

Varietal productivity of cereals in conditions of Central Black Earth Region

Natalia Dolgopolova^{1*}, *Kristina Kalugina*¹, *Alexander Polyansky*¹, *Igor Rudov*¹, and *Tatyana Dudkina*²

¹Kursk State Agricultural University named I.I. Ivanov, Kursk, Russia

²Federal Agricultural Kursk Research Center, Kursk, Russia

Abstract. The article presents the material on the assessment of productivity of released varieties of winter wheat in the conditions of the Central Chernozem region. On the territory of Russia more than half of the sown area of grain crops is occupied by wheat, 70% of which is the area of winter crops. In advanced farms there is a high culture of agriculture (crop rotation, fertilization, soil treatment, etc.). However, the yield of winter wheat throughout the country is still insufficient and does not reach the maximum potential of the crop. One of the reasons for this is the lack of a scientifically based varietal technology for growing this crop in relation to soil-climatic and regional zones.

1 Introduction

In the conditions of modern Russia, it is possible to create a highly profitable agricultural production, which will allow to achieve high economic indicators. Modern technologies and effective innovative products of Dubovitskoye LLC of Maloarkhangel'sky district of Oryol oblast allow solving the main task - to obtain products of the highest quality. Most of the production in Dubovitskoye is directed to seed production, which doubles the profitability of cultivated crops. The rest of the production is sold as marketable products of at least third class. Seed products are sold in the region and beyond. The developed and applied systems of grain quality assessment allow to create varieties with consistently high-quality indicators, which is confirmed by production tests. It should be noted that not only the high yield of new varieties has caused increased interest in them on the part of commodity producers. Qualitative properties of new varieties also play an important role. Although the production of valuable quality grain is associated with additional costs due to higher doses of fertilizers, expanded plant protection complex, nevertheless, the analysis shows that it is profitable, because nowadays the market price of grain takes into account the quality indicators.

Analysis of the data accumulated by science and practice [1, 2, 3, 4, 5] to date shows that some agronomic techniques are recommended without taking into account the specifics of local conditions, and this is the reason why the system of winter wheat cultivation remained almost universal. And this, in turn, determines the winter wheat yield, which is

* Corresponding author: dunaj-natalya@yandex.ru

not always high and stable for many years. It is relevant and realistic to select varieties that can effectively utilize heat energy and different illumination. Only having information about the potential yield, adaptability and stability of the variety, its ability to respond to improved growing conditions, it is possible to effectively use the variety under different energy conditions.

The purpose of our research was to identify varietal productivity of winter wheat in the conditions of the Central Chernozem region. The research was conducted in 2020-2022 in the conditions of the foothill zone in LLC "Dubovitskoe" Maloarkhangel'sky district of Orel region. The work considers the issues of biology, developed agrotechnical bases of winter wheat production, allowing to scientifically justify the technology of growing high and stable yields of this crop [6, 7, 8].

2 Materials and Methods

Technology of grain sowing, generally accepted in the zone. AMAZONED 9-60 Super seeder was used for sowing (row spacing width - 12.5 cm) with seed application rate - 2.5 (4.5) million seeds/ha. Mineral fertilizers: main fertilizer - diamphoska application rate (NPK - 10:26:26); pre-sowing - sulfur-containing ammonium nitrate (N+S - 31:6). The area of the sowing plot is equal to 1200 m², the area of the accounting plot is equal to 100 m². Repetition in the experiment was threefold. All related analyses were carried out according to generally accepted methods and GOSTs. Studying the conditions for winter care of the crop, we can characterize them as satisfactory. Analyzing the meteorological data of the vegetation period of winter wheat (April - July), the following features of the season can be noted.

In the system of agrotechnical measures determining the efficiency of intensive technologies, an important role belongs to crop rotation. The influence of crop rotation extends to all aspects of plant life and all processes in the soil. As for weed treatment, it should be borne in mind that modern herbicides are highly effective, used in small doses. When determining the timing of harvesting use visual: by the state of the crops, the color of the straw, the upper internode, the color and consistency of the grain.

