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Complex of agrotechnical methods for different varieties of winter wheat

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Abstract. Increasing grain production and improving its quality are of great importance for our country. A special role is given to winter wheat as a highly productive and valuable food crop, which occupies about 2 million hectares in the Central Black Earth Region. Winter wheat also occupies significant areas in Belgorod region, which, according to agroclimatic zoning, is included in the zone of unstable moisture. Under these conditions, the development and opening up resource-saving adaptive technologies for the cultivation of crops, in particular winter wheat, as the most important grain crop, which would be assessed not only by productivity, but also by the degree of anthropogenic load on ecological systems, are of particular importance. The aim of the research is to change the agrophysical and biological properties of the soil, weed infestation of crops, yield and quality of different varieties of winter wheat, depending on preceding crops, new types of fertilizers and growth regulator. In this work, for the first time for the Central Black Earth Region, the complex effect of preceding crops, new types of fertilizers and growth regulator on changes in agrophysical, biological properties of soil, yield and quality of cultivated varieties of winter wheat Maiskaya Yubileinaya and Almera was studied. A complex of agrotechnical techniques for different varieties of winter wheat, identified on the basis of the research results, based on the use of optimal preceding crops, new types of fertilizers and plant growth regulators, allows the development of energy and resource-saving technologies of the cultivated crop. The expediency of using the most adaptive for the conditions of the region combination of agricultural practices for promising varieties of winter wheat is shown.

1. Introduction

The current negative state of agriculture in Russia is aggravated by the progressive degradation of agricultural land, the area of which is constantly increasing. According to the state of land resources and environmental stress, the Central Black Earth Region should be attributed to the zones of ecological disaster. In conditions of high plowing of lands, the territory of Belgorod region is subject to intensive deterioration of many properties of chernozems, the prevailing types of soils.

The accepted concept of agriculture development in Belgorod region, based on landscape principles, at a new stage requires research to improve the most important elements of technology.

The development of adaptive varieties that are resistant to various stresses has been and remains an urgent problem, especially since the set of negative factors affecting plants is expanding due to climate change. Only having information about variety productivity, adaptability and stability, you can effectively use it [1, 2]

With the introduction of intensive technologies into production, the use of complex chemization and liming of acidic soils, it became possible to obtain higher yields.

In conditions that limit the potential realization of winter wheat (unfavorable abiotic and biotic factors), it becomes necessary to study varieties with a complex of economically valuable traits and a wide reaction rate in contrasting environmental conditions, as well as adapted to various cultivation technologies [3, 4].

In FSBEI of Higher Education Belgorod GAA named after V Ya Gorin, work is underway to create new varieties of winter wheat, most fully realizing the potential in the conditions of Central Black Earth zone [3, 4].

2. Methodology

The studies were carried out from 2016 to 2020 under the conditions of selection problem laboratory field experience and industrial seed production of the Belgorod State Agrarian University named after V.Ya. Gorin. The soil cover of the site is represented by typical medium-thick medium-humus chernozem, slightly eroded, heavy loamy texture. The arable layer contained 4.1% humus, pH_{slt} - 6.2, easily hydrolyzable nitrogen 99.3 mg, mobile phosphorus 107.6 mg, and exchangeable potassium 93.5 mg / kg.

The 2x3x4 multifactorial experiment scheme includes two varieties, three winter wheat predecessors and four fertilization options.

The plots in the experiment were arranged systematically in one tier. The experiment was repeated three times. The total area of the plot is 25 m^2 (6.25x4). The accounting area of the plot is 20 m^2 (5x4). The experience is deployed in time and space.

The experiment studied three preceding crops of winter wheat:

- Summer fallow;
- Peas;
- Spring barley.

We studied two varieties of winter wheat:

Almera - originator: V N Baturin, I O Shestopalov, R E Shestopalova, Belgorod (ZAO “Krasnoyaruzhskaya Grain Company”);

Maiskaya Yubileinaya - originator: FSBEI of HPE Belgorod State Agricultural Academy named after V Ya Gorin.

Winter wheat was treated with the following treatments:

- Albite - seed treatment during sowing - (ground);
- Ground + Albite for vegetation;
- Ground + Poly-Feed for vegetation;
- Ground + Albite together with Poly-Feed for vegetation.

