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## Early ripening variety of spring soft wheat Kanskaya

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**Abstract.** The forest-steppe zone, where the main sown areas of spring wheat are located, is characterized by a short frost-free period and frequent repetition of the spring-summer type of drought. The purpose of this research was to create an early ripening variety of spring wheat that combines high productivity and drought resistance. The article presents biological, agronomic, genetic, technological and morphological characteristics of the new variety. The experimental part of the work was carried out on the experimental fields of the Krasnoyarsk Scientific Research Institute of Agriculture. The predecessor is fallow, the seeding rate is 5 million germinating grains per hectare, the soil is leached chernozem. Standard varieties - early ripening Novosibirskaya 15 and mid-early Altayskaya 70. Variety Kanskaya was created by the method of intraspecific hybridization and subsequent individual selection from a hybrid population (Altai 98 x G-17-1) x Altai 98. Since 2015, the variety is included in the State Register of Breeding Achievements of the East Siberian region. Kanskaya belongs to lutescens type. The variety is medium early. In terms of the growing season, it occupies an intermediate position between Novosibirskaya 15 and Altayskaya 70. For four years of competitive variety testing (2011-2014), the average grain yield of the new variety was 31.8 c / ha (from 16.8 to 38.2 c / ha). Kanskaya surpassed Novosibirskaya 15 by 6.6 c / ha, Altai 70 by 1.1 c / ha. In the conditions of the Krasnoyarsk Scientific Research Institute of Agriculture, the variety showed resistance to brown rust and head smut. Has an individual allelic composition of gliadins and a high component composition in the electrophoretic spectrum. In terms of grain quality, the variety is classified as a valuable wheat.

### 1. Introduction

The creation and introduction of new varieties with high adaptive capacity and plasticity, resistance to unfavorable biotic and abiotic environmental factors, which most fully use the soil and climatic resources of the region, is an important task of the agricultural production [1].

One of the main points in wheat breeding is the length of the growing season [2]. The duration of the growing season determines not only the size of the crop, but also its quality, as well as the possibility of avoiding frost and drought, damage by pests and diseases [3].

To create new varieties with high quality characteristics, it is necessary to study breeding material not only at the phenotypic, but also at the genotypic level. Gliadins, which do not change under the influence of environmental factors, are effective markers of common wheat [4, 5].

Storage proteins mark different genotypes and, as a result, certain economically valuable traits associated with them. Alleles of gliadincoding loci in wheat from different climatic zones have



different frequencies of occurrence, probably due to the fact that certain alleles mark different gene associations responsible for the adaptability of the genotype to certain environmental conditions [6].

The main cultivated areas of wheat are located in the forest-steppe zone, which is characterized by a short frost-free period. Spring frosts are periodically observed in the first ten days of June, and autumn ones in the first ten days of September. In 2006, the first autumn frost was recorded on August 20 and this is not an isolated case. The situation is even more difficult in the taiga and subtaiga regions, where more precipitation falls, the availability of heat is lower, and field work begins later.

At the same time, the forest-steppe zone is characterized by a frequent repetition of the spring-summer type of drought, in which the period of ear formation is reduced, which leads to a decrease in its grain content. In some years, drought is observed at the initial stages of loading, which sharply reduces the grain size. Drought resistance is the most important characteristic for the variety created for this zone.

As the studies carried out in the Krasnoyarsk Research Institute of Agriculture have shown, the signs that increase drought resistance without reducing potential productivity include: the number and degree of development of embryonic roots, the optimal ratio of interphase periods of plant development, the presence of awns, the area of the flag leaf, the stability over the years of weight indices 1000 grains and leaf area [7].

For a long time, in the conditions of the Krasnoyarsk Research Institute of Agriculture, it was not possible to create an early ripening variety that combines early maturity, resistance to the June type of drought and productivity. Early ripening samples had a short ear-laying period, which, under conditions of moisture deficit, was even more reduced, which led to a sharp decrease in yield [8]. The aim of the research is to create an early-ripening variety of spring wheat that combines high productivity and drought resistance.

## **2. Conditions, materials and methods**

The experimental part of the work was carried out on the experimental fields of the Krasnoyarsk Research Institute of Agriculture, located in the central part of the Krasnoyarsk forest-steppe. The predecessor is fallow, the seeding rate is 5 million viable grains per hectare. The soil is leached chernozem. The humus content in the soil of the experimental plot is 4.3-5.2%, K<sub>2</sub>O - 14.8-17.9 mg / 100 g of soil, P<sub>2</sub>O<sub>5</sub> - 17.6 - 25.6 mg / 100 g of soil.

