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WORK COMPLETION REPORT

UNDER THE CONTRACT No. 10/10-2019 DATED OCTOBER 10, 2019

Subject: "STUDY OF THE EFFECTIVENESS OF AGROCHEMICALS BASED ON HUMIC ACIDS "EKO-SP" MADE BY LLC "EKOR-SP" COMPANY ON WINTER WHEAT CROPS IN THE ROSTOV REGION"

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ABSTRACT

In the Aksai district of the Rostov region, on common medium-deep chernozem, the effect of "EKO-SP" fertilizer, based on humic substances, on the productivity and quality of winter wheat grain was determined. The highest level of wheat grain productivity was obtained from the application of the "EKO-SP" agrochemical with B concentrate at a dose of 0.5 l/ton for seed treatment before sowing and at a dose of 1 l/ha by the spray method in the spring tillering phase, stem elongation phase and in the flowering phase. The increase in productivity to the control variant increased by 0.59 t/ha or by 16.3%, the amount of protein increased by 0.25%, gluten - by 2.1%. The net cost of production of 1 kg of wheat grain decreased by 0.48 rubles/kg, the level of profitability of production increased by 47%, conditionally net income - by 7729 rubles/ha.

1.JUSTIFICATION OF THE STUDY TOPIC

At present, according to various assessments, about half of the total harvest is due to the application of mineral and organic fertilizers. The application of fertilizers should not only increase the productivity of agricultural crops, but also contribute to the creation of expanded reproduction of soil fertility (A.N. Levchenkova, T.I. Volodina, 2013).

The preservation and increase of fertility of chernozem soils with a constantly increasing volume of agricultural production is a global direction in maintaining agroecological security based on the cycling of biogenic substances (O.V. Kutovaya et al., 2013).

Winter wheat is the main and strategic grain crop in the Russian Federation and the North Caucasus (S.V. Zhilenko et al., 2016). In the Rostov region, winter wheat crop acres exceed 2.2 million hectares annually, which corresponds to more than 50% of the region's crop acres. But the crop productivity annually is lower than the potential of this crop and does not exceed 40 c/ha (A.V. Labyntsev, M.A. Shchepetiev, 2012).

In increasing the productivity and gross yield of winter wheat the leading place belongs to fertilizers along with the correct choice of varieties and plant protection agents (A.H. Sheudzhen, I.A. Buldykova, R.V. Shtuts, 2014).

An intensive farming system with the cultivation of the most productive varieties, the application of highly concentrated ballastless nitrogen-phosphorus-potassium fertilizers led to a decrease in the content of forms of microelements in soils, available to plants, and, as a consequence, to the need for widespread application of microfertilizers, i.e. fertilizers, the active substance of which are microelements (D.V. Kulagin, A.N. Esaulko, V.V. Kukushkina, 2017).

A significant reserve for increasing the productivity and quality of winter wheat grain is currently the widespread introduction of plant growth regulators (PGR) in agricultural production, (A.H. Sheudzhen et al., 2006). The selection of optimal plant growth regulators with agronomic, ecological and economic assessment is an important task of agrochemical study.

The application of organomineral fertilizers of humic nature is promising in the practice of modern agriculture.

Therefore, the purpose of our study was to determine the effect of "EKO-SP" fertilizer, based on humic substances, on the productivity and quality of winter wheat grain on common chernozem in the conditions of the Aksai district of the Rostov region.

2. STUDY PROCEDURE AND CONDITIONS

2.1 Study purposes and objectives

The study was carried out in 2020 in the conditions of the Agricultural Enterprise "Altair" in the Aksai district of the Rostov region. When performing the work, the following objectives were set:

- to study the dynamics of productive moisture in the soil under winter wheat;
- to determine the effect of an agrochemical on the NPK content in winter wheat plants at the earing (flowering) phase;
- to establish the effect of fertilizers on the productivity of winter wheat grain and product quality;
- to calculate the economic effectiveness of application of fertilizers under winter wheat.

2.2 Climate and weather conditions in the year of the experiment

The productivity of agricultural crops is largely limited by weather conditions and, first of all, by a lack of humidity. Ambient temperature also plays an important role. The ratio of these indicators makes it possible to assess weather conditions as favorable or negative for the formation of crop productivity (V.V. Chekmarev, O.V. Postovaya, 2013).

Aksai district is located in a temperate climate zone. The hottest month is July with an average month temperature of + 23 °C, the coldest month is January with a temperature of -4 °C. Their maximum number is in December - up to 77 mm on average, the minimum - in October, up to 33 mm. On average, 91 days a year are rainy, 32 days are snowy. Air humidity in the district is at around 72% on average. The maximum snow cover depth is in March - up to 69 cm.

According to the meteorological station in Rostov-on-Don, the average annual precipitation in the study area is 520.8 mm, the average annual air temperature is 10.9 ^{0}C (Table 1).

Table 1- Average long-term precipitation and temperature according to the meteorological station of Rostov-on-Don

Month	Air temperature, ^{0}C	Precipitation, mm
September	16.3	46.0
October	9.4	31.9
November	2.7	45.4
December	-0.7	67.6
January	-4.1	48.9
February	-3.2	44.8
March	1.8	42.9
April	10.7	53.0
May	16.6	56.9
June	20.8	59.8
July	23.0	57.1
August	22.0	44.4
Average	10.9	-
Amount	-	520.8

In the autumn months of the 2019-2020 agricultural year, there was a significant shortage of precipitation. Their number was 31.2 mm less than the average long-term norms. The shortage of precipitation in September was 13 mm, which did not allow accumulating sufficient reserves of productive moisture for the emergence of even sprouts of winter wheat after sowing winter wheat on the predecessor winter wheat in the first decade of October (Table 2).

In the first winter months (December and January), there was a significant shortage of precipitation, but in February the amount was 117.8 mm. In total, there were 167.1 mm during the winter months, which is 5.8 mm more than the average long-term values.

In the spring months of 2020, a significant lack of precipitation was recorded. In March, there were only 1 mm. May was distinguished by abundant moisture. The amount of precipitation exceeded the average month norms by 16 mm.

