VARIABILITY AND HERITABILITY CHARACTERISTICS OF PLANT HEIGHT IN F_2 HYBRID GENERATIONS OF DURUM WHEAT *(TRITICUM DURUM)*

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Abstract. This article presents the results of the analysis of variability and heritability of *plant height in F_2 hybrid generations of durum wheat (Triticum durum). The research was conducted from 2019 to 2021 in the irrigated fields of the Lalmikor Agricultural Research Institute. According to the analysis results, the plant height of F_2 hybrid generations of durum wheat ranged from 83.8 cm to 97.8 cm. The coefficient of variation (V-variation) ranged from 1.5% to 5.8%, and the heritability (h2%) of the trait ranged from 22.54% to 80.49%. High heritability (60-100%) for the plant height trait was observed in 8 of the studied hybrid combinations. Specifically, F_2 hybrid generations with plant height heritability (h^2) above 60.0, which were selected, include Mingchinor x IcaKader, Mingchinor x Istiqbolli, Istiqbolli x Mingchinor, Omrabi 5 x Krupinka, Kristella x Makuz-3, Kristella x Mingchinor, IcaKader x Mingchinor, Mingchinor x Krupinka, and Makuz-3 x Omrabi 5.*

Keywords: *durum wheat, F2 hybrid generation, plant height, variability, inheritance, heritability coefficient, breeding.*

Introduction. Global gurum wheat cultivation in 2019, over 17 million hectares worldwide were sown with durum wheat, yielding a total of 38 million tons of grain. The leading countries in durum wheat production included: Canada – 5.2 million tons, Italy – 4.3 million tons, Turkiye – 3.7 million tons, United States – 2.3 million tons, Kazakhstan – 2.2 million tons, Syria – 2.2 million tons, Algeria – 2.2 million tons, France – 1.9 million tons, Morocco – 1.8 million tons, Greece – 1.1 million tons, Spain – 1.0 million tons, Tunisia – 1.0 million tons. These countries are considered the world's leading producers of durum wheat grain. [1]. Impact of climate change on durum wheat production due to increasingly severe climate changes from year to year, global air temperatures have risen by approximately +1.6°C, which has adversely affected both the grain yield and quality of durum wheat varieties. Furthermore, one of the major challenges in global agriculture is the development of new early-maturity durum wheat cultivars that offer high yield and grain quality, and are well-adapted to diverse soil and climatic conditions. [2].

Hybridization in plant breeding in the process of selection and development of new varieties and hybrids, crossbreeding plays a crucial role. It is essential to select parental lines appropriately, meaning that the choice of parent forms should be guided by the breeding objectives and target traits. One of the key approaches to selecting parental forms for hybridization is based on their yield performance indicators. [3, 4].

Challenges in breeding and hybrid selection as breeding challenges become increasingly complex, the demand for initial genetic sources and hybridization efforts continues to grow.

Although many cultivars have demonstrated strong performance under field and laboratory conditions, the resulting hybrid generations have not always been successful, as they often exhibit a range of undesirable traits. To achieve effective selection outcomes in breeding programs, it is crucial to perform accurate selection within F_2 hybrid populations, particularly based on valuable agronomic traits.

Experimental Results: Experimental research conditions (2019–2021) the research was conducted during the years 2019 to 2021 at the experimental irrigated fields of the Scientific Research Institute of Rainfed Agriculture. The F_2 hybrid generations were sown in autumn, side by side with their parental lines.

Genetic analysis of plant height in durum wheat hybrids in the seedling nursery of durum wheat, 16 F_2 hybrid populations were sown, and the heritability coefficient of plant height was analyzed using the formula proposed by Mahmud and Kramer (1951).:

$$h^2=\frac{VF_2-\sqrt{VP_1*VP_2}}{VF_2} * 100$$

VF_2 – Hybrid variation, VP_1 – Maternal (female parent) variation, VP_2 – Paternal (male parent) variation.

The obtained results were evaluated according to the Robinson et al. (1949) classification scale, dividing heritability capacity into the following categories: Low heritability: 0–30%, Moderate heritability: 30–60%, High heritability: 60–100%.

