National Academy of Sciences of Ukraine, Myronivskyi Wheat Institute of NAAS named after V. M. Remesla, variety of intensive type, medium-ripening. The fertilization was carried out with the complex biological preparation "MegaVrozhai" produced by "ORHANYTSIA" LLC. The scheme of the experiment: factor A (precursor) – winter rye and sunflower, factor B (foliar top dressing): I – no top dressing (control), II – top dressing with KAS-32 at a dose of 70 l/ha, III – top dressing with the biological preparation MegaVrozhai (5,5 l/ha), IV – top dressing KAS-32 (70 l/ha) + MegaVrozhai (5.5 l/ha).

The first feeding with the studied drug was carried out at the beginning of the recovery of spring vegetation simultaneously with nitrogen feeding of winter wheat plants.

The second was at the beginning of the emergence of winter wheat plants in the tube exclusively with a biological preparation. Crop seeds were sown at the optimum time for this zone, with a sowing rate of 5 million pieces per hectare, with a row width of 0.15 m row-sowing method.

The harvesting was carried out at the onset of biological ripeness, separately according to options by direct combining. The protein content was determined by the method of infrared spectroscopy (National Standard of Ukraine NSTU 4117:2007), the raw gluten content was determined by the manual method (NSTU ISO 21415-1:2009) in the laboratory of genetics, biotechnology and quality of the Plant Breeding

³⁶⁹ Zabolotnyi O.I., Zabolotna A.V. (2013). Vmist khlorofilu u lystkakh pshenytsi yaroi pry zastosuvanni herbitydu Lintur 70 WG i rehuliatora rostu roslyn Emistym S, p.414-418.

Institute named after V. Ya. Yuriev. Mathematical data processing was carried out by the method of dispersion analysis according to B. O. Dospiekhov using Microsoft Office Excel table editor³⁷⁰.

The formation of the crop depends on the productivity of one plant. Predecessor, soil tillage quality, nutrition background, level of moisture supply – these factors affect the result of growing winter wheat. Therefore, in the conducted research, the plant productivity was evaluated by the next indicators: the number and mass of grains from an ear, the mass of 1000 grains. The research has revealed a positive effect of the action of the biological preparation on the formation of the yield of winter wheat plants.

Based on the results given in the table 1, it can be noted that 24.6 pieces are formed in the control after the grain precursor of grains, when feeding KAS-32 this indicator increases significantly and amounts to 28.7 pcs., the number of grains observed under the action of the biological preparation MegaVrozhai is almost at the same level, namely 30.4 pcs.

The highest manifestation of this indicator was established with the complex treatment of KAS-32 and the biological preparation MegaVrozhai – 32.6 pcs. As for the values after the precursor sunflower, the number of grains from the ear of corn, it was noted that 20.3 pieces of grain were formed in the control, when processing KAS-32 plants – 23.4 pcs., when applying a biological preparation – 25.9 pcs., and the highest result is given by complex processing of winter wheat plants – 29.4 pcs.

A high level of the indicator of the number of grains per ear does not guarantee us a satisfactory level of harvest. Due to the fact that with an insufficient level of nutrition, plants form thin, incomplete grain, accordingly, the grain mass will be of low quality, therefore a significant part of the profit will be lost³⁷¹.

In the research, an analysis of the formation of the mass of the ear depending on feeding was carried out. The following results were obtained: when sowing on winter rye, the plants formed an ear weighing 0.8 g, when feeding KAS-32 – 0.9 g, when plants were treated with the biological preparation MegaVrozhai, the weight of grains from the ear increased to 1.1 g, and accordingly the highest level of this indicator, 1.3 g was formed with complex feeding KAS-32 + MegaVrozhai.

The mass of 1000 grains is also an important technological indicator of grain quality. It characterizes the fullness of the grain and its size. In our research, the mass index of 1000 grains ranged from 29.7 to 42.2 g. The smallest mass of 1000 was observed on the control option when sowing after sunflower, namely 29.7 g. Accordingly, it was the highest when sowing winter wheat after rye and under the action of complex fertilization KAS-32 + MegaVrozhai.

