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WHEAT CULTIVATION IN UZBEKISTAN-CASE STUDY FROM NORTH UZBEKISTAN

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ABSTRACT

The article provides data on the results of the study of seven varieties of winter wheat. According to the data obtained, the growth and development of winter wheat varieties differ depending on the characteristics of weather and climatic conditions and the genotypic properties of winter wheat varieties. Thus, in the growing season favorable in terms of heat supply, the leaf area and the accumulation of dry matter were higher than the hot growing season. Analysis of the technological properties of wheat also showed that these indicators change depending on the genotype of varieties and the prevailing conditions of the spring-summer period. Thus, during the growing season favorable in terms of heat supply, the leaf area and the accumulation of dry matter were higher than during the hot growing season. Analysis of the technological properties of wheat also showed that these indicators change depending on the genotype of the variety and the prevailing conditions of the spring-summer period.

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Introduction. At present, winter wheat occupies the 2nd place (29%) after corn (40%) in terms of the volume of grain production worldwide. Wheat grain is a staple food crop for more than half the world's population; its calorific value is about half of the food balance in the human diet. The volume of global wheat production in 2019 amounted to 742.4 million tons, of which over 715.1 million tons (96.3%) are the soft wheat varieties.

Winter wheat is one of the main crops in the agricultural sector of the Republic of Karakalpakstan. The five priority directions of development of the Republic of Uzbekistan during the period of 2019–2021 stated in the Chapter III of the Strategy of Action indicate further strengthening of the country's food security, widespread introduction of intensive methods into agricultural production, primarily resource-saving agro-technologies in the development of grain production. In this regard, the increase in the production of high-quality soft wheat for domestic consumption and export is the main issue of agricultural production.

To date, no previous studies have been conducted in the soil and climatic conditions of the Republic of Karakalpakstan on developing zonal technologies in the region that ensure formation of soft wheat varieties, which will provide favorable conditions for the growth and development of soft wheat, and contribute to improving the grain quality in the northernmost region of Uzbekistan.

The purpose of the study is to select winter wheat varieties and sowing dates, taking into account the soil and climatic conditions of the area of cultivation, improvement of the cultivation technology aimed at reducing the harmful effects of soil salinity in the Republic of Karakalpakstan.

Research objectives are to:

study the cultivation technology of soft winter wheat varieties in the soil and climatic conditions of the central zone of Karakalpakstan;

identify the response of high-yielding wheat varieties to wintering conditions, photosynthetic productivity, yield formation and grain quality in conditions of the central zone of Karakalpakstan;

scientifically substantiate the effects of optimal winter wheat sowing dates on field germination of seeds, plant height, photosynthetic productivity, accumulation of dry matter, yield and grain quality.

Materials and methods. The objects of the study are the winter wheat varieties Kroshka, Polovchanka, Krasnodarskaya 99, Grom, Asr, Zimnitsa, Gratsiya, Tanya, Garezsizlik, winter wheat sowing dates.

Subject of research are germination, overwintering, preservation of plants by the harvest period, growth and development, photosynthetic activity of wheat plants, dynamics of dry weight accumulation, yields of grain in various cultivation methods, amino-acid composition of proteins by wheat varieties, quality indicators of winter wheat grain.

Research methods. Field and laboratory studies, phenological observations were carried out in accordance with the "Methodology of the State variety testing of agricultural crops", "Methods of agrochemical, agrophysical and microbiological studies in irrigated areas" and "Methods of field experiments" developed at the Uzbek scientific research institute of cotton growing (Tashkent, 2007);

The study of photosynthetic crop activity was carried out according to a method developed by A. Nichiporovich; Statistical analyses of experimental data were carried out according to the method of B.A. Dospekhov using Microsoft Excel.

The scientific novelty of this research work is that field germination, overwintering, plant preservation by harvest period, photosynthetic activity, peculiarities of yield formation and grain quality of the new adaptive wheat varieties were identified for the first time in meadow-alluvial soils of the Central zone of the Republic of Karakalpakstan.

