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ASSESSMENT OF HEAT RESISTANCE OF DURUM WHEAT VARIETIES AND LINES FROM THE CONTROL FIELD UNDER LABORATORY CONDITIONS

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Abstract. 25 varieties and lines of rainfed durum wheat from the Control variety-testing field were evaluated for drought resistance under laboratory conditions. In a 15% sucrose solution, seed germination decreased by an average of 13%, while root length decreased by up to 35%. The lines KR21-DW-38, KR20-DW-17, and KR22-F6-DW-23 showed the highest drought resistance, while KR20-IDYT-15 and KR18-IDYT-25 showed the lowest resistance. The results indicate that these varieties and lines can be used in future breeding programs.

Key words: durum wheat, drought resistance, germination, breeding, rainfed region.

Introduction. Local wheat varieties grown in Central Asia are heat-resistant, with the high temperature causing protein coagulation being +55°C to +56°C during the early growth phases of the plant, and +61°C during the heading-grain filling phase; the most resistant wheat varieties belonging to other ecotypes can withstand up to +56.6°C to +58.2°C.

Furthermore, high temperature affects the plant's reproductive organs, leading to incomplete fertilization during flowering. If this occurs during the grain-filling period, grains are observed to remain unfilled and become shriveled. Yield drops sharply due to a decrease in the weight of 1000 grains. In varieties and lines resistant to heat and drought conditions, it has been observed that the closed, horizontal arrangement of leaves, the vigorous development of the root system, and the short duration of the grain-filling period are the main factors contributing to increased yield.

The most significant environmental problem in agriculture is the increase in global temperature. According to global climate models, the average ambient temperature is predicted to increase by 1-6°C by the end of the twenty-first century [Akter N., p. 37].

Plants grown in hot environments produce less biomass compared to those grown under optimal or lower temperature conditions. Daytime and nighttime temperatures around 30°C and 25°C, respectively, can have a serious negative effect on leaf formation and productive tillering processes in wheat [Farooq M., pp. 491-507].

Materials and methods. Field experiments were conducted in 2023-2025 in the rainfed fields of the Kurbonov Azizbek Ismatullayevich farm in Kamashi district, Kashqadaryo region. 25 varieties and lines of durum wheat from the control variety-testing field were sown in 20 m² plots, and their heat resistance was analyzed under laboratory conditions using the N. Kozhushko (1987) method, whereby seeds were subjected to a temperature of 56°C in a water bath [3]. The durum wheat varieties Langar, Leukurum-3, and Mingchinor, which are regionally zoned for rainfed areas, were used as standard varieties.

Results and discussion. During the study, root length, number of rootlets, and coleoptile length were also of great importance in assessing the heat resistance of the 25 durum wheat varieties and lines from the competitive variety-testing field for rainfed areas under laboratory conditions. Root length was observed to be higher in all varieties and samples when germinated in the control variant, i.e., in distilled water, compared to germination in the sucrose solution.

In carrying out the scientific research, 25 varieties and lines of durum wheat seeds were placed in bags sewn from gauze in the laboratory; the varieties and lines were placed in separate bags, and the serial number or name of each variety and line was written in pencil. The bags were tied with soft wire and placed in water preheated to the required temperature (56-58°C), and this temperature was maintained for 20 minutes in an ultra-thermostat.

According to the results, while the average seed germination rate in the control variant was 93.9%, this indicator decreased to 88.7% under heat exposure, i.e., an average decrease of 5.2 percentage points. This is considerably lower than the decrease observed under drought conditions (9.6%), indicating that durum wheat varieties are somewhat more resistant to heat stress than to salinity/drought.