The weather conditions varied from excessive moisture in 2018, the hydrothermal coefficient (HTC 1.44) to severely arid in 2019 (HTC 0.59), and the average HTC 1.16 over three years.

3. Results

The study of soil moisture reserves, its amount necessary for planned harvest formation, remains an important task in the conditions of Belgorod region southwestern part. In our zone of unstable moisture content, the limiting factor of plant productivity is the content of available moisture in the soil. Thus, the ways to optimize the water regime in the cultivation of winter wheat are of great scientific and industrial importance [1, 5, 6].

Analysis of soil moisture before sowing on average for 2016-2018 showed that according to preceding crops fallow in the soil layer 0-30 cm and in the meter layer it was the same and amounted to

18.03 and 18.74%. As for preceding crops of peas and barley, it is lower, so in the 0-30 cm layer by 4.67 and 4.13% and by 3.5 and 2.76% than in the meter layer. Soil moisture in the tillering period of winter wheat showed that the difference between preceding crops and varieties is not significant and moisture in the arable layer was at the level of soil moisture in a meter layer. In the 0-30 cm soil layer, it was 19.29, 18.31 and 19.79% for the Maiskaya Yubileinaya variety and for the Almera variety 18.91, 19.80 and 19.61% for preceding crops of fallow, peas and barley, respectively. In a meter layer of soil for the Maiskaya Yubileinaya variety - 19.07, 18.46 and 19.84%, for the Almera variety - 19.54, 19.67 and 20.18% for preceding crops of fallow, peas and barley, respectively. By the time of harvesting, the moisture content decreased approximately 1.5 times and there were no significant differences between varieties and preceding crops. In the arable soil layer of 0-30 cm, it was 12.70, 13.10 and 13.01% for the Maiskaya Yubileinaya variety and for the Almera variety 12.44, 11.85 and 11.72% for preceding crops of fallow, peas and barley, respectively. In a meter layer of soil for the Maiskaya Yubileinaya variety - 14.18, 13.13 and 13.73%, for the Almera variety - 13.52, 13.06 and 13.41%.

One of the reasons for soil degradation in modern conditions is its compaction as a result of the passage of agricultural machines during the cultivation of crops. Preceding crops influences chosen indicator [7-9].

Soil density was determined by the cutting ring method in layers of 0-10 cm, 10-20 cm, 20-30 cm, in four replicates at the same time as the determination of its moisture content for all options for preceding crops and for 2 options for fertilizers: ground and ground + Poly-Feed for vegetation.

Analysis of soil compaction degree before sowing on average for 2016-2018 showed that according to the preceding crops fallow in the soil layer (0-10 and 10-20 cm), the soil is moderately compacted and amounted to 1.11 and 1.19 g / cm^3. According to preceding crops peas and barley in the 0-10 cm soil layer are loose - 1.08 and 1.07 g / cm^3, in the 10-20 cm layer according to preceding crops peas are moderately compacted -1.16 g / cm^3, according to preceding crops barley is dense – 1.22 g / cm^3. With depth, the density of the soil increases by 0.06-0.21 g / cm^3 (dense soil is 1.27 and 1.28 g / cm^3 according to preceding crops of fallow and peas, barley, respectively). On average, in the layer 0-30 cm - 1.19 g / cm^3 for preceding crops of fallow and barley and 1.18 g / cm^3 for preceding crops of peas, which is characterized as a medium-dense soil.

By the tillering period and harvesting of winter wheat on average for 2017-2019 soil compaction occurs. Analysis of soil compaction degree during the tillering period of winter wheat variety Maiskaya Yubileinaya showed that in the soil layer (0-10 cm) the soil is moderately compacted and amounted to 1.11, 1.10 and 1.15 g / cm^3 according to preceding crops of fallow, peas and barley respectively. In soil layers 10-20 and 20-30 cm, it increases by 0.18-0.27 g / cm^3 (compacted to very dense, 1.33 - 1.37 g / cm^3). On average, in the soil layer 0-30 cm - 1.27 g / cm^3 for preceding crops of fallow and 1.28 g / cm^3 for preceding crops of peas and barley, which is characterized as a dense soil. The degree of soil compaction during the tillering period of winter wheat variety Almera showed that in the soil layer (0-10 cm) the soil is moderately compacted and amounted to 1.14, 1.12 g / cm^3 for preceding crops of fallow and barley and loose – 1.08 g / cm^3 for peas, in soil layers 10-20 and 20-30 cm, it increases by 0.18-0.33 g / cm^3 (compacted to a very dense, 1.33 - 1.41 g / cm^3). On average, in the 0-30 cm soil layer, the density was 1.26 g / cm^3 for preceding crops of fallow, 1.28 g / cm^3 for preceding crops of peas and 1.29 for barley, which is characterized as a dense soil.

