The quality of spring wheat and barley grain under the influence of protective-stimulating preparations in the conditions of the forest-steppe zone of the Trans-Urals

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Abstract. The purpose of the research is to study the effect of the fungicide Lamador and the humic preparation Rostok on the quality of spring wheat and spring barley in the conditions of the northern forest-steppe of the Tyumen region. According to the yield, we found that presowing seeds treatment with Lamador protectant and joint treatment with Rostock contributed to an increase in yield by 0.70 t/ha of spring wheat and 0.15 t/ha of spring barley, in the option with the pre-sowing seeds treatment with Lamador protectant and Rostock preparation by 0.90 t/ha and 0.10 t/ha. The highest yield of spring wheat was noted in the third option – 4.10 t/ha, of spring barley in the second option – 3.52 t/ha. An increase in the thousand kernel weight was noted in the crops under study. The highest thousand kernel weight was observed for spring wheat and spring barley in the third option – 30.2 g and 54.3 g, respectively. The maximum protein content in the spring wheat grain was noted in the third option –13.3%, which is higher than the control option by 1.3%, for spring barley we also noted protein increase by 0.4-0.5%. Thus, the experimental application of the fungicide Lamador together with the preparation Rostok for wheat seeds treatment demonstrated a positive effect of the protectants on plants in the agro-climatic conditions of the forest-steppe zone of the Tyumen region and contributed to an increase in crop yield by 28% for spring wheat and 4% for spring barley, which proved the need for their use in the plant protection system, to increase the productivity and quality of the grain obtained.

1. Introduction
The Tyumen region is the third-largest territory in Russia, has always been one of the main regions of the country in the cultivation of grain crops, despite the harsh climatic conditions of this region. Crop rotations in the northern forest-steppe are saturated with grain crops [1], which raises the question of real productivity and obtaining a high-quality grain crops with integrated protection. Various technologies are used to improve quality indicators [2,3].

Grain quality is determined by the combination of biological, technological, and consumer properties indicating its suitability for seed and food purposes. The quality of the seed material is very important, since the seed is programmed with the crop yield potential, and good quality is one of the factors of its full realization [4].

Many authors note that one of the promising and highly effective methods that increase the yield and quality of agricultural products is the use of plant growth regulators to stimulate growth processes, as well as reduce the stress load from the use of fungicides. This is evidenced by long-term studies [5,6].
The main task of agriculture is a rapid and sustainable increase in the volume of grain and grain products production, in solving which an important role is played by the optimization of agricultural techniques aimed at increasing productivity, improving the quality of agricultural products, as well as reducing the anthropogenic load on agrocoenosis.

The purpose of the research is to study the effect of the fungicide Lamador and the humic preparation Rostok on the quality of spring wheat and spring barley in the conditions of the northern forest-steppe of the Tyumen region.

2. Materials and methods
The experiments were carried out on the experimental field of the Agrotechnological Institute of the Northern Trans-Ural State Agricultural University. The objects of the study were varieties of spring wheat Novosibirskaya 31, spring barley Biom, fungicide Lamador in the consumption rate (0.175 l/t), in a tank mixture with a growth regulator Rostok in the consumption rate (0.5 l/t).

Experimental options: 1. Control; 2. Pre-sowing seeds treatment with Lamador fungicide; 3. Pre-sowing seeds treatment with Lamador fungicide and Rostok growth regulator. Agricultural technology was generally accepted for grain crops in the forest-steppe zone. Previous crop – annual grasses. Soil – leached, low-power, medium-humus, heavy-loamy chernozem. According to the chemical composition, the soil is characterized by an average content of humus in the arable layer, an average supply of phosphorus, potassium and low – nitrogen, a slightly acidic reaction of the soil solution. According to its characteristics, the soil of the experimental site corresponds to the chernozems of the south of the Tyumen region. Sampling, accounting, and crop determination were performed according to standard methods [7]. Mathematical data processing was performed using the method of variance according to B.A. Dospekhov [8].

3. Results and discussion
The increase in the potential crop yield includes the ability of plants to use the conditions of intensification. The crop yield is shown in the diagram (Fig. 1).

![Crop yield graph](image)

**Figure 1.** The effect of preparations on the yield of spring wheat and barley, t/ha

The grain yield in the control option for the studied crops ranged from 3.20 t/ha for spring wheat to 3.37 t/ha for spring barley. To date, a large amount of experimental material has been accumulated,
indicating the nature of the effect of the fungicides and growth regulators on the productivity and quality of the grain [9]. According to the yield, we found that pre-sowing seeds treatment with Lamador protectant and joint treatment with Rostock contributed to an increase in yield by 0.70 t/ha of spring wheat and 0.15 t/ha of spring barley, in the option with the pre-sowing seeds treatment with Lamador protectant and Rostock preparation by 0.90 t/ha and 0.10 t/ha. The highest yield of spring wheat was noted in the third option – 4.10 t/ha, of spring barley in the second option – 3.52 t/ha.