Results and discussion. According to statistical data, the irrigated area under cultivation of the grain crops in the country in 1991 was 221 thousand ha. In 1998, only in the irrigated areas the wheat was sown on 1,150 thousand ha, and in 2019, the cultivated area amounted to 1,446.3 thousand ha. More than 7,500 thousand tons of grain were produced in 2018, while in 2019, 8,377 thousand tons of grain were harvested. The average yield of wheat in the country reached 5.5 tons per ha, while in some areas the yield was 6.0-7.7 tons per ha.

The reforms in grain production and the improvement of wheat cultivation technology have contributed to expanding the area under this crop, increased yields and production of wheat grains.

The Republic of Karakalpakstan is located in the northern zone of Uzbekistan and is characterized by a sharp continental climate typical of extratropical deserts. The region of Southern Aral Sea region is distinguished by a continental climate, intensive insolation, increased air dryness and a small amount of precipitation. The average annual precipitation is 60-110 mm, which is considered the lowest in the Central Asia. The temperature regime is subject to sharp fluctuations from -30°C in winter to +45°C in summer as it should be in a sharply continental climate. Relative humidity in summer is very low, while in winter it is high.

During time of seed germination, the air temperature varies from +8.1 to 20.8ºC, which is +6.1 - 18.8ºC higher than the minimum germination temperature of winter wheat. During the years of the experiments, the sum of temperatures above +10ºC was higher than perennial by 232.1-632.9ºC, and the amount of precipitation was less by 2.6-56.1 mm.

According to literature data [2, 10, 11-13], conducted in different natural and climatic conditions, it is noted that the use of winter wheat varieties, which are better adapted to local conditions is the most effective way to obtain high yields with good quality of grain. Therefore, we have selected promising varieties that are distinguished by such economically useful properties as: high productivity, frost resistance, drought and heat resistance, grain quality.

During the study period of 2018–2019, the meteorological conditions in the study sites were favorable for seed germination, development in autumn, overwintering and spring- summer growth and formation of yields by winter wheat varieties in all three planting periods.

The wheat crops were sown on September 25, first shoots appeared in October 3-5, tillering phases started in October 11-13. The average daily temperature during this period was 12-10ºC.

Spring growth of winter wheat took place in February 19-20, the heading phase in April 27-29. The phenological development phases were similar during the years 2019-2019.

Field germination, overwintering and preservation of plants by period of harvesting differed over the research years. In 2019, all varieties had high rates, but the wheat variety Asr had the highest field germination rates – 442 plants m^{-2} or 73.7% (Table 2), together with the local selection varieties

Garezsizlik - 469.3 plants m^{-2} (78.2%); Krasnodarskaya-99 variety had similar rates – 438 plants m^{-2} (73%), while Gratcia (418.6, 69.8%) and Grom (422.6 plants m^{-2}, 70.4%) has the smallest rates.

The most important indicator of the stable productivity of winter wheat varieties in the Republic of Karakalpakstan is a certain level of overwintering and frost resistance, which should be a guarantee of reliable wintering in years with harsh winter conditions. According to D.V. Vornikov et al. [4], greater winter- and frost resistance of a winter variety leads to the less losses and higher yields. According to the obtained experimental data, the largest number of overwintered plants was observed in the varieties Gratsiya, Grom, Krasnodarskaya 99 and Garezsizlik.

Dynamics of plant height. V.I. Vozian, A.A. Postolati, T.D. Sergey, L.V. Geine [5], recommend predicting the possibility of assessing the adaptability of wheat varieties by plant height than by productivity, the first method being more accurate. Higher productivity is formed in genotypes with a relatively low plant height. Our studies showed that the growing conditions influenced on the plant height (Fig. 2 and 3). For example, during the growing season of 2019, the height of plants was higher compared to that in 2018. Measurements showed that the most intensive growth of plants takes place during phenological period of "stem elongation" – "heading", when the growth rate of Krasnodarskaya 99 was 26 cm; for other varieties, the increase of height was 40-41 cm. Among the studied varieties, the highest plant height was observed in the Garezsizlik variety – 97 cm, in the Gratsiya variety it was 92.7 cm and in the Zimnitsa variety - 91.2 cm.

