

Effect of biological products on productivity of winter wheat on various backgrounds of nutrition in conditions of Donetsk oblast

Viniukov O.¹, Bondareva O.², Korobova O.³, Chugrii H.⁴

Donetsk state agricultural experimental station of NAAS, Gagarin Str., 1, Grishino, Pokrovsk region, Donetsk oblast, 85330, Ukraine; e-mail: ¹alex.agronomist@gmail.com, ²olbraun58gm17@gmail.com, ³, ⁴cnzdiapw@ukr.net

The purpose. To determine efficiency of specimens of biological origin at growing winter wheat on various backgrounds of nutrition in conditions of Donetsk oblast. **Methods.** Field, added by analytical researches, measurements, counts and observation according to the standard techniques and methodical recommendations in plant growing. **Results.** Researches were carried out in 2015 – 2017 in field rotation of SE «OX» Zaboishchik» Donetsk state agricultural experimental station of NAAS». Scheme of experiments provided presowing treatment of seeds with biological products in day of sowing, sprinkling of sowings in stages of tillering and heading. In the control they treated seeds and sowings with water. At the moment of harvesting on both backgrounds of feed the best parameters of crop structure was formed in the alternative with joint application of specimens Sizam and Rost-concentrate. The greatest productivity of grain of winter wheat on the 1-st background of feed (N30P30) was at complex use of specimen Sizam and at its joint application with specimen Rost-concentrate — 6,08 and 6,12 t/hectare, the increase in comparison with the control made 1,18 and 1,22 t/hectare. On the 2-nd background of feed (N60P60) the greatest productivity was gained at complex use of specimen Sizam — 6,86 t/hectare (the increase in comparison with the control made 1,55 t/hectare). Calculation of economic feasibility of use of biological products at growing winter wheat testifies to significant efficiency of use of backgrounds of feed and probed specimens. On the 1-st background of feed the highest profitableness was gained at treatment of seeds and sowings with specimens Sizam and Rost-concentrate (271,2%). On the 2-nd background of feed the highest level of profitableness was at complex use of specimen Sizam (296,8%). That alternative had the highest economic parameters in researches. **Conclusions.** Application of biological products irrespective of background of feed effectively influenced growth of plants of winter wheat, and parameters of structure of crop have considerably improved. The greatest productivity of grain and the highest level of profitableness were gained on the 2-nd background of feed (N60P60) at complex use of specimen Sizam — 6,86 t/hectare (increase in comparison with the control made 1,55 t/hectare) and 296,8%.

Key words: winter wheat, biological product, background of feed, biometric parameters, structure of crop, productivity, profitableness.

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The peculiarities of growing winter wheat are based on optimization of a huge number of biotic and abiotic conditions affecting the formation of high grain productivity of the required quality [1-5]. A significant number of new developments that have appeared recently, indicates the possibility of achieving the main goal - increasing gross grain harvest [6,7]. For this there is a huge arsenal of sorts of agricultural methods. Each of them has not only direct, but also indirect influence, which does not always positively affect the adaptive capabilities of plants.

Recently, the biologization of winter wheat cultivation has become increasingly popular [8-10], namely: the use of preparations of biological origin, the application of organic fertilizers and biological measures to protect crops. This is especially true for technologically loaded regions of Ukraine, such as the Donbass.

The purpose of the research is to determine the efficacy of preparations of biological origin in the cultivation of winter wheat on various nutrition backgrounds in the Donetsk region.

Research methods: fielding, supplemented by analytical studies, measurements, calculations and observations in accordance with generally accepted methodologies and methodological recommendations in crop production.

The investigations were carried out in the field crop rotation of the State Enterprise "EF "Zaboyschchik" DSASS NAAN" in 2015-2017. Multifactor field experiments are based on the method of successive plots, in a systematic way. Repeatability is 3-fold. The area of the registration plot was 40-80 m². Soil - black earth ordinary low-humus heavy loam.

The technology of cultivation was common for the northern part of the Steppe of Ukraine, except for the questions put to study and met the zonal and regional recommendations. The sowing of winter wheat of Kraplyna variety was carried out at the optimal time for the region. The precursor is fallow. Mineral fertilizers were introduced according to the scheme of the experiment.