Analysis of soil compaction degree for the period of harvesting winter wheat variety Maiskaya Yubileinaya showed that in the soil layer (0-10 cm) the soil is moderately compacted and amounted to 1.17, 1.16 and 1.12 g / cm^3 according to preceding crops of fallow, peas and barley, respectively. In soil layers 10-20 and 20-30 cm, it increases by 0.08-0.19 g / cm^3 (compacted to dense fallow according to preceding crops - 1.25, 1.27 g / cm^3 and very dense, 1.30 - 1.31 g / cm^3 for peas and barley preceding crops). On average, in the soil layer 0-30 cm - 1.23 g / cm^3 for preceding crops of fallow and barley and 1.24 g / cm^3 for preceding crops of peas, which is characterized as a medium dense soil.

Soil compaction degree for the period of harvesting winter wheat variety Almera showed that in the soil layer (0-10 cm) the soil is moderately compacted and amounted to 1.18, 1.12 and 1.11 g / cm^3 according to preceding crops of fallow, peas and barley, respectively, in soil layers 10-20 and 20-30 cm, it increases by 0.05-0.19 g / cm^3 (compacted to dense 1.26 and 1.27 g / cm3 for fallow and barley and very dense - 1.31 g / cm^3 for peas). On average, in the 0-30 cm soil layer, the density was 1.23 g / cm^3 for fallow preceding crops, 1.24 g / cm^3 for peas and 1.20 for barley, which is characterized as medium-dense soil.

The efficiency of a crop cultivation technology depends on how efficiently it uses the available moisture. This is especially true for our zone of unstable moisture, where moisture acts as a limiting factor in the yield [5, 6].

When analyzing productive moisture (table 1), the classification developed by A F Vadyunina and Z A Korchagina (1986).

Analysis of productive moisture reserves before sowing on average for 2017-2019 showed that in the soil layer of 0-30 cm, they were characterized as unsatisfactory for all preceding crops and amounted to 18.9, 10.1 and 11.6 mm for fallow, peas and barley, respectively. In a meter layer for fallow, this indicator was characterized as satisfactory - 112.6 mm, according to preceding crops of peas and barley, the moisture reserves were 36.4 and 34.4 mm lower and were characterized as poor.

Table 1. Influence of winter wheat preceding crops on the reserves of productive moisture in the soil, mm (on average for 2017-2019).

Preceding crops	Soil layers, cm	Before sowing	Maiskaya yubileinaya		Almera	
			Tillering period	Period of harvesting	Tillering period	Period of harvesting
Fallow	0-30	18.86	33.74	9.09	32.19	9.27
	0-100	112.58	137.98	47.57	135.46	48.58
Peas	0-30	10.08	30.11	9.84	35.35	7.08
	0-100	76.24	128.10	47.98	144.16	46.42
Barley	0-30	11.60	36.60	9.41	35.44	5.96
	0-100	78.24	141.30	55.60	150.04	48.23

The reserves of productive moisture in the tillering phase of winter wheat on average for 2017-2019 in the soil layer of 0-30 cm for both varieties and for all preceding crops were characterized as satisfactory and amounted to 33.7, 30.1, 36.6 mm for the Maiskaya Yubileinaya variety. for preceding crops of fallow, peas and barley, respectively, and for the Almera variety, for preceding crops of fallow is 32.2 mm and 35.4 mm for preceding crops of peas and barley.

In the meter layer of the soil, the reserves of productive moisture for the Maiskaya Yubileinaya variety according to preceding crops fallow and barley were characterized as good - 138.0 and 141.3 mm for peas, satisfactory - 128.1 mm. For the Almera variety, for all its preceding crops, the reserves of productive moisture were characterized as good and amounted to 135.5, 144.2 and 150.0 mm for fallow, peas and barley, respectively.

