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DEVELOPMENT OF INTENSIVE-TYPE, HIGH-YIELDING SPRING WHEAT BREEDING MATERIAL WITH HIGH GRAIN QUALITY

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ABSTRACT
Hybridization of wheat varieties from ecologically and geographically distant origins provides a basis for producing genetically productive hybrids that combine hereditary characteristics developed under different conditions. These hybrids express traits that arose in the parental forms under different environmental conditions.

Keywords: Bread wheat, hybrid, inheritance, variability, 1000-grain weight, protein content, grain, iron content, selection.

Introduction
Relevance and necessity of the dissertation topic. Worldwide, “in 2023, winter and spring wheat were sown on a total area of 29,9 million hectares (0,8% compared with 2022), with winter wheat accounting for 52,7 % and spring wheat for 47,3 % of the area.” In particular, “the shares in spring-wheat-growing countries are Canada - 55 %, the USA - 42 %, Mexico - 70 %, the European Union - 35 %, and Russia - 23 %. Furthermore, the area under spring wheat worldwide is increasing because of its high grain quality (protein content of 16-24 %, gluten content of 28-

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40 %, and bread-making properties) and its ability to provide 2-3 harvests per year."

Climate change currently observed worldwide is adversely affecting various sectors. Agriculture remains one of the most severely affected sectors and is undergoing substantial changes as temperatures rise. Studies in many countries indicate that climate change may cause considerable agricultural losses. Therefore, analysing the two-way relationship between climate change and agriculture, selecting intensive-type, high-yielding spring wheat breeding material with tolerance to abiotic factors and high grain quality, and using this material to develop new varieties adapted to different climatic conditions are pressing tasks.

Research aim

To develop intensive-type, high-yielding, early-maturing spring bread wheat breeding material with tolerance to abiotic factors, resistance to heat and drought, and high grain quality, adapted to the soil and climatic conditions of irrigated areas in the southern region of the republic.

The research objectives are as follows:

to select parental pairs for developing, through hybridization, early-maturing, high-yielding varieties with high grain quality and resistance to adverse environmental conditions, particularly heat and drought;

to analyse the inheritance and variability of economically valuable traits in the F_1-F_2 hybrid generations;

The objects of the research were irrigated light sierozem soils in Kashqadarya Region; the spring bread wheat varieties Janub Gavhari, Navruz, and Parvoz; 75 varieties and lines obtained from international research centres (ICARDA and CIMMIT); and 20 F_1–F_2 hybrids.

The subject of the research comprised hybridization of spring wheat varieties and lines, grain quality parameters, and analyses of the inheritance and variability of plant height, spike length, number of spikelets per spike, and 1000-grain weight.

Hybridization of spring wheat varieties and accessions.

Although the varieties currently included in the State Register for cultivation in the

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southern regions of the republic have high yield potential, they have attracted some criticism because of unstable yields across years under adverse environmental conditions and poor grain quality. The main objective of the research is to develop high-yielding, drought-resistant primary breeding material and varieties with high grain quality, adapted to the natural and climatic conditions of all regions of the republic.

Developing new varieties with novel genotypes, high and stable yields, and high grain quality, taking into account the natural and climatic conditions of each region, is one of the pressing tasks today.

When developing varieties adapted to each region, it is particularly important for plant breeders to select highly productive genotypes and to make appropriate, targeted choices of parental forms for hybridization.

Crossing is a key component of breeding and was carried out by crossing parental forms ♀♂ and selected donor varieties.

In this study, spring bread wheat was evaluated in a competitive variety trial nursery. Taking plant earliness into account, accessions with heat and drought tolerance and high grain yield were selected from among the varieties and lines, and 20 cross combinations were produced in 2025.

Analysis of hybrid seed set showed the highest values in the combinations Janub Gavhari x Navruz, Janub Gavhari x KR20-DSBWYT-07, Janub Gavhari x KR20-HTSBWYT-38, KR20-HTSBWYT-35 X KR20-ESBWYT-12, Navro‘z X Parvoz, and KR19-DSBWYT-29639 X KR20-HTSBWYT-41, which produced 70 to 82 grains, corresponding to 70% to 82%. The other hybrid combinations produced 57 to 68 grains, with seed set exceeding 68 %. It should be noted that hybrid seed set was particularly high in combinations in which Janub Gavhari and Navruz were used as male parents.

The hybrid grains obtained were generally well filled and had normally developed embryos. In the following year, the hybrid grains were sown alongside their male and female parental forms for comparison, and the inheritance and variability of the traits were analysed.

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Table 1 Number of grains obtained from spring bread wheat hybrid combinations (Karshi, 2025).