The choice of high-quality winter wheat varieties, that is, the use of the genetic resource of the variety, is a decisive factor in increasing the yield of many crops, including winter wheat. When choosing seed material, it is worth competently assessing it and understanding all the risks of its cultivation. Breeders around the world have been working for many years to develop new productive and high-quality crop varieties [9].

3 Results

One of the priority directions for breeders is to improve the quality of wheat grain, depending on the initial seed. The economic value of a variety depends on the quality of the grown products, which is determined by the totality of biological and technological, food and baking properties. The understanding of grain quality can be different depending on the direction of its use. It is believed that grain quality consists of many components that best match the genetic potential of the variety being bred. Great attention should be paid to the adaptive adaptation of varieties to external environmental conditions, which will determine how consistently the programmed yields can be obtained. When selecting source material for breeding, not only the genotypic potential of grain quality should be taken into account, but also the reaction to changes in conditions during the period of filling and formation, the degree of its preservation in unsuitable environmental conditions. The quality of seed material is shown in Table 1.

Table 1. Seed quality of original seed material

Category of seed sown	Grom	Sineva	Moskovskaya 56
Purity, %	99.8	99.6	99.0
Viability, %	98.0	96.0	99.0
Seed yield, %	97.8	95.6	99.0

The climatic conditions in May can be characterized as normal for this period in comparison with long-term data. At the end of the vegetation period of winter wheat (July), when grain formation is completed, most of the precipitation fell in the first and third ten-day period of the month, 56.8 mm, which is 25% less than the multiyear norm. At the same time, precipitation had a heavy rainfall character, which increased susceptibility to diseases of leaf-stem apparatus of plants. The temperature was below the multiyear norm by 1.1°C. Assessing the season of 2022, it can be noted that in general meteorological data characterize the growing season of winter wheat as dry, and moisture conditions are insufficient. Data on overwintering of winter wheat varieties are presented in Table 2. According to the data of Table 2, it follows that variety Sineva best passed the overwintering stage (95%), which is more than the control (variety Grom) by 17%. The variety Moskovskaya 56 index characterizing overwintering was 2% lower than the control.

Table 2. Influence of varietal characteristics on winter wheat overwintering

Winter wheat variety	Number of stems before winterization, pcs./1 plant	Number of stems after overwintering, pcs./1 plant	Overwintering %
Grom (control)	3.6	2.8	78
Sineva	3.8	3.6	95
Moskovskaya 56	3.7	2.8	76

Our research shows that winter wheat varieties have a significant effect on the indicators of yield structure elements (Table 3)

Table 3. Effect of variety on elements of winter wheat yield structure

Winter wheat variety	Productive bushiness	Spike length, cm	Number of grains in spike, pcs.	Grain weight in spike, g	Weight of 1,000 grains, g
Grom	2.1	8.6	30	1.10	36.9
Sineva	2.3	9.5	38	1.12	41.1
Moskovskaya 56	2.2	7.4	27	1.06	34.2

The highest weight of 1000 grains of winter wheat was achieved in the variety Sineva - 41.1 g, which is 4.2 g higher than the standard Grom.

The highest coefficient of productive bushiness of winter wheat was provided by variety Moskovskaya 56 - 2.2, which is higher than the standard Grom by 0.1 and the variety Sineva (+0.2 to control). The variety Sineva showed the best indicators for spike length, grain weight in the spike and the number of grains in it (9.5 cm, 1.12 g, 38 pcs.), which is higher than the control by 0.9 cm, 0.02 g and 8 pcs. grains, respectively.

The data in Table 4 show that both weather conditions and genetic characteristics of cultivated varieties influenced winter wheat yield. Thus, under the conditions of 2022, this indicator by variety ranged from 51.0 kg / ha for variety Moskovskaya 56 to 78.6 kg / ha for variety Sineva.

Table 4. Yield of winter wheat varieties

Winter wheat variety	Yield, c/ha	Deviation from control, +, -	
		c/ha	%
Grom (control)	71.5	-	-
Sineva	78.6	+7.1	+ 9.9 %
Moskovskaya 56	51.0	-20.4	- 28.5 %
NWR ₀₅		4.8	

In the variety Sineva, the yield increased by 7.1 c/ha, or 9.9 %. At the same time, the yield of Moscow 56 decreased by 20.4 c/ha (28.5 %).