Field studies were carried out according to the GSI method [9]. Variety Novosibirskaya 15 was used as an early maturing standard; mid-early - Altai 70. Evaluation of breeding material for resistance to fungal diseases was carried out by the immunity sector according to the methods developed in VIR [10]; assessment of technological and baking qualities of grain - by the sector of technological assessment of grain in accordance with the methods of national standards of the Russian Federation and ISO methods. Wheat gliadin electrophoresis was carried out by the laboratory of genetics according to the method of A.A. Pomortsev. and others [11]. Determination of the allelic composition of gliadins was carried out by comparing the obtained electrophoretic spectra of the components of the studied sample with those of the reference variety Bezostaya 1 with the formula Gli-A1b, Gli-B1b, Gli-D1b, Gli-A2b, Gli-B2b, Gli-D2b [12].

## **3. Results and discussion**

The variety of spring soft wheat Kanskaya was bred in the Krasnoyarsk Research Institute of Agriculture by the method of individual selection from a hybrid population created in 2004 (Altai 98 x G-17-1) x Altai 98. Since 2015, the variety has been included in the State Register of Breeding Achievements in the East Siberian Region. Recommended for cultivation in the Krasnoyarsk Territory and the Irkutsk Region.

Kanskaya belongs to lutescens type. Grain size is medium (1000 grain weight 31-37 g). Culm is of average height - 76-92 cm, 10-15 cm higher than standard varieties. In years with excessive moisture, the lodging resistance is inferior to the standards from 0.5 to 1 points.

Medium early variety. The growing season is 72-82 days. Under the conditions of the Krasnoyarsk Research Institute of Agriculture, it ripens simultaneously or 1-2 days later than the early maturing standard Novosibirskaya 15 and 2-4 days earlier than the average early standard Altai 70. According to the State Variety Commission, on average in terms of the duration of the growing season, it takes an intermediate position between Novosibirskaya 15 and Altayskaya 70.

Using the methods of recombination selection, it was possible to change the ratio of interfacial periods in the early ripening variety. Heading of the variety begins 2-3 days later than Novosibirskaya 15 and 1-2 days later than Altayskaya 70. Due to the longer period of ear-laying, Kanskaya exceeds both varieties in the number of spikelets by 2.8 and 1.1 and in the number of grains per ear by 6.0 and 3.7, respectively.

When studying the allelic composition of the Kanskaya variety, a genetic formula was determined, consisting of five alleles at the gliadincoding loci Gli-A1b, Gli-D1i, Gli-A2b, Gli-B2b, Gli-D2g. The formula of the studied variety has an individual allelic composition that differs from the reference sample "Bezostaya" 1.

Considering the component composition of the Kanskaya variety, it was noted that the studied variety contains 21 components, and not all of them coincide with the components of the standard, which is characterized by the presence of 24 components.

For four years of competitive variety testing (2011-2014), the average grain yield of the new variety was 31.8 c / ha (from 16.8 to 38.2 c / ha). Kanskaya surpassed Novosibirskaya 15 by 6.6 c / ha, Altai 70 by 1.1 c / ha (table 1). A more modest increase in relation to Altayskaya 70 is explained by the smaller grain size of the Kanskaya variety. The largest increments of 10.4 and 2.7 c / ha, respectively, were obtained in 2011 under severe drought conditions during the ear-laying period.

**Table 1.** Productivity of a new variety of spring wheat Kanskaya (Krasnoyarsk, 2011-2014).

Variety	Harvest, centner per hectare				
	2011 г.	2012 г.	2013 г.	2014 г.	average
Novosibirskaya 15, st.	16.6	26.1	34.0	24.1	25.2
Altayskaya 70, st.	25.3	27.6	39.7	30.2	30.7
Kanskaya	27.0	30.7	38.2	31.3	31.8
Least significant difference <sub>0.05</sub>	3.0	2.8	2.9	2.6	

Ecological testing of the variety confirmed its high productivity. When tested in Krasnoyarsk State Agriculture University the increase in yield to the Novosibirskaya 15 variety was 5.1 centner per hectare, in the State Agriculture University of the Northern Trans-Urals, the increase to the Iren variety was 6.0 centner per hectare. When studying the variety in JSC "Dzerzhinskoe", Dzerzhinsky District, Krasnoyarsk Territory, the increase to the variety Novosibirskaya 15 was 3.0 c / ha. According to the data of the department for the assessment of breeding material of the Krasnoyarsk Research Institute of Agriculture, the Kanskaya variety has a high physiological resistance to drought and increased soil acidity [13].

In agricultural production, the variety is one of the most important factors affecting the phytosanitary situation in crops, and selection for immunity is the most effective means of combating diseases. The problem of selection for disease resistance will always be relevant, since resistance is the result of the interaction of the joint evolution of a plant and a pathogen [14]. In the Krasnoyarsk Research Institute of Agriculture, purposeful selection is carried out for resistance to head smut and brown rust. In the process of evaluating breeding material, samples resistant to other diseases are identified.

The variety Kanskaya practically in all the years of testing showed moderate resistance to the local population of brown rust (reaction type 1). Only in 2016 a severe defeat of the variety was noted, possibly due to the introduction of a new race of the pathogen. Varieties Novosibirskaya 15 and Altayskaya 70 were severely affected (reaction type 3-4).

