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Research on Yield and Quality Values of Some Chickpea (*Cicer arietinum* L.) Genotypes in Winter Sowing

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ABSTRACT

This research is a regional yield trial study within the scope of the national project carried out as a part of breeding studies. In this study, advanced chickpea genotypes and registered varieties are tested at different locations and the results of Adana location are discussed in this study. The experiment was conducted in 2023 to determine yield, morphological characteristics and quality values in winter sowing under Eastern Mediterranean ecological conditions. The experiment was set up in a randomized block design with four replications. In the study, plant height, flowering time, grain yield, hundred grain weight and quality parameters of the varieties were analyzed. According to the results, plant height of the varieties varied between 46,5-59,8 cm; Urfa GAP-3 genotype was the shortest and Adana-5 genotype was the tallest. Flowering time varied between 68,3-77,3 days; Aksu chickpea variety was the earliest and Diyarbakır-2 genotype was the latest. Hundred grain weight values varied between 38,8-49,3 g (Hasanbey-Adana-1 genotypes, respectively). Grain yield ranged between 129,5-316,0 kg/da from Adana-1 genotype and Hasanbey chickpea varieties, respectively. According to the data obtained at the end of the research, Hasanbey, Ubet, UrfaGAP-1, Aksu, and UrfaGAP-1 genotypes, which have the highest values in terms of grain yield, can be recommended for the region. However, in order to make a better decision, it should be supported by more long-term and detailed agronomic studies.

Keywords: Chickpea, winter sowing, yield and quality

Introduction

Chickpea belongs to the group of self-fertilizing plants with diploid chromosome number (2n=16) (Cobas et al., 2007 and chickpea is classified under the Fabaceae family. In Türkiye, chickpea is widely cultivated throughout the country and especially in Central Anatolia and serves as a multipurpose crop. First, it fixes atmospheric nitrogen in the soil, increasing soil fertility and reducing the need for fertilizer in subsequent crops. Legumes play an important role in promoting sustainable agriculture by maintaining soil fertility through biological nitrogen fixation together with symbiotic *rhizobium* present in root nodules (Negi et al., 2004). Secondly, chickpea can be grown in arid regions due to its taproot; it encourages more intensive and productive use of land, especially in areas where land is limited, as it plays an active role in removing or reducing fallow areas by making maximum use of soil moisture and ensuring crops every year (Yeşilgün, 2006). According to Gil et al., (1996) chickpeas are very important as an affordable source of protein. This suggests that the inclusion of chickpeas in a person's regular diet can reduce malnutrition and improve health, especially for poor people who cannot afford to buy cattle products.

The data for chickpea in Türkiye for the year 2022 show a cultivation area of 456,480 ha, a production of 580,000 tons, and a grain yield of 127,00 kg/da (FAO, 2024). Although the importance of chickpea plant is known, the average productivity is low throughout the country and production is realized far below its potential due to various reasons. The main factors limiting chickpea production are difficulty in accessing certified seeds, difficulty in accessing

improved varieties, constraints of biotic and abiotic stress factors Singh et al., (2016). Sharma et al., (2013). In addition to these, global climate change is another issue affecting agricultural production all over the world. Global climate change affects the growth and development of plants with decreasing precipitation, changing seasonal distribution of precipitation, increasing temperature and CO_2 concentration, changes in diseases, pests and weeds, and affects yield positively or negatively for different plant groups (Naumann et al., 2018; Zhu et al., (2016).

The aim of this study is to achieve the deserved yield and quality in chickpea production, which is intensively cultivated for sustainable agriculture in Türkiye. For this purpose, registration of chickpea varieties with high adaptation to regions, resistant/tolerant to biotic and abiotic stress factors and providing certified seeds to the service of farmers.

Materials and Methods

This research was conducted in the experimental field of the Institute at Adana location in the Eastern Mediterranean region in the 2023 growing year. The research experiment was established according to the randomized block design with four replications. Plots of 9 m^2 were planned as 4 rows (5mX4 rowsX0,45m) with 45 cm between rows and 8 cm above rows, and fertilizer was applied at 3 kg/da N and 6 kg/da P_2O_5 with planting. After the plants emerged from winter, weeds were controlled mechanically by hoeing when the plant height was about 10-15 cm and before flowering. The traits examined in the field studies were analysed in the JUMP statistical analysis programme using a random blocks experimental design.