If we consider the indicator of the weight of 1000 grains when sowing on a separate predecessor, it can be noted that when feeding KAS-32 plants, the indicator

³⁷⁰ Dospiekhov, B.A. (1985). Metodika polevogo opyita.

³⁷¹ Heller O.Y., Pashova V.T., Korbaniuk R.A., Zaitseva O.S., Kravchenko K.O. (2012).

Osobystosti formuvannia kilkisnykh i yakisnykh pokaznykiv yachmeniu yarohto pry zastosuvanni biotekhnolohichnykh preparativ, p.36-40.

increased by 0.5–4.1 g, when feeding with the biological preparation MegaVrozhai by 4.7–7.6 g, with complex treatment KAS-32 + MegaVrozhai for 7.5–9.1 g.

Table 1 – Indicators of the yield structure of winter wheat depending on foliar feeding in 2022

Predecessor (factor A)	Variant of foliar feeding (factor B)	Indicators of yield structure		
		The number of grains in an ear, pcs.	Mass of grains from an ear of corn, g	Weight of 1000 grains, g
Winter rye	without feeding (control)	24,6	0,8	32,1
	KAS-32	28,7	0,9	36,2
	«MegaVrozhai»	30,4	1,1	39,7
	KAS-32 + «MegaVrozhai»	32,6	1,3	41,2
Sunflower	without feeding (control)	20,3	0,6	29,7
	KAS-32	23,4	0,7	30,2
	«MegaVrozhai»	25,9	0,9	36,4
	KAS-32 + «MegaVrozhai»	29,4	1,0	37,2
NIR0.5 for: factor A		0,66	0,06	0,53
factor B		0,93	0,09	0,76
interaction of AB factors		1,31	0,13	1,07

The main criterion by which it is possible to evaluate the technological methods used in the cultivation of winter wheat is, of course, the yield obtained³⁷². The yield data obtained indicate that both precursors and foliar fertilizing with nitrogen fertilizers and the biological preparation MegaVrozhai had a significant effect on the yield of winter wheat ($HIP_{05} = 0.93$ t/ha) (Table 2).

Table 2 – Yield of winter wheat depending on foliar feeding in 2022

Predecessor (factor A)	Variant of foliar feeding (factor B)	The yield, t/ha	The increase, т/га
Winter rye	без підживлення (контроль)	3,24	-
	without feeding (control)	4,09	0,85
	KAS-32	4,32	1,08
	«MegaVrozhai»	4,46	1,22
Sunflower	KAS-32 + «MegaVrozhai»	2,91	-
	without feeding (control)	3,58	0,66
	KAS-32	3,85	0,94
	«MegaVrozhai»	3,97	1,06
NIR0.5 for: factor A		0,47	
factor B		0,66	
interaction of AB factors		0,93	

³⁷² Shevnikov D.M. (2019). Formuvannya vrozhaivosti pshenytsi tverdoi yaroї zalezhno vid mineralnykh dobryv ta mikrobiolohichnykh preparativ v umovakh Livoberezhnoho Lisostepu, p.20-27.

According to the results of the analysis of productivity indicators, it was established that the increase was from 0.66 to 1.22 t/ha. The lowest level of increase was observed when sowing winter wheat after sunflower and feeding KAS-32, namely 0.66 t/ha. The highest increase was observed for sowing after winter rye and feeding with a complex of preparations KAS-32 + MegaVrozhai – 1.22 t/ha. Also, a significant increase in productivity was observed when treated only with the biological preparation MegaVrozhai, namely 0.94 t/ha when sowing with the precursor sunflower and 1.08 t/ha when sowing with winter rye. Such results are due to the complex effect of the drug on the plant. Thanks to the fact that MegaVrozhai contains bacteria of the genus *Bacillus Subtilis* in its composition, which provide fungicidal protection of the plant, *Bacillus licheniformis* – stimulates growth processes in plants. *Trichiderma Viride* – synthesizes phytohormones, amino acids, proteins for the plant, *Bacillus Megaterium* – phosphate and potassium mobilizer, helps the plant to absorb nitrogen, phosphate and potassium micro fertilizers as much as possible.