By the time of harvesting, the moisture reserves decreased by 3-4 times compared to the tillering phase. So, productive moisture reserves in the soil layer 0-30 cm for all preceding crops were characterized as unsatisfactory and amounted to 9.1, 9.8, 9.4 mm for the Maiskaya Yubileynaya variety, and 9.3, 7.1, 6.0 mm for the variety. the Almera variety, according to preceding crops of fallow, peas and barley, respectively. In the meter layer, they were characterized as very poor - 47.6, 48.0 and 55.6 mm for the Maiskaya Yubileinaya variety and 48.6, 46.4 and 48.2 mm for the Almera variety according to preceding crops of fallow, peas and barley, respectively.

Successful ecological farming requires high biological activity of the soil. Only then the organic matter entering the soil can be really used. The main way to increase the productivity of agriculture is to increase soil fertility.

To assess the activity of soil biota, the indicator "biological activity of the soil" is used. Under the biological activity is understood, in some cases, the total biogenicity of the soil, determined, as a rule, by counting the total number of soil microorganisms, and the analysis of the decomposition of linseed by microorganisms is also used as an indicator of biological activity.

The cellulose activity of the soil was determined by the "application" method by the decomposition of linen in it according to E N Mishustin.

Cellulose-breaking capacity of soil microorganisms in winter wheat crops on average for 2017-2019 in the soil layer 0-30 cm, according to all preceding crops, it was characterized as very low. The use of a complex fertilizer containing the microelements "Poly-Feed" by the fallow precursor led to an insignificant increase of 0.1%, by the peas and barley preceding crops the activity of cellulose-destroying microflora decreased by 1.8 and 0.9% relative to the control. The greatest biological activity of the soil in Almera crops is according to preceding crops, the least according to preceding crops is barley. In the crops of Maiskaya Yubileinaya on the control, the highest activity was observed for preceding crops of peas, when Poly-Feed was used for preceding crops of fallow. In the crops of winter wheat cultivar Almera, the activity of microorganisms destroying cellulose was 4.5% on the control of the preceding crops of fallow, the activity of the preceding crops of peas was higher by 0.4%, and for barley it was 0.9% lower than that of preceding crops of the fallow. and by 1.3% than the pea preceding crops. The use of Poly-Feed led to an increase in the biological activity of the soil for all precursors by 1.1% for the preceding crops fallow and by 0.8% for preceding crops of peas and barley.

One of the important reasons for the adverse effect on the reduced yield and unsatisfactory growth of wheat is the toxicity of the soil environment. It was found that long-term cultivation of plants of the same species in the same place leads to the accumulation of phytotoxic substances in the soil. To identify them, it is required to determine the presence of water-soluble substances - colins, since they are precisely the ones who are able to move in soil conditions.

In our studies, an increase in soil toxicity can be associated with the use of mineral fertilizers and chemical plant protection products as a result of agricultural activities.

We analyzed the toxicity of the soil selected according to the variants of the experiment with preceding crops and varieties. The substratum with wetted water was taken as a comparison option. Soils should be considered toxic if they reduce seed germination or inhibit seedling growth by at least 20-30% soil toxicity was determined using a plant test according to the method used at the Department of Soil Biology, Moscow State University.

The results obtained for the control variant were taken as 100% and the experimental variants were compared with them. 25 seeds were analyzed: 25 emerged, the average length of seedlings was 12.1 cm, the average length of the roots was 6.7 cm.

The highest soil toxicity was observed in Maiskaya Yubileinaya variety after the preceding crops barley (30.8%) in the Almera variety after the pea preceding crops (29.2%), and lower after the fallow in both varieties (14.8-17.2%). The cultivars did not have a significant effect on soil toxicity.

According to the results of our studies, the length of seedlings and roots of a winter wheat plant in all variants of the experiment was inferior to the control variant.

More favorable effect on the length of seedlings was exerted by preceding crops peas, regardless of the variety, 46.3 - 58.7%. The shortest seedling length was noted after the barley variety Almera, the largest after the pea variety Maiskaya Yubileinaya. The same tendency was noted when taking into account the length of the roots: the largest peas according to preceding crops were 29.9-41.8%. The shortest root length was noted after barley, the Almera variety, and the largest after peas.