Doğankent location, where the trials were planted in this study, is located at (37°00´ N, 35°20´ E) latitude and longitude coordinates and has alluvial soils in terms of soil structure. Çukurova region is a delta plain formed by the alluvium carried by Seyhan, Ceyhan and Tarsus rivers. The soils in the test area are loamy and have a slightly alkaline reaction. It is medium in organic matter, poor in nitrogen and phosphorus, but rich in potassium. Eastern Mediterranean Agricultural Research Institute Experimental Area Soil Analysis Report (Table 1.)

The experimental area is under Mediterranean climatic conditions and meteorological data are given in Table 2. When the temperature averages of the year in which the experiment was carried out are examined, it is observed that the temperature values are close to the long-term average in terms of temperature, but the temperature values in July showed values above the long-term average. In recent years, due to global warming, there have been irregularities in the distribution of precipitation and intensities in the amount of precipitation from time to time. In some years, heavy rainfall can damage plants by promoting root diseases. Stresses experienced in plants (drought, drying out, rotting due to excessive rainfall, or root diseases, etc.) cause yield and quality losses. In the 2023 growing year, it is observed that rainfall amounts are low compared to long years and their distribution is irregular. Relative humidity rates showed values parallel to long years (Table 2).

Results and Discussion

This research was carried out in the experimental field of Adana-Doğankent Institute in the 2023 growing year by sowing in December during the winter sowing period.

The lowest and highest plant height values of chickpea genotypes were obtained from Gap-3 chickpea genotype with 46,5 cm and Adana-5 genotype with 59,8 cm, respectively. The overall average plant height of the genotypes was 53,6 cm (Table 3). Plant height and first pod height are very important agronomic parameters in chickpea farming and they indicate whether the plants are suitable for machine harvesting or not. The height of the plant height of chickpea plants determines the suitability for machine harvesting Mart et al., (2017). It was found that plant height of chickpea genotypes varied between 39,0-60,2 cm in Konya conditions Ceyhan et al. (2013). The plant height values obtained by the researcher and the values determined in this study were similar. Chickpea sowing time has an effect on plant height values. Plant height values are higher in winter sowing than in summer sowing. Bakoğlu and Memiş, (2002), Since varieties with short plant height may cause significant grain losses in machine harvesting, it is of great importance to prefer tall varieties. Long plant height reduces grain loss in machine harvesting.

Plant Height (cm), Days of Flowering (days) and Anthracnose Disease Observations Values of Chickpea Genotypes are given in Table 3.

In terms of days to flowering, the lowest and highest values of days to flowering were obtained from Aksu chickpea variety with 68,3 days and Diyarbakır-2 genotype with 77,3 days, respectively. The average number of days to flowering of the genotypes was 72,6 days (Table 3). In chickpea farming, days to flowering values and days to pod pod podding represent the most important parameters indicating whether chickpea varieties are early or late Mart et al., (2017). In the studies conducted with the

days to flowering values of chickpea plants in terms of agronomic characteristics, Aydoğan (2012) found that the number of days to 50% flowering varied between 59,0-67,3 days, Karakan (2014) 57,0-62,3 days, Uzun et al., (2012) 57,5- 65,5 days, Bayrak et al., (2015) 56,5 days.

In the current study, varieties were tested for Ascochyta blight disease in disease gardens under artificial epidemic conditions in Ankara and Eskişehir locations. Under artificial epidemic conditions, Diyarbakır-2 genotype and Hasanbey and Ubet chickpea varieties were sensitive with a score reading of 7 in the Ankara disease garden,

In Eskişehir disease garden, varieties and genotypes were found to be tolerant genotypes with a score reading of 4-5 (Table 3). Ascochyta blight disease has a negative effect on chickpea hundred grain weight, average grain size values and yields, causing yield losses and decreasing hundred grain weight. Chickpea varieties to be planted for winter should have high tolerance/resistance to winter and Ascochyta blight disease.

Grain Yield (kg/da) and 100 Grain Weight (g) Values of Chickpea Genotypes are given in Table 4.

In this study, the statistical difference between genotypes in terms of yield was not found to besignificant. The lowest grain yield of chickpea genotypes was obtained from Adana-1 genotype with 1295 kg/ha, while the highest grain yield was obtained from Hasanbey chickpea variety with 3160 kg/ha. The general yield average of the genotypes was 2065 kg/ha. However, in terms of grain yield, Ubet with 2648 kg/ha, Urfagap-1 genotype with 2595 kg/ha, Aksu variety with 2581 kg/ha and Urfagap-2 genotypes with 2436 kg/ha were found suitable for evaluation (Table 4). Mishra et al. (2002) reported that the number of pods in a plant was the character with the highest positive effect on seed yield. Grain yield may vary depending on factors such as cultivation technique, climate and soil conditions and genetic structure of chickpea.