Table 2 - Weather conditions in the 2019-2020 agricultural year (meteorological station Rostov-on-Don)

Month	Average monthly air temperature, ^{0}C	Precipitation, mm	Relative air humidity, %
September	17.3	33.1	53.1
October	12.3	19.2	74.4
November	4.0	39.8	76.6
December	2.1	17.0	88.5
January	1.2	32.3	83.0
February	0.9	117.8	82.7
March	7.7	1.0	57.6
April	9.4	16.0	47.2
May	15.3	72.9	67.8
June	23.2	21.6	54.6
July	24.8	72.2	49.3

IN June, there was a significant shortage of precipitation. Their amount was only 21.6 mm, which is 38.2 mm less than the average long-term norms.

Thus, the weather conditions of the 2019-2020 agricultural year can be considered unfavorable for the cultivation of winter wheat.

2.3 Experimental plot soils

The soil of the experimental plot is common chernozem - micellar-carbonate (Severo-Azov), according to the 1977 classification. The predominant part of the soil is formed on loesslike and yellow-brown clays, in connection with which they have a clay grain-size distribution.

The depth of the humus horizon A + B of common chernozems ranges from 70 to 90 cm (E.V. Agafonov, E.V. Poluektov, 1999). This type of soil is characterized by a uniform and gradual drop in the humus content down the profile with its amount in the top soil of 4.0-4.2%, pH - 8.2-8.3; the amount of absorbed footings is 39-42 meq/100 g of soil. Exchangeable calcium in the upper half-meter layer is over 80% of the total Ca^{2+} + Mg^{2+}.

2.4 Study procedure

The study was carried out in 2019-2020 in the conditions of the Agricultural Enterprise "Altair" in the Aksai region. The predecessor of winter wheat is winter wheat. Winter wheat variety Zolushka. The area of the experimental plot is 20 m * 5.6 m (112 m^2). The experiment replication is fourfold.

Experimental design:

1. Control (farm fertilization system), (background) pre-sowing application of Azophoska at a dose of $N_{24}P_{24}K_{24}$, nitrogen fertilization with ammonium nitrate on thawed-frozen soil at a dose of 250 kg/ha (86 kg/ha a.i.);
2. Background + seed treatment (0.5 l/ton) with A product;
3. Background + seed treatment (0.5 l/ton) with B product;
4. Background + seed treatment (0.5 l/ton) + 2-fold spraying of plants during the growth with A product, 1 l/ha;
5. Background + seed treatment (0.5 l/ton) + 3-fold spraying of plants during the growth with A product, 1 l/ha;
6. Background + seed treatment (0.5 l/ton) + 2-fold spraying of plants during the growth with B product, 1 l/ha;
7. Background + seed treatment (0.5 l/ton) + 3-fold spraying of plants during the growth with B product, 1 l/ha;
8. Background + 2-fold spraying of plants during the growth with A product, 1 l/ha;
9. Background + 3-fold spraying of plants during the growth with A product, 1 l/ha;
10. Background + 2-fold spraying of plants during the growth with B product, 1 l/ha;
11. Background + 3-fold spraying of plants during the growth with B product, 1 l/ha;

Mineral fertilizers in the form of azofoska (16-16-16) were applied in the autumn simultaneously with the sowing of winter wheat at a dose of 150 kg/ha. In February (19/03/2020), nitrogen fertilization with ammonium nitrate was carried out on thawed-frozen soil at a dose of 250 kg/ha in gross weight.

The object of study was a "EKO-SP" fertilizer, based on humic substances. The "EKOR-SP" company is a Russian developer and producer of environmentally friendly biological products based on peat extract, strains of microorganisms, groups of humic acids, low molecular weight organic acids. Production is located in the Moscow region. This is a high-tech, modern equipment capable of producing an effective product, high-quality raw materials, as well as highly qualified specialists who implement progressive market trends in production. The fertilizer is packed in canisters of various sizes, which makes it easy to use.

The enterprise produces "EKO-SP" fertilizer, based on humic substances. The product is a concentrated liquid product, that meets the highest quality requirements, both in composition and in physical and morphological parameters (dispersity). The basis of the fertilizer is an extract from lowland peat with a high concentration of humic and fulvic acids, treated structured water, a set of macro- and microelements. High production technology, filtration, ozonation, homogenization and the use of structured treated water - were able to extract the living force of nature and transform it into the company's product line. It is a natural product with very high biological activity.

The object of the study was the Zolushka winter wheat variety. Developer: State Scientific Institution Donskoy Zonal Scientific Research Institute of Agriculture of the Russian Agricultural Academy.

The variety is lutescense. The ear is cylindrical, white, bald, medium length (8-10 cm). Medium density (23 spikelets per 10 cm length). In the upper part of the spike, there are short awnlike sprouts. Gluma is oval, medium length. The gluma tooth is very short. The arm is straight, wide. The grain is filled, glassy, red, with a medium crease. Weight of 1000 grains is 44 - 53 g, grain unit is 780-820 g/l. The variety is semidwarf. Plant height is 70-100 cm. Resistant to lodging and shedding. Designed for above average to high levels of fertility. Resistant to damage by snow mold and root rot, viral yellow dwarfism of barley.

The establishment of a trial, observations and recording during the growth were carried out according to the methods of experiments with fertilizers (S.V.

Shcherba, F.A. Yudin, 1975; F.A. Yudin, 1980). Sheaves of winter wheat were harvested from five plots of 1 m^2 each.

The studies were carried out by field and laboratory methods using the following methods: soil sampling - GOST-28168-89; general requirements for conducting analyzes - GOST-29269-91; soil humidity - GOST-28268-89; calculation of productive moisture taking into account the humidity of permanent wilting of winter wheat - E.V. Agafonov (1992); the economic effectiveness of the application of fertilizers was determined according to Baranov N.N., 1966 "The main elements of the methods for determining the economic effectiveness of fertilizers"; mathematical processing of the obtained results - by means of dispersion analysis according to B.A. Dospehov (1985).

Chemical analyzes of soil and plant samples were carried out in the laboratory of the Department of Agrochemistry and Ecology named after Professor E.V. Agafonov DonSAU.

