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INVESTİGATİON OF YIELD AND QUALITY OF SOME CHICKPEA (*Cicer arietinum* L.) GENOTYPES UNDER MEDITERRANEAN CLIMATIC CONDITIONS

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Summary. This research was established to determine yield and quality factors in the experimental field of Eastern Mediterranean Agricultural Research Institute in Adana province under Mediterranean climatic conditions during the 2021-2022 growing period. The experimental material consisted of 18 genotypes and 5 commercial cultivars which were considered as control. The experiment was carried out according to the Coincidence Blocks Experiment design with three replications, 45 cm between rows, 8 cm above rows, 5 m long rows and 4 rows (5mX4 rowsX0,45m) for each genotype. The sowing of the experiment was done in December for winter and the harvest was completed in July. The research findings obtained from the varieties in the study showed that grain yield varied between 267.6-191.2kgda, hundred grain weight 51.3-36gr, plant height 63.7-43.7cm, 50% flowering period 94-90 days. The quality parameters examined were water absorption capacity 0.477gr/grain, swelling index 2.29%, cooking time 60min, %protein 22.7% and sieve value 8.2mm. It is useful to continue the studies and support them with agronomic trials.

Keywords: Chickpea, winter sowing, Yield and Quality.

Introductıon

The data for chickpea in Turkey for 2022 is 456,480 ha of cultivation area, 580,000 tons of production and 127.00 kg/ha of grain yield per unit area (FAO, 2024). Chickpea has an important place in human and animal nutrition, especially in developing countries because it is rich in protein. In addition, because it is not selective in terms of soil requirements and gives good yield in arid and semi-arid areas, it is of great importance in cereal-edible legume crop rotation (Craufurd & Wheeler, 2009). Chickpea plant is among the most produced edible grain legumes in our country because it is a plant that can withstand heat and drought the most after lentils and can grow in nutrient-poor soils (Şahin & Geçit, 2006). The economic importance of chickpea as a protein source is increasing due to the drought stress of chickpea plant with global warming. In addition to these, chickpea also constitutes the raw material of chickpea industry. The most important factor limiting chickpea cultivation areas in the world and in our country is Anthracnose blight disease. The climate of the Mediterranean region is suitable for winter cultivation of chickpea plants, but yield losses are observed in late spring sowing due to high temperatures. In addition to the increases in yield with winter sowing, other benefits should not be ignored. Chickpea sown in winter stays in the field longer compared to summer sowing. Considering the global drought and water shortage in recent years, breeding of varieties with high tolerance or resistance to environmental conditions will become more important in order to make better use of winter precipitation in variety development and selection studies. In addition, the importance of conducting breeding programs in different ecological conditions in order to develop varieties resistant to yield, quality and stress conditions, and therefore the importance of developing varieties that are resistant/tolerant to diseases, resistant/tolerant to extreme heat and drought, i.e. biotic and abiotic stress conditions, increases even more with breeding programs.

Materıal and methods

This research was conducted in the experimental field of the Eastern Mediterranean Agricultural Research Institute in the 2021-2022 growing year. The research experiment was established according to the randomized block design with three replications. The plots were planned as 4 rows (5mX4 rowsX0.45m) of 9 m2 with 45 cm between rows and 8 cm above rows, and fertilizer was applied as 3 kg /da N and 6 kg /da P_2O_5 with planting. Doğankent locality, 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.

Table 1

Climate values for 2022-2023 and long years in Adana province

Months	Rainfall (mm)	Long Years (37years)	Temperature (^{0}C)	Long Years (37years)	Moisture (%)	Long Years (37years)
	2021-2022	1982-2021	2021-2022	1982-2021	2021-2022	1982-2021
December	6,91	121,48	11,5	10,43	68,26	68,67
January	5,07	109,01	10,2	9,05	67,19	67,69
February	2,48	81,87	11,5	10,15	70,97	65,68
Mart	2,31	63,08	12,7	13,14	60,04	66,74
April	2,6	49,67	18,3	17,27	57,2	68,02
May	1,0	42,15	23,9	21,40	61,7	68,03
June	12,8	13,97	25,8	25,17	72,7	69,01
July	0	7,46	29,4	27,08	66,2	69,94
Total	33,17	488,69		133,69		543,78

The experimental area is under the influence of Mediterranean climate and meteorological data are given in Table 1. When the temperature averages of the years in which the experiments were 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 have shown values above the long-term average. As for precipitation values, there have been irregularities in precipitation distribution and intensities in precipitation amounts in recent years due to global warming. In the 2022 growing year, it was observed that precipitation amounts were lower than in many years and their distribution was irregular. Drought stress was observed in plants during the growing period. Relative humidity rates showed values parallel to long years (Table 1).