It was observed that the accumulation of dry matter in trials varied by varieties. The largest amount of dry matter was accumulated by the following varieties: Gratsiya – 10.26 t ha^{-1} (2019) and 12.26 t ha^{-1} (2018); Krasnodarskaya 99 – 10.96 and 11.07 t ha^{-1}, respectively; Tanya – 10.51 and 11.04 t ha^{-1} and Zimnitsa 10.28 and 10.39 t ha^{-1}. High rates of dry matter accumulation by these varieties contributed to an increase of grain yield. The correlation between the accumulation of dry matter and yield was very high, $r = 0.96$ (Fig. 1).

Yield and structure of the harvest of varieties of winter wheat. According to E.V. Ionova, N.E. Samofalov [9], V.S. Valekzhanin, N.I. Korobeynikov [3], the capacity of wheat varieties to resist the influence of adverse abiotic factors of winter and spring conditions and hot weather during the grain accumulation period allows to increase the wheat grain yields in an inexpensive way.

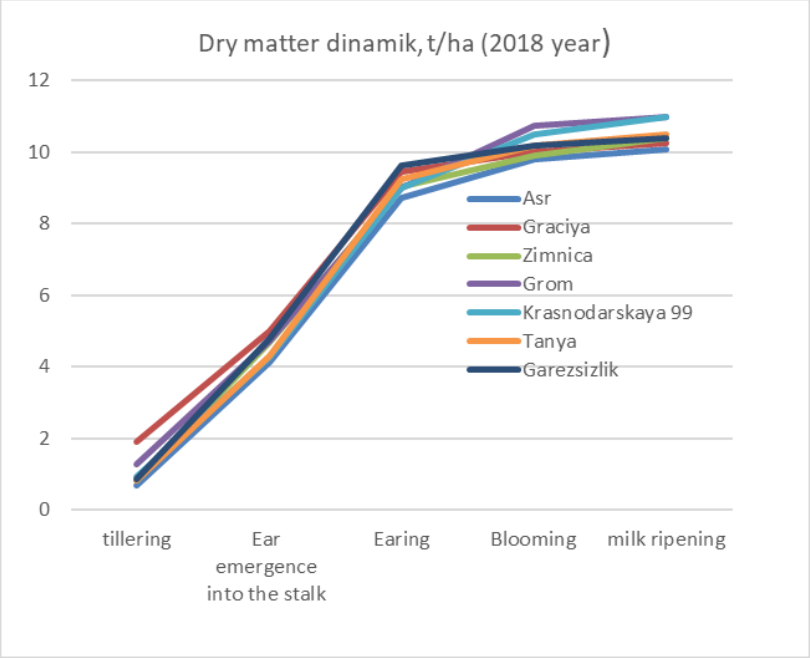

Fig. 1. Dynamics of dry matter formation by winter wheat varieties (2018 year), kg ha^{-1}

The varieties used in the experiment were distinguished by good resistance to adverse wintering conditions, heat and drought and good grain quality.

According to the research results, the wheat variety Grom had high productivity under these conditions: the average grain yield was significantly higher compared to the other varieties and amounted to 7.03 t ha^{-1} (Table 1).

Table 1. Productivity and yield structure of the winter wheat varieties in 2018

Name of varieties	Producti-vity, t ha^{-1}	Plant density before harvest, plants m^{-2}	Productive layering capacity, branches	Length of ear, cm	Number of grains in one spike, grains	Weight of grain per spike, g	Weight of 1000 grains, g
Asr	6.46	248.0	2.6	8.9	34.4	1.4	41.3
Gratsiya	6.61	277.2	2.4	10.4	36.5	1.5	42.1
Zimnitsa	6.38	279.1	2.2	7.5	33.4	1.2	42.4
Tanya	5.73	244.0	2.2	6.7	30.6	1.2	40.8
Grom	6.86	258.0	2.4	6.4	37.2	1.4	42.5
Krasnodarskaya 99	5.92	236.4	2.1	7.5	33.5	1.4	42.1
Garezsizlik	5.25	232.0	2.1	8.3	31.3	1.2	40.3
least significant difference$_{05}$ 0.23 t ha^{-1}							
$S_{\bar{x}}$ 4,2 %							

