

# Spring wheat seed production in Krasnoyarsk region

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**Abstract.** The economic and biological properties of the variety are successfully implemented only through a well-established seed production system, which is an integration into a single complex of breeding, production and marketing of seeds. High-quality seed material provides a yield increase of at least 25-30%. In modern economic conditions, commodity producers need varieties and seeds of grain crops that meet specific production requirements.

## 1 Introduction

The strategic task facing the Russian agro-industrial complex is to provide the population with high-quality, affordable and safe agricultural products. For its effective solution, first of all, it is necessary to accelerate the development of our own highly productive and competitive agricultural production [1,2,3].

The Krasnoyarsk Territory has a need to develop a concept for the sustainable development of the agro-industrial complex, which will reflect the state policy, laws in the field of crop production, plans and measures for organizing seed production of grain, oilseeds, legumes, perennial grasses, as well as marketing, logistics, consulting services and market formation sales of products of local agricultural producers [4,5].

One of the most important directions for the effective development of agricultural production is modern specialized seed production of zoned varieties of agricultural plants. Competitive modern agricultural production cannot exist without new effective hybrids, plant varieties that provide the maximum yield. So, thanks to the quality of the seeds, it is possible to increase the yield by 20%, due to the variety by 25%, and the technology for the production of adapted, zoned and high-quality seeds of local production - by 45% [6,7].

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## 2 Methods and materials

Scientific research was carried out on the experimental fields of the Krasnoyarsk Research Institute of Agriculture in the village of "Minino". Zoned varieties of grain crops were used as objects of research.

Sowing of the experiment was carried out with a SSFC-7 seeder, harvesting was carried out with a Hege combine, the grain was dried, cleaned, weighed, the germination energy was determined, germination according to GOST 12036-66 [8,9,10]. The soil of the experimental plot is represented by leached, thin, heavy loamy chernozem. Statistical data processing was carried out using the SNEDECOR software package.

According to the branch of the Federal State Budgetary Institution Rosselkhozcenter in the Krasnoyarsk Territory, wheat is sown with varieties included in the State Register of Breeding Achievements approved for use on the territory of the Russian Federation, of which 99.6% are approved for use in the East Siberian region. Sowing is carried out with seeds of high sowing conditions (Table 1).

**Table 1.** The volume of sowing seeds of spring wheat in the Krasnoyarsk Territory

Indicators	Years		
	2018	2019	2020
Spring wheat seeds sown, thousand tons	145.3	135.5	142.6
Including varietal, %	92	94	96
Conditional seeds sown, %	90	96	98
Number of sown varieties (including foreign selection), pcs.	27 (3)	27 (4)	26 (4)

In 2020, 26 varieties of spring wheat were sown, including 4 imported and 4 varieties of durum wheat. In general, varieties of domestic selection account for 99.8% of wheat sowing in the region.

Currently, the percentage of sown varietal seeds is 95.7%, including 4.2% - original seeds, 13.7% - elite and 79.3% - reproduction. Measures taken by the Ministry of Agriculture and Trade of the Krasnoyarsk Territory to stimulate the acquisition by farms of high-quality varietal seeds of high reproductions have a beneficial effect on the results of variety change and variety renewal.

Among the total crops of spring wheat, varieties of Novosibirsk breeding are in the lead. In 2020, the most widespread variety in the region was Novosibirskaya 31, the share of which was 40.7% of the sowing of this crop, Novosibirskaya 29 - 16.4%, Novosibirskaya 15 - 16.1%, Novosibirskaya 18 - 5.0%.

Recently, there has been a slight decrease in sown areas: Novosibirskaya 15 (from 28% in 2012 to 16% in 2020), Novosibirskaya 29 (from 31% to 16%). They were replaced by new varieties: Novosibirskaya 31 and Novosibirskaya 18. The key to the successful development of seed production in the region is the production of high-quality seeds of zoned varieties of higher reproductions, the production of which is entrusted to the farms of the region, located in various soil and climatic zones, having a material and technical basis for maintaining primary and industrial seed production.

For this purpose, the branch of the Federal State Budgetary Institution Rosselkhoztsentr in the Krasnoyarsk Territory certified seed farms. The commission was attended by specialists of science, the Ministry of Agriculture and Trade.

Currently, 16 seed farms are certified in the region (5 in the southern group of districts, 5 in the central group, 4 in the western and 2 in the eastern groups). This is enough to cover the need for seeds in the region. In accordance with the federal law "On Seed Production", any

individual (or) legal entity that has concluded a license agreement with the originator of the variety can be engaged in the production of elite seeds. The producer of original seeds of agricultural plants may be an individual or legal entity that has created, bred, identified an agricultural plant variety and (or) ensures its preservation, the data on which are entered in the State Register of Breeding Achievements Approved for Use.

The above basic seed farms are responsible for maintaining the genetic affiliation of varieties, maintaining high sowing qualities of seeds and economic and biological properties. Farms such as: Solyanskoye LLC, Mikhailovskoye, Kuraginskoye, Poultry Farm Zarya, LLC Educational and Experimental Farm Minderlinskoye, KrasNIISKh - a separate subdivision of the FRC KSC SB RAS, independently receive seeds of wheat varieties in the primary links and bring them to the elite.

