DOI: 10.12731/2658-6649-2025-17-3-1179 **EDN: JTMKKJ**
UDC 633.853

Original article

PRODUCTIVITY OF WINTER GRAIN CROPS VARIETIES AND THEIR CULTIVATION EFFICIENCY DEPENDING ON THE USE OF AGROCHEMICALS IN THE NON-BLACK EARTH REGION CONDITIONS

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Abstract

Background. Considering that winter wheat and rye are among the important and main agricultural crops in the region, which are grown for food and feed purposes, the task was to increase its yield and grain quality, as well as to study the possibility of increasing the survival of crops after wintering. One of the ways to increase the survival of plants for the spring period and for harvesting in general is the use of various organomineral fertilizers in agrocenoses. Such a preparation can be agrochemical Arksoil, KKR in various doses, which is used as seed treatment before sowing and when spraying during the growing season of the crop. With the advent of new, promising varieties of winter wheat and rye, which require agroecological testing in conditions of a specific terrain in combination with organomineral fertilizers, it becomes possible to increase the productivity of winter grain crops, and this was the subject of these scientific experiments.

Materials and methods. Research methods and methodology were based on the generalization of scientific sources of domestic and foreign authors, conducting laboratory and field studies, phenological observations, records, according to recommendations and generally accepted methods, using correlation and statistical analysis of the obtained experimental data. Microsoft Office Excel 10 was used for statistical work.

Results. In conditions of the Non-Black Earth Region in 2021-2023, the highest yield level in experimental variants was shown by winter wheat variety Grom. In the variant without treatment, the average yield of winter wheat of Grom variety was 43.3 dt/ha, in variants with the use of organomineral fertilizer with growth-stimulating activity Arksoil KKR at dosages of 80 ml/ha and 120 ml/ha, respectively, it was 46.0 dt/ha and 47.7 dt/ha. Treatment with an agrochemical in the fall during the tillering period affected the survival rate by spring, increasing this indicator by 5.6-19.8% to 86.0-79.5%. On average, the maximum survival of plants was revealed in variants Grom + Arksoil KKR,

120 ml/ha (79.5%), Ethana + Arksoil KKR, 120 ml/ha (74.6%), Grom + Arksoil KKR, 80 ml/ha (75.0%). Relatively low overwintering of winter wheat plants was noted for varieties Lipetskaya Zvezda and Torrild. In the experiment, the most effective fertilizer in increasing the productivity of winter rye was Folirus Active, the variants of which had the maximum yield recorded among the hybrids. Among the studied winter rye hybrids, higher yields were shown by plots of ZU Forzetti hybrid, from 32.6 to 41.4 dt/ha; low productivity was revealed for Eterno hybrid, from 28.1 to 32.6 dt/ha.

Conclusion. The use of organomineral fertilizer Arksoil KKR on all studied varieties provided a significant increase in the yield, as well as an increase in the economic efficiency of winter wheat grain production. The maximum economic effect was demonstrated by the technology of growing winter wheat of Grom variety with the introduction of agrochemical Arksoil KKR at a dosage of 120 ml/ha. In the studies conducted in agrocenoses of winter rye, the efficiency of all used organomineral fertilizers was observed. The maximum efficiency was revealed in the variant of growing winter rye ZU Forzetti + Folirus Active (41.4 dt/ha), Eterno + Folirus Active (32.6 dt/ha), Ravo + Folirus Active (35.7 dt/ha). The role of the studied organomineral fertilizers in experiments with winter wheat and rye in conditions of the Non-Black Earth Region was proven.