For study the specific features of the formation of the winter wheat crop depending on the biological preparations, microfertilizers, growth regulators, the mineral nutrition system, in the experiments strictly was adhered to the corresponding regulations for their use. Mathematical processing of the research results was carried out in accordance with B. A. Dospekhov's «Methodology of Field Experience» [11].

Results. The scheme of experiments (table 1) presupposed the pre-sowing treatment of seeds with biological preparations on the day of sowing, followed by the spraying of crops in the phase of tillering and earing. Control - treatment of seeds and crops by water.

The development of winter wheat plants during the termination of the autumn vegetation (table 1) on backgrounds of nutrition (background 1 - N₃₀P₃₀, background 2 - N₆₀P₆₀) did not differ significantly. The sugar content in the nodes of tillering was higher on the first background.

The greatest tillering coefficients were obtained on variants with seed treatment: against the background of N₃₀P₃₀ - using the rost-concentrate preparation, against the background of N₆₀P₆₀ - using the sisam preparation. The coefficient of secondary roots on both backgrounds was the best on variants with seed treatment with rost-concentrate.

At the end of the tillering phase, the largest tillering coefficient and the coefficient of secondary roots on both backgrounds were on the variant when the Sisam and rost-concentrate preparations were combined (5,2 and 5,5 and 4,9 and 5,2) (table 2).

1. Biometric indicators of winter wheat at the time of termination of autumn vegetation

Variant	Plant height, cm	Average depth of bedding node of tillering, cm	Coefficient of tillering	Coefficient of secondary roots	Sugar content, %
Nutrition background 1 - N ₃₀ P ₃₀					
Control	13,5	4,3	2,2	1,5	28,38
Aidar – seed	12,7	4,6	1,6	1,8	24,65
Rost- concentrate - seed	12,4	4,0	2,3	2,1	30,40
Sisam – seed	12,9	4,2	2,0	1,6	32,08
Sisam – seed + tillering + earing	13,1	5,0	1,9	1,2	32,10
Sisam – seed, sisam + aidar – tillering and earing	13,5	5,3	1,8	1,5	31,79
Sisam – seed, sisam + Rost- concentrate – tillering and earing	13,5	4,7	1,8	1,3	31,94
Nutrition background 2 - N ₆₀ P ₆₀					
Control	13,6	4,4	1,9	1,7	28,38
Aidar – seed	12,8	4,7	1,7	1,8	21,85
Rost- concentrate - seed	12,8	5,0	2,0	2,5	22,35
Sisam – seed	13,0	5,1	2,3	1,9	27,52
Sisam – seed + tillering + earing	13,2	5,3	1,8	1,4	28,60

Sisam – seed, sisam + aidar – tillering and earing	13,1	5,7	1,9	1,6	28,78
Sisam – seed, sisam + Rost- concentrate – tillering and earing	13,4	5,2	1,9	1,4	29,43

The height of the plants against the background of $N_{30}P_{30}$ was 56,4 cm, against the background of $N_{60}P_{60}$ was 59,4 cm. The average value of the tillering coefficient against the background of $N_{30}P_{30}$ was 3,86, against the background of $N_{60}P_{60}$ – 4,0.

The average value of the coefficient of secondary roots against the background of $N_{30}P_{30}$ was 4,56, against the background of $N_{60}P_{60}$ was 4,44. That is, at the end of the tillering phase, the biometric indicators of winter wheat were the best on the second background.

At the time of harvest, the coefficients of total and productive tillering in winter wheat plants are shown in table 3. On the first background, the high coefficient of both total and productive tillering was with the joint use of Sisam and rost-concentrate preparations – 2,43. On the second background of nutrition, the high rates were with joint use of sisam and aidar preparations – 3,02 and 2,85, respectively.