In this study, statistical differences among the genotypes in terms of 100 grain weight were significant; in terms of the values obtained, the largest grain variety was Adana-1 genotype with 49,3 g, the smallest grain varieties were Urfagap-3 genotype with 38,5 g and Hasanbey variety with 38,8 g. The general average of 100 grain weight of chickpea genotypes was 43,7 g. However, Adana-5 genotype with 47,9 g, Ubet variety with 47,1 g, Adana-3 genotype with 46,7 g and Urfagap-1 genotypes stood out as coarse grain (Table 4). The most important factor in price formation in the markets is the cleanliness and grain size of the product.

Generally, chickpeas with large grains are sold at higher prices. Another important issue in variety breeding is that grain size should be as homogeneous and stable as possible. In chickpea, hundred grain weight varies according to the environment in which the plant is grown, sowing time and norm and is known to directly affect grain yield. In the previous studies, it was reported that facial grain weight varied between 29,87-39,90 g by Yaşar (2010), between 30,6 and 47,6 g by Erdin and Kulaz (2014), between 32,2-41,4 g by Kaya et al., (2016), between 41,2-41,3 g by Yalçın et al., (2018). Facial grain weight is similar to previous studies. The reasons for the difference are thought to be affected by the genotypes used and environmental conditions.

The results of quality analysis of chickpea genotypes in Adana location are given in Table 5.

In Adana location, the average hundred grain weight values obtained from chickpea varieties in winter sowing were 40,5 g; water absorption capacity 0,460 g/grain; swelling index 2,23%; cooking time 49 min; %protein ratio 25,7%; and sieve values 8,3 mm. The lowest average crude protein values of the genotypes were determined from Ubet variety with 23,6% and the highest average crude protein values were determined from Diyarbakır-3 genotypes with 27,3% (Table 5). Although there is a wide variation in the chemical structure and composition of the grain among chickpea varieties, it has been reported that climate, soil structure, soil nutrient content, agronomic practices, living and non-living stress factors and heredity are effective on the chemical composition of the grain Güngör et al. (2018), Adak, (2021); Erol et al. (2023).

Conclusions

In terms of suitability of chickpea genotypes used in this study for the ecology of the region, some varieties were found to be prominent. The general yield average of the genotypes was determined as 206,5 kg/da. However, in terms of grain yield, Ubet with 264,8 kg/da, Urfagap-1 genotype with 259,5 kg/da, Aksu variety with 258,1 kg/da and Urfagap-2 genotypes with 243,6 kg/da were found suitable for evaluation.

Table 1. Some physical and chemical properties of trial area soils.

Soil Structure Distribution							
Sand (%)	**Silt (%)**	**Clay (%)**	**pH (1:1)**	**Lime (%)**	**Org. Matter (%)**	**Total salt (%)**	**P_2O_5 (kg/da)**
32.0	37.7	30.3	7.43	12.0	1.3	0.2	4.1

(Trial Area altitude 23m)

Table 2. Adana province climate values for 2022-23 and long years.

Months	**Average Temperature (°C)**		**Rainfall (mm)**		**Relative humidity (%)**	
	Long Years (1982-2021)	**2022-23**	**Long Years (1982-2021)**	**2022-23**	**Long Years (1982-2021)**	**2022-23**
December	10,43	11,2	121,48	24,7	68,67	68,53
January	9,05	9,9	109,01	16,0	67,69	63,65
February	10,15	8,62	81,87	61,1	65,68	58,89
March	13,14	14,86	63,08	81,4	66,74	67,09
April	17,27	17,14	49,67	47,5	68,02	66,08
May	21,40	21,55	42,15	42,2	68,03	61,27
June	25,17	23,72	13,97	0,0	69,01	67,50
July	27,08	36,32	7,46	2,00	69,94	62,15
Total			488,69	274,9		

Table 3. Plant height (cm), days of flowering (days) and anthracnose disease observations in chickpea genotypes.