Keywords: winter wheat; winter rye; variety; Non-Black Earth Region; organomineral fertilizer; yield; productivity; economic efficiency

For citation. Vinogradov, D. V., Dedova, E. M., Shkurkina, A. S., Zubkova, T. V., & Lupova, E. I. (2025). Productivity of winter grain crops varieties and their cultivation efficiency depending on the use of agrochemicals in the non-black earth region conditions. *Siberian Journal of Life Sciences and Agriculture*, *17*(3), 268-282. https://doi.org/10.12731/2658-6649-2025-17-3-1179

Научная статья

УРОЖАЙНОСТЬ СОРТОВ ОЗИМЫХ ЗЕРНОВЫХ КУЛЬТУР И ЭФФЕКТИВНОСТЬ ИХ ВОЗДЕЛЫВАНИЯ В ЗАВИСИМОСТИ ОТ ПРИМЕНЕНИЯ АГРОХИМИКАТОВ В УСЛОВИЯХ НЕЧЕРНОЗЕМЬЯ

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Аннотация

Обоснование. Учитывая, что озимая пшеница и рожь относятся к числу важных и основных сельскохозяйственных культур в регионе, которые выра-

щиваются в продовольственных и кормовых целях, была поставлена задача повысить их урожайность и качество зерна, а также изучить возможность повышения выживаемости посевов после зимовки. Одним из способов повысить приживаемость растений к весеннему периоду и к сбору урожая в целом является применение в агроценозах различных органоминеральных удобрений. Таким препаратом может быть агрохимикат Arksoil, KKR в различных дозах, который используется в качестве обработки семян перед посевом и при опрыскивании в период вегетации культуры. С появлением новых, перспективных сортов озимой пшеницы и ржи, которые требуют агроэкологического тестирования в условиях конкретной местности в сочетании с органоминеральными удобрениями, становится возможным повысить урожайность озимых зерновых культур, что и было предметом данных научных экспериментов.

Материалы и методы. Методы и методология исследования были основаны на обобщении научных источников отечественных и зарубежных авторов, проведении лабораторных и полевых исследований, фенологических наблюдений, учетов, согласно рекомендациям и общепринятым методикам, с использованием корреляционного и статистического анализа полученных экспериментальных данных. Для статистической работы использовался Microsoft Office Excel 10.

Результаты. В условиях Нечерноземья в 2021-2023 годах самый высокий уровень урожайности в опытных вариантах показал сорт озимой пшеницы Гром. На варианте без обработки средняя урожайность озимой пшеницы сорта Гром составила 43,3 ц/га, на вариантах с применением органоминерального удобрения со стимулирующей рост активностью Arksoil KKR в дозировках 80 мл/га и 120 мл/га соответственно - 46,0 ц/га и 47,7 ц/га./га. Обработка агрохимикатом осенью в период кущения повлияла на приживаемость к весне, увеличив этот показатель на 5,6-19,8% до 86,0-79,5%. В среднем максимальная приживаемость растений была выявлена в вариантах Grom + Arksoil KKR, 120 мл/га (79,5%), Ethana + Arksoil KKR, 120 мл/га (74,6%), Grom + Arksoil KKR, 80 мл/га (75,0%). Относительно низкая перезимовка растений озимой пшеницы была отмечена у сортов Липецкая Звезда и Торрилд. В эксперименте наиболее эффективным удобрением для повышения урожайности озимой ржи был Фолирус Актив, у вариантов которого была зафиксирована максимальная урожайность среди гибридов. Среди изученных гибридов озимой ржи более высокую урожайность показали участки с гибридом ZU Forzetti - от 32,6 до 41,4 ц/га; низкая урожайность была выявлена у гибрида Eterno - от 28,1 до 32,6 ц/га.

Вывод. Применение органоминерального удобрения Arksoil KKR на всех изучаемых сортах обеспечило значительное повышение урожайности, а также повышение экономической эффективности производства зерна озимой пшени-

цы. Максимальный экономический эффект продемонстрировала технология выращивания озимой пшеницы сорта Гром с внесением агрохимиката Arksoil KKR в дозировке 120 мл/га. В исследованиях, проведенных в агроценозах озимой ржи, была отмечена эффективность всех применяемых органоминеральных удобрений. Максимальная эффективность была выявлена в варианте выращивания озимой ржи ZU Forzetti + Folirus Active (41,4 ц/га), Eterno + Folirus Active (32,6 ц/га), Ravo + Folirus Active (35,7 ц/га). Доказана роль изучаемых органоминеральных удобрений в опытах с озимой пшеницей и рожью в условиях Нечерноземья.