The foliar fertilizing had a positive effect on the formation of grain quality indicators. In the research, the moisture content of the grain mass was determined and it can be noted that this indicator was lower than the critical value of 14 % and ranged from 10.8 to 13.2 %. In our research, the protein content of winter wheat grains ranged from 9.3 to 15.6 % (Figure 1) when sowing after winter rye and from 8.7 to 12.6 % when sowing wheat after sunflower.

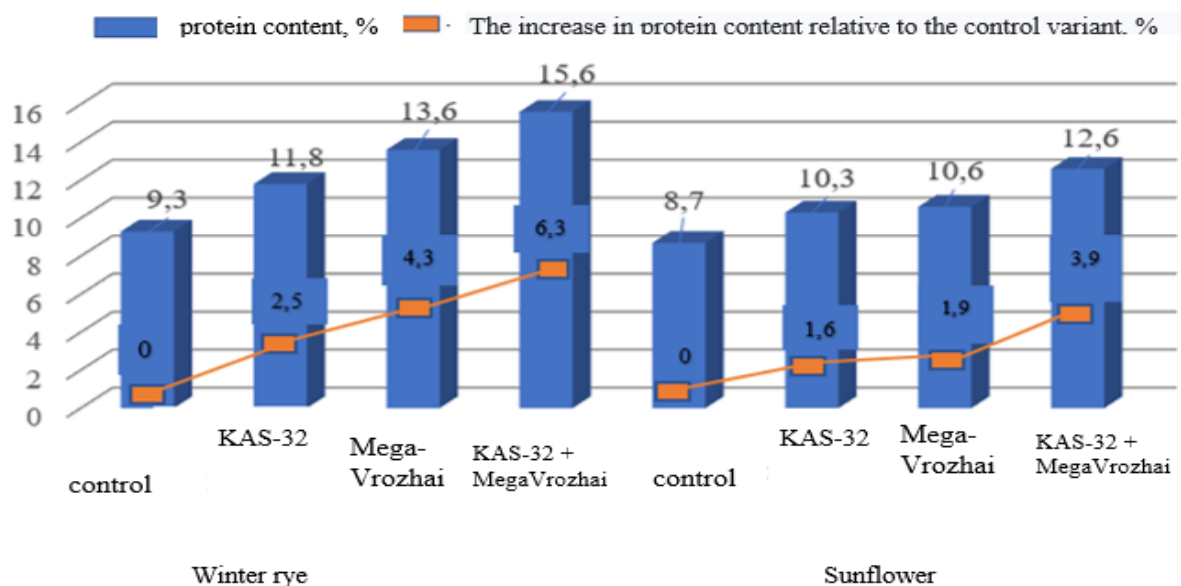


Fig. 1. Dynamics of protein content in wheat grains of the Bohdana winter variety depending on foliar feeding and precursors

The bacterial composition of the MegaVrozhai biological preparation creates an environment in which plants better absorb poorly soluble compounds from the soil and help fix nitrogen from the atmosphere, which contributes to a more intensive accumulation of protein in the grain. The higher the protein content, the more moisture the wheat grain can safely hold. Thus, the increase in the protein content of

the options for foliar feeding of winter wheat crops makes it possible to store safely the grain at a slightly higher humidity.

The analysis of the conducted research indicates a significant effect of the investigated factors (at $HIP_{0.5} - 0.32$), namely the highest level of protein was observed when sowing winter wheat on a grain precursor and when feeding with a complex of fertilizers KAS-32 + MegaVrozhai, and it was 15.6 %.

When wheat is sown after sunflower, the highest level of bun is also observed, at the level of 12.6 %, with complex feeding KAS-32+MegaVrozhai.

The crude gluten content is an important indicator of winter wheat grain quality. In our research, a significant influence of foliar feeding and the action of the precursor on the accumulation of gluten in winter wheat grains was noted (at $HIP_{0.5} - 0.36$). Thus, in the control variant (Figure 2), the level of crude gluten content was 12.4 %, when sowing after winter rye and 11.9 % after sunflower. When feeding KAS-32, the gluten content increased by 8.0 % in the grain precursor and by 0.7 % in the sunflower. A high increase in the content of gluten was observed when plants were fed with the biological preparation MegaVrozhai and with complex feeding KAS-32 + MegaVrozhai, namely by 12.2, 15.6% and 7.0%, 8.4%, respectively, for sowing according to different predecessors.