3. STUDY RESULTS AND THEIR ANALYSIS

3.1 Dynamics of productive moisture in soil

Before sowing winter wheat in 2019, the topsoil of 0-20 cm was completely wasted (Table 3).

Table 3 - Dynamics of productive moisture in the soil under winter wheat in 2019-2020, mm

Soil layer, cm	Before sowing 05/10/20.	Spring tillering 14/04/20.	Stem elongation 13/05/20.	Flowering 30/05/20.	Harvesting 27/06/20.
0-20	0	14.2	5.2	10.6	5.2
20-40	1.5	12.3	6.5	17.2	8.7
40-60	1.1	17.1	10.1	14.5	5.3
60-80	2.0	15.3	15.6	17.7	2.9
80-100	1.1	10.1	9.8	7.0	2.2
0-60	2.6	43.6	21.8	42.2	19.2
0-100	5.7	69.0	47.2	66.9	24.3

Sowing of crop seeds was carried out into dry soil. The lack of precipitation in the autumn contributed to the late emergence of winter wheat seedlings. Full crop seedlings were obtained only at the beginning of December (Figure 1).

At the spring tillering phase of winter wheat, due to the lack of precipitation in the autumn and winter-spring periods, the content of productive moisture in the meter soil layer was only 69.0 mm. This stock of available soil moisture was characterized as low (<100 mm) for this growth according to the gradation of E.V. Agafonov and E.V. Полуэктова (1999), (рисунок 2).

At the stem elongation phase, the stock of available moisture in the 0-100 cm soil layer decreased compared to the amount at the spring tillering phase by 21.8 mm, in the 0-20 cm layer - almost 2.7 times (Figure 3).

Figure 1 - State of winter wheat crops on 02/12/2019.

But due to the abundant precipitation in the last decade of May, the content of productive moisture in the soil increased compared to the amount at the stem elongation phase in the 0-100 cm soil layer by 19.7 mm, in the 0-20 cm layer - up to 10.6 mm.

From the flowering phase to the moment of harvesting winter wheat, due to a lack of precipitation and high temperatures settled in, the amount of productive moisture in the meter soil layer has significantly decreased, in the 0-100 cm soil layer 2.8 times, in the 0-20 cm layer - 2 times (Figure 4).

During the growth of winter wheat in 2019-2020 due to an acute shortage of precipitation in the autumn and spring growth, the reserves of productive moisture were significantly less than optimal values, which negatively affected the crop productivity.

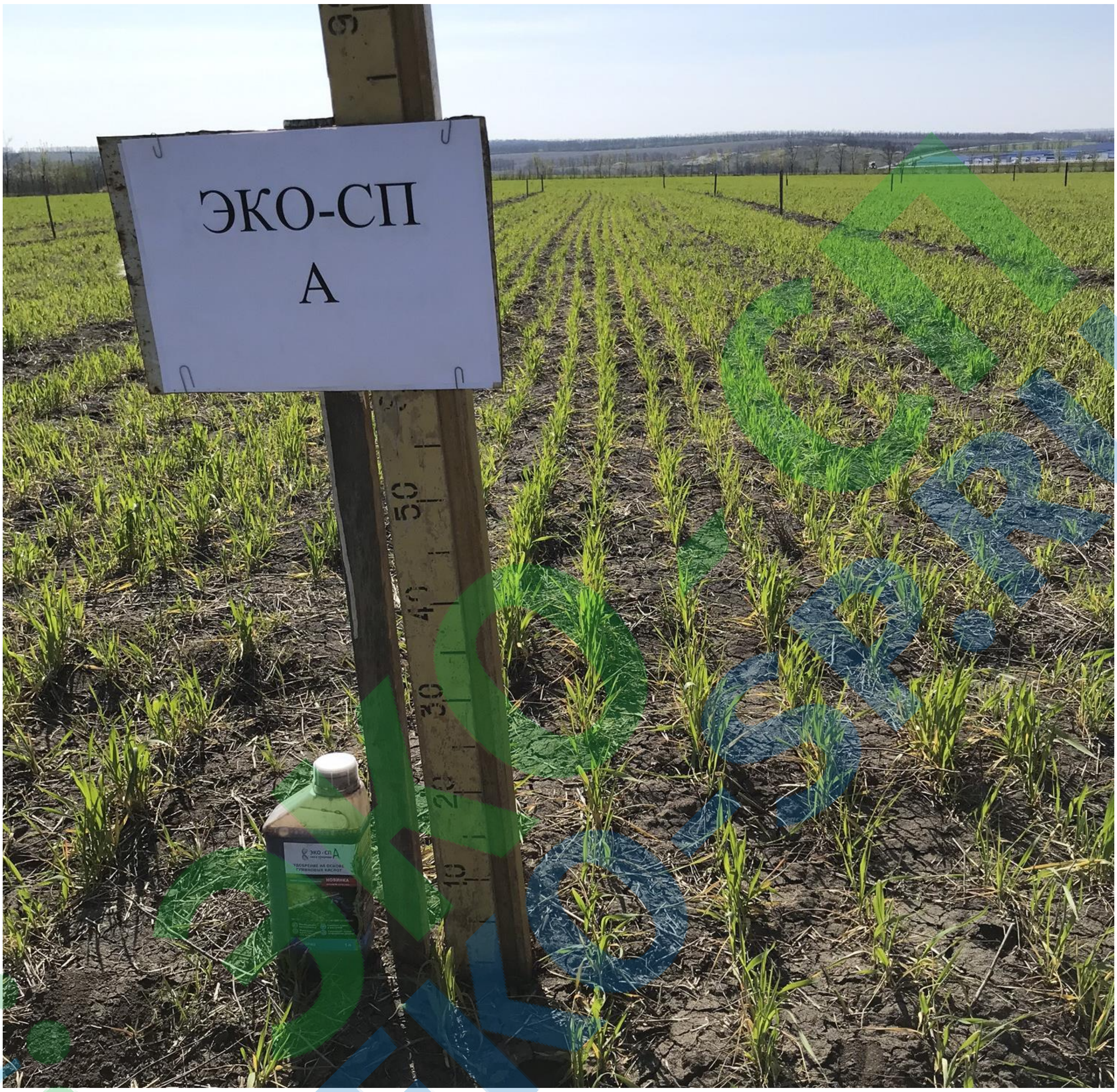

Figure 2 - The state of winter wheat crops during the first treatment with the "EKO-SP" agrochemical on 14/04/2020.