Weed damage is felt at any stage of wheat growth. However, crop yields fall most of all due to the limitation of the number of shoots and the size of ears. Weeds compete with wheat for water, mineral nutrients and sunlight. The situation is aggravated if any of the important factors is in short supply.

The weed infestation of wheat crops was taken into account in the phase of tillering of wheat and before harvesting. Weeds were counted by superimposing four counting plots of 0.25 m^2 in equidistant places along the diagonal of the plot in two non-adjacent repetitions.

Preceding crops has a significant impact on the nature of the weed infestation of crops of the field. The system of soil treatment for sowing wheat depends on this (table 2).

Table 2. Influence of predecessors on weed infestation of winter wheat crops, 2017-2019.

Preceding crops	Number of weed plants, pcs/m^2			
	Maiskaya Yubileinaya		Almera	
	Tillering period	Period of harvesting	Tillering period	Period of harvesting
Fallow	49	72	65	89
Peas	50	111	70	107
Barley	86	111	79	120
Hcp$_{05}$	2	4	2	4

The greatest weed infestation of crops both in the tillering phase of winter wheat and before harvesting was noted for preceding crops barley, the smallest for the preceding crops fallow. So, during the tillering period the difference was 37 pcs / m^2 and 14 pcs / m^2, during the harvesting 39 pcs / m^2 and 31 pcs / m^2 for the May Yubileynaya and Almera varieties, respectively.

The result of any research is the result obtained in the form of an increase in crop yield or an improvement in the quality of crop products. The use of fertilizers is the main measure that ensures high yields of grain crops with timely and high-quality implementation of other agrotechnical methods. The balanced use of mineral, organic fertilizers, calcium-containing compounds will improve the technology of winter wheat cultivation in relation to specific soil and climatic conditions, significantly increase the grain yield of this crop and improve product quality (table 3).

Table 3. Influence of preceding crops and fertilizers on the yield of winter wheat, on average for 2017-2019.

Variants of experiment	Maiskaya Yubileinaya			Almera		
	Preceding crops					
	Fallow	Peas	Barley	Fallow	Peas	Barley
Without fertilizers	41.4	41.4	40.0	41.6	39.0	39.0
Albite	47.5	45.1	40.7	41.9	45.0	45.0
Poly-Feed	42.7	41.3	39.7	43.7	42.4	42.4
Albite+Poly-Feed	47.9	42.8	42.5	47.5	43.5	43.5
Average on variety	44.3	42.6	39.9	43.7	43.1	43.1
HCP$_{05}$	2.3					

A significant increase in grain yield (+6.1 c / ha or 14.7%) is due to the use of Albitee in the cultivation of winter wheat of the Maiskaya Yubileynaya variety in fallow. To a lesser extent, there was a tendency to an increase in yield when placing on peas (+3.7 c / ha or 8.9%). With the use of the treatment, the Almera variety showed a clearly pronounced tendency to an increase in the yield of peas preceding crops (+6.0 c / ha or 15.3%). To a lesser extent, there was a tendency to an increase in yield when placing on barley (+4.3 c / ha or 10.7%).

A noticeable effect from the use of Poly-Feed was observed for fallow and peas in the Almera variety (+2.1 c / ha or 5% and +3.4 or 8.7%) and, when combined with Albite, for all preceding crops (+5.9, 4.5 and 4.4 c / ha or 14.2, 11.5 and 11.0% for a pair of peas and barley, respectively). Poly-Feed showed efficiency in relation to preceding crops of fallow in the Maiskaya Yubileinaya variety (+1.3 c / ha or 3.4%) and in combination with Albite for all preceding crops (+6.5, 1.4 and 2.5 c / ha or 15, 7, 3.4 and 6.2%). For a couple of peas and barley, respectively. Determination of the quality of wheat grain was carried out by a laboratory method (table 4).

Table 4. Influence of predecessors and fertilizers on the quality of winter wheat variety Maiskaya Yubileinaya (2017-2019).