Results and dıscussıon

This research was carried out in the experimental field of Adana-Doğankent in the 2022 growing year by sowing in December during winter sowing.

When the table is examined; the difference between the varieties in terms of yield was found to be statistically significant at 5% in Adana location. In Adana, the average yield was 229 kg/ha. The highest yield in Adana location was found to be in Ş.Urfa3 line with 267 kg/da. When the 100 grain weights of the varieties included in the experiment were examined; the statistical difference between the lines at Adana location was found to be significant according to 1%. The highest 100 grain weight average was 42,8 g.

In this study, the highest grain yield values of chickpea varieties were obtained from Azkan, Şurfa3 and Dbakır2 varieties with a range of 272.4-267.3 kg/ha and were analyzed in the same group. The lowest grain yield was obtained from KMN 16-55 genotype with 191.2kg/ha. In terms of 100 grain weight, the highest value was obtained from X09 T.H 71-1 genotype with 51.1 g. The lowest 100 grain weight was obtained from Hasanbey and Şurfa1 genotypes with 36-37.1 g, respectively (Table 2).

Table 2

Grain Yield (kg/ha) and 100 Grain Weight (g) Values of Chickpea Genotype/Varieties

Genotype/Varieties	Yield (kg/da)	100 Grain Weig (g)
D.Bakır 1	207,7 bc	43,6 cd
D.Bakır 2	267,3 a	42,4 de
D.Bakır 3	232 a-c	43,3 cd
KMN 16-55	191,2 c	48,8 b
KMN 16-76	207,4 bc	51,3 a
KMN 16-270	207,2 bc	43,3 cd
FLİP 03-110C	221,1 a-c	44,4 c
FLİP 03-61C	250,8 ab	39,1 gh
X09 T.H 71-1	230,1 a-c	51,1 a
FLİP 09-284C	213,8 bc	44,5 c
Ş.Urfa 1	232,6 a-c	37,1 ı
Ş. Urfa 2	212,8 bc	39,6 fg
Ş. Urfa 3	267,6 a	39,3 fg
HASANBEY	250,8 ab	36 ı
ARDA	247,7 ab	37,3 hı
AKSU	214,4 bc	41,1 ef
AZKAN	272,4 a	44,8 c
UBET	200,5 bc	44,4 c
Average	229,3	42,8
Coefficient of variation (%)	16,04	3,02
F	*	**
AÖF	52,23	1,84

* 5% significant level, ** 1% significant level

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. It is reported that plant height increases in winter sowing and there is a significant and positive relationship between plant height and yield (Özdemir and Karadavut, 2003). The most important factor in price formation in the market is the cleanliness and grain size of the product. Generally, the product with large grains is sold at a higher price. Another issue as important as grain size in variety development is that grain size should be as homogeneous as possible. Because at the marketing stage and before packaging, the grains are separated according to their size in order to make them conform to the standard (Atmaca, 2008).

In Adana ecological conditions, the highest plant height values obtained from chickpea varieties in winter sowing were determined from Ubet variety with 58.3 cm and the lowest plant height values were determined from D.Bakır3 genotype with 43.7 cm (Table 3). (Mart et al., 2017), In terms of agronomic characteristics, high plant height of chickpea plants indicates suitability for machine harvesting. Ceyhan et al. (2007), plant height of chickpea varieties varied between 33.1 - 44.1 cm in Konya ecological conditions. In another study, Ceyhan et al. (2013) found that plant height of chickpea genotypes varied between 39.0 - 60.2 cm under Konya conditions. Although the plant height values obtained by the researchers are similar to the values obtained in this study, sowing time has an effect on plant height. Higher plant height values were obtained in winter sowing compared to summer sowing.

Table 3

Plant Height (cm) and Days to Flowering (days) and Ascochyta Blight in Chickpea Genotype/ Varieties

Genotype/ Varieties	**Plant Height** (cm)	**Flowering (days)**	Ascochyta Blight **(*Ascochyta rabiei* (*Pass. Labr.*))** SUNİ EPİDEMİ (1-9)	
			ANKARA	**ESKİŞEHİR**
D.Bakır 1	44,6	94	4	5
D.Bakır 2	53,7	92	4	5
D.Bakır 3	43,7	93	5	5
KMN 16-55	57,9	93	4	5
KMN 16-76	54,2	90	5	5
KMN 16-270	53,3	91	5	5
FLİP 03-110C	47,1	90	5	5
FLİP 03-61C	55,0	91	4	5
X09 T.H 71-1	53,7	92	5	6
FLİP 09-284C	52,1	90	4	6
Ş.URFA 1	50,4	92	4	5
Ş.URFA 2	48,3	92	5	5
Ş.URFA 3	50,8	92	4	6
HASANBEY	51,7	91	5	5
ARDA	55,8	92	4	5
AKSU	50,8	93	5	4
AZKAN	63,7	93	5	5
UBET	58,3	92	6	5
Average	52,5	92		
MİN	43,7	90	4	4
MAX	63,7	94	6	6
Coefficient of variation (%)	4,9	1		