Ключевые слова: озимая пшеница; озимая рожь; сорт; Нечерноземье; органоминеральное удобрение; урожайность; продуктивность; экономическая эффективность

Для цитирования. Виноградов, Д.В., Дедова, Е.М., Шкуркина, А.С., Зубкова, Т.В., & Лупова, Е.И. (2025). Урожайность сортов озимых зерновых культур и эффективность их возделывания в зависимости от применения агрохимикатов в условиях Нечерноземья. *Siberian Journal of Life Sciences and Agriculture*, *17*(3), 268-282. https://doi.org/10.12731/2658-6649-2025-17-3-1179

Introduction

Winter wheat and rye are the most common grain crops for the Non-Black Earth Region. They are grown in all categories of farms and in all soil and climatic zones of the region.

According to official data from Rosstat, 155.3 thousand hectares were sown in Ryazan region in 2023, which, however, was significantly (55.6%) less than in 2022. Nevertheless, winter wheat crops in terms of the total area of agricultural crops in Ryazan region made up about 46% and more than 97% of the total area of winter crops. In general, in the Russian Federation in 2023, winter wheat crops amounted to more than 15.650 thousand hectares or 19.3% of the total sown area in all categories of farms. Unfavorable wintering conditions for the 2022/2023 season in the Non-Black Earth Region, when an ice crust was observed, affected the crop yield, where some of the crops simply died.

Winter wheat, due to its morphological and biological characteristics, showed good yield in conditions of the Non-Black Earth Region of the Russian Federation. Thus, according to the results of the 2023 harvesting campaign, the average yield of winter wheat in Ryazan region in farms of all categories amounted to 39.5 dt/ha, which was 7.8 dt/ha or 19.7% lower than the last year's level in conditions of Moscow region - 38.0 dt/ha.

Analysts noted a decrease in this indicator in 2023 compared to 2022 and in Russia as a whole by 8.1%. Nevertheless, over the past 6 years, this was the

second largest harvest of winter wheat, and experts called unfavorable weather conditions, worsening phytosanitary conditions, and the lack or poor quality of herbicide treatments as the reasons for the shortfall in 2023.

During the development process, winter wheat forms are most demanding of macronutrient reserves, such as nitrogen, potassium and phosphorus. The most significant consumption of nitrogenous substances occurs during the period of tube emergence before the wheat earing phase [1; 2; 3]. Nitrogen is responsible for the growth of the aboveground mass, the growth of the root system activates phosphorus, and potassium strengthens the plant stem [4]. For the conditions of Ryazan region, the application of nitrogen-phosphorus fertilizers must be carried out under cultivation or pre-sowing cultivation [5; 6]. The balance of nutritional elements is especially important in the initial period of growth and development of winter wheat; in its absence, all further fertilizing will be ineffective.

In recent years, the use of microbiological fertilizers and humates, which are used as foliar feeding and as seed treatment before sowing, has been greatly developed in crop cultivation technologies [7; 8; 9]. Biological fertilizers significantly increase grain yield and quality. They are cheap preparations compared to mineral fertilizers, and are relatively environmentally friendly agrochemicals [10; 11; 12]. The use of biological fertilizers is an important way to increase the yield and quality indicators of agricultural grain [13; 14; 15].

