

Original Article

Evaluation of Winter-Sown Chickpea (*Cicer Arietinum* L.) Varieties for their Yield and Morphological Traits in the Mediterranean Ecological Conditions

Dürdane MART¹

¹Eastern Mediterranean Agricultural Research Institute -Turkey,

Received: 28 March 2022

Revised: 15 May 2022

Accepted: 30 May 2022

Published: 16 June 2022

Abstract - This study was conducted to identify the agricultural features of some chickpea (*Cicer arietinum* L.) varieties in Adana Eastern Mediterranean ecological conditions for one year. The study was carried out in the experimental area of Adana Eastern Mediterranean Agricultural Research Institute. The experiment was conducted in randomized blocks with 4 replications using 10 chickpea cultivars. In the study, the number of days until the emergence of chickpea, the number of days until flowering, the number of days until pod binding time, plant height, the height of the first pod, harvest maturity, seed yield, and weight of one hundred were investigated. As a result of the study, it was revealed that chickpea cultivars weren't significantly affected by the *Ascochyta* blight disease. The highest yield was in the *Seçkin* cultivar with 587kg/da, while the lowest yield was in *Diyar95* with 383kg/da. Regional varieties *İnci*, *Hasanbey*, and *Seçkin*, had higher grain yield values in these years than other varieties.

Keywords - Adana-chickpea-variety-yield.

1. Introduction

The edible grain legumes are an important source of plant-derived protein, which is widely consumed in Turkey. It is an important basic nutrient in human and animal nutrition in terms of its average protein richness of 22-26%. Chickpeas are rich in nutritional value and positively contribute to the soil due to their symbiotic lifestyle with rhizobia. In Turkey, the chickpea production was 630,000 tons, with a sowing area of 517.785 ha, while the grain yield was 122.00 kg/day (FAO, 2021). The gene center of chickpeas and lentils, edible legumes, is Turkey (Eylem, 2017). The aim is to breed the varieties with tolerance against *Ascochyta* blight, suitable for mechanized cultivation and harvest, and offer them to the farmers as promising varieties. Since the purpose of chickpea production is high yield and quality, developing suitable varieties for target

regions where they will be grown is an important factor that needs to be considered. This study aimed to develop recommended chickpea varieties for different regions.

2. Material and method

2.1. Material

Field trials of this research were carried out in the research trial field of the Eastern Mediterranean Agricultural Research Institute (located between the geographic latitudes of 36° 51' 17.21 North and 35° 20' 41.61 East with an altitude of 23m.) in the Adana province, Yüreğir district Doğankent location in the 2021 growing season. In the study, 10 chickpea registered varieties (*İnci*, *Hasanbey*, *Seçkin*, *Azkan*, *Diyar95*, *Arda*, *Aksu*, *Aslanbey*, *Botan*, *Ubet*) by Agricultural Research Institutes in our country were used.

Table 1. Some phenotypic properties of chickpea cultivars used in the experiment

Sıra No	Cultivar name	Phenotypic properties		
		Growth Form	Grain Form	Grain Color
1	İnci	Erect	Medium -sized	Beige
2	Hasanbey	Erect	Angular- round	Yellow
3	Seçkin	Erect	Angular	Pale Yellow
4	Azkan	Erect	Large -sized	Beige
5	Diyar95	Erect	Angular- round	Beige
6	Arda	Semi Erect	Angular- round	Yellow



7	Aksu	Semi Erect	Angular- round	Yellow
8	Aslanbey	Erect	Large -sized	Beige
9	Botan	Erect	Angular- round	Beige
10	Ubet	Semi Erect	Angular- round	Beige

2.2. Climatic Characteristics of the Research Site

The long-term average (1982-2021) of the chickpea growing period in Adana and the meteorological values of the 2021 growing season in which the research was carried out are given in Table 2. When Table 2 is examined, Although it is seen that there is not much difference between the average of long years and the average temperature of the growing year, the temperatures have remained above the long years. However, the % humidity values remained below

for many years; As a result, Ascochyta blight disease was not observed in the trial. The monthly total precipitation value for 2020-2021 was higher than average for many years (103.7mm), only for January (160.7mm). The amount of precipitation during the other months of the growing season remained below the long years. As a result, suitable conditions for Ascochyta blight disease did not occur. Therefore, Ascochyta blight disease damage did not occur in cultivars.