### 3 Elite seed production methods

The maintenance of all economically valuable qualities and biological properties of the variety when growing seeds is carried out in nurseries of primary seed production and is achieved by selecting the most productive, healthy and typical for the variety of elite ears; growing plants on an optimal agrotechnical background, with the obligatory carrying out of specific and varietal weeding. These works are assigned to research institutions, educational institutions of universities, technical schools, and experimental seed farms in accordance with the methodological recommendations for the production of seeds of the elite grain, leguminous and cereal crops.

The nursery for testing progeny of the first year (Figure 1) is planted with seeds of individually selected plants from crops made with original seeds or from crops of breeding nurseries of the superelite, elite.



**Figure 1.** a) a nursery for testing offspring of the first year; b) cattery testing offspring of the second year.

The scheme for the production of seeds of the elite by the method of individual family selection includes the following links:

1. Nursery selection
2. Nursery testing of offspring of the first year (PI1)
3. Second year offspring test nursery (PI2)
4. First year breeding nursery (PR1)

5. Second year breeding nursery (PR2)

6. Breeding nursery of the third year (PR3) - as agreed by the originator of the variety and the seed farm (Categories are indicated in accordance with the letter of the Federal State Budgetary Institution "Rosselkhoztsentr" No. 1-8/644 dated 06/20/2012)

7. Super elite

8. Elite

The nursery for testing offspring of the second year (Figure 1 b) is designed to evaluate selected lines from the nursery for testing offspring of the first year, selecting the best of them, and culling atypical ones. Sowing in this nursery is carried out by small-sized seeders (SSFC-7 type) with a plot length of 5-20 m. Seeds of the best offspring are combined and sown in the breeding nursery of the first year, followed by breeding nurseries of the second and third years.

The main purpose of breeding nurseries is to maintain purity and obtain seeds with high sowing qualities.

Sowing of the above nurseries is carried out according to the best predecessors, against the background of mineral nutrition with the obligatory application of phosphate fertilizers in the fallow field, in the early sowing periods. Lower seeding rates are allowed. Be sure to carry out varietal and species weeding.

Mass selection in terms of its technical implementation is simpler, less laborious, but its disadvantage is that the selected best plants are combined in the first year and cannot be evaluated by offspring. When it is used, the production of seeds of the elite proceeds according to the following scheme:

- Nursery selection (original variety)
- First year breeding nursery (PR1)
- Second Year Breeding Nursery (PR2)
- Superelite.
- Elite

At all stages of primary seed production, the documentation provided for by the "Methodological recommendations for the production of seeds of the elite grain, leguminous and cereal crops" must be maintained.

Seeds of the best plants from selection nurseries are called parental; seeds obtained from the nursery for testing progeny of the first year - seeds PI1, from the nursery for testing progeny of the second year - PI2, from breeding nurseries of the first, second and third years - PR1, PR2, PR3.

Seeds of agricultural plants, depending on the stage of reproduction of the variety, are divided into categories: original, elite (seeds of the elite) and reproductive (seeds of the first and subsequent reproductions).

The original seeds (OS) include: nurseries testing progeny of the first, second year; breeding of the first, second and third year; superelite, produced by the originator of the variety or a person authorized by him.

Elite seeds (ES) are seeds of agricultural plants that are obtained from original seeds and meet the requirements of regulatory documents in the field of seed production.

Elite seeds are used for the production of reproduction seeds (RS). The number of generations of reproductive seeds is determined by the territorial bodies of the specially authorized federal agricultural management body or the relevant executive bodies of the constituent entities of the Russian Federation.

The Ministry of Agriculture and Trade of the Krasnoyarsk Territory, in accordance with Order No. 369 dated October 18, 2010 - "On determining the number of generations of reproductive seeds of agricultural plants in the Krasnoyarsk Territory", limited the number of generations of reproductive seeds of grain and leguminous crops to four (PC1; PC2; PC3; PC4).

Starting from the breeding nurseries of the first year, testing of varietal crops is carried out in accordance with the instructions for approbation of varietal crops, based on its results, an act of approbation of the established form is issued. Approbation of varietal crops intended for sale is carried out by specialists of authorized organizations at the request of seed producers.

Approbation of crops of original seeds can be carried out by the variety originator or a commission consisting of specialists from authorized organizations and representatives of farms producing original and (or) elite seeds.

Approbation of crops of agricultural plants, seeds from which are intended for the producers' own needs, is carried out by specialists - approbators of farms certified for the right to conduct approbation, as well as specialists from authorized organizations. The limit (control) area on which approbation is carried out, the number of points for taking approbation plants, the number of these plants are indicated in Table 2.