Research has established that winter wheat varieties provide gluten content in grain at the level of 23.9 - 26.6% (Table 5), which corresponds to the second quality group.

Table 5. Technological qualities of winter wheat grain depending on variety

Winter wheat variety	Sodium, g/l	Vitreousness, %	Gluten in grain, %	Gluten quality, units. FDM	Quality Group
Grom	775	45	23,9	77	II
Sineva	765	47	26,6	85	II
Moskovskaya 56	725	44	25,9	84	II

An important indicator characterizing the quality of winter wheat grain is gluten content. The highest quality of gluten in the grain of winter wheat variety Sineva - 26.6%, which is higher than the variety Grom by 2.7%. The studied varieties of winter wheat by gluten content in the grain corresponds to the second class. Thus, on average, the highest grain vitreousness is provided by variety Sineva 47%, which is 2% higher than the control variety Grom. The variety Sineva corresponds to the second class in terms of grain vitreousness. The higher the grain with high natura, the more endosperm it contains. High natura grain has a higher flour yield. Thus, more fulfilled grain was in variety Sineva 765 g/l, which is lower than variety Grom by 10 g/l.

4 Conclusions

Based on the research conducted in 2020-2022 the following conclusions follow:

1. Variety has a significant effect on the level of winter wheat overwintering: in the control variety Grom overwintering was 78%, and in the variety Sineva increased by 17%, reaching the level of 95%.

2. The maximum indicators of elements of yield structure were observed in the variety Sineva: compared to the control, productive bushiness increased by 0.2, spike length - by 0.9 cm, the number of grains in a

3. Compared to the control, the yield of the variety Sineva increased by 7.1 c/ha, or 9.9%, the variety Moskovskaya 56 showed a decrease in yield by 20.4 c/ha, or 28.5%.

4. The best indicators of technological qualities of winter wheat grain were observed in the variety Sineva: vitreousness increased by 2%, crude gluten content - by 2.7%.

5. The maximum natural grain was formed on the control variety Grom and amounted to 775 g / l, which is higher than the variety Sineva by 10 g / l and variety Moskovskaya 56 - by 50 g / l.

References

1. E. A. Batrachenko, et.al., IOP Conference Series: Earth and Environmental Science **677**, 42081 (2021) DOI 10.1088/1755-1315/677/4/042081
2. A. V. Musyal, *The concept of investment activity in agriculture*, Priorities of economic growth of the country and regions in the postpandemic period: Collection of materials of the All-Russian scientific and practical conference, Kursk, November 19-20, 2020 / Edited by O. N. Pronskaya. - Kursk: Kursk State University, 2020. pp. 62-64 (2020)
3. Z. I. Latysheva, E. V. Skripkina, N. A. Kopteva, et al. CuestionesPolíticas **37**, 65. 116-126 (2020). DOI 10.46398/cuestpol.3865.09
4. N. V. Dolgopolova, Agrobiological substantiation of the development of cultivation technologies of spring durum wheat in adaptive-landscape farming of the Central Black Earth Region forest-steppe: specialty 06.01.01 "General agriculture, plant growing": abstract of the dissertation for the degree of Doctor of Agricultural Sciences (Bryansk, 2014)
5. E.N. Kovaleva, D.A. Vasilyev, S.A. Plygun, et al. Advances in Environmental Biology **10**, 3. 1-3 (2016)
6. E.V. Malysheva, N.V. Dolgopolova, A.V. Nagornykh, Bulletin of Kursk State Agricultural Academy **6**. 35-40 (2021)
7. S.N. Volkova, E.E. Sivak, A.V. Shleenko, Provincial Scientific Notes **1(9)**. 100-105 (2019)
8. A.S. Akimenko, T.A. Dudkina, N. V. Dolgopolova et al., Zemledeliye **4**. 10-14 (2021). DOI 10.24411/0044-3913-2021-10403
9. T. A. Dudkina, et.al., *The role of weather conditions in the formation of yield and quality of winter wheat grain in Central Chernozem Region*, IOP Conference Series: Earth and Environmental Science, Omsk City, March 29-30, 2021. - Omsk City, 2022. - P. 012024 (2022). DOI 10.1088/1755-1315/954/1/012024