The maximum infestation of the dust smut variety against an artificial infectious background was 2.9%. The variety, like the standard Altayskaya 70, is classified as practically resistant (damage up to 5%). The maximum damage to the Novosibirskaya 15 variety was 15%. Powdery mildew Kanskaya is heavily affected at the level of standard varieties.

The difficult climatic conditions of the Krasnoyarsk Territory complicate both the production of high-quality grain and selection for quality. The water and temperature regime varies greatly not only from year to year, but also during the growing season.

Under these conditions, even the grain of strong wheat rarely meets basic conditions. Out of ten years (1997-2006), in the competitive variety testing of the spring wheat breeding laboratory, for the strong wheat cultivar Tulunskaya 12, the grain met the requirements for the nature of grain in eight cases, gluten content in seven, gluten quality in five, vitreous in three and never for all indicators simultaneously [15].

In terms of most quality indicators, Kanskaya is inferior to the Novosibirsk 15 standard, which belongs to strong wheat. However, the main quality indicators (protein and gluten content, flour strength) meet the requirements for strong wheat. Kanskaya is superior to the valuable wheat grade Altayskaya 70 in terms of protein and gluten content, flour strength and bread volume, yielding in weight of 1000 grains and grain nature (table 2). The variety is included in the list of valuable wheat by the State Variety Commission.

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

Indicators	Kanskaya a	Novosibirskaya 15	Altayskaya 70
Mass of 1000 grains, g.	30.4	30.4	34.6
Natural weight, g/l	767	756	775
Protein %	15.5	16.3	15.1
Gluten %	35.9	38.9	33.0
Flour strength, e.g.	395	484	386
Bread volume, ml	600	653	544
Baking ranking, grade	4.0	4.3	4.0

It should be noted that in addition to the genetic characteristics of the variety, the duration of the growing season also affects the formation of grain quality. In the conditions of the Krasnoyarsk Research Institute of Agriculture, early ripening varieties are generally superior in quality to mid-ripening ones. Since their ripening occurs in a period more favorable in terms of temperature conditions. The mid-ripening varieties of strong wheat Vetluzhanka, Altayskaya 75 are in most cases inferior in terms of quality to the earlier ripening varieties Kanskaya and Altayskaya 70 related to valuable wheat.

The results of testing the variety at the variety test plots of Eastern Siberia confirmed its high productivity. In some cultivar plots of the Krasnoyarsk Territory, a significant increase in yield to the Novosibirskaya 15 variety was 1.9 - 5.6 c / ha, to the Altayskaya 70 variety from 1.6 to 3.1 centner per hectare (Table 3).

**Table 3.** Results of testing the variety Kanskaya on the fallow sections of the Krasnoyarsk Territory (2015-2017).

Variety test plot	Kanskaya	Novosibirskaya 15		Altayskaya 70	
	centner per hectare	centner per hectare	deviation	centner per hectare	deviation
Kansky	32.7	30.8	1.9	29.7	3.0
Kazachinsky	18.1	14.5	3.6	16.5	1.6
Minusinsky	35.7	30.7	5.0	33.5	2.2
Krsnoturansky	22.9	17.3	5.6	19.8	3.1

In 2016-2018 In the southern forest-steppe zone of the Krasnoyarsk Territory, 8 early ripening varieties were studied, recommended for cultivation in the Krasnoyarsk Territory in terms of yield, environmental stability and plasticity. According to all indicators, the Kanskaya spring soft wheat variety was the best [16].

Good results were obtained at the variety test plots of the Irkutsk region. In terms of the growing season, the Kanskaya variety occupied an intermediate position between the early-maturing Iren variety and the mid-early Tulunskaya 11 variety. At a number of variety test plots, Kanskaya surpassed the Iren variety in productivity by 3.2 - 7.9 c / ha, the Tulunskaya 11 variety by 1.9 - 5.9 centner per hectare (Table 4).

**Table 4.** Results of testing the variety Kanskaya on the fallow sections of the Irkutsk region (2015-2017).

Variety test plot	Kanskaya	Iren		Tulunskaya 11	
	centner per hectare	centner per hectare	deviation	centner per hectare	deviation
Kuitunsky	29.9	26.7	3.2	26.0	3.9
Nizhneudinsky	42.5	38.3	4.2	42.5	0.0
Nukutsky	12.5	7.6	4.9	9.9	3.6
Bratsky	14.7	8.4	6.3	8.8	5.9
Irkutsky	26.5	18.6	7.9	24.6	1.9

#### 4. Conclusions

As a result of purposeful selection work in the Krasnoyarsk Research Institute of Agriculture, a variety of early ripening spring wheat Kanskaya was created. The variety has high productivity, resistance to certain fungal diseases, individual allelic composition, high component composition, good grain quality. The variety is recommended for cultivation in the Krasnoyarsk Territory and the Irkutsk Region. Its competent use will increase the level of wheat yield and stabilize its level over the years. The variety is of interest not only for use in production, but also as a valuable starting material for selection.

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