In recent years, varieties “Angelina”, “Lipetskaya Zvezda”, “From”, “Etana” and “Torid” have occupied ever larger areas in Ryazan region, demonstrating stable yields above the regional average. Thus, in 2023, Angelina variety occupied an area of more than 20 thousand hectares in Ryazan region, and Grom variety occupied more than 10 thousand hectares. Etan and Lipetskaya Zvezda varieties also proved themselves well in the region, although they are not included in the State Register of Breeding Achievements of the Central (3) Region. In the production conditions of Ryazan region, all varieties are characterized by high quality indicators and high winter hardiness, in connection with which the regional producers are interested in growing these varieties and developing elements of agricultural technologies that contribute to increasing crop yields.

Thus, determining the efficiency of biological fertilizers in winter wheat agrocenoses in conditions of the southern part of the Non-Black Earth Region is a relevant area of research, which served as the subject of these studies.

The purpose of the work was to identify the efficiency of using organomineral fertilizers on the yield of winter grain crops in conditions of the Non-Black Earth Region of Russia.

Scientific novelty. For the first time in conditions of the Non-Black Earth Region of Russia, an agroecological assessment of winter wheat varieties Angelina, Lipetskaya Zvezda, Grom, Etana, Torrild to Moskovskaya 56 standard was given, and the reaction of the crop to treatment with the organomineral fertilizer Arksoil KKR was studied at two rates of application of the preparation: 80 ml/ha and 120 ml/ha.

In conditions of the Non-Black Earth Region of Russia, studies on agroecological testing of winter wheat varieties against the background of the crop's response to treatment with organomineral fertilizer Arksoil KKR had not been previously conducted. For the first time in winter wheat agrocenoses in conditions of Ryazan region, the effect of agrochemical Arksoil KKR was studied. It was a new anti-stress preparation created on the basis of a combination of indoleacetic acid, aliphatic amino acid, aliphatic dicarboxylic amino acid and auxins.

In conditions of the Non-Black Earth Region, the efficiency of growing winter rye with treatment with agrochemicals in the complex of ZU Forzetti + Folirus Active, Eterno + Folirus Active, Ravo + Folirus Active was proved.

Materials and methods

These studies on the agroecological assessment of winter wheat and rye and treatment with agrochemicals were carried out in conditions of the Non-Black Earth Region of Russia in 2021-2023.

Two multifactorial field experiments were conducted:

Experiment 1 – Studying the effect of the agrochemical Arksoil KKR on the productivity of winter wheat varieties in conditions of Ryazan region (experimental agrotechnological station of the Federal State Budgetary Educational Institution of Higher Education Ryazan State Agricultural University, Stenkino settlement, Ryazan district, Moscow region).

Experiment 2 – Determining the productivity of winter rye hybrids depending on the treatment with agrochemicals (experimental field of the All-Russian Research Institute of Agrochemistry, Barybino settlement, Domodedovo district, Moscow region).

The agrochemical composition of the experimental dark gray forest soil in Ryazan region was as follows: humus (according to Tyurin) - 3.54-3.86%, mobile phosphorus and potassium (according to Kirsanov) - 149-157 mg/kg and 129-136 mg/kg, respectively, pH - 5.49-5.59. The agrochemical composition of the experimental sod-podzolic soil in Moscow region was as follows: humus (according to Tyurin) - 2.2-2.3%, mobile phosphorus and potassium (according to Kirsanov) - 128-132 mg/kg and 108-124 mg/kg, respectively, pH - 5.5.

Agrotechnical operations for growing winter grain crops were generally accepted for the Non-Black Earth Region.