* 5% significant level, ** 1% significant level

In Adana location, the highest number of days to flowering values of chickpea varieties in winter sowing were obtained from D.bakır1 genotype with 94 days and the lowest number of days to flowering was obtained from KMN 16-76, FLİP 03-110C, FLİP 09-284C genotypes with 90 days (Table 3). In chickpea farming, 50% days to flowering values represent the most important parameters indicating whether chickpea varieties are early or late (Mart et al., 2017).

Genotypes were tested for Anthracnose disease under field and artificial epidemic conditions. Under artificial epidemic conditions, FLIP 03-110C, X09 T.H 71-1 genotypes were the most susceptible genotypes with a score reading value of 5 at Ankara location; X09 T.H 71-1 and FLIP 09-284C genotypes were the most susceptible genotypes with a score reading value of 6 at Eskişehir location (Table 3). The occurrence of Ascocyhta blight disease has a negative effect on 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 Ascocyhta blight disease ((Nalçacı et al., 2021, Kocalar et al2020, Bakoğlu, 2009, Mart et al, 2001).

Table 4

Results of Analysis of Quality Values of Chickpea Varieties in Winter Sowing

Genotype/ Varieties	Dry Weight (100 grain) (g)	Water Intake Capacity (g/grain	Water Intake Index (%)	Cooking time (minutes)	Protein (%)	Sieve value (mm)
D.Bakır 1	41,4	0,493	2,32	61	22,6	8,3
D.Bakır 2	39,9	0,466	2,36	64	21,7	8,3
D.Bakır 3	39,9	0,462	2,31	65	24,3	8,4
KMN 16-55	45,1	0,551	2,29	60	22,9	8,5
KMN 16-76	46,6	0,601	2,41	61	23,9	8,7
KMN 16-270	39,9	0,471	2,32	71	22,7	8,2
FLİP 03-110C	40,1	0,495	2,39	53	23,7	8,2
FLİP 03-61C	36,7	0,433	2,28	59	23,3	7,8
X09 T.H 71-1	48,8	0,608	2,18	63	22,9	8,8
FLİP 09-284C	41,2	0,477	2,16	51	23,9	8,4
Ş.URFA 1	35,5	0,421	2,27	51	21,6	7,9
Ş.URFA 2	35,8	0,402	2,19	61	21,8	7,8
Ş.URFA 3	37,0	0,428	2,22	68	21,5	7,9
HASANBEY	34,9	0,408	2,31	60	21,4	7,8
ARDA	34,1	0,423	2,40	58	22,1	7,9
AKSU	37,5	0,444	2,37	55	21,9	8,0
AZKAN	43,9	0,515	2,26	66	24,1	8,4
UBET	41,7	0,483	2,22	54	21,6	8,3
Average	**40,0**	**0,477**	**2,29**	**60**	**22,7**	**8,2**

In terms of variety averages of the quality values of chickpea varieties in winter sowing at Adana location; the obtained values of hundred grain weight were 40 g, water absorption capacity was 0.477 g/grain, swelling index was 2.29%, cooking time was 60 min, %protein was 22.7% and sieve values were 8.2 mm. The lowest and highest average crude protein values of the varieties were determined from Dbakır3 genotype with 24.3% and Hasanbey chickpea varieties with 21.4% (Table 4). After animal proteins, the highest vegetable protein is found in edible grain legumes. Depending on the variety and environment, they contain 18-36% protein (Çiftçi et al. 2004). 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 (Adak, 2021; Erol et al., 2023).

Conclusıons

In order to be evaluated in breeding studies, yield and yield parameters of chickpea genotypes used in the experiment were examined in terms of their suitability for the ecology of the region. In terms of grain yield, Azkan (272,4 kgda), Ş.Urfa3 (267,6 kgda), D.Bakır2 (267,3 kgda) chickpea varieties were examined in the same statistical group and their performances were remarkable. In terms of 100 grain weight, KMN 16-76 (51,3g), X09 TH 71-1 (51,1g) genotypes stood out. The average plant height values of the varieties were 52.25 cm; average days to flowering values were 92 days; and the disease values of the varieties were generally in the tolerant (4-5) group. These varieties were recorded for evaluation in breeding studies. These studies need to be repeated and studied for longer years and multi-locations in line with our aim.

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