

Mid-season spring wheat variety Kuraginskaya 2

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Abstract. The biological features and economically useful traits of the spring soft wheat variety Kuraginskaya 2 were studied. The studies were carried out in 2010-2021 on experimental fields and in laboratories of the Krasnoyarsk Research Institute of Agriculture. Sowing was carried out on a fallow predecessor with a rate of 500 germinating grains per 1 m². The soil of the experimental site is leached chernozem. Variety Kuraginskaya 2 was created by the method of intraspecific hybridization and subsequent selection from the population K-817xKazakhstanskaya 10 of Lutescens variety. The variety is mid-season, the duration of the growing season is at the level of standards. In competitive variety testing the average grain yield was 27.7 centner/ha. The advantage over the Omskaya 33 standard is 3.8 centner/ha. Kuraginskaya 2 surpasses Omskaya 33 in terms of 1000-grain weight and ear grain content. The maximum yield of 71.0 centner/ha was obtained in 2019 at the Uyar variety plot. The variety has high ecological plasticity, resistant to lodging and root rot. Grain quality corresponds to a good filler.

1 Introduction

Wheat is one of the main grain crops in agricultural production. It is grown annually on an area of about 250 million hectares [1]. In the Krasnoyarsk Territory, mainly spring soft wheat is produced. In 2021, it was sown on an area of 558 thousand hectares, about 62% of the area occupied by grain crops.

The scope of wheat grain is quite diverse. Wheat is most widely used in the production of bakery products. Confectionery and pasta, various cereals, starch, alcohol, biofuels are also made from wheat grain. About half of the produced wheat grain is used for fodder purposes.

The decisive factor in increasing the efficiency of grain production is the creation and introduction into production of new varieties with high productivity, disease resistance, and high baking performance. According to many authors, the contribution of the variety to the increase in productivity is from 30 to 50% [2-4].

A factor in the sustainable growth of wheat productivity is the presence of adaptive varieties that can effectively use the soil and climatic conditions of the cultivation region [5-6]. Varieties are needed both with narrow adaptation, which most fully use the agro-climatic

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resources of a particular ecological point, and varieties with a wide adaptive capacity, which are adapted to a variety of soil-climatic and weather conditions [7].

The southern regions of the Krasnoyarsk Territory are most suitable for the production of food wheat and obtaining seeds with high sowing qualities. Slightly leached chernozems are widespread in the southern forest-steppe. Soils are rich in nutrients. The average annual rainfall is 422 mm. Potential fertility makes it possible to grow intensive varieties on fallow plots. For seeding crops, adaptive varieties are needed. The main areas are occupied by mid-season varieties, potentially more productive.

In the steppe zone the soils are leached and southern chernozems, slightly acidic and medium loamy texture. The supply of nutrients is lower than in the southern forest-steppe. There is insufficient rainfall throughout the area. The annual rainfall is 248-340 mm. For the steppe zone, mid-season drought-resistant varieties with high adaptive capacity are needed. The combination of sufficient heat and a long frost-free period makes it possible to cultivate medium-late varieties in the steppe zone, which, under conditions of lack of moisture, are able to form a satisfactory crop. The purpose of the study is to create an early-ripening spring wheat variety that combines high productivity and drought resistance.

2 Conditions, methods and research

Research on the study of the variety was carried out in 2010-2021 on experimental fields and in the laboratories of the Krasnoyarsk Research Institute of Agriculture. Sowing was carried out on a fallow predecessor with a rate of 500 germinating grains per 1 m². The soil of the experimental site is leached chernozem. Harvest area 30 m², in four repetitions. Standards - Omskaya 33 (2010-2015) and Altaiskaya 75 (2016-2021). Nitrogen fertilizers were applied at a dose of N40 kg per hectare of the active substance.

Field observations, assessments, accounting were carried out according to the method of the State Variety Testing [8]. Resistance to loose smut was studied against an artificial infectious background, resistance to brown rust against the background of a natural lesion, according to the VIR guidelines [9]. Grain quality assessment was carried out according to the methods of the National Standards of the Russian Federation. The mass of 1000 grains was determined according to GOST 10842-89, the nature of the grain according to GOST 10841, the protein content according to the Kjeldahl method, the content of raw gluten in the grain according to GOST 13586.1-68, the flour strength according to GOST R 51415, and the baking properties according to laboratory baking by the method of intensive dough kneading. The article uses the results for 2013-2021 branches of the State Sort Commission for Eastern Siberia.

3 Results and discussion

The main selection method in the Krasnoyarsk Research Institute of Agriculture is intraspecific hybridization. Variety Kuraginskaya 2 was obtained by individual selection from a hybrid combination from crossing the breeding sample KS-817 and variety Kazakhstanskaya 10. The pedigree is presented in detail in Figure 1.

