

# Cultivation efficiency of new varieties of winter soft wheat in the north-eastern zone of the Krasnodar Territory

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**Abstract.** The paper presents a comparative assessment of new varieties of winter soft wheat cultivated in the north-eastern zone of the Krasnodar Territory. It provides the results on yield, grain quality and cost efficiency of their cultivation. On average over the years of study the Alekseich and Bezostaya 100 varieties have consistently provided high actual grain yields for the predecessor of peas – 6.67 and 6.55 t/ha, respectively. The highest grain quality was formed by the Bezostaya 100 variety. The average protein content over three years was 13.3%, gluten content 2 – 4.6%, grain unit – 806 g/l. Bezostaya 100 and Alekseich varieties ensured a high profit of 38,625-39,885 rub/ha and a level of profitability of 128-132% when cultivating the predecessor of peas. The study resulted in conclusions and proposals to the production to increase the efficiency of growing winter soft wheat varieties in Kuban.

## 1 Introduction

The main industry of domestic agriculture is grain farming, which provides the industry with high-quality raw materials, livestock with feed, and the population with food. The Krasnodar Territory is one of the leading regions of the South of Russia in terms of gross winter soft wheat harvest, which receives about 10 million tons of grain annually. The average yield of winter soft wheat in the region varies over the years and averages about 6.0 t/ha [1].

One of the factors that increases the stability of grain production, and its gross yield is the cultivation of new high-yielding varieties with good technological qualities [2–4].

Russian breeders have created a number of varieties, but only a few have played an outstanding role in increasing grain production. A critical review of the achievements of the world's breeders shows that those who use the richest and most genetically diverse source material, as well as apply the most progressive, scientifically based methods of work at all stages of the breeding process, achieve great success. The wheat plant during the growing season is greatly influenced by a large number of environmental factors. Some of them contribute to the realization of the potential of high productivity, while others hinder it. The most important task is to make the most of the former and neutralize the latter [5].

The importance of the grain variety is now especially increasing due to the great demand in the consumer market for high-quality grain suitable for baking bread. However, modern varieties have not only positive but also negative properties, which manifest themselves in

different ways in individual years. In particular, they form a high yield only in favorable weather and agrotechnological conditions of cultivation and sharply reduce it when they deteriorate [6, 7].

Consequently, grain producers must move faster from old to new varieties of winter wheat and, above all, to their domestic ones, which are better adapted to local conditions. In addition, the shortage of winter wheat grain from the use of old varieties is 900–1000 thousand tons [8, 9].

The studies covered new varieties of winter soft wheat – Alekseich and Bezostaya 100 – and compared it with the Grom variety approved for cultivation since 2010 ordinary chernozem of the Prikubanskaya plain. The issue of cultivating new varieties according to the most common predecessors in the region for agricultural producers is always relevant, because currently the variety has become the main factor in the economic growth of agricultural production.

The choice of a predecessor is one of the most important factors in winter wheat cultivation technology, because among the variety of agronomic issues, the observance of crop rotation and appropriate soil preparation are considered a strong measure in increasing the agriculture crop and improving the yield of agricultural plants, in particular winter soft wheat [10].

In this regard, the purpose of this study was to assess the efficiency of cultivation of new varieties of winter soft wheat for various predecessors in the north-eastern zone of the Krasnodar Territory. This requires a comparative assessment of new varieties in terms of yield, grain quality and cost efficiency of cultivation according to different predecessors.

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## 2 Materials and methods

The studies were carried out in 2018–2020 in the north-eastern zone of the Krasnodar Territory on the territory of the Gorbach S.E. Farm located in the Pavlovsky District. The farm is located in the zone of risky agriculture, so the yield is largely determined not only by agrotechnical, but also by agroclimatic conditions. The limiting factor in the cultivation of crops in this zone is the soil moisture. The average annual rainfall in the district is 579.8–611.0 mm and their total amount is determined as sufficient, but they are distributed unevenly throughout the year. In summer there are frequent droughts and destructive effects of dry winds with the predominance of easterly winds. Such conditions pose the need for strict adherence to a science-based farming system in the cultivation of crops, and winter wheat in particular.

The soil of the experimental site is represented by ordinary chernozem. The grain-size distribution is heavy loamy. The soil cover is heterogeneous, mosaic. The humus layer thickness makes 120–140 cm. The humus content – 3.3–3.6%, however, the total supply of organic matter in the entire humus horizon is quite large and amounts to 400–500 t/ha. The reaction of the soil medium is neutral, pH – 6.7–7.0, which is a favorable factor for the cultivation of crops.