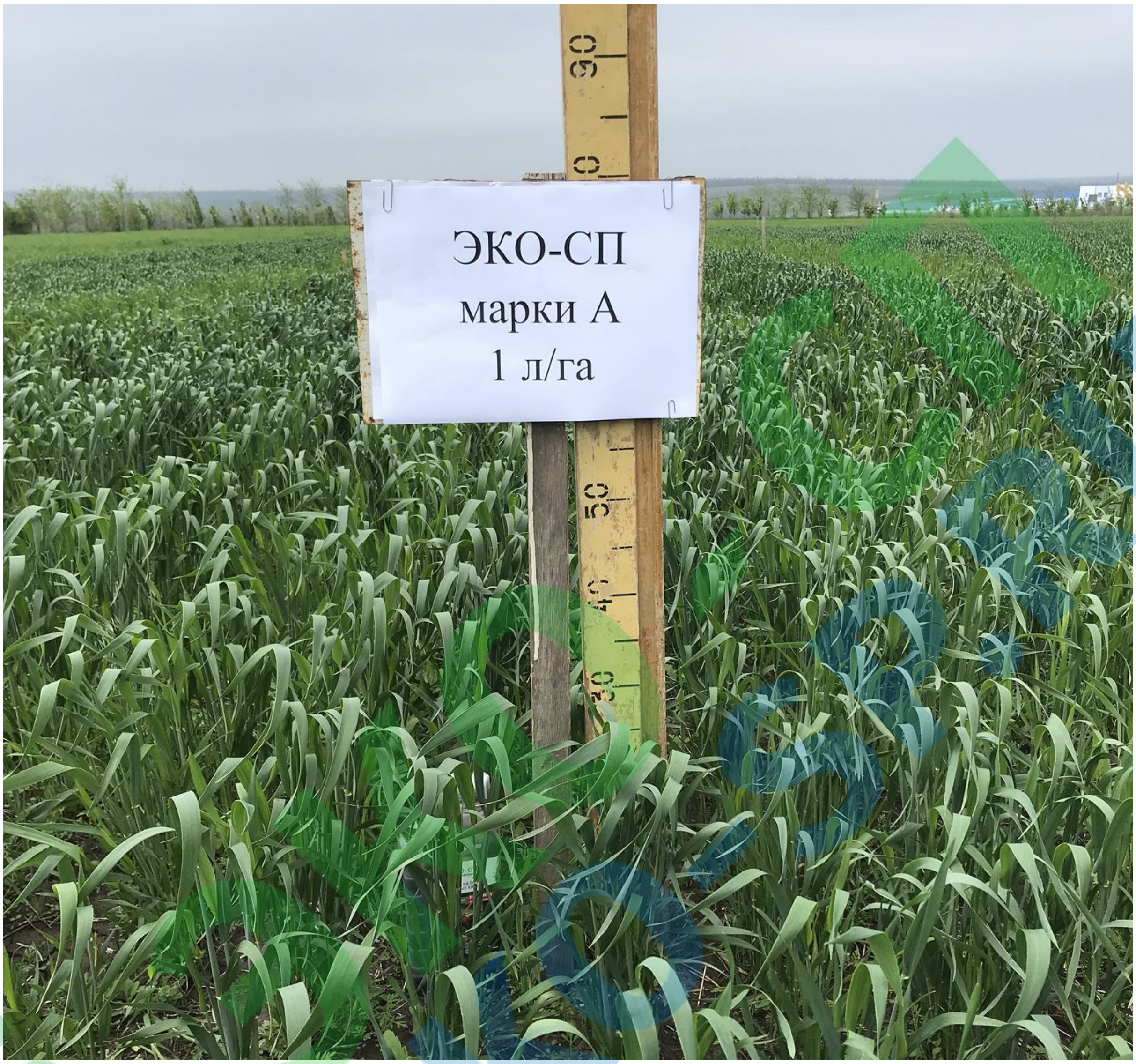

Figure 3 - The state of winter wheat crops during the second treatment with the "EKO-SP" agrochemical on 13/05/2020.

Figure 4 - The state of winter wheat crops during the third treatment with the "EKO-SP" agrochemical on 30/05/2020.

3.2 The content of nutrients in the soil and plants of winter wheat during growth

When carrying out soil diagnostics (19/03/2020) before fertilization in thawed-frozen soil, the content of mineral nitrogen in the 0-100 cm soil layer was 42.4 kg/ha. The soil availability with mobile phosphorus was very low according to the Machigin gradation (<10 mg/kg of soil) - 7.3 mg/kg of soil in the 0-20 cm soil layer, and 3.1 mg/kg of soil in the 20-40 cm soil layer. The soil availability in the 0-

20 cm soil layer is 452 mg/kg - high according to the Machigin gradation, in the 20-40 cm soil layer - average - 270 mg/kg of soil.

During the flowering phase, the reserve of mineral nitrogen in the soil was completely depleted. The content of mobile phosphorus in the 0-20 cm soil layer decreased significantly and amounted to 2.7 mg/kg at this phase, in the 20-40 cm soil layer - 1.4 mg/kg of soil. The amount of exchangeable potassium also decreased in both soil layers and amounted to 405 and 220 mg/kg of soil, respectively. This is obviously due to the absorption of available reserves of basic nutrients by winter wheat plants during the formation of green matter and caryopses.

In the flowering phase in active green leaves of winter wheat in the control variant (farm fertilization system), the nitrogen concentration was 3.05% (Table 4).