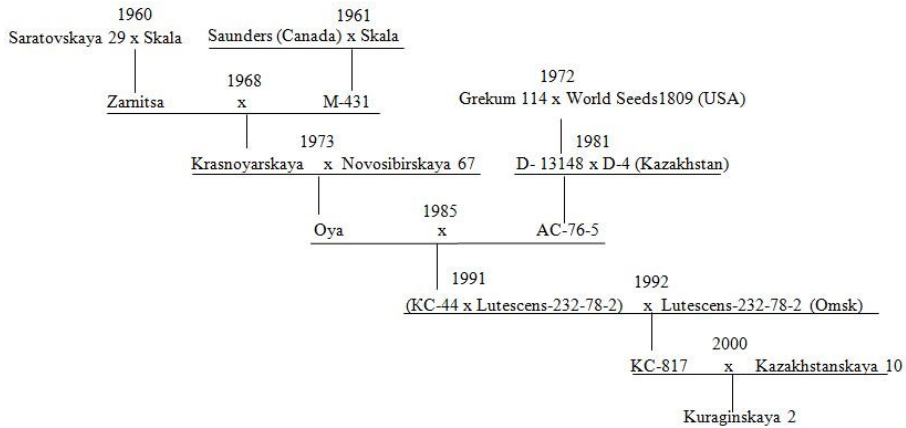


Fig. 1. Origin of soft spring wheat variety Kuraginskaya 2.

The variety is mid-season, the duration of the growing season is at the level of standards. In competitive variety testing, the average grain yield was 27.7 c/ha (Table 1). The advantage over the Omskaya 33 standard is 3.8 centner/ha. Kuraginskaya 2 surpasses Omskaya 33 in terms of 1000-grain weight and ear grain content. The maximum yield of 71.0 centner/ha was obtained in 2019 at the Uyar variety plot. Lodging resistance is high.

Table 1. Characteristics of the wheat variety Kuraginskaya 2 (KSI, 2010-2012).

Variety	Vegetation period, days	Harvest, centner/ha				Defeat		Lodging, score
		2010	2011	2012	average	By dusty smut, %	By Brown rust, reaction type	
Omskaya 33	93	22.2	21.8	27.8	23.9	3.1	3	4.6
Kuraginskaya 2	92	29.4	24.5	29.1	27.7	19.2	2	5.0
HCP0.5		2.7	2.3	2.2	-	-	-	-

Despite some advances in breeding for disease resistance, losses from pests remain quite high. In the Krasnoyarsk Territory dusty and hard smut, root rot, brown rust, and septoria blotches are the most common. Helminthosporium spotting, fusarium, and powdery mildew are less common. Cultivar Kuraginskaya 2 showed moderate resistance to the local leaf rust population (reaction type 2). According to this indicator, it somewhat exceeds the Omskaya 33 standard. In terms of resistance to loose smut, the variety belongs to weakly susceptible varieties (damage against an artificial infectious background is up to 25%). The maximum damage of the variety on an artificial infectious background was 19.2%, in the variety Omskaya 33 - 3.1%.

The variety is resistant to root rot. A study of the susceptibility of 10 Siberian wheat varieties to a complex of phytopathogenic fungi that cause seed infection in the Krasnoyarsk Territory, carried out at the Krasnoyarsk State Agrarian University, confirmed these conclusions. The minimum prevalence of pathogens 29% was found in the variety Kuraginskaya 2, with the maximum prevalence in the variety Altaiskaya 75-66% [10].

According to the technological and baking qualities of the Kuraginskaya 2 grain, it is close to the Omskaya 33 standard, which belongs to valuable wheat. The variety surpasses the standard in terms of flour strength by 158 AU, weight of 1000 grains by 3.6 grams. Yields to the standard in terms of gluten content by 1.7%. The remaining indicators for both varieties are close (Table 2).

Table 2. Grain quality indicators of spring wheat Kuraginskaya 2 (Krasnoyarsk, 2012-2017).

Quality indicators	Kuraginskaya 2		Omskaya 33	
	range of variability	Average	range of variability	Average
Weight of 1000 grains, g	33.5 - 40.7	37.3	29.9 - 39.8	33.7
Nature, g/l	728 - 795	769	727 - 791	763
Protein content, %	12.2 - 14.6	13.5	12.3 - 16.4	13.9
Gluten content, %	27.0 - 31.6	29.6	28.0 - 34.0	31.3
The power of flour e.a.	273 - 624	454	205 - 388	296
Volume output of bread, cm ³	420 - 700	588	450 - 720	595
General bakery score, score	3.6 - 4.1	4.0	3.7 - 4.1	3.9

The results of testing Kuraginskaya 2 on variety plots in Eastern Siberia confirmed the high productivity of the variety. In the south of the Krasnoyarsk Territory, the differences with the Omskaya 33 standard when tested on fallow ranged from 0.0 centner/ha at the Minusinsk GSU to 6.8 centner/ha at the Novoselovsky GSU. For continuous sowing crops, the differences with the standard ranged from -0.8 to 3.4 centner/ha (Table 3).

Table 3. The results of testing the variety Kuraginskaya 2 on variety plots in the south of the Krasnoyarsk Territory (2013-2015).