Field and laboratory tests were conducted in accordance with GOSTs and generally accepted methods.

The material for the study included promising and new varieties of winter soft wheat: Grom, Alekseich and Bezostaya 100 selected in the P.P. Lukyanenko National Grain Center (Krasnodar).

The varieties studied were sown according to three predecessors:

- winter wheat,
- grain maize,
- pea.

Diagrams of field experiments will be given in the tables below.

The main cultivation and preparation of soil, crop sowing and tending were carried out according to the farming system of the Krasnodar Territory [11].

## 3 Results and discussion

The most important economic and valuable sign of the variety is its yield. In 2018, the yield of varieties ranged from 5.18 to 7.09 t/ha. The minimum yield was obtained from Grom variety in terms of its predecessor winter wheat – 5.18 t/ha. According to this predecessor for Alekseich and Bezostaya 100 it was also minimal and amounted to 5.91 and 6.07 t/ha, respectively. The maximum yield in 2018 was obtained from Alekseich variety according to the predecessor of peas 7.09 t/ha.

The most favorable conditions in the 2018–2019 agricultural years contributed to higher grain yield of the studied varieties compared to the previous year. The yield in 2019 was 5.64–7.71 t/ha. The maximum yield, similar to 2018, was obtained from the Alekseich variety according to the predecessor of peas – 7.71 t/ha. The yield for this predecessor was quite high for the Grom variety – 7.58 t/ha and for the Bezostaya 100 – 7.62 t/ha. 2020 was not quite favorable for winter soft wheat, when the yield ranged from 4.11 to 5.20 t/ha. The minimum yield in 2020 was obtained from the Grom variety according to its predecessor winter wheat – 4.11 t/ha, and the maximum – from Alekseich according to its predecessor peas – 5.20 t/ha (Table 1).

**Table 1.** Impact of predecessors on winter wheat yields (2018–2020).

Variety	Predecessor	Yield, t/ha			
		2018	2019	2020	$\bar{x}$
Grom	winter wheat	5.18	5.64	4.11	4.98
	grain maize	5.96	5.75	4.42	5.38
	pea	6.27	7.58	5.00	6.28
Alekseich	winter wheat	5.91	5.97	4.24	5.37
	grain maize	6.24	6.02	4.61	5.62
	pea	7.09	7.71	5.20	6.67
Bezostaya 100	winter wheat	6.07	6.26	4.13	5.49
	grain maize	6.62	6.83	4.59	6.01
	pea	6.90	7.62	5.14	6.55
	HCP <sub>05</sub>	0.58	0.41	0.34	–

On average, over three years, all varieties formed the highest yield according to the predecessor of peas: Grom – 6.28 t/ha, Bezostaya 100 – 6.55 t/ha, and Alekseich – the maximum yield of 6.67 t/ha.

In 2018 a reliable increase was formed by the Alekseich variety according to the predecessor of peas and the Bezostaya 100 variety according to the

predecessor of winter wheat compared to the Grom zoned variety. In 2019 the reliability of the increase was proven only by the Bezostaya 100 variety according to the predecessor of grain maize. In 2020 the reliability of increase has not been proven.

Thus, on average, over three years of study, the responsiveness of winter wheat varieties to the

predecessor of peas was positive. Grain maize can also serve an acceptable predecessor for the Bezostaya 100 variety.

The successful solution of the grain problem involves not only an increase in gross grain yield, but also an increase in its quality. Grain quality indicators are important in assessing certain methods of cultivation, since the yield and quality of grain processing products strongly depend on them. This evaluation makes it possible to make mix compositions of grain with satisfactory baking properties. Let us consider the grain quality for protein content, gluten, gluten quality and grain unit as the average of all assessments made for each grade after storage.

In 2018 the grain unit of the varieties was quite high and amounted to 808-814 g/l. The highest grain unit was obtained from the Bezostaya variety – 100-814 g/l. In 2019 the grain unit was also high, but slightly lower than in the previous year and amounted to 800-804 g/l, while for the Bezostaya 100 variety it was also the largest. The

lowest grain unit was noted in 2020 – 780-799 g/l, however, according to the requirements for food wheat in all varieties, it met the first-grade quality.