Table 4 - The content of the main plant food elements during the flowering phase of winter wheat, %. Active green leaves

N	Increase to control	P_2O_5	Increase to control	K_2O	Increase to control
control (farm fertilization system)					
3.05	-	0.83	-	2.52	-
dose of 1 l/ha of A concentrate (twofold on 14/04/2020					
3.12	0.07	0.86	0.03	2.55	0.03
dose of 1 l/ha of B concentrate (twofold on 13/05/2020					
3.03	-0.02	0.88	0.05	2.55	0.03
seed treatment 0.5 l/ton of A concentrate					
3.11	0.06	0.91	0.08	2.60	0.08
seed treatment 0.5 l/ton of B concentrate					
3.04	-0.01	0.84	0.01	2.65	0.13
LSD_{05}					
0.08		0.06		Fact. < Ftheor.	

According to Sheudzhen A.H. (2007) this level of availability is insufficient to obtain the planned productivity (optimal concentration is more than 4.5%). The availability of plants with phosphorus at this phase was higher. The content was 0.83%, which corresponds to a very high content according to V.V. Tserling (1990), (> 0,50%).

The application of "EKO-SP" fertilizer, based on humic substances, with spray method during the growth and for seed treatment did not have a significant effect on the concentration of nitrogen and phosphorus in active green leaves of winter wheat, since the content of these elements corresponded to the values in the control variant.

The concentration of potassium in winter wheat plants did not depend on the application of the EKO-SP fertilizer and corresponded to the optimal values (2.52-2.65%).

3.3 Productivity of winter wheat

The productivity of winter wheat grain in the control variant (fertilization system of the farm) was 3.63 t/ha (Table 5, Table 6, Figure 5 and Figure 6).