Varietal plot	Harvest, centner/ha		Deviation
	Kuraginskaya 2	Omskaya 33	
Predecessor steam			
Novoselovsky	34.2	27.4	6.8
Krasnoturansky	25.9	22.6	3.3
Karatuzsky	35.2	33.4	1.8
Minusinsky	42.8	42.8	0.0
The predecessor of the seeding culture			
Novoselovsky	24.3	20.9	3.4
Krasnoturansky	20.3	21.1	-0.8
Karatuzsky	31.4	28.8	2.6
Minusinsky	27.8	26.1	1.7

Positive results have also been obtained in other regions. At the Shirinsky GSU in the Republic of Khakassia, the increase to the standard was 7.3 centner/ha, at the Kuytun GSU in the Irkutsk region - 4.9 centner/ha, at the Barguzinsky GSU in the Republic of Buryatia - 4.2 centner/ha. Based on the test results, since 2015, the variety has been included in the State Register of Breeding Achievements in the East Siberian Region.

Since 2016 the Omskaya 33 standard has been replaced by the more productive Altaiskaya 75 variety. Differences in productivity between Kuraginskaya 2 and Altaiskaya 75 were not significant. In most variety plots in the south of the region, the advantage of the variety was noted in comparison with the new standard, however, the gains were somewhat less than in comparison with Omskaya 33 (Table 4).

Table 4. The results of testing the variety Kuraginskaya 2 in the variety plots of the south of the Krasnoyarsk Territory (2016-2021).

Varietal plot	Harvest, centner/ha		Deviation
	Kuraginskaya 2	Omskaya 33	
Predecessor steam			
Novoselovsky	30.0	31.0	-1.0
Krasnoturansky	30.3	29.0	1.3
Karatuzsky	20.1	18.3	1.8
Minusinsky	45.2	43.2	2.0
The predecessor of the seeding culture			
Krasnoturansky	17.6	16.1	1.5
Karatuzsky	24.1	21.8	2.3
Minusinsky	32.0	30.7	1.3

The variety shows good results in various environmental and weather conditions, both at high yield levels and in severe drought conditions. In 2018, when the yield of the standard at the Kazachinsky variety plot was 3.6 centner/ha, Kuraginskaya 2 formed a yield of 17.2 centner/ha, almost 4.8 times higher. In 2019, at the Uyar variety plot, Kuraginskaya 2 formed a yield of 71.0 centner/ha, 5.4 centner/ha higher than the Altaiskaya 75 standard.

In 2016-2018 16 wheat samples were evaluated for stability parameters. The study was carried out on 8 variety plots of the Krasnoyarsk Territory according to two predecessors. Variety Kuraginskaya 2 ranked second in terms of average yield and first in yield stability [11].

Physiological resistance to drought, which negatively correlates with potential productivity, is at an average level in the variety [12]. The drought resistance of the variety is due to the increased number of germinal roots, the presence of awns and the ability to maintain the area of the upper leaves with a lack of moisture. These features make it possible to increase the drought resistance of the variety without conflicting with potential productivity.

4 Conclusions

As a result of purposeful breeding work in the Krasnoyarsk Research Institute of Agriculture a mid-ripening wheat variety Kuraginskaya 2 was created. The variety is characterized by high productivity and ecological plasticity, resistant to lodging and root rot. In terms of grain quality, the State sorting commission classified it as a good filler. Recommended for cultivation in the southern regions of the Krasnoyarsk Territory, in the Trans-Baikal Territory, the Republics of Khakassia and Tyva. It is of interest not only for use in production, but also as a valuable source material for breeding for adaptability.

References

1. G. A. Filipenko, T. I. Firsova, D. M. Marchenko, *Agrarian Bulletin of the Urals* **6**, 61-69 (2016)
2. G. V. Tobolova, Yu. A. Letyago, R. I. Belkina, *Agro-food policy of Russia* **5(41)**, 64-67 (2015)
3. I. V. Deryugina, *Vostochnaya analytics* **5**, 27-51 (2015)

4. P. L. Goncharov, *Complexity in the selection of agricultural plants* Principles and methods of breeding intensive varieties of agricultural plants: Proceedings of Novosibirsk 4-15 (2005)
5. A. A. Zhuchenko, *Agricultural biology* **3**, 4-31 (1995)
6. V. I. Kovtun, L. N. Kovtun, K. A. Maiorova, *Bulletin of KrasGAU* **8**, 40-46 (2021)
7. A. V. Sidorov, N. A. Neshumaeva, L. V. Plekhanova, *Bulletin of KrasGAU* **4**, 10-15 (2020)
8. M. A. Fedin, *Methodology of the State Variety Testing of Agricultural Crops* (Kolos, Moscow, 1985)
9. E. E. Radchenko, *Study of Genetic Resources of Cereals for Resistance to Pests* (Rosselkhozakademiya, Moscow, 2008), 5-85
10. V. V. Koeler, S. V. Ovsyankina, D. M. Shcheklein, E. D. Mashkovskaya, S. V. Khizhnyak, *Vestnik of KrasGAU* **8**, 3-10 (2021)
11. V. I. Nikitina and A. A. Kolichenko, *Bulletin of KrasGAU* **3**, 58-64 (2019)
12. A. V. Sidorov, L. V. Plekhanova, *Siberian Bulletin of Agricultural Science* **4**, 5-10 (2010)