Table 1

Laboratory analysis results for determining heat resistance of varieties and lines (Kamashi, 2023-2025)

№	Name of varieties and lines	Germination, %		Number of roots, (units)		Root length, (cm)		Coleoptile length, (cm)	
		H	X	H	X	H	X	H	X
1	Langar (st)	92	82	3,9	3,1	2,2	4,1	4,3	4,4
2	KR18-IDYT-13	96	88	4,5	4,1	4,1	2,3	4,2	3,8
3	KR18-IDYT-15	99	99	4,9	4,2	8,9	9,1	5,2	5,4
4	40th-IFWDON-35	90	92	4,6	4,0	5,4	4,2	2,4	2,1
5	KR17-DW-61	96	90	4,5	3,8	4,7	5,1	2,1	2,3
6	KR18-IDYT-22	92	87	3,9	3,6	5,2	4,7	4,8	4,0
7	40th-IFWDON-45	94	86	3,8	3,5	4,3	5,1	4,9	3,1
8	KR17-DW-72	95	84	4,6	4,3	5,7	4,3	4,2	3,7
9	KR18-IDYT-25	90	86	3,9	3,8	5,5	4,7	4,1	3,9
10	KR20-IDYT-15	97	98	4,9	5,0	8,8	8,9	5,0	5,1
11	KR20-F6-DW-8	94	84	3,9	3,8	7,1	7,0	4,7	4,9
12	KR19-IDYT-13	90	82	3,8	3,9	5,9	5,5	4,1	3,3
13	KR20-F6-DW-8	96	84	3,5	3,4	4,6	4,7	4,1	3,9
14	KR20-F6-DW-3	97	98	4,5	4,3	8,7	8,8	4,8	5,1
15	KR20-DW-28	91	84	4,4	4,2	5,7	5,1	4,1	3,5

16	KR20-IDYT-12	96	98	4,5	4,2	8,1	8,4	4,7	4,9
17	KR20-DW-17	94	100	5,0	4,6	9,0	9,1	5,1	5,3
18	KR21-DW-25	96	86	4,4	3,9	5,1	5,0	4,2	4,3
19	KR21-DW-29	94	90	4,5	3,9	7,5	7,0	3,1	3,1
20	KR21-DW-34	98	98	5,0	4,5	9,0	9,1	5,2	5,4
21	KR21-DW-38	97	90	5,0	4,2	6,6	6,5	4,5	4,1
22	KR22-DW-11	92	86	4,6	4,1	7,9	7,8	4,8	4,2
23	KR22-DW-20	91	83	4,2	4,0	8,5	8,1	5,1	4,5
24	KR22-F6-DW-23	90	82	4,6	4,2	7,7	7,5	4,3	4,4
25	KR22-F6-DW-34	91	80	5,0	4,1	8,4	8,1	4,7	4,0

Note: N - control (in plain water), X - seeds in a water bath at 56°C temperature

The average number of rootlets decreased from 4.42 to 4.03 (~8.8%). Notably, the average root length decreased by only 6.58 cm to 6.41 cm (~2.7%) — a fundamentally different result from the 37% decrease observed under drought. Furthermore, in a number of varieties (Langar, 40th-IFWDON-45, KR20-IDYT-12, KR20-IDYT-15, KR20-F6-DW-3, KR20-DW-17), root length was even observed to increase under heat exposure, which suggests that short-term high temperature may trigger an adaptive response that activates the root system in certain genotypes. Coleoptile length decreased on average from 4.35 cm to 4.11 cm (~5.5%).

Varieties most resistant to heat**.** According to the results, the KR20-DW-17 variety demonstrated the highest resistance — under heat exposure, its germination even increased from 94% to 100%, and its root length remained almost unchanged (from 9.0 cm to 9.1 cm). Likewise, 40th-IFWDON-35 (germination increased from 90% to 92%), KR20-IDYT-12 (increased from 96% to 98%), and KR20-IDYT-15, KR20-F6-DW-3 (germination difference of only 1%) also showed high heat resistance.

Varieties most sensitive to heat**.** In contrast, the KR20-F6-DW-8 line (row 13, from 96% to 84%, a difference of 12%) showed the largest decrease. Likewise, KR17-DW-72 (from 95% to 84%, a difference of 11%), KR22-F6-DW-34 (from 91% to 80%, a difference of 11%), and the standard variety Langar (from 92% to 82%, a difference of 10%) also showed relatively low heat resistance (Table 1).

Conclusion. The results obtained show that durum wheat varieties are relatively more resistant to heat stress than to drought, and that in some genotypes, short-term high temperature can even activate root system development. Varieties such as KR20-DW-17, 40th-IFWDON-35, and KR20-IDYT-12 are considered promising as heat-resistant genotypes for future breeding programs.

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