The average yield during the three years of experiments was 6.67 t ha^{-1} of the Zimnitsa variety; 6.59 variety Gratsiya variety and 6.41 Asr variety (Tables 2,3). No significant differences were observed between these varieties. The grain yields of Tanya variety ranged 5.73 – 6.26 t ha^{-1}.

The yield of selected varieties varied over the research years. Analysis of weather conditions showed that in 2019, the year characterized as the most high-yielding, the temperature in May and June was at the annual average level, the maximum temperature did not exceed +38ºC in May and +41ºC in June.

The maximum temperature in 2018 and 2019 reached 41-43ºC in May and June, during which inhibition of crops, decreased layering capacity and grain mass of an ear were observed. The average yield in the trials was 6.17 and 6.06 t ha^{-1}, respectively, which was 0.47 and 0.60 t ha^{-1} lower than the average yield in 2019 (Tables 2,3). In general, high daytime temperatures in combination with low air humidity during the grain formation phases lead to reduced crop yields.

Hence, the wheat varieties with a potential high-yield in conditions of the Southern Aral Sea region, cannot show their full potential especially in field conditions. For example, a highly productive Tanya variety with a potential grain yield of 9.48 t ha^{-1} in the experimental plots, exhibited the average grain yield of only 5.95 t ha^{-1} during the 3 years of experiments, which is lower compared to other highly productive winter wheat varieties.

In all research years, high productivity was observed in the variety Grom with an average yield for the three years of 7.03 t ha^{-1}, Gratsia 6.59 t ha^{-1}, Zimnitsa 6.67 t ha^{-1}, ASR 6.43 t ha^{-1}. These observed yields were significantly higher than the standard yield of the local variety Garezsizlik, the productivity of which was relatively low compared to other varieties, especially in the climatic conditions of 2019.

Analyses of the yield structure showed that the high productivity of varieties was due to the greater plant density by the time of harvest. Productive layering capacity of wheat plants was 2.4-2.6 branches, the number of grains per spike 33.4 (Zimnitsa variety) and 37.2 (Grom variety). High productivity of varieties characterizes their higher adaptability to the adverse winter and spring periods, high temperature in early summer and aridity of the soil and climatic conditions of the region.

According to P. Joseph [8], the environmental conditions affect the number of grains, grain weight and yields of winter wheat. In research conditions, the grain yield is formed due to greater productive layering capacity, number of grains in a spike and weight of grain from one ear. The high-yielding varieties had high values of these indicators. For example, the grain yields of the wheat varieties Asr, Gratsiya and Grom in the climatic conditions of 2018, increased due to the greater plant density: 248-279 plants per 1 m^2; high productive layering capacity of 2,4 - 2,6 branches per plant; a larger weight of grain per spike of 1.4-1.5 g.

The weight of 1000 grains characterizes the size, which varies depending on the characteristics of the variety and the environmental conditions. The varieties Grom (42.5 g), Zimnitsa (42.4 g) and Gratsiya (42.2 g) had the high weight of 1000 grains in 2018. In 2019 and 2019, these values were slightly higher (Table 3).