Preceding crops	Variants of experiment	Maiskaya Yubileinaya				Almera			
		Crude proteine, %	vegetable gelatine, %	GDI, un.	Quality group	Crude proteine, %	vegetable gelatine, %	GDI, un.	Quality group
Fallow	Control	15.10	27.7	80.8	II	14.11	28.87	75.1	I
	Albite	14.63	29.4	77.9	I	14.45	29.19	80.6	II
	Poly-Feed	14.81	29.8	84.3	II	15.27	28.47	80.1	II
	Albite+Poly-Feed	14.63	29.9	81.8	II	15.05	23.97	78.0	I
Peas	Control	13.76	26.05	85.5	II	13.19	24.75	85.3	II
	Albite	13.48	25.79	82.3	II	13.14	24.65	85.2	II
	Poly-Feed	14.09	26.35	85.7	II	13.53	25.80	90.5	II
	Albite+Poly-Feed	13.51	25.70	81.7	II	13.68	26.80	88.2	II
Barley	Control	14.08	26.05	81.8	II	12.99	23.00	75.8	I
	Albite	13.06	24.95	85.8	II	11.58	22.25	73.8	I
	Poly-Feed	13.26	25.15	82.1	II	11.81	22.90	73.6	I
	Albite+Poly-Feed	12.87	24.85	79.7	I	12.28	20.90	73.4	I

According to the results of a study of the quality and chemical composition of winter wheat grain of the Maiskaya Yubileinaya variety, it was revealed that the use of the Albite treatment led to a decrease in the protein content in the grain, respectively, for fallow, peas and barley by 0.47, 0.28 and 1.02%. At the same time, the gluten content for peas and barley decreased by 0.26 and 1.1%. GDI remained at the control level (group II is satisfactorily weak), and in a pair it increased by 1.7, and GDI increased to good group I. At the same time, there was a decrease in the nitrogen content by 0.8, 0.5 and 0.8%, phosphorus by 0.009, 0.042 and 0.023% for preceding crops of fallow, peas and barley, respectively, and potassium by 0.026 and 0.039% for preceding crops of peas and barley, and for a couple, an increase of 0.012%.

The use of the Poly-Feed treatment on winter wheat of the Maiskaya Yubileynaya variety led to a decrease in the protein content in the grain in pairs by 0.29%, but to an increase in the gluten content by 2.1%, the GDI quality group remains at the control level. Group II is satisfactorily weak. For peas, the protein content increased by 0.33% and the gluten content by 0.30%, the GDI quality group remains satisfactorily weak as in control II. For barley, the protein content and gluten content decreased by 0.82 and 0.9%, but the GDI remains at the level of control II, satisfactorily weak. The influence of Poly-Feed on the content of nutrients in the grain of winter wheat is different for different preceding crops. For fallow, there was a decrease in the content of nitrogen and potassium by 0.05 and 0.002%, but an increase in phosphorus by 0.004%. For peas, an increase in nitrogen by 0.06%, but to a decrease in phosphorus by 0.041% and potassium by 0.024%. For barley, the nitrogen content decreased by 0.04%, phosphorus by 0.032% and potassium by 0.025%.

The combined use of Albite and Poly-Feed treatments on winter wheat of the Maiskaya Yubileynaya variety resulted in a decrease in the protein content in grain for fallow, peas and barley, respectively, by 0.47, 0.25 and 1.21%. At the same time, the gluten content decreased for peas and barley by 0.35 and 1.2%, but increased for fallow by 2.2%. At the same time, there was a decrease in the content of nitrogen (N) by 0.08, 0.04 and 0.11% and phosphorus by 0.023, 0.035, 0.046% for fallow, peas and barley, respectively. A decrease in potassium was noted for preceding crops of fallow and peas by 0.015 and 0.022%, but an increase in preceding crops for barley by 0.041%

The gluten deformation index (GDI) corresponded to the control variant for the precursors of fallow and peas (group II was satisfactorily weak) and increased to group I with good barley in terms of the predecessor. The use of the Albite treatment on winter wheat of the Almera variety led to a decrease in the protein content in grain for peas and barley by 0.05 and 1.41%. At the same time, the gluten content in peas and barley also decreased by 0.10 and 0.75% GDI remained at the control level (group II is satisfactorily weak for peas and group I is good for barley). In the case of fallow, both the protein and gluten content increased by 0.34 and 0.32%, but the GDI decreased to group II, which was satisfactorily weak. The influence of Albite on the content of nutrients in the grain of winter wheat is different for different preceding crops. For fallow, there was an increase in the content of nitrogen and phosphorus by 0.06 and 0.004%, but a decrease in potassium by 0.009%. For peas, the nitrogen content does not change and is 2.29%, the content of phosphorus and potassium decreased by%. For barley, the content of nitrogen and phosphorus decreased by 0.24 and 0.002%, while the content of potassium increased by 0.039%.