Variety	**Varieties /Line**	**Plant Height (cm)**	**Flowering (days)**	**Ascochyta Blight [*Ascochyta rabiei* (Pass. Labr.)] artificial epidemic**	
				Ankara	**Eskişehir**
1	DİYARBAKIR-1	50,8	72,3	4	5
2	DİYARBAKIR-2	48,5	77,3	7	5
3	DİYARBAKIR-3	55,5	70,8	4	5
4	GAP-1	49,3	72,8	6	5
5	GAP-2	52,5	70,0	6	5
6	GAP-3	46,5	69,5	6	5
7	ADANA-1 (FLIP97-74C / FLIP97-125C // FLIP-98-31C)	56,0	72,3	6	5
8	ADANA-2 (FLIP98-177C /CIYT SP-90/ FLIP85 -75C -5/3/ FLIP-09-21C)	55,0	74,0	4	5
9	ADANA-3 (FLIP98-177C /CIYT SP-90// FLIP85 -75C -5/3/ FLIP-97-32C)	54,0	74,8	4	4
10	ADANA-4 (ER/IŞIK-05-11E/ÇAGATAY)	48,3	72,8	5	5
11	ADANA-5 (MEKSİKA NOHUTU/ CIYT SP-90/ FLIP85 -75C -5E/3/ FLIP-97-90C)	59,8	74,8	5	5
12	HASANBEY	57,8	71,8	7	5
13	ARDA	54,0	74,0	4	5
14	AKSU	56,0	68,3	6	5
15	AZKAN	57,0	74,3	6	5
16	UBET	57,5	71,8	7	5
Average		53,6	72,6	-	-
Minimum		46,5	68,3	4	4
Maximum		59,8	77,3	7	5

Table 4. Grain yield (kg/ha) and 100 grain weight (g) values of chickpea genotypes.

Variety	Varieties	Yield (kg/ha)	100 Grain Weight (g)
1	DİYARBAKIR-1	1715	44,5 c-e
2	DİYARBAKIR-2	1604	40,1 fg
3	DİYARBAKIR-3	2106	40,9 fg
4	URFAGAP-1	2595	46,7 a-c
5	URFAGAP-2	2436	41,2 e-g
6	URFAGAP-3	1899	38,5 g
7	ADANA-1 (FLIP97-74C / FLIP97-125C // FLIP-98-31C)	1295	49,3 a
8	ADANA-2 (FLIP98-177C /CIYT SP-90/ FLIP85 -75C -5/3/ FLIP-09-21C)	2428	45,7 b-d
9	ADANA-3 (FLIP98-177C /CIYT SP-90// FLIP85 -75C -5/3/ FLIP-97-32C)	1963	46,7 a-c
10	ADANA-4 (ER/IŞIK-05-11E/ÇAGATAY)	1828	42,4 d-f
11	ADANA-5 (MEKSİKA NOHUTU/ CIYT SP-90/ FLIP85 -75C -5E/3/ FLIP-97-90C)	1421	47,9 ab
12	HASANBEY	3160	38,8 g
13	ARDA	1926	39,8 fg
14	AKSU	2581	44,6 b-d
15	AZKAN	1428	44,7 b-d
16	UBET	2648	47,1 a-c
Average		2065	43,7
CV (%)		340	5,3
F		not significant	**
Minimum Significant Difference		-	3,3

CV: Variation of Coefficient * : 5% Significant level ** : 1% Significant level

Table 5. Quality analysis results of chickpea genotypes in Adana location.

Variety	Varieties	Dry Weight (100 grain) (g)	Water Intake Capacity (g/grain	Water Intake Index (%)	Cooking Time (minutes)	Protein (%)	Sieve Value (mm)
1	DİYARBAKIR-1	40,1	0,471	2,42	50	27,2	8,2
2	DİYARBAKIR-2	34,8	0,426	2,23	57	25,1	7,7
3	DİYARBAKIR-3	37,4	0,419	2,19	42	27,3	8,1
4	GAP-1	42,9	0,520	2,35	46	25,8	8,5
5	GAP-2	40,9	0,461	2,26	40	26,0	8,4
6	GAP-3	35,3	0,412	2,19	49	26,5	7,9
7	ADANA-1	44,8	0,520	2,26	56	26,6	8,7
8	ADANA-2	40,6	0,443	2,17	52	25,0	8,4
9	ADANA-3	42,1	0,486	2,19	50	24,6	8,7
10	ADANA-4	46,2	0,503	2,20	54	25,1	8,4
11	ADANA-5	46,5	0,499	2,12	50	25,1	8,6
12	HASANBEY	33,9	0,372	2,17	60	25,0	7,7
13	ARDA	37,8	0,431	2,21	46	25,8	8,1
14	AKSU	40,4	0,470	2,26	44	26,1	8,2
15	AZKAN	40,8	0,451	2,20	45	26,8	8,1
16	UBET	42,7	0,476	2,25	49	23,6	8,3
Average		**40,5**	**0,460**	**2,23**	**49**	**25,7**	**8,3**

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