2. Biometric indicators of winter wheat at the end of the tillering phase

Variant	Plant height, cm	Coefficient of tillering	Coefficient of secondary roots
Nutrition background 1 - $N_{30}P_{30}$			
Control	57,2	3,8	3,5
Aidar – seed	56,4	3,8	3,8
Rost- concentrate - seed	56,7	3,9	4,9
Sisam – seed	53,9	3,3	4,7
Sisam – seed + tillering + earing	53,1	3,1	4,9
Sisam – seed, sisam + aidar – tillering and earing	59,2	3,9	4,6
Sisam – seed, sisam + Rost- concentrate – tillering and earing	58,5	5,2	5,5
Nutrition background 2 - $N_{60}P_{60}$			
Control	58,5	3,6	4,0
Aidar – seed	58,8	3,3	3,7
Rost- concentrate - seed	60,1	4,1	4,5
Sisam – seed	57,2	3,9	4,4
Sisam – seed + tillering + earing	60,5	3,5	4,8
Sisam – seed, sisam + aidar – tillering and earing	62,2	4,7	4,5
Sisam – seed, sisam + Rost- concentrate – tillering and earing	58,7	4,9	5,2

3. Biometric indicators of winter wheat in the earing phase

Variant	Plant height, cm	Number of stems, pc./m ²		Coefficient of tillering	
		total	productive	total	productive
Nutrition background 1- $N_{30}P_{30}$					
Control	75,5	484,5	446,0	1,89	1,82
Aidar – seed	78,1	496,0	456,0	2,05	1,93
Rost- concentrate - seed	79,6	525,0	490,5	2,23	2,06
Sisam – seed	77,4	519,0	488,5	2,25	2,12

Sisam – seed + tillering + earing	76,8	547,5	503,5	2,26	2,02
Sisam – seed, sisam + aidar – tillering and earing	81,2	454,0	443,0	2,38	2,28
Sisam – seed, sisam + Rost-concentrate – tillering and earing	78,6	511,5	491,5	2,43	2,40
Nutrition background 2- N ₆₀ P ₆₀					
Control	77,8	477,0	450,5	2,22	1,99
Aidar – seed	79,3	486,5	434,0	2,26	2,04
Rost- concentrate - seed	79,7	591,5	501,0	2,37	2,51
Sisam – seed	79,6	545,0	483,0	2,44	2,49
Sisam – seed + tillering + earing	83,4	652,0	575,0	2,54	2,67
Sisam – seed, sisam + aidar – tillering and earing	80,3	568,0	497,0	3,02	2,85
Sisam – seed, sisam + Rost-concentrate – tillering and earing	78,7	587,0	499,5	2,61	2,13

It should be noted that the use of biologics, regardless of the background of nutrition, has effectively influenced the development of plants.

With regard to the indicators of the structure of the crop (table 4), then on the first and second backgrounds the best indicators of the crop structure were on the variant with the joint use of preparations of sisame and rost-concentrate.

4. Indicators of the structure of the yield of winter wheat

Variant	Plant height, cm	The number of grains in the ear, pc.	Weight of 1000 grains, g	Nature grain, g/l
Nutrition background 1- N ₃₀ P ₃₀				
Control	10,0	28,3	38,85	717,0
Aidar – seed	10,4	30,2	40,23	729,2
Rost- concentrate - seed	10,6	30,5	39,64	720,8
Sisam – seed	10,7	30,6	39,96	732,7
Sisam – seed + tillering + earing	10,7	30,8	39,23	721,7
Sisam – seed, sisam + aidar – tillering and earing	10,9	31,0	41,35	730,0
Sisam – seed, sisam + Rost-concentrate – tillering and earing	11,2	31,2	39,88	720,6
Nutrition background 2- N ₆₀ P ₆₀				
Control	10,3	30,3	38,87	751,0
Aidar – seed	10,5	30,5	41,25	751,9
Rost- concentrate - seed	10,7	30,6	39,96	754,4
Sisam – seed	10,9	30,8	39,84	763,8
Sisam – seed + tillering + earing	11,2	31,5	37,90	756,3
Sisam – seed, sisam + aidar – tillering and earing	11,4	31,5	39,64	758,4
Sisam – seed, sisam + Rost-concentrate – tillering and earing	11,6	31,6	39,86	757,9

This trend was observed. The length of the ear in the best variants by backgrounds exceeded its controls by 12,0% and 12,6%. The number of grains in the ear in the best variants by backgrounds exceeded its

controls by 10,2% and 4,3%. The weight of 1000 grains - by 2,65% and 2,55%. The nature of grain is 0,5% and 0,9%. That is, biopreparations more strongly influenced the value of indicators of the number of grains in the ear and the mass of 1000 grains in the plants of winter wheat on the first background of nutrition.