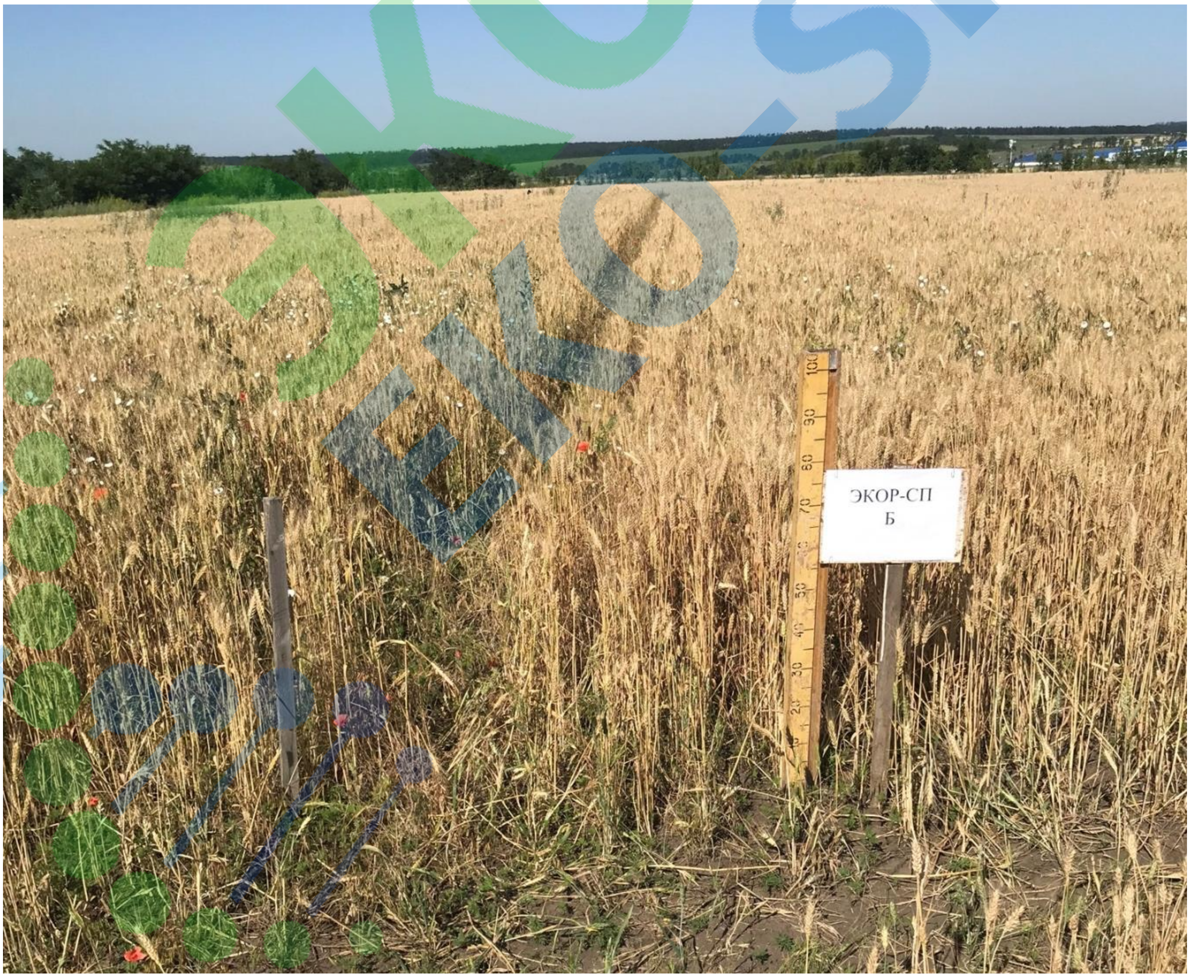

Figure 5 - Carrying out registration harvesting

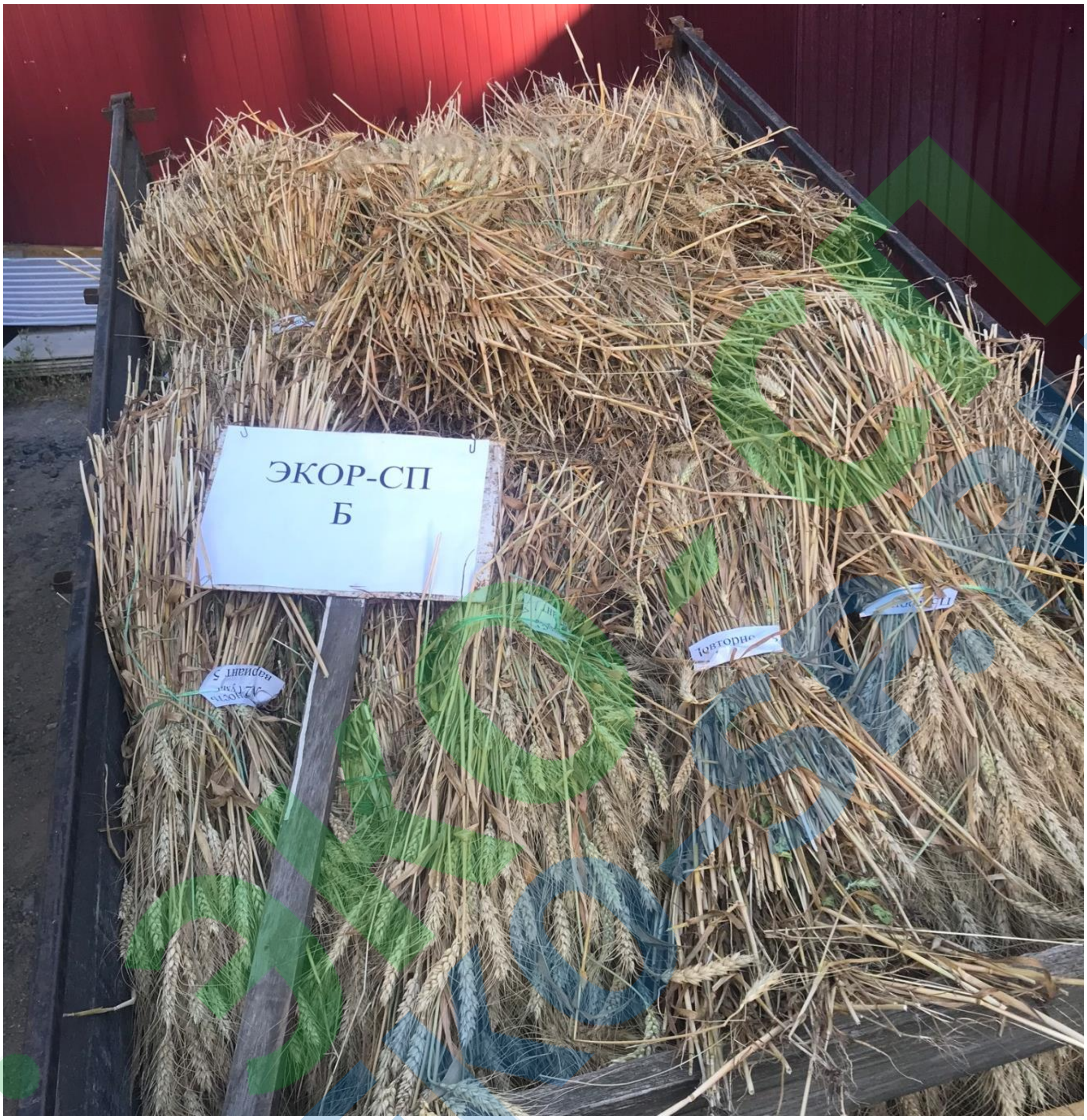

Figure 6 - Carrying out registration harvesting

Table 5 - Productivity of winter wheat grain in 2020, t/ha

Variants	Replications			
	No. 1	No. 2	No. 3	No. 4
farm fertilization system - background	3.56	3.68	3.72	3.56
background + seed treatment with EKO-SP (A) 0.5 l/ton	3.88	3.84	3.82	3.86
background + seed treatment EKO-SP (B) 0.5 l/ton	3.64	3.88	3.88	3.90
background + EKO-SP (A) 0.5 l/ton + 2-fold (1 l/ha)	4.16	4.00	4.00	4.14
background + EKO-SP (B) 0.5 l/ton + 2-fold (1 l/ha)	4.18	4.24	4.16	4.12
background + EKO-SP (A) 0.5 l/ton + 3-fold (1 l/ha)	4.04	4.28	4.00	4.12
background + EKO-SP (B) 0.5 l/ton + 3-fold (1 l/ha)	4.28	4.28	4.18	4.14
background + EKO-SP (A) 2-fold (1 l/ha)	4.08	4.08	3.98	4.06
background + EKO-SP (B) 2-fold (1 l/ha)	4.04	4.08	3.92	4.10

background + EKO-SP (A) 3-fold (1 l/ha)	4.14	3.92	4.04	4.12
background + EKO-SP (B) 3-fold (1 l/ha)	4.18	4.12	4.18	4.15

Table 6 - Productivity of winter wheat grain in 2020, t/ha Average of four replications

Variants	Productivity, t/ha	Increase to control	
		t/ha	%
farm fertilization system - background	3.63	-	-
background + seed treatment with EKO-SP (A) 0.5 l/ton	3.85	0.22	6.1
background + seed treatment EKO-SP (B) 0.5 l/ton	3.83	0.20	5.4
background + EKO-SP (A) 0.5 l/ton + 2-fold (1 l/ha)	4.08	0.45	12.3
background + EKO-SP (B) 0.5 l/ton + 2-fold (1 l/ha)	4.18	0.55	15.0
background + EKO-SP (A) 0.5 l/ton + 3-fold (1 l/ha)	4.11	0.48	13.2
background + EKO-SP (B) 0.5 l/ton + 3-fold (1 l/ha)	4.22	0.59	16.3
background + EKO-SP (A) 2-fold (1 l/ha)	4.05	0.42	11.6
background + EKO-SP (B) 2-fold (1 l/ha)	4.04	0.41	11.2
background + EKO-SP (A) 3-fold (1 l/ha)	4.06	0.43	11.7
background + EKO-SP (B) 3-fold (1 l/ha)	4.16	0.53	14.5
LSD_{05}	0.12		

Treatment of winter wheat seeds before sowing with "EKO-SP" humus fertilizer with A and B concentrations contributed to an increase in crop productivity almost equally - by 0.20-0.22 t/ha or 5.4-6.1%.

Twofold treatment of winter wheat plants at a dose of 1 l/ha with "EKO-SP" humus fertilizer with A and B concentration against the background of seed treatment with organomineral fertilizer increased the productivity of winter wheat compared with the control variant by 0.45-0.55 t/ha or by 12.3-15%, and compared to the variants, where only seed treatment was carried out at a dose of 0.5 l/ton - by 0.23-0.25 t/ha or 6.2-9.6%. The difference in the effect on the productivity of winter wheat seeds of fertilizers, based on humic substances of B concentration compared with the A concentration with twofold treatment was 0.10 t/ha. But this increase is less than the LSD of the experiment.