Experiment 1. The following winter wheat varieties were used as factor A in the experiment: Moskovskaya 56 (standard), Bezostaya 100, Lipetskaya Zvezda, Tanya, Torrild, Shkola, Ethana, which were sown after peas for grain with a seeding rate of 5.1 million pcs/ha. Ammophoska was added as background nutrition at a dose of 1 dt/ha during sowing, and ammonium nitrate was applied by scattering in early spring at 35 kg s.d./ha. Variants of treatment with agrochemical Arksoil KKR at two consumption rates of 80 ml/ha and 120 ml/ha were used as factor B. Uniform spraying with Arksoil KKR was carried out in the evening, pre-adding the preparation to water with subsequent intensive mixing. Arksoil KKR was applied to winter wheat crops twice: the first time in the autumn during the tillering phase, the second time in the spring during the flag leaf phase of the crop. This agrochemical was used for experimental crops in a tank mixture with insecticide Euphoria, KS, 0.2 l/ha (lambda-cyhalothrin, 106 g/l + Thiamethoxam, 141 g/l) against a complex of pests and herbicide Shansti, VDG, 0.025 kg/ha (750 g/kg thifensulfuron-methyl) in the tillering phase of the crop. The consumption of the working tank liquid was 250-280 l/ha.

In experiment 2 with winter rye, factor A was winter rye hybrids ZU Forzetti, Ravo, Eterno. Factor B was treatment of plants during the growing season with agrochemicals Lebozol, Arksoil KKR, Folirus Aktive, Folirus Maxi, which were applied as foliar feeding twice during the crop growing season: in the early autumn period - in the tillering phase at a dose of 2 l/ha and in the spring - during the development of the flag leaf - the beginning of heading - 3 l/ha. Arksoil KKR was processed in the same phases at a dose of 0.15 l/ha. Agrochemicals were applied together with pesticides at a liquid consumption of 300 l/ha. During the growing season, insecticides Borey Neo, 0.2 l/ha; Titul KKR, 390, 0.26 l/ha and Primadonna Super, KKR, 0.7 l/ha were used.

The experiments were laid out according to the method of B.A. Dospekhov, where the plot area was 100 m^2.

Results and discussion

Analyzing the phenological data in the studies conducted in Ryazan region, we noted that the vegetation period of the studied varieties of winter wheat was 296-314 days. In general, in 2022, winter wheat ripened 8-14 days earlier (in the third decade of July) than in 2023 (the first decade of August). On average, over two years, the vegetation period of the standard variety - Moskovskaya

56 was 304 days. Varieties Grom (279 days) and Lipetskaya Zvezda (288 days) turned out to be earlier ripening in the experiment.

The variants with treatment with Arksoil KKR were characterized by a longer vegetation period, on average, 4-6 days longer than in the control variant. When treated with agrochemical Arksoil, the interphase period of the flag leaf emergence - earing - was significantly extended, as well as the ripening period in the milk ripeness phase of the grain in the crop was extended. Later ripening was noted in the variants with Arksoil KKR treatment, 120 ml/ha for varieties Angelina (8 days more than the control), Torrild and Ethana (6-7 days more).

The yield of winter wheat varieties consisted of the yield structure indicators, mainly due to the weight of 1 000 seeds, the number of seeds in an ear, as well as plant density taking into account better overwintering of plants. An increase in the overwintering of wheat was revealed in variants with treatment with Arksoil, KKR with doses of 80 ml/ha and 120 ml/ha, relative to the control. Thus, treatment with an agrochemical in the fall during the tillering period affected the survival rate by spring, increasing this indicator by 5.6-19.8% to 86.0-79.5%. On average, the maximum survival of plants was revealed in variants Grom + Arksoil KKR, 120 ml/ha (79.5%), Ethana + Arksoil KKR, 120 ml/ha (74.6%), Grom + Arksoil KKR, 80 ml/ha (75.0%). Relatively low overwintering of winter wheat plants was noted for Lipetskaya Zvezda and Torrild varieties.

In the 2022/2023 season, the worst wintering in the last ten years was noted in Ryazan region. That winter, there was a frequent change of thaws and high negative temperatures, which led to the rupture of wheat plant tissues and the death of winter grain crops. By spring, winter crops in many farms in the region were completely destroyed by the ice crust, which led to re-sowing of wheat with other spring crops. We noted the relatively good wintering of experimental crops for all varieties of winter wheat, at the same time, the 2023 harvest was lower than in 2022, which affected the average values for experimental variants (Table 1).