The protein content in the grain of the studied varieties in 2018 ranged from 11.9 for Grom to 12.6% for Bezostaya 100. The gluten content in the grain also changed in the same way: from 22.3% for Grom to 23.9% for Bezostaya 100. Such grain met the requirements of the third and fourth grades for food wheat. In 2019 the protein and gluten content of the grain was higher than in 2018. The maximum content of protein (15.0%) and gluten (26.0%) was noted in Bezostaya 100. In 2019 all varieties formed a grade 3 food grain that meets the requirements for “valuable” wheat. In 2020 Bezostaya 100, as in previous years, formed the highest quality grain with a protein content of 12.3% and a gluten content of 24.0% compared to other varieties. Such indicators also characterized grain of this grade as “valuable” wheat (Table 2).

**Table 2.** Winter wheat grain quality (2018–2020).

Variety	Grain unit, g/l	Protein content, %	Gluten		Grade*
			%	FDM, c.u.	
2018					
Grom	808	11.9	22.3	79	4
Alekseich	812	12.1	23.6	85	3
Bezostaya 100	814	12.6	23.9	81	3
2019					
Grom	801	13.1	23.5	80	3
Alekseich	800	14.5	24.6	79	3
Bezostaya 100	804	15.0	26.0	83	3
2020					
Grom	781	11.5	21.4	78	4
Alekseich	780	11.9	22.1	80	4
Bezostaya 100	799	12.3	24.0	81	3

\* Grain grade as per GOST 9353-2016.

There was a strong positive correlation between protein and gluten content in all years of studies:  $r = 0.83 \pm 0.16$ ;  $r = 0.94 \pm 0.18$ ;  $r = 0.78 \pm 0.14$  according to years.

The issue of economic feasibility is always relevant in any sector of agriculture. The general methods formed the basis for the calculation of the economic efficiency indicators of cultivation of new varieties of winter soft wheat. The cost of gross production per hectare was

calculated at the average purchase prices for wheat grain over 3 years, which amounted to 10.500 rub/t.

Winter wheat grain production costs amounted to 31.628 rub/ha for winter wheat; 30.956 rub/ha for grain maize and 30.150 rub/ha for peas. Higher predecessor costs of winter wheat are associated with the use of more expensive insecticides to control crop pests after the spiked predecessor (Table 3).

**Table 3.** Cost efficiency of winter wheat cultivation (2018–2020).

Variety	Predecessor	Yield, t/ha	Cost, rub/ha	Production costs, rub/ha	Gross product cost, rub/ha	Profit, rub/ha	Cost efficiency, %
Grom	winter wheat	4.98	6351	31628	52290	20662	65
	maize	5.38	5754	30956	56490	25534	82

	pea	6.28	4801	30150	65940	35790	118
Alekseich	winter wheat	5.37	5890	31628	56385	24757	78
	maize	5.62	5508	30956	59010	28054	90
	pea	6.67	4520	30150	70035	39885	132
Bezostaya 100	winter wheat	5.49	5761	31628	57645	26017	82
	maize	6.01	5151	30956	63105	32149	104
	pea	6.55	4603	30150	68775	38625	128

A comparative evaluation of efficiency indicators for different predecessors showed that from an economic point of view the most efficient for all varieties due to grain yield is the predecessor of peas. Thus, the Alekseich variety in crops for this predecessor had the maximum profit of 39.885 rub/ha and the highest production profitability of 132%. A slightly lower profit was received for Grom – 35.790 rub/ha and Bezostaya 100 – 38.625 rub/ha with a profitability level of 118 and 128%, respectively. It is worth noting the economic efficiency of Bezostaya 100 according to the predecessor of grain maize, where the profit amounted to 32.149 rub/ha, and the profitability level – to 104%.

The calculations found that the cultivation of all the winter soft wheat varieties under study is cost effective, especially for the predecessor of peas. This is confirmed by the positive profit and high profitability of production. The cultivation of the studied varieties according to other predecessors will also generate income, which in absolute terms will be slightly less.

## 4 Conclusion

On average, over the years of study the winter soft wheat variety Alekseich and Bezostaya 100 formed a consistently high actual grain yield for the predecessor of peas – 6.67 and 6.55 t/ha, respectively.

The highest grain quality was formed by the Bezostaya 100 variety. On average, over three years, the protein content was 13.3%, gluten – 24.6%, grain unit – 806 g/l. Such grain met the requirements of the third food grade and was characterized as “valuable” wheat. There was a strong positive correlation between protein and gluten content in all years ( $r = 0.83 \pm 0.16$ ;  $r = 0.94 \pm 0.18$  and  $r = 0.78 \pm 0.14$ ).

The highest profit of 38.625–39.885 rub/ha and the profitability level of 128–132% were obtained from the Bezostaya 100 and Alekseich varieties according to the predecessor of peas.

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