On the first background, the highest grain yield was achieved with the integrated use of the preparation sisam and when it was used together with the rost concentrate preparation, 6,08 and 6,12 t/ha, the increment compared to the control was 1,18 and 1,22 t/ha or 24,1% and 24,9% (table 5). On the second background, the highest yield was obtained with the complex use of the preparation sizam – 6,86 t/ha, the increase in comparison with the control was 1,55 t/ha or 29,2%. This is the highest yield of winter wheat grain in the experiment. In general, on all variants with the use of biologic preparations on both backgrounds, a significant increase in the grain yield was obtained.

5. Crop of winter wheat

Variant	Crop yield, t/ha	Increase of crop yield	
		t/ha	t/ha
Nutrition background 1- N ₃₀ P ₃₀			
Control	4,90	-	-
Aidar – seed	5,54	0,64	13,1
Rost- concentrate - seed	5,93	1,03	21,0
Sisam – seed	5,97	1,07	21,8
Sisam – seed + tillering + earing	6,08	1,18	24,1
Sisam – seed, sisam + aidar – tillering and earing	5,68	0,78	15,9
Sisam – seed, sisam + Rost- concentrate – tillering and earing	6,12	1,22	24,9
Nutrition background 2- N ₆₀ P ₆₀			
Control	5,31	-	-
Aidar – seed	5,46	0,15	2,8
Rost- concentrate - seed	6,13	0,82	15,4
Sisam – seed	5,93	0,62	11,7
Sisam – seed + tillering + earing	6,86	1,55	29,2
Sisam – seed, sisam + aidar – tillering and earing	6,21	0,90	16,9
Sisam – seed, sisam + Rost- concentrate – tillering and earing	6,29	0,98	18,5
LSD ₀₅ , t/ha	0,14		

The calculation of the economic feasibility of using biologics for the cultivation of winter wheat demonstrated a significant efficiency in the use of backgrounds of nutrition and preparations that have been studied (table 6). On the first background N₃₀P₃₀, the highest profitability was obtained by treating seeds and crops with sisam preparations and rost-concentrate (271,2%). On the second background N₆₀P₆₀, the highest level of profitability was in the complex use of the preparation sisam (296,8%) - this is the option on which the highest economic indicators were obtained in the studies.

6. Economic efficiency of growing winter wheat

Variant	Cost of crop yield, uah	Production costs, uah/ha	Production cost of 1 ton of grain, uah	Net profit, uah/ha	Level of profitability, %
Nutrition background 1 - N ₃₀ P ₃₀					
Control	22050	6980	1406,1	15070	215,9
Aidar – seed	24930	7500	1353,8	17430	232,4

Rost- concentrate - seed	26690	7200	1214,2	19490	270,7
Sisam – seed	26865	7400	1239,5	19465	263,0
Sisam – seed + tillering + earing	27360	7500	1233,6	19860	264,8
Sisam – seed, sisam + aidar – tillering and earing	25560	7580	1334,5	17980	237,2
Sisam – seed, sisam + Rost-concentrate – tillering and earing	27540	7420	1212,4	20120	271,2
Nutrition background 2 - N ₆₀ P ₆₀					
Control	23895	7350	1384,2	16545	225,1
Aidar – seed	24570	7870	1441,4	16700	212,2
Rost- concentrate - seed	27585	7650	1248,0	19935	260,6
Sisam – seed	26685	7790	1313,7	18895	242,5
Sisam – seed + tillering + earing	30870	7780	1134,1	23090	296,8
Sisam – seed, sisam + aidar – tillering and earing	27945	7810	1257,6	20135	257,8
Sisam – seed, sisam + Rost-concentrate – tillering and earing	28305	7750	1232,1	20555	265,2

Thus, the use of biologics for the cultivation of winter wheat contributes to the good development of plants during the growing season, the formation of high yields and the level of profitability.

Conclusions

The use of biologics irrespective of the background of nutrition effectively influenced the development of plants, the parameters of the crop structure improved significantly, the yield of winter wheat increased in conditions of the Donetsk region. The highest yields of winter wheat grains and the highest profitability level were obtained on the second background of nutrition (N₆₀R₆₀) with a combined use of the sisam preparation – 6,86 t/ha (the increment compared to the control was 1,55 t/ ha) and 296,8% .

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