Table 1.

The yield of winter wheat varieties depending on the use of agrochemical Arksoil KKR, dt/ha

Variety (factor A)	Variants for using agrochemicals (factor B)		
	Without treatment	Arksoil KKR, 80 ml/ha	Arksoil KKR, 120 ml/ha
Moskovskaya 56	40.1	41.8	43.4
Angelina	41.0	43.2	44.4
Grom	43.3	46.0	47.7
Lipetskaya Zvezda	40.7	41.7	42.0

Torrild	34.2	36.3	38.6
Ethana	42.5	44.6	47.0
LSD_{05}, AB interactions: 2022 – 4.58; 2023 – 4.31. LSD_{05}, by factor A: 2022. – 4.58; 2023 – 2.49. LSD_{05}, by factor B: 2022 – 4.58; 2023 – 1.76. Sx: 2022 – 1.61; 2023 – 1.52. Sd: 2022 – 2.28; 2023 – 2.15.			

Analyzing the data in Table 1, one can draw the following conclusion: the highest yield in all three experimental variants was shown by winter wheat variety Grom. In the variant without treatment, the average yield of winter wheat of Grom variety was 43.3 dt/ha, in variants with the use of organomineral fertilizer with growth-stimulating activity Arksoil KKR at doses of 80 ml/ha and 120 ml/ha, respectively, it was 46.0 dt/ha and 47.7 dt/ha. The variety that showed the minimum yield in all three experimental variants was Torrild, which was explained by its morphological and production characteristics and agronomic traits.

In general, it can be noted that the yield of winter wheat of all studied varieties in variants with the use of organomineral fertilizer Arksoil KKR at a dosage of 120 ml/ha turned out to be higher than the variant with the use of this agrochemical at a dosage of 80 ml/ha.

An important criterion for the feasibility of a particular agrotechnical technique, an element of improving the technology of cultivating an agricultural crop, is economic efficiency, which is expressed in the growth of profits and the level of profitability of the industry.

The economic efficiency of winter wheat cultivation depending on the variety and the use of organomineral fertilizer with growth-stimulating activity Arksoil KKR at dosages of 80 ml/ha and 120 ml/ha is considered in Table 2.

Table 2.

Economic efficiency of winter wheat cultivation depending on the variety and application of organomineral fertilizer Arksoil KKR

Variety	Variant	Yield, dt/ha	Production costs, rub/ha	Cost, rub/ha	Profit from sales, rub/ha	Profitability level, %
Moskovskaya 56	Without treatment	40.1	27 123	43 308	16 185	59.7
	Arksoil KKR, 80 ml/ha	41.8	27 331	45 144	17 813	65.2
	Arksoil KKR, 120 ml/ha	43.4	27 435	46 872	19 437	70.8

Angelina	Without treatment	41.0	27 123	44 280	17 157	63.3
	Arksoil KKR, 80 ml/ha	43.2	27 331	46 656	19 325	70.7
	Arksoil KKR, 120 ml/ha	44.4	27 435	47 952	20 517	74.8
Grom	Without treatment	43.3	27 123	46 764	19 641	72.4
	Arksoil KKR, 80 ml/ha	46.0	27 331	49 680	22 349	81.8
	Arksoil KKR, 120 ml/ha	47.7	27 435	51 516	24 081	87.8
Lipetskaya Zvezda	Without treatment	40.7	27 123	43 956	16 833	62.1
	Arksoil KKR, 80 ml/ha	41.7	27 331	45 036	17 705	64.8
	Arksoil KKR, 120 ml/ha	42.0	27 435	45 360	17 925	65.3
Torrild	Without treatment	34.2	27 123	36 936	9 813	36.2
	Arksoil KKR, 80 ml/ha	36.3	27 331	39 204	11 873	43.4
	Arksoil KKR, 120 ml/ha	38.6	27 435	41 688	14 253	52.0
Ethana	Without treatment	42.5	27 123	45 900	18 777	69.2
	Arksoil KKR, 80 ml/ha	44.6	27 331	48 168	20 837	76.2
	Arksoil KKR, 120 ml/ha	47.0	27 435	50 760	23 325	85.0

The data in Table 2 showed that the use of organomineral fertilizer with growth-stimulating activity Arksoil KKR in the technology of winter wheat cultivation at doses of 80 ml/ha and 120 ml/ha on all the studied varieties led to an increase in the economic efficiency of production.