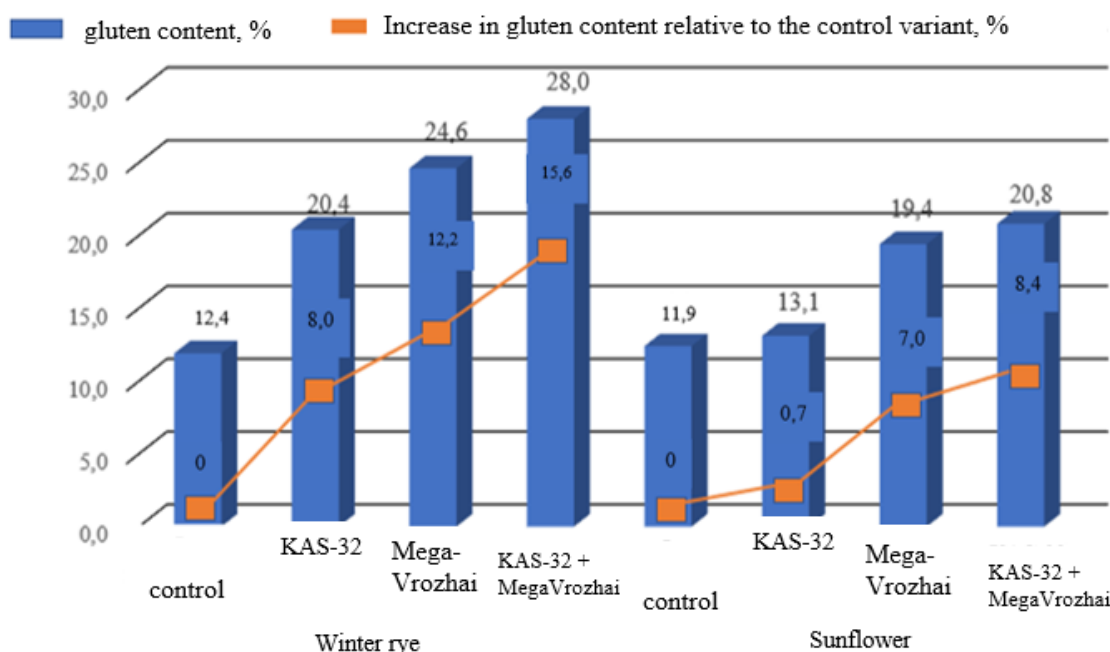


Fig. 2. Crude gluten content in Bohdana winter wheat grains depending on foliar fertilization and precursors

Increasing the amount of protein and raw gluten in Bohdana winter wheat grain gives us the opportunity to obtain high-quality raw materials for bakery production, which increases the selling price of grain and increases the profitability of production.

The results of research on the influence of various precursors and foliar fertilization on the formation of yield and grain quality of soft winter wheat confirmed the feasibility of their implementation.

It was established that a higher level of yield is formed when winter wheat is sown with grain precursors than when it is sown with sunflower, and the highest level of yield is formed with complex foliar fertilization with nitrogen fertilizers and the biological preparation MegaVrozhai at the level of 4.2 and 4.3 t/ha, which on 1.1 and 1.3 t/ha more than in the control when sowing according to different predecessors.

The treatment of plants with a biological preparation had a significant effect on the accumulation of bran and raw gluten in grain, which contributed to the formation of higher quality grain. Thanks to the bacteria of the genus *Bradyrhizobium japonicum* and *Azotobacter chroococum*, which ensured the binding of molecular nitrogen from the atmosphere into chemical compounds available to the plant, a positive nutritional background was created, and in the complex with nitrogen fertilizer KAS-32, an additional source of nutrition for winter wheat plants was created. The higher quality of wheat grain can ensure a higher sales price and production profitability.

The grain with the highest level of protein and crude gluten content was formed when winter wheat of the Bohdana variety was sown after winter rye and under complex fertilization with nitrogen fertilizer KAS-32 and the biological preparation MegaVrozhai.

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