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**Determination of Yield And Some Yield Components of The
Registered Chickpea (*Cicer arietinum* L.) Cultivars in Van
Conditions**

Abstract

This study was conducted to determine chickpea cultivars which grown at Van ecological conditions and their some important agricultural and plant properties in 2013 summer season in Van. In the study was used 14 cultivars which officially registered such as Yaşa-05, Hisar, Azkan, Işık-05, Seçkin, İnci, Diyar-95, Taek, Çağatay, Hasanbey, Aksu, Çakır, Zühal, Ilgaz. The trial was conducted by using randomized complete blocks design with the three replications. In the study were investigated plant height, first pod height, numbers of branches, numbers of pod per plant and numbers of seed per plant, numbers of seed per pod, seed yield per unit area, harvest index, biological yield, 100 seed weight, protein and oil ratio in seed. While the highest seed yield per area was obtained from Işık-05 varieties with 98.65 kg da⁻¹, but the difference with Yaşa-05 and Çağatay varieties was not statistically significant, the lowest seed yield per area was obtained from İnci varieties with 60.20 kg da⁻¹.

INTRODUCTION

After cereals, the most cultivated crops are edible legumes (Soysal et al., 2020). Breeding high-yielding and well-adapted varieties in recent years can increase chickpea cultivation areas and replace fallow lands in the traditional wheat-fallow system in the region. In general, as in the agriculture of the country, fallow lands occupy an important place in the agricultural lands in Van. Narrowing down fallow lands and increasing agricultural production is seen as an important target in our country's agriculture. Chickpea is resistant to low temperatures (-8, -10 °C) and consumes less water because it has small vegetative parts. It is a suitable plant for crop rotation with cereals in fallow lands. In addition, chickpeas, which are a legume plant, fix the free nitrogen in the air to the soil by means of *Rhizobium* bacteria that live symbiotically in their roots. The amount of nitrogen determined by chickpeas in this way is 80 kg ha⁻¹ in a year (Sepetoğlu, 1996). This phenomenon, called symbiotic nitrogen fixation, occurs as a result of mutually beneficial interactions between *Rhizobium* spp bacteria and the host legume plant (Soysal and Erman, 2020).

There has been a decrease in cultivation areas in our country in recent years. Increasing our cultivation areas will only be possible by purchasing products from fallow lands every year. For this, cereals, which are our main food source, should be put into crop rotation with edible legumes with low water consumption. A second way to increase production; to take more product per unit area. In order to get higher efficiency from the unit area, it will be possible by providing a good variety and sufficient certified seed as well as suitable cultivation techniques. A good seed yield can increase 20-30% (Şehirali, 1990).

The aim of all field trials is to increase efficiency and quality in production. Before

the yield and quality studies, various adaptation and yield studies have been carried out continuously in order to determine the best variety for regions in various parts of the world as in our country. In adaptation studies of agricultural products. It is also very important for the continuity of production that high-yielding varieties determined to make sense in practice can be provided by the growers. However, the selection and dissemination of high-yielding and high-quality varieties adapted to the planting area is an important factor for the solution. The increase in chickpea production over the years depends on the increase in the cultivated areas as well as the increase in the amount of product obtained per unit area. It is possible to say that with the solution of problems such as not using suitable varieties and seeds that restrict the productivity in chickpea production, more products can be obtained from the cultivation areas and thus more products can be offered for foreign sale.

This study was carried out to determine the yield and yield elements of some newly registered chickpea varieties in Van ecological conditions in recent years.

MATERIAL and METHODS

Research has been registered in Turkey 14 chickpea varieties (Yaşa-05, Hisar, Azkan, Işık-05, Seçkin, İnci, Diyar-95, Taek, Çağatay, Hasanbey, Aksu, Çakır, Zühal and Ilgaz) was used.

The study was carried out in 2013 on the trial fields of the Faculty of Agriculture in Yüzüncü Yıl University Campus.

The province of Van, where the study was conducted, is located in the Eastern Anatolia Region, in a basin surrounded by mountains and Lake Van to the west. The altitude of the province is 1725 m above sea level and it is located at 38° 25' north latitude and 43° 21' east longitude.

Table 1. Some climatic data for the 2013 growing season and long years average in the province of Van (TSMS, 2013)

Months	Precipitation (mm)		Average Temp. (°C)		Relative humidity (%)	
	2013	LTA	2013	LTA	2013	LTA
April	36.0	57.2	9.8	7.7	52.2	62.1
May	48.8	46.6	13.9	13.1	56.8	56.6
June	8.6	18.8	18.5	18.2	46.2	49.4
July	---	5.1	23.3	22.3	44.6	44.3
Total	93.4	127.7				
Average			16.4	15.3	49.9	53.1

The winter season in Van is cold and covered with snow, and the summers are cool and dry. The climate data for the months covering the period in which the experiment was carried out and the average of long years are given in Table 1. The annual rainfall related to the average of long

years in the growing season is 127.7 mm, the average temperature is 15.3 °C, the average relative humidity is 53.1%. The amount of rainfall in 2013 growing season is 93.4 mm. The average temperature was 16.4 °C and the average relative humidity was 49.9% (Anonymous, 2013).