Table 2. Eastern Mediterranean region (Adana) during long years and the years of research (2020-2021).

Months	Rain (mm)	Long Years (37years)	Average Temperature(°C)	Long Years (37years)	Average Moisture (%)	Long Years (37years)
	2020-2021	1982-2021	2020-2021	1982-2021	2020-2021	1982-2021
December	18.3	115.9	11.5	10.1	64,3	66,4
January	160.7	103.7	10.2	9.05	63,20	67,4
February	23.5	81.8	11.5	10.15	62,60	65,3
March	42.1	61.9	12.7	13.14	62,47	66,5
April	44.0	48.2	18.3	17.27	68,65	67,8
May	4.1	43.1	23.9	21.40	64,87	68,2
Jun.	0.4	22.0	25.8	25.80	67,25	67,1
Jul.	15,8	7.46	29,99	27.08	68,13	69.94

2.3. Soil Properties of the Research Site

According to the results of the physical and chemical analyzes carried out on the soil of the trial field where the research was carried out; It has a clay loam soil texture, is salt-free, slightly alkaline as a soil reaction, and very calcareous in terms of lime (%), organic matter (%), and available P₂O₅ (kg/da) content is low. It was determined that the volume weights varied between 1.48-1.57 gr/cm³, field capacity (%) 28.68-31.51, and wilting point (%) ranged between 14.74-18.93 (Table 3). Alaç (2006), in the research, carried out on the Yuregir plain, reported that the citrus

orchard soils are among the Mürsel series soils that are dominant in that environment. This series of soils are with A.C. horizons developed on alluvial deposits of old river terraces. Although the soil structure is generally heavy, some parts have a sandy soil structure. According to the soil analysis results of the profile up to 30 cm depth, the field capacity is 33.58-33.74%; the wilting point is 16.25-18.62%, the volume weight is 1.23-1.41 gr/cm³, and the lime content varies between 15.80-18.33%, the texture has a clayey-loamy structure. It has been reported to have a pH value of 7.6.

Table 3. Chickpea trial Field soil Analysis Report

Depth (cm)	Saturation (%)	pH	E.C. (dS/m)	Lime (%)	P ₂ O ₅ (kg/da)	O.M. (%)	H.A. (g/cm ³)	% T.K	% S.N.	Clay	Silt	Sand	structure
0-25	52,8	7,78	0,481	16,72	1,9	1,11	1,48	29,74	18,76	30,9	43,3	25,9	CL
25-50	51,7	7,75	0,502	20,00	0,9	0,60	1,57	28,68	17,88	28,7	45,3	25,9	CL
50-75	57,2	7,78	0,338	25,24	0,7	0,31	1,46	31,51	18,93	35,1	45,5	19,4	SiCL
75-100	50,6	7,92	0,591	22,95	0,3	0,34	1,52	28,87	14,74	26,5	43,0	30,5	L

3. Research Field Studies

In the 2021 growing season, this study was prepared in a randomized block experimental design with 10 chickpea genotypes in the Adana location and carried out in field conditions. In this study, sowing was done in 4 rows of 5 m in length and 9 m² plots with 45 cm row spacing and 8 cm row spacing. Fertilization was applied with 2-3 kg N and 5-6 kg P₂O₅ per decare before planting. To determine the inertness readings for tolerance to Ascochyta blight disease, 1-9 (1=resistant, 9=very sensitive) scale (Reddy and Singh, 1985; Chen et al., 2004) necessary disease readings are planned. However, no scorings had been made due to the absence of disease in this growing year. The sowing of the cultivars was performed in winter on 6 December 2020, and the harvest of the experiment was done on 08 July 2021. After the harvest, the necessary observations, measurements, and analyzes were made, and the materials were evaluated.

4. Results and Discussion

It is considered the time elapsed for the seeds to germinate and emerge to the soil surface from sowing. The sowing of the experiment was done in winter on 6 December 2020, and the exits were made on 31 December (23 days). Beysarı (2012) reported in his study that the emergence days of the varieties varied between 11-12 days. In another study on this subject, Biçer and Anlarsal (2004) determined the emergence time as 24.5-26.8 days, and Ağasakallı and

mature (1999) determined it as 17.8-33.5 days. Depending on the soil temperature between winter and summer plantings, there may be differences in the number of days.