At the same time, on all varieties of winter wheat, the dosage of 120 ml/ha provided greater profitability than the dosage of 80 ml/ha. Agrochemical Arksoil KKR at a dosage of 120 ml/ha showed its best efficiency on winter wheat varieties Grom and Ethana. In the first case, it had profitability of grain production at the level of 87.8%, in the second case, at the level of 85%.

In experiment 2 with winter rye hybrids, the efficiency of using all agrochemicals in the studies was revealed (Table 3).

Table 3.

The yield of winter rye hybrids depending on the use of agrochemicals, dt/ha

Treatment variant	Yield, dt/ha		
	ZU Forzetti	Eterno	Ravo
Without treatment	32.6	28.1	28.5
Arksoil KKR	37.6	30.3	31.3
Lebozol - Complete Care	36.3	28.6	29.7
Folirus Active	41.4	32.6	35.7
Folirus Maxi	34.8	29.8	31.6
LSD_{05}, AB interactions: 2022 – 1.32; 2023 – 2.79.			

Among the studied winter rye hybrids, plots of ZU Forzetti hybrid showed higher yields, from 32.6 to 41.4 dt/ha; low productivity was revealed for Eterno hybrid, from 28.1 to 32.6 dt/ha.

The most effective fertilizer in increasing rye productivity was Folirus Aktive, on variants of which the maximum yield was recorded for hybrids: ZU Forzetti + Folirus Aktive (41.4 dt/ha), Eterno + Folirus Aktive (32.6 dt/ha), Ravo + Folirus Aktive (35.7 dt/ha). Relatively high yield indicators were revealed on variants with Arksoil KKR for all hybrids (37.6-30.3 dt/ha) and Lebozol (36.3 dt/ha for ZU Forzetti hybrid), Folirus Maxi (29.3 dt/ha for Eterno and 31.6 dt/ha for Ravo).

Growing ZU Forzetti rye hybrid showed the profitability of the technology at the level of 107.4%, Eterno hybrid had 63.3%, Ravo hybrid had 78.9%.

Conclusion

Thus, the experiments showed that of the six winter wheat varieties studied, in the Non-Black Earth Region, Grom and Ethana varieties showed the best yield results. The use of organomineral fertilizer Arksoil KKR on all the studied varieties provided not only an increase in the yield, but also an increase in the economic efficiency of grain production. The maximum economic effect was demonstrated by the technology of growing winter wheat of Grom variety with the introduction of agrochemical Arksoil KKR at a dosage of 120 ml/ha. In the studies conducted in winter rye agrocenoses, we noted the efficiency of all applied organomineral fertilizers. The maximum efficiency was revealed in the variant of growing winter rye ZU Forzetti + Folirus Active (41.4 dt/ha), Eterno + Folirus Active (32.6 dt/ha), Ravo + Folirus Active (35.7 dt/ha).

The results of the research allow to conclude that it is advisable to include various organomineral fertilizers as an element of the technologies for producing winter rye and winter wheat grain in conditions of the Non-Black Earth Region.

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ВКЛАД АВТОРОВ

Все авторы сделали эквивалентный вклад в подготовку статьи для публикации.

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Поступила 23.10.2024 Received 23.10.2024
После рецензирования 10.12.2024 Revised 10.12.2024
Принята 17.12.2024 Accepted 17.12.2024