Table 2. Some physical and chemical analysis results of the trial area soil

Depth (cm)	Teksture	pH (1:2.5)	Lime (%)	Phosphorus (ppm)	Potassium (ppm)	Organic Matter (%)	Total Salt (%)
0-20	Loam	8.88	6.6	8.9	70	1.89	0.01

According to the soil analysis results, soil samples taken from 0-20 cm depth of the research area have loamy texture, with strong alkaline reaction, low organic matter content, medium lime in terms of lime content, salt-free phosphorus content was found to be medium while sufficient potassium content.

Methods

The trial was established in three replications according to the Randomized Blocks Trial Design. There are a total of 42 parcels in the trial and each parcel consists of 5 rows, the distance between rows in parcels is 30 cm. Parcel area; It was planned to be 5 m x 1.5 m = 7.5 m². In the

experiment, there was a distance of 2 m between blocks and 1 m between parcels. The amount of seed to be thrown into the parcels was determined, corresponding to 60 seeds per m². In the experiment, 14 kg da⁻¹ DAP fertilizer was applied with sowing. At harvest, two outer rows for each plot and 50 cm from each end of the plots were left as borders and the middle 3 meters of the central rows were harvested. All measures were made on 0.9 m x 4 m = 3.6 m² areas. Seeds were sown on 02/04/2013 by hand. In the experimental area, weed control was done by hand twice before and after flowering. The experiment was harvested between 13.07.2013-21.07.2013

(İnci and Aksu 18.07.2013, Azkan 20.07.2013, Diyar-95 21.07.2013 and other varieties 13.07.2013). Since this trial is aimed at investigating the effects of ecological conditions of the region on yield and yield elements on some newly registered chickpea varieties in the dry agricultural areas of the region, irrigation was not carried out. All calculations and measures were conducted as based on the procedures and methods used by Akdağ and Şehirali, (1994) and Sepetoğlu, (1988). Calculations and weighting pertained to yield components were made within the context of 10 plant samples randomly chosen after the margin effect was omitted from each plot. Crude protein and oil ratios in the seeds of the varieties were determined with the Spectra Star laboratory type NIR (Near Infrared) analyzer. The obtained values were subject to variance analysis according to Randomized Blocks Trial Pattern and the difference between averages were tested at 1% significance level in accordance with Duncan Multiple Comparative Method. SAS (1998) by using PROC GLM and Düzgünes et al. (1987) were used at the significance controls of results and averages.

RESULTS and DISCUSSION

Plant height of chickpea varieties used in the experiment varied between 28.96-41.26 cm. The highest plant height value was obtained from Hisar variety with 41.26 cm, while the lowest value was obtained from Aksu variety with 28.96 cm. Çiftçi et al. (2004) reported that the average plant height varied between 24.2-38.2 cm in their study conducted for three years under Van conditions, and Türk and Koç (2003) reported that the plant height varied between 34.0-49.7 cm in the chickpea adaptation study they conducted in Diyarbakır dry conditions. The averages of the characteristics examined in the chickpea varieties used in the study are given in the Table 3. The plant height values obtained by the researchers and the values obtained in

this study are partially similar. Mart et al. (2005) found that the plant height varied between 75.58-82.23 cm in Çukurova conditions, Karaköy (2008) used two registered chickpea varieties (İnci, İzmir-92) and 43 chickpea local genotypes in Adana and found that the plant height was between 60.1-70.5 cm. They reported that they have changed. The findings of the researchers were higher than the findings obtained in this study. This is thought to be due to the different cultivars and ecologies as well as the different planting times (summer and winter planting).

The average first pod height of chickpea varieties used in the study varied between 19.13-25.33 cm. While the lowest first pod height was obtained in Işık-05 variety, Hisar variety had the highest first pod height and the difference between them and Azkan variety was found to be statistically insignificant. Türk and Koç (2003) found that the average first pod height is 10.07-14.45 cm. Although the first pod height is primarily affected by the genetic structure of the plant, environmental conditions also significantly affect the first pod height.

The average number of branches of chickpea varieties used in the study varied between 2.13-3.33. While Yaşa-05 variety showed the lowest average number of branches with 2.13, the difference with Zuhul variety was statistically insignificant. Azkan variety, on the other hand, has the highest average number of