The use of threefold treatment of winter wheat plants in the spring tillering phase, stem elongation and earing against the background of seed treatment before sowing did not contribute to an increase in the productivity of winter wheat compared to twofold treatment. There was only a tendency to an increase in grain productivity.

Two- and threefold treatment of winter wheat plants during the growth contributed to almost the same increase in grain productivity compared to the control variant by 0.41-0.53 t/ha. The maximum was reached on the variant with the application of "EKO-SP" humus fertilizer with B concentration three times during the growth. But the increase in comparison with the analogous variant with "EKO-SP" humus fertilizer with A concentration was 0.10 t/ha, which is less than the LSD of the experiment.

3.4 Quality of winter wheat grain

The gluten content in the winter wheat grain in the control variant (farm fertilization system) was 19.3%, the protein content was 12.5%, which corresponded to the 4th product class (table 7 and table 8).

In all variants of the experiment, the product class of grain corresponded to 4.

Table 7 - Grain quality of winter wheat in 2020

Variants	Protein, %	Increase, %	Gluten, %	Increase, %
farm fertilization system - background	12.5	-	19.3	-
background + seed treatment with EKO-SP (A) 0.5 l/ton	12.8	0.25	22.4	3.1
background + seed treatment EKO-SP (B) 0.5 l/ton	12.7	0.22	22.6	3.3
background + EKO-SP (A) 0.5 l/ton + 2-fold (1 l/ha)	12.7	0.23	20.5	1.2
background + EKO-SP (B) 0.5 l/ton + 2-fold (1 l/ha)	12.8	0.30	20.3	1.0
background + EKO-SP (A) 0.5 l/ton + 3-fold (1 l/ha)	12.8	0.25	21.0	1.7
background + EKO-SP (B) 0.5 l/ton + 3-fold (1 l/ha)	12.8	0.25	21.4	2.1
background + EKO-SP (A) 2-fold (1 l/ha)	12.6	0.05	20.3	1.0
background + EKO-SP (B) 2-fold (1 l/ha)	12.7	0.15	20.2	0.9
background + EKO-SP (A) 3-fold (1 l/ha)	12.9	0.35	20.8	1.5
background + EKO-SP (B) 3-fold (1 l/ha)	13.0	0.53	20.9	1.6
LSD_{05}	0.18		0.36	

Table 8 - Protein content in winter wheat grain in 2020, %

Variants	Replications			
	No. 1	No. 2	No. 3	No. 4
farm fertilization system - background	12.4	12.5	12.3	12.7
background + seed treatment with EKO-SP (A) 0.5 l/ton	12.7	12.8	12.8	12.7
background + seed treatment EKO-SP (B) 0.5 l/ton	12.9	12.5	12.7	12.8
background + EKO-SP (A) 0.5 l/ton + 2-fold (1 l/ha)	12.9	12.6	12.7	12.7
background + EKO-SP (B) 0.5 l/ton + 2-fold (1 l/ha)	12.8	12.9	12.8	12.7
background + EKO-SP (A) 0.5 l/ton + 3-fold (1 l/ha)	12.8	12.7	12.6	12.9
background + EKO-SP (B) 0.5 l/ton + 3-fold (1 l/ha)	12.7	12.8	12.7	12.8
background + EKO-SP (A) 2-fold (1 l/ha)	12.8	12.5	12.6	12.3
background + EKO-SP (B) 2-fold (1 l/ha)	12.9	12.6	12.6	12.5
background + EKO-SP (A) 3-fold (1 l/ha)	12.9	12.7	12.9	12.9
background + EKO-SP (B) 3-fold (1 l/ha)	13.1	12.9	13.0	13.1

The application of "EKO-SP" fertilizer for seed treatment and with spray method during the growth contributed to a mathematically valid increase in the gluten content in all variants of the experiment. An increase in the amount of protein was also noted in all variants, with the exception of the twofold application of "EKO-SP" fertilizer in the spring tillering and earing phase. In these variants, the increases in the increase in protein compared to the control variant were statistically invalid.

The maximum increase in the gluten content compared to the control variant was obtained from the application of the "EKO-SP" agrochemical for the seed treatment with the spray method. Increases in comparison with the control variant were 3.1-3.3% (Table 9). In variants with spray application of fertilizer, the increases in the amount of gluten were 0.9-2.1%. Apparently, this can be explained by the effect of "growth dilution", since the productivity in these variants is more than in the variants with only seed treatment.

Table 9 - Gluten content in winter wheat grain in 2020, %

Variants	Replications			
	No. 1	No. 2	No. 3	No. 4
farm fertilization system - background	19.3	19.5	19.1	19.3
background + seed treatment with EKO-SP (A) 0.5 l/ton	22.2	22.4	22.5	22.4
background + seed treatment EKO-SP (B) 0.5 l/ton	22.4	22.9	22.5	22.6
background + EKO-SP (A) 0.5 l/ton + 2-fold (1 l/ha)	20.4	20.8	20.4	20.2
background + EKO-SP (B) 0.5 l/ton + 2-fold (1 l/ha)	20.1	20.6	20.4	20.2
background + EKO-SP (A) 0.5 l/ton + 3-fold (1 l/ha)	21.1	21.0	20.8	21.1
background + EKO-SP (B) 0.5 l/ton + 3-fold (1 l/ha)	21.2	21.1	21.6	21.5
background + EKO-SP (A) 2-fold (1 l/ha)	20.1	20.0	20.6	20.5
background + EKO-SP (B) 2-fold (1 l/ha)	20.1	20.3	20.2	20.0
background + EKO-SP (A) 3-fold (1 l/ha)	20.9	20.5	20.6	21.0
background + EKO-SP (B) 3-fold (1 l/ha)	20.9	21.0	20.7	20.8

4. ECONOMIC ASSESSMENT OF THE APPLICATION OF FERTILIZERS

The economic assessment of the application of fertilizers allows to conclude about the feasibility of its use in production The economic efficiency of the application of fertilizers was determined by the following indicators: the cost of cultivation of products per 1 hectare, the cost of products per 1 hectare, the net cost of 1 ton of manufactured products (the ratio of the costs of cultivation of products per 1 hectare to grain productivity, t/ha), conditional net income from 1 hectare (the cost of marketable products minus additional costs) and the profitability of the application of fertilizers (the ratio of conditionally net income to costs). To calculate the cost of products, the following purchase prices for 2020 were used: 13,100 rubles per 1 ton of grain of winter wheat of the 4th grade. The price of 1 liter of "EKO-SP" fertilizer is   . When combined with treatments with plant protection agents, costs were not taken into account. Transportation of additional products of winter wheat grain harvest is 200 rubles for 1 ton.