**Table 2.** Guidelines for the selection of sheaves (samples) and inspection of plants during the testing of spring wheat

Agricultural plant	Development phase	Limit area for plant inspection or sampling, ha	Number of plant inspection or sampling points	The number of analyzed stems from the entire area (not less than)
яровая пшеница	в начале восковой спелости	450	150	1,500

## 4 Features of the technology of cultivation of spring wheat for seeds

Varieties lose their qualities in the process of reproduction due to weather conditions, violations of agricultural practices, and mechanical clogging of seeds. Therefore, all operations associated with the cultivation of seeds require careful observance of measures aimed at the inadmissibility of such contamination, especially with hard-to-separate cultivated plants.

Seed technology (Table 3) is somewhat different from the cultivation of wheat for food grains.

**Table 3.** Features of seed agrotechnology

Technological methods	On seed crops	
	Recommended	Unacceptable
Predecessor	Pure fertilized steam Layer of perennial grasses Row crops Legumes	Serve with second bread after steam
Crop rotations	Steam - wheat - oats - steam Row crops - wheat - peas - oats Steam - wheat - peas - wheat Steam - winter rye - peas - wheat Layer of perennial grasses - fallow wheat	Placement in hard-to-separate crops to eliminate clogging
Tillage	In taiga, steppe regions, non-moldboard and combined, in arid zones, surface and minimal (protective)	Zero (disposed to the appearance of pests and diseases)

	Before sowing, harrowing and rolling is necessary	
Fertilizers	Strictly in accordance with field cartograms and current soil analysis, but not lower than N <sub>60</sub> P <sub>30</sub> K <sub>30</sub> . In order to accelerate maturation and improve the quality of seeds, the dose of phosphorus and potassium can be increased by 15-20%	Without the use of fertilizers
Preparing seeds for sowing	Seed treatment as a mandatory technological method, regardless of the results of phytoexamination	Sowing seeds, untreated means of protection
Sowing dates	Early dates	Late dates
Seeding rates	Decreased seeding rates by 500-1000 seedlings. grains per hectare compared to production.	Heavily thickened and sparse crops
Seeding depth	In the northern and taiga regions - 3-5 cm, in the forest-steppe and steppe regions - 5-8 cm.	Too shallow (reduces field germination) and too deep (strong tillering)
Crop care	The field number and area, crop, variety, crop reproduction, varietal and species weeding, herbicide treatment are indicated	Leave seed plots without inspection and treatment with chemical protective equipment
Approbation	Plot mowing	Depersonalization of seeds
Harvesting seed crops	Submission of applications no later than a month before the approbation	New combines without running-in in the threshing of marketable grain
Post-harvest seed treatment	Primary cleaning	Overheating of grain and coolant;
Seed storage	Drying (grain temperature 45°C) of the carrier depending on the type of dryer (shaft 70°C, drum-120°C)	Without monitoring the quality of cleaning and disassembly of grain samples

## 5 Conclusion

The most crucial moment in the production technology of high-quality seeds is the harvesting of seed crops and post-harvest processing of seed material.

When threshing grain, careful adjustment of combines is necessary, especially the threshing drum. It is not recommended to allow for threshing new combines that have not been run-in when threshing marketable grain.

Post-harvest processing of seeds includes primary cleaning, drying, sorting, formation of batches and their storage.

When drying seed grain in mine grain dryers, the temperature of the heat carrier should not exceed 70 °C, the grain temperature should not exceed 45 °C. For drum grain dryers, this temperature regime should not be higher than 120, the grain temperature - no more than 45. If these indicators are exceeded, the moisture content of the grain sharply decreases. For one pass, the humidity should not decrease by more than - 1.5-2.0%.

After the primary post-harvest treatment of seeds, they are temporarily preserved by active ventilation with external or artificially cooled air. With a decrease in grain temperature during ventilation from 20 to 15°C, the duration of seed conservation increases by almost 1.5 times, to 10°C - by 2 times or more.

This is followed by immediate post-harvest cleaning of seeds from various impurities, then drying seeds with high humidity to the optimum condition, secondary cleaning and sorting of dry seeds with sufficient resistance to long-term storage.

All sowing and varietal qualities are recorded in the cord book of seed accounting, which are transferred under the act to the responsible person. In elite wheat seeds, a varietal purity of 99.7%, moisture up to 16%, germination rate of at least 92% is allowed according to GOST R52325-2005 (Table 4).

**Table 4.** Varietal and sowing qualities of wheat seeds in accordance with GOST R 52325-2005

Seed category	Varietal purity of seeds, % not less than	Seed purity, %, not less	Content of seeds of other plants, pcs/kg, no more		Impurity (%) no more		Germination, %	Damage to crops by smut (dusty/solid) %, no more
			total	including weedy	smut formations	ergot sclerotium		
ES	99.7	99.0	10	5	0	0.01	92	0.1/0
PC	98.0	98.0	40	20	0.002	0.03	92	0.3/0.1
PCt	95.0	97.0	200	70	0.002	0.05	87	0.5/0.3

Different grain crops and their varieties should be stored under conditions that do not allow mixing. Preparing the warehouse for grain storage includes thorough cleaning and disinfection of the premises. Each batch of seeds must have a stack label indicating the place of storage, culture, variety, reproduction, batch number, varietal purity category, batch weight, and varietal quality indicators.

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