Table 2. Productivity and yield structure of the winter wheat varieties in 2018

Name of varieties	Producti-vity, t ha^{-1}	Plant density before harvest, plants m^{-2}	Productive layering capacity, branches	Length of ear, cm	Number of grains in one spike, grains	Weight of grain per spike, g	Weight of 1000 grains, g
Asr	6.51	316	2,4	10,0	48,2	1,9	43,4
Gratsiya	6.75	272	2,7	11,0	49,4	2,2	42,9
Zimnitsa	7.08	228	2,6	7,9	44,7	1,6	44,6
Tanya	6.26	232	2,9	7,9	41,9	1,8	45,0
Grom	7.62	276	2,7	9,0	42,0	1,6	45,2
Krasnodarskaya 99	6.28	216	2,3	11,7	47,2	2,2	46,6
Garezsizlik	6.07	264	2,3	9,9	46,0	1,9	43,2
least significant difference$_{05}$ 0.38 t ha^{-1} $S_{\bar{x}}$4,3%							

The technological properties of the grain characterize the use of grain of soft wheat varieties in baking. The natural weight of grain is 728 - 770 g l^{-1} (Table 4). The highest indicators of the natural weight of the grain were observed in the varieties Krasnodarskaya 99 - 760 g l^{-1}; Gratsiya - 748 g l^{-1}, Grom - 752 g l^{-1}, and Zimnitsa - 750 g l^{-1}. The lowest values were observed in the varieties Tanya and Garezsizlik - 740 g l^{-1} and Asr - 730 g l^{-1}. Grain glassiness is closely correlated with a protein content in the grain. Grain glassiness of the varieties Krasnodarskaya 99 and Zimnitsa was 72%, and the protein contents in these varieties were the highest, being 14.4 and 14.5%, respectively. These indicators of the Tanya variety were 68% and 13.6%, Gratsiya 64 and 12.8%, Garezsizlik: 63 and 13.2%, Asr varieties 61 and 12.5%, respectively, and Grom - 60%.

Table 3. Productivity and yield structure of the winter wheat varieties in 2019

Name of varieties	Producti-vity, t ha^{-1}	Plant density before harvest, plants m^{-2}	Produc-tive layering capacity, branches	Length of ear, cm	Number of grains in one spike, grains	Weight of grain per spike, g	Weight of 1000 grains, g
Asr	6.27	316	2.2	10.0	45.2	1.6	41.5
Gratsia	6.41	192	2.3	10.4	43.5	2.0	42.4
Zimnitsa	6.54	228	2.6	7.9	44.7	1.3	42.2
Tanya	5.87	232	2.4	7.9	40.6	1.6	41.8
Grom	6.63	276	2.7	9.0	41.4	1.5	42.7
Krasnodarskaya 99	5.68	216	2.2	11.7	42.5	2.0	42.7
Garezsizlik	5.01	264	2.3	9.9	41.0	1.4	42.1
least significant difference $_{05}$ 0.31 t ha^{-1}							
$S_{\bar{x}}$ 3.2 %							

Table 4. Technological indicators of the grain quality of various winter wheat varieties

Variety	Grain nature, g l^{-1}	Glassiness, %	Protein contents in grain, %	Gluten contents, %	Gluten quality (IDK indicator)
Asr	730	61	12,5	24	74
Gratsiya	748	64	12,8	25	70
Zimnitsa	750	72	14,4	27	68
Tanya	740	68	13,6	24	77
Grom	752	68	12,2	24	78
Krasnodarskaya 99	760	72	14,5	28	72
Garezsizlik	730	63	13,2	25	82

The protein contents of the grains above 14% were observed in the wheat varieties Krasnodarskaya 99 - 14.5 %, Zimnitsa 14.4 % and Garezsizlik 14.2 %, and slightly less in Tanya - 13.6 %. The other varieties had the protein contents of 12,2 - 12.8 %. The gluten contents in the grain

in these varieties were similar. The correlation between the contents of protein and gluten in the grains of the studied varieties was high, *r = 0.76*.

According to Alabushev A.V. [2] the quality of wheat grain depends on the protein content in the grain and its balance in amino acids. Therefore, the mineral acid composition and the biological value of proteins are important.

Conclusions. In the field conditions of the Republic of Karakalpakstan, the choice of the right variety, adapted to the local soil and climatic conditions on the basis of photosynthetic activity and the accumulation of dry matter, as well as the structure of the yield, contributes to the formation of the highest grain yield in large sowing areas. The grain quality was also the highest in the Krasnodarskaya 99 variety adapted to these conditions, the protein content was -14.5 and the gluten content was 28%.

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