The use of the Poly-Feed treatment on winter wheat of the Almera cultivar led to an increase in the protein content in the grain in fallow by 1.16%, but to a decrease in the gluten content by 0.4% and to a decrease in the GDI quality group to group II satisfactorily weak. For peas, the protein content increased by 0.34% and the gluten content by 1.05%, the GDI quality group remains satisfactorily weak as in control II. For barley, the protein content and gluten content decreased by 1.18 and 0.10%, but the GDI remains at the level of control, group I is good. The influence of Poly-Feed on the content of nutrients in the grain of winter wheat is different for different preceding crops. For fallow and peas, there was an increase in nitrogen content by 0.20 and 0.06%, but a decrease in phosphorus by 0.024, 0.005% and potassium by 0.060, 0.051%. For barley, the nitrogen content decreased by 0.20%, and the phosphorus content and potassium increased by 0.013 and 0.055%.

The combined use of Albite and Poly-Feed treatments on winter wheat of the Almera variety caused an increase in the protein content in grain, respectively, for fallow and peas by 0.94 and 0.49% and a decrease in barley by 0.71%. At the same time, the gluten content decreased for fallow and barley by 4.90 and 2.10%, but increased for peas by 2.05%. At the same time, there was an increase in nitrogen content for fallow and peas by 0.16 and 0.09% and a decrease for barley by 0.12%, an increase in phosphorus for fallow and barley by 0.002, 0.034% and a decrease in peas by 0.022%. A decrease in the content of potassium was noted for preceding crops of fallow and peas by 0.010 and 0.058%, but an increase in preceding crops for barley by 0.035%.

The gluten deformation index (GDI) corresponded to the control variant for preceding crops of fallow and barley (group I, good), for peas (group II, satisfactory weak).

4. Conclusion

Before sowing, on average for 2016-2018 in the arable soil layer (0-30cm), the soil density is characterized as an average density of 1.18-1.19 g / cm^3 in the tillering phase of winter wheat, it compresses to a dense (1.26-1, 29 g / cm^3) for harvesting, the density decreases to medium density (1.20 -1.24 g / cm^3).

The reserves of productive moisture before sowing in the topsoil were characterized as unsatisfactory (<20 mm) in the tillering phase of winter wheat for both varieties and for all preceding crops were characterized as satisfactory (30.1-36.6 mm). By the time of harvesting, the moisture reserves decreased 3-4 times compared to the tillering phase and were characterized as unsatisfactory.

In general, the cellulose-destructive capacity of microorganisms is very low for all studied variants. And for the soil layers, no clear pattern of the activity of microorganisms for the destruction of cellulose was established.

The weed infestation of winter wheat crops at the time of tillering for preceding crops of peas and barley was 20-70% higher than for preceding crops fallow, during the harvesting period the trend of weed infestation remained and for the same preceding crops the increase was 20-35%.

The use of fertilizers has had an ambiguous effect on the yield of winter wheat. The Albite treatment turned out to be more effective in the cultivation of winter wheat of the Maiskaya Yubileinaya variety in fallow, and the Almera varieties for peas, Poly-Feed - for peas in the Almera variety. Combination of Poly-Feed with Albite is more effective in fallow for both varieties.

The gluten deformation index (GDI) of winter wheat grain was in the range from I group good to II group satisfactorily weak. The grain of the Maiskaya Yubileynaya variety belonged to group I (IDK) when using the treatment Albite for preceding crops of fallow and Albite + Poly-Feed for preceding crops of barley. Grain of the Almera variety belonged to group I (IDK) in all studied variants for preceding crops barley and for the variant Albite + Poly-Feed for preceding crops of fallow.

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