Analysis results revealed that in F_2 hybrid generations of durum wheat, plant height ranged from 83.8 cm to 97.8 cm. The coefficient of variation (V-variation) for this trait was observed to be between 1.5% and 5.8%, and the heritability (h^2%) ranged from 22.54% to 80.49%. Among the studied hybrid generations, a high heritability (60-100%) for plant height was identified in 8 combinations. Specifically, in the Mingchinor x IcaKader hybrid generation, plant height was 86.8 cm, the coefficient of variation (V) was 3.4, and the heritability (h^2) of the trait was 66.38. For the Mingchinor x Istiqbolli hybrid generation, plant height was 87.6 cm, V=3.9, and h^2=74.49. In the Istiqbolli x Mingchinor hybrid generation, plant height was 87.3 cm, V=3.7, and the heritability was h^2=73.11. The Omrabi 5 x Krupinka hybrid generation showed a plant height of 97.8 cm, V=5.8, and h^2=65.52. In the Kristella x Makuz-3 hybrid generation, plant height was 89.1 cm, V=4.9, and h^2=73.79. The Kristella x Mingchinor hybrid generation had a plant height of 89.9 cm, V=5.1, and h2=80.49. For the IcaKader x Mingchinor hybrid generation, plant height was 87.3 cm, V=3.2, and h^2=63.69. Finally, in the Makuz-3 x Omrabi 5 hybrid generation, plant height was 90.7 cm, V=4.6, and h^2=62.35, all of which were highly evaluated. (Table 1.).

Table 1.

Heritability of Plant Height in F_2 Hybrid Generation of Durum Wheat.

№	Names of hybrid generations (♀ x ♂)	Plant height, см			
		X	V	ẍ±	h²%
1	Mingchinor x IcaKader	86,8	3,4	3,7	66,38
2	Mingchinor x Istiqbolli	87,6	3,9	4,2	74,49
3	Istiqbolli x Mingchinor	87,3	3,7	4,0	73,11
4	Istiqbolli x ICAMOR TA04	90,1	2,0	2,3	40,21
5	Omrabi 5 x Krupinka	97,8	5,8	7,1	65,52
6	Makuz-3 x Krupinka	88,9	4,1	4,5	57,75
7	Makuz-3 x Mingchinor	83,8	1,6	1,6	27,38

8	Mingchinor x Makuz-3	84,2	1,5	1,6	22,54
9	Kristella x Makuz-3	89,1	4,9	5,5	73,79
10	Kristella x Mingchinor	89,9	5,1	5,7	80,49
11	IcaKader x ICAMOR TA04	89,3	3,4	3,8	58,93
12	IcaKader x Mingchinor	87,4	3,2	3,5	63,69
13	Mingchinor x Krupinka	90,1	4,3	4,9	68,80
14	Omrabi 5 x Mingchinor	87,5	3,0	3,3	55,28
15	Omrabi 5 x Makuz-3	89,0	3,2	3,5	45,87
16	Makuz-3 x Omrabi 5	90,7	4,6	5,2	62,35
Max. value		**97,8**	**5,8**	**7,1**	**80,49**
Min. value		**83,8**	**1,5**	**1,6**	**22,54**
Mean		**75,6**	**3,0**	**3,4**	**49,29**

Conclusions. In the F_2 hybrid generations of durum wheat, the segregation of the plant height trait was clearly observed in those hybrids exhibiting heritability estimates (h^2) above 60%, in accordance with Mendel's second law. Based on these findings, the following hybrid combinations were selected for further study due to their high heritability levels: Mingchinor × IcaKader, Mingchinor × Istiqbolli, Istiqbolli × Mingchinor, Omrabi 5 × Krupinka, Kristella × Makuz-3, Kristella × Mingchinor, IcaKader × Mingchinor, Mingchinor × Krupinka, and Makuz-3 × Omrabi 5. These results suggest significant genetic potential for stabilizing and improving plant height through selective breeding in early hybrid generations.

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