No	Varieties and hybrid combinations	Number of spikes crossed	Number of spikelets crossed	Grains obtained	
				Count	%
1	Janub Gavhari X Parvoz	5	100	58	58
2	Janub Gavhari X Navro‘z	5	100	70	70
3	Janub Gavhari X KR20-DSBWYT-07	5	100	70	70
4	Janub Gavhari X KR20-HTSBWYT-38	5	100	68	68
5	KR19-DSBWYT-29639 X Janub Gavhari	5	100	58	58
6	KR19-DSBWYT-29639 X KR20-HTSBWYT-41	5	100	77	77
7	KR20-DSBWYT-04 X KR20-ESBWYT-39	5	100	65	65
8	KR20-DSBWYT-04 X SBWYT-2017-P-72	5	100	61	61
9	KR20-DSBWYT-04 X Parvoz	5	100	60	60
10	KR20-DSBWYT-04 X Janub Gavhari	5	100	68	68
11	KR20-HTSBWYT-35 X Janub Gavhari	5	100	57	57
12	KR20-HTSBWYT-35 X KR20-DSBWYT-05	5	100	57	57
13	KR20-HTSBWYT-35 X KR20-ESBWYT-12	5	100	71	71
14	Navro‘z X KR20-ESBWYT-12	5	100	63	63
15	Navro‘z X KR20-DSBWYT-05	5	100	67	67
16	Navro‘z X Parvoz	5	100	82	82
17	KR20-20thESBWYT-05 X Janub Gavhari	5	100	63	63
18	KR19-DSBWYT-29782 X KR20-HTSBWYT-38	5	100	67	67
19	KR20-HTSBWYT-38 X Navro‘z	5	100	58	58
20	KR20-20thDSBWYT-05 X KR20-DSBWYT-07	5	100	63	63
	Total:	**100**	**2000**	**1303**	**65,2**

Inheritance of plant height and spike length in F_1 hybrid combinations. To determine the inheritance of traits and characteristics of the varieties used as male and female parents in subsequent generations, the first-generation F_1 hybrids were sown in wide rows (30 cm between rows), with the male parent in the first row, hybrid seeds in the second row, and the female parent in the third row.

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Under field conditions, seeds of 20 hybrids were sown in 1-m rows on 20 February 2025 at the S. Raximov field site in Karshi District.

Evaluation of plant height inheritance in the F_1 generations studied in the experiment showed a very high degree of dominance, hp, of 5,00-13,00 in 5 hybrid combinations; strong dominance, hp, of 2,00-4,33 in 6 combinations; moderate dominance, hp, of 1-1,50 in 5 combinations; and intermediate values, hp, of 0,43-1,00 in 3 combinations. A negative correlation was noted.

Table 2 Inheritance of plant height in F_1 hybrid combinations of spring bread wheat (Karshi, 2025).

No.	Varieties and hybrid combinations	Female parent	Male parent	Plant height	
				F_1	hp
1	Janub Gavhari X Parvoz	71	72	78	13,00
2	Janub Gavhari X Navruz	72	74	74	1,00
3	Janub Gavhari X KR20-DSBWYT-07	70	76	78	1,67
4	Janub Gavhari X KR20-HTSBWYT-38	65	75	75	1,00
5	KR19-DSBWYT-29639 X Janub Gavhari	72	78	81	2,00
6	KR19-DSBWYT-29639 X KR20-HTSBWYT-41	74	76	80	5,46
7	KR20-DSBWYT-04 X KR20-ESBWYT-39	80	73	78	0,43
8	KR20-DSBWYT-04 X SBWYT-2017-P-72	72	79	83	2,23
9	KR20-DSBWYT-04 X Parvoz	83	81	87	5,00
10	KR20-DSBWYT-04 X Janub Gavhari	82	80	87	6,10
11	KR20-HTSBWYT-35 X Janub Gavhari	82	78	81	0,50
12	KR20-HTSBWYT-35 X KR20-DSBWYT-05	80	79	81	3,00
13	KR20-HTSBWYT-35 X KR20-ESBWYT-12	80,7	80	80	1,86
14	Navruz X KR20-ESBWYT-12	79	77	83	5,00
15	Navruz X KR20-DSBWYT-05	83	80	80	-1,00
16	Navruz X Parvoz	83	81	85	3,00
17	KR20-20thESBWYT-05 X Janub Gavhari	72	80	82	1,50
18	KR19-DSBWYT-29782 X KR20-HTSBWYT-38	75	79	82	2,50
19	KR20-HTSBWYT-38 X Navruz	76	73	81	4,33
20	KR20-20thDSBWYT-05 X KR20-DSBWYT-07	79,3	83	82	0,46

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In 3 F_1 hybrid combinations, the degree of dominance, hp=0,43 and -1,00, was found to be very low relative to the parental values.

The study of spike length inheritance in F_1 hybrid combinations showed that, relative to the parental traits, 17 of the 20 hybrid combinations had a degree of dominance ranging from hp=1,00 to 9,02. The highest values, ranging from hp=5,01 to 9,02, were recorded in 6 F_1 hybrids: KR20-DSBWYT-04 x Parvoz, KR20-DSBWYT-04 x Janub Gavhari, KR20-HTSBWYT-35 x KR20-DSBWYT-05, Navruz x KR20-ESBWYT-12, Navruz x KR20-DSBWYT-05, and KR20-DSBWYT-04 X SBWYT-2017-P-72. In 3 F_1 hybrid combinations, the degree of dominance was negative, with values of -1,00 and -1,05 (see Table 3.3).

CONCLUSIONS

1. In the F_1 hybrid combinations, the inheritance of plant height showed degrees of dominance ranging from hp=1,00-13,00 in 16 combinations. For spike length, hp=1,1-9,02 was recorded in 17 combinations; for the number of spikelets, hp=1,02-19,03; and for 1000-grain weight, hp=1,15-25,50. Hybrid combinations in which F_2 plants surpassed both parental forms in the inheritance of economically valuable traits were identified and will serve as initial material for selection breeding.
2. The effect of air temperature during the growing season of spring wheat varieties and lines was analysed. Two early-maturing lines, KR19-19thDSBWYT-29782 and KR20-20thDSBWYT-12, were found to have growing seasons 2-3 days shorter than those of the standard varieties and to be resistant to lodging and the abiotic stress of hot, dry winds (garmsel). Four additional lines were found to be tolerant and were selected.

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