Grain quality is a complex indicator that depends on various factors. The nutritional value and baking properties of grain are determined primarily by the protein content, the ratio of its fractions, and the amino acid composition [10,11].

Thousand kernel weight characterizes the density and plumpness of the grain and determines the nutrients supply in the grain. The milling properties of the grain depend on the thousand kernel weight. An increase in the thousand kernel weight was noted in all experimental options under study in comparison with the control option. The highest thousand kernel weight was observed for spring wheat and spring barley in the third option with the use of the Lamador protectant and the Rostok humic preparation – 40.2 g and 54.3 g, respectively (Fig. 2).

![Figure 2. Effect of preparations on the thousand kernel weight of spring wheat and barley, g](image)

The main task in grain crops cultivation for food purposes is to increase the protein content of the grain. In the Northern Trans-Urals, the range of protein variation in grain crops ranged from 12.1 to 24.3% in recent years. The results of the studies show that the maximum protein content in the spring wheat grain was noted in the third option – 13.3%, which is higher than the control option by 1.3%, for spring barley we also noted protein increase by 0.4-0.5% in comparison with the control in the second option with the use of the protectant Lamador and in the third option with the joint use of the studied preparations (Fig. 3).

One of the requirements imposed by GOST to the quality of spring wheat is the grain bulk density (natural weight). The grain bulk density of spring soft wheat should not be less than 750 g/l for grain of I and II classes. The natural weight of the grain depends on the grain density, the content of its most valuable part – the endosperm. The higher the grain bulk density, the higher the endosperm content, the higher the yield of high-grade flour [12].

Among the grain quality indicators, its natural weight is of great importance, the value of which determines the yield of flour, cereals and other products obtained during grain processing [5]. In the control option, the natural weight of spring wheat grain was noted at the level of 766 g/l. In all the studied options, the grain natural weight exceeded the control option by 8-30 g/l (Fig. 4).
Figure 3. The effect of preparations on the protein content in the grain of spring wheat and barley, %

Figure 4. Effect of preparations on the natural weight of spring wheat and barley grain, g/l

For spring barley, the same trend was observed in the studied experimental options and ranged from 650 g/l to 656 g/l, which is higher than the control option by 4-6 g/l.

4. Conclusion
Thus, the experimental application of the fungicide Lamador together with the preparation Rostok for wheat seeds treatment demonstrated a positive effect on plants in the agro-climatic conditions of the forest-steppe zone of the Tyumen region and contributed to an increase in crop yield by 28% for spring wheat and 4% for spring barley, which proved the need for their use in the plant protection system, to increase the productivity and quality of the grain obtained. According to the results obtained, in terms of the performed technologies, spring wheat can be attributed to the grade of valuable wheat.
References
[1] Moiseev A N, Fedotkin V A, Moiseeva K V 2018 Productivity of crop rotations and fertility of leached chernozem in the Northern forest-steppe of the Tyumen region: monograph (Tyumen) 176 p
[2] Kazak A A, Loginov Yu P 2020 Yield and baking quality of spring wheat varieties of Siberian breeding in the northern forest-steppe of the Tyumen region Bulletin of the Buryat State Agricultural Academy Named After V.R. Filippov 2(59) 6-14
[3] Polyakov M V, Belkina R I, Shulepova O V 2020 Spring wheat and barley in the Northern Trans-Urals: varieties, elements of technology, yield and grain quality (Tyumen: Northern Trans-Ural State Agricultural University) 148 p
[4] Shulepova O V, Belkina R I 2017 Grain quality of barley varieties in the conditions of Northern Trans-Urals Bulletin of the Krasnoyarsk State Agrarian University 10(133) 9-14
[5] Belkina R I, Akhtarieva T S, Kucherov D I, Maslenko M I, Savchenko A A, Moiseeva K V 2017 Productivity and grain quality of spring soft wheat in the Northern Trans-Urals (Tyumen) 188 p
[6] Grekhova I V, Matveeva N V 1997 Reaction of spring wheat to the application of regulators and microfertilizers in seed dressings Agrarian Bulletin of the Urals 1(119) 6-8
[7] 1997 Method of state variety testing of agricultural crops (Moscow) 216 p
[8] Dospekhov B A 1985 Methodology of field experience (Moscow: Agropromizdat) 351 p
[9] Fedotova O V, Grekhova I V 2016 Efficiency of application of humic substances on cereal crops in the Northern Trans-Urals Living and bio-inert system 18 6
[10] Kostin V I 1998 Physiological and biochemical processes that determining wheat quality Information bulletin of JSC “Prodovolstvie” (Ulyanovsk) 4 5-6
[11] Karpova G A 2009 Optimization of the production process of agrophytocenoses of spring wheat and barley when using growth regulators and bacterial preparations, Abstract of Doctoral Dissertation (Penza) 51 p
[12] Abduazimov A M 2017 Technological qualities of grain of spring wheat varieties in the northern conditions of the Republic of Uzbekistan Bulletin of Michurinsk State Agrarian University 3 67-72