Assessment of the economic efficiency of cultivation of winter wheat showed, that the level of profitability in the control variant (fertilization system of the farm) was 194%, the net cost of production of 1 kg of grain - 4.46 rubles (table 10).

The application of the "EKO-SP" agrochemical contributed to an increase in the level of profitability and a decrease in the net cost of winter wheat grain. The highest level of profitability was obtained when the "EKO-SP" fertilizer was applied for seed treatment and with spray application during the growth. Two- and threefold application of "EKO-SP" fertilizer with B concentrate increased the level of profitability compared to the control variant by 44 and 47%, respectively, while reducing the cost by 0.48 and 0.47 rubles/kg.

Table 10 - Economic assessment of the application of fertilizers under winter wheat

Variants	Productivity, t/ha	Harvest cost, rubles/ha	Production costs, rubles/ha	Net cost, rubles/kg	Conditional net income, rubles/ha	Profitability level, %
Control (farm fertilization system - background)	3.63	47553	16200	4.46	31353	194
background + seed treatment with EKO-SP (A) 0.5 l/ton	3.85	50435	16264	4.22	34235	211
background + seed treatment EKO-SP (B) 0.5 l/ton	3.83	50173	16260	4.25	33973	210
background + EKO-SP (A) 0.5 l/ton + 2-fold (1 l/ha)	4.08	53448	16630	4.08	37248	230
background + EKO-SP (B) 0.5 l/ton + 2-fold (1 l/ha)	4.18	54758	16650	3.98	38558	238
background + EKO-SP (A) 0.5 l/ton + 3-fold (1 l/ha)	4.11	53841	16796	4.09	37641	232
background + EKO-SP (B) 0.5 l/ton + 3-fold (1 l/ha)	4.22	55282	16818	3.99	39082	241
background + EKO-SP (A) 2-fold (1 l/ha)	4.05	53055	16604	4.10	36855	228
background + EKO-SP (B) 2-fold (1 l/ha)	4.04	52924	16602	4.11	36724	227
background + EKO-SP (A) 3-fold (1 l/ha)	4.06	53186	16766	4.13	36986	228
background + EKO-SP (B) 3-fold (1 l/ha)	4.16	54496	16786	4.04	38296	236

CONCLUSION

Due to the large lack of precipitation during the agricultural year when cultivating winter wheat, the conditions for soil availability with moisture were unfavorable during the entire growth of winter wheat.

The treatment of winter wheat seeds before sowing with "EKO-SP" fertilizer, based on humic substances, with A and B concentration contributed to an increase in crop productivity almost equally - by 0.20-0.22 t/ha or 5.4-6.1%.

Twofold treatment of winter wheat plants at a dose of 1 l/ha with "EKO-SP" agrochemical with A and B concentration against the background of seed treatment with organomineral fertilizer increased the productivity of winter wheat grain compared to the control variant by 0.45-0.55 t/ha or by 12.3-15%, and compared to the variants, where only seed treatment was carried out - by 0.23-0.25 t/ha or 6.2-9.6%.

Two- and threefold treatment of winter wheat plants during the growth contributed to almost the same increase in grain productivity compared to the control variant by 0.41-0.53 t/ha. The maximum was reached on the variant with the application of agrochemical with B concentration threefold during the growth.

In all variants of the experiment, the product class of grain corresponded to 4. The application of "EKO-SP" fertilizer for seed treatment and with spray method during the growth contributed to a mathematically valid increase in the gluten content in all variants of the experiment.

The application of the "EKO-SP" agrochemical contributed to an increase in the level of profitability and a decrease in the net cost of winter wheat grain. The highest level of profitability was obtained when the "EKO-SP" fertilizer was applied for seed treatment and with spray application during the growth. Two- and threefold application of "EKO-SP" fertilizer with B concentrate increased the level of profitability compared to the control variant by 44 and 47%, respectively, while reducing the cost by 0.48 and 0.47 rubles/kg.

RECOMMENDATIONS FOR PRODUCTION

In order to increase the grain productivity of winter wheat on ordinary medium-deep chernozem in the conditions of the Aksai district of the Rostov region, it is advisable to use "EKO-SP" fertilizer, based on humic substances, with B concentrate at a dose of 0.5 l/ton of seeds and at a dose of 1 l/ha by the spray method in the phase of spring tillering, stem elongation and flowering (earing) during the growth.

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Annex

Results of dispersion analysis of grain productivity of winter wheat in 2020, t/ha

Correction factor	709.85			Fact	Ftheor
General variation	1.48	43			
Variation of replications	0.01	3			
Variation of variants	1.26	10	0.13	18.45	2.12
Residual variation	0.21	30	0.01		
		LSD_{05}	0.12		

Results of dispersion analysis of protein content in winter wheat grain in 2020, %

Correction factor	7073.92			Fact	Ftheor
General variation	1.99	43			
Variation of replications	0.09	3			
Variation of variants	1.17	10	0.12	4.86	2.12
Residual variation	0.72	30	0.02		
		LSD_{05}	0.22		

Results of dispersion analysis of gluten content in winter wheat grain in 2020, %

Correction factor	19144.47			Fact	Ftheor
General variation	38.57	43			
Variation of replications	0.09	2			
Variation of variants	37.20	10	3.72	90.58	2.12
Residual variation	1.27	31	0.04		
		LSD_{05}	0.36		