Flowering Time (days) is evaluated as the number of days by taking the date that 50% of the chickpea parcel has bloomed since emergence. The flowering date is an important consideration in determining the earliness of varieties. In this study, Diyar95, Azkan cultivars as late cultivars with the highest number of flowering days of 91 days; Botan, Aslanbey, Seçkin, and İnci cultivars were determined with the lowest flowering days of 88 days as an early variety. It has been reported that the temperatures are seen one day before or after flowering; the days before flowering largely determine the grain yield of the cultivated variety (Sepetoğlu 1994).

Broad Bean Fixing Time (days) is the number of days by taking the date of pod binding in 50% of the chickpea parcel. Broad bean tying date is another important criterion in determining the earliness of cultivars. In this study, the highest number of days to bind the broad beans is 140 days; that is, Arda, Aslanbey, and İnci chickpea varieties as of late varieties; As early varieties, Diyar95 and Ubet varieties were determined with 136 days as the lowest number of pod setting days.

Table 4. Flowering, pod binding, plant height, and first pod height values of chickpea cultivars

Cultivar no	Cultivar name	Flowering (Day)	Pod Binding (Day)	Plant Height (cm)	First pod elevation (cm)
1	DİYAR 95	91	136	90	47
2	ARDA	90	140	85	42
3	BOTAN	88	139	80	41
4	AKSU	89	138	75	45
5	ASLANBEY	88	140	80	45
6	UBET	90	136	86	48
7	SEÇKİN	88	137	80	44
8	HASANBEY	89	138	84	45
9	İNCİ	88	140	88	48
10	AZKAN	91	139	85	45
Mean		89	138	83	45
Min		88	136	75	41
Max		91	140	90	48
SD		1,28		4,44	

As a result of the study, the values related to the plant height characteristic obtained from chickpea varieties are given in table 4. Although plant height is important among the criteria affecting yield, it is also an important feature in determining the suitability of chickpea varieties for machine harvesting. In this study, the highest plant height was in the Diyar95 variety with 90 cm, followed by the İnci variety with 88 cm. The lowest plant height was in the Aksu variety

at 75 cm. When all varieties are taken into account, it is seen that the average plant height is 83 cm. Eser et al. (1989), in their research using 160 different chickpea populations between 1984-86 in Ankara conditions, determined that the plant height values of the materials varied between 24.2-42.0 cm. Ağasakallı and Olgun (1999), on the other hand, showed a variation between 27,-.7-49.6 cm in plant height in 16 chickpea lines and varieties in Erzurum between 1993-1997. Ceyhan et al. (2007) determined that the plant height of

chickpea cultivars varied between 33.1 and 44.1 cm in Konya ecological conditions. Ceyhan et al. (2013) also reported that plant heights in chickpea genotypes varied between 39.0-60.2 cm in Konya ecological conditions. The plant heights obtained in this study varied between 75-90cm; There is a wide variation in the values obtained by researchers with plant height. The fact that the studies carried out in this variation are sowing in summer and winter affects the plant height.

As a result of the study, the values related to the first pod height feature obtained from chickpea cultivars are given in table 4. Although the first pod height feature is an important criterion affecting the yield, it is also an important feature that determines the suitability of chickpea varieties for machine harvesting and preventing harvest losses. In this study, the highest first pod height was in İnci and Ubet cultivars with 48cm, followed by the Diyar95 cultivar with 47cm. The lowest first pod height was observed in the Botan cultivar with 41 cm, and right after, it was in the Arda cultivar with 42 cm. The average height of the first pod was 45 cm. Vural and Karasu (2007) aimed to determine the agronomic characteristics of 11 chickpea lines and varieties between 1996 and 1997 under Bursa ecological conditions. They have reported the lowest first pod height in red chickpea with 14.8 cm and the highest first pod height from ICC 5566 line with 19.14 cm. Yalçın (2017) revealed that chickpea cultivars' first pod height values vary between 16.5-25.5cm in Afyonkarahisar and 20.8-27.0cm in Yozgat. In other studies, Güngör and Dumlupınar (2018) reported that they ranged between 19.6-30cm, Topalak and Ceyhan (2015) 20.9-30.4cm, Patan (2014) 20.7-32.8cm. The hundred-grain weight parameter, an important feature in chickpea plants, is due to the genetic structure of the varieties. However, the hundred-seed weight parameter ecological factors (temperature, humidity, and precipitation amounts) can significantly affect grain yield. As a result of this study, the values obtained from chickpea varieties and the analysis results are given in Table 5. In the experiment conducted in the Adana location, the difference between cultivars based on 100-grain weight was found to be statistically significant at the 1% level. Hundred-grain weight values of chickpea cultivars in the study varied between 51.6-36.5gr values. In this study, the highest hundred-grain weight was in Aslanbey and 49.5gr Ubet cultivars with 51.6gr, followed by the Aksu cultivar with 46.9cm. The lowest hundred-grain weight was in the İnci chickpea variety with 36.5gr. Yaşar (2010) studied the grain yield and various properties of some chickpea genotypes grown in Southeastern Anatolian under summer conditions in 2009. The hundred-grain weight values obtained from 15nout pitch varieties varied between 29.87-39.90 gr. In a similar study Yaşar (2010) and Yalçın et al. (2018) carried out to determine the grain yield and some quality characteristics of 8 chickpea cultivars grown in Afyonkarahisar and Yozgat conditions in 2015-2016, according to the two-year average results, a hundred-grain

weight in Afyonkarahisar was 99.7-45.1gr. In Yozgat, they determined the weight of one hundred grains as 37.6-44.6gr. March et al. (2015), in the winter evaluation of chickpea (*Cicer arietinum* L.) cultivar breeding in Çukurova climatic conditions, determined the hundred-grain weights between 42.87-31.77gr. One gram increase in hundred grain weight causes a 0.515 g increase in yield per plant. Accordingly, studies on hundred-grain weight will be beneficial in terms of increasing the yield. The number of seeds in the pod harms the yield (Babagil et al., 2013). In addition to these studies, other studies on this parameter (Biçer,2001) 9.61-39.82gr, (Arshad et al.2004)16.98-23-98gr, (Kacar et al. 2005) 31.88-47.36gr, Ceyhan et al.2007) 44.92- They determined the hundred-grain weights of 47.83gr (Ceyhan and Ark 2012) 34.92-93.19gr and (Topalak and Ceyhan 2015) 31.4-40.1gr.

Grain yield per decare, which ranks first among the most important agronomic parameters, is one of the first parameters considered in cultivar development. During breeding studies, the grain yield values per decare are analyzed first. As a result of this study, the values obtained from chickpea varieties and the analysis results are given in Table 5. In the experiment conducted in the Adana location, the difference between the yield parameters of the cultivars was statistically significant at the 1% level. When Table 5 is examined, it is obvious that the grain yield values of chickpea varieties vary between 572-383kg/da, and the average grain yield values of the varieties are 503kg/da. While Seçkin, which is the region's variety, ranks first among all chickpea varieties with a grain yield of 587kg/da. 572kg/da, Botan chickpea variety 551kg/da, and Arda chickpea variety 538kg/day took place in the same group with grain yield values. The lowest grain yield was in the Diyar95 chickpea variety with 382kg/da. Doğan et al. (2018) have determined the yield and yield components of five chickpea genotypes under Mardin ecological conditions. The difference observed was between the grain yield values of 72.4-108.2kg/da.

In another study (Beysari 2012), 72.4-108.2kg/da, (Bakoğlu 2011) 61.6-158.2kg/da (Ceyan et al. 2007), 13.92-158.43kg/da (Ceyan et al 2012) 120.42-196.01kg/da, (Ceyan et al. 2013) 30.61-80.97kg/da, (Topalak and Ceyhan 2015) 131.40-169.30kg/da.

In this study, the protein quantity (%) was investigated, and protein values in chickpea cultivars in this study varied between 26.6% and 25.3%. Amir et al. (2006), chickpeas, lentils, and bean products grown in Algerian conditions in years when the amount of precipitation is higher, protein content and total sugar content are higher; They found that other parameters were higher in years with less precipitation. In another study, Atikyılmaz (1997) determined that the protein ratio changed according to the climatic events that occurred during the growing season.

Table 5. Yield, 100-seed weight and protein quantity of chickpea cultivars

Cultivar No	Cultivar Name	Yield (kg/da)	100-seed weight (gr)	Protein (%)
1	DİYAR 95	383 c	37,2 f	26,1
2	ARDA	538 a	37,3 f	26,1
3	BOTAN	551 a	42,1 d	25,7
4	AKSU	487 a-c	46,9 c	26,0
5	ASLANBEY	420 bc	51,6 a	26,6
6	UBET	501 ab	49,5 b	24,6
7	SEÇKİN	587 a	40,7 de	26,6
8	HASANBEY	504 ab	39,6 e	25,3
9	İNCİ	572 a	36,5 f	25,7
10	AZKAN	493 a-c	45,8 c	26,5
Mean		503	42,7	25,9
Df (%)		15,27	3,20	-
F		**	**	-
LSD		111,57	1,99	-

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

5. Conclusion

The current study was carried out to reveal the yield and yield components of some chickpea cultivars in Adana under East Mediterranean ecological conditions. The regional varieties Seçkin, İnci, and Hasanbey, exhibited the highest parameters, and their suitability in the regional conditions attracted attention. Botan and Arda chickpea varieties were

found suitable for winter planting. However, it was concluded that it would be more appropriate to repeat the studies in different locations representing the region for at least two or three years in order to make more reliable recommendations with the results to be obtained in such adaptation studies.

References

- [1] Alaç, V., Evaluation of the Performance of the Drip Irrigation System Installed in a Citrus Orchard Planted on the Ridge, (master's thesis, unpublished). Çukurova University, *Institute of Science and Technology*, Adana, (2006).
- [2] Amir, Y., Haenni, A. L. and Youyou, A., Differences in The Biochemical Composition of Dry Legumes Cultivated in North Algeria. *EJEAFChe*, 5(3) (2006) 1411-1418.
- [3] Arshad M, Bakhsh A, Ghafoor A., Path coefficient analysis in chickpea (*Cicer arietinum*L.) under rainfed conditions. *Pakistan Journal of botany*. 36(1) (2004) 75-58.
- [4] Atıkyılmaz, N., A Study on the Relationship between Yield and Yield Components and Determination of Some Quality Traits in Winter and Summer Chickpea Planting. Master Thesis (Unpublished). *Dicle University, Diyarbakır*, 53 (1997).
- [5] Babagil, G., Tozlu, E., ve Dizikisa, T., Determination of Yield and Yield Components of Some Dry Bean (*Phaseolus vulgaris* L.) Genotypes Grown in Erzincan and Hınıs Ecological Conditions. *Journal of Atatürk University Faculty of Agriculture*, 42(1) (2013) 11-17.
- [6] Bakoğlu A., Determination of yield and some agricultural characteristics of some chickpea (*Cicer arietinum*L.) lines and varieties in Bingöl ecological conditions. Bingol University. *Journal of Science*. 1(2) (2011) 1-6.
- [7] Beysarı V., Determination of yield and adaptation abilities of some chickpea (*Cicer arietinum*L.) cultivars in Bingöl conditions. Master Thesis. Bingöl University, Institute of Science and Technology, *Department of Field Crops*, (2012).
- [8] Biçer, BT., Research on the determination of important herbal and agricultural characteristics in some local varieties of chickpea (*Cicer arietinum*L.) collected from Diyarbakır region. Doctoral thesis. Çukurova University, *Institute of Science and Technology*, Adana.130 (2001).
- [9] Biçer BT, Anlarsal AE., Determination of vegetative and agricultural characteristics of some chickpea (*Cicer arietinum* L.) village cultivars, Ankara University Faculty of Agriculture, *Journal of Agricultural Sciences*. 10(4) (2004) 289-396.
- [10] Ağasakallı A, Olgun M., Determination of selection criteria for chickpea breeding in Erzurum conditions. Turkey 3rd Field Crops Congress. Meadow and Pasture Forage Crops and Edible Grain Legumes, 3 (1999) 324-329.

- [11] Ceyan E.,Önder M.,Harmankaya M.,Hamurcu M.,Gezgin S., Response of chickpea cultivars to application of boron in boron deficient calcareous soils .*Communications in soil Science and Plant Analysis*, 38 (2007) 2381-2399.
- [12] Ceyan E.,Önder M.,Kahraman A., Topak R.Ateş MK,KaradasS, Avcı MM., Effects of drought on yield and some yield components of chickpea, world Academy of Science, *Engineering and Technology*, 66 (2012) 38-3382.
- [13] Ceyhan E., Kahraman A..Ateş MK, Topak R Şimşek D., Avcı MA, Önder M., Dalgıç., Determination of grain yield and yield components of Chickpea (*Cicer arietinum*L.) genotypes in Konya Conditions Turkey X Field Crops Congress 1 (2013) 789-796.
- [14] Doğan Ş, Doğan Y, Kendal Y., Determination of yield and adaptation abilities of some chickpea (*Cicer arietinum* L.) genotypes in Mardin conditions. *Anatolian Multidisciplinary Studies Congress*, (2018).
- [15] Düzdemir O.ve Akdağ C. Yanar Y., A Study on the Resistance and Grain Yield of Some Chickpea (*Cicer arietinum* L.) Varieties to Anthracnose (*Ascochyta rabiei*) in Different Environments, *Journal of Gazi Osman Uni. Faculty of Agriculture*, 24(2) (2007) 87-97.
- [16] Eser D.,Geçit HH, EmeklilerY,Kavuncu O., Increasing and valuating of chickpea gene material.*Turkish Journal of Agriculture Forestry*, 13 (1989) 246-254.
- [17] Eylem, Tugay Karagül, Turkey Edible Grain Legumes Genetic Resources, *Anadolu Journal of AARI* , 27(1) (2017) 56-70.
- [18] Güngör H, Dumlupınar Z., Evaluation of some chickpea varieties and lines in terms of yield and yield elements DERİM, 35(2) (2018) 194-200.
- [19] Kaçar O, Göksu E. Azkan N., Determination of chickpea (*Cicer arietinum* L.) lines that can be grown in winter in Bursa. *Journal of Uludag University Faculty of Agriculture*, 19(2) (2005) 33-45.
- [20] Mart, D., Yücel, D., Türkeri, M., Evaluation of Yield and Morphological Characteristics of Chickpea (*Cicer arietinum* L.) Genotypes in Winter Sowing in Çukurova Region, *Field Crops Congress*, (2015)19-23.
- [21] Patan F., Adaptation of some registered chickpea (*Cicer arietinum* L.) cultivars to Erzurum ecological conditions. Master Thesis.. Atatürk University Institute of Science and Technology Erzurum, 59 (2014).
- [22] Sepetoğlu H., Edible Grain Legumes. *Ege University Faculty of Agriculture publications*, 24 (1994).
- [23] Topalak C, Ceyhan E., The effects of different sowing times on grain yield and some agricultural characteristics in chickpea. *Selcuk Journal of Agricultural Sciences*.2(2) (2015) 130-139
- [24] Vural H., Karasu A., Variability studies in chickpea (*Cicer arietinum*L.) vareties grown in Isparta, Turkey,*Revista UDO Agricola*, 7(1) (2007) 35-40.
- [25] Yalçın F., Determination of some quality characteristics in yield in chickpea (*Cicer arietinum* L.) cultivars. Master Thesis. *Bozok Uni. Science Ins. Yozgat*, (2017) 74.
- [26] Yalçın F, Mut Z, Doğanay Ö, Köse E., Determination of suitable chickpea varieties that will provide high yield in Afyonkarahisar and Yozgat conditions. *Journal of Gazi Osman Uni. Faculty of Agriculture*, 35(1) (2018) 46-59.
- [27] Yaşar M., A research on the determination of yield and yield components of some chickpea (*Cicer arietinum*L) lines and varieties in Diyarbakır ecological conditions. Master's thesis, Çukurova University, *Faculty of Agriculture, Sciences, Ens Field Crops Department*, Adana, (2010).
- [28] Wallace DH, Gniffke PA, Masaya PN, Zobel .R 1991.Photoperiod, temperature, and genotype interaction effects on days and notes required fob flowering of bean, *Journal of American Soc. For Hort. Sci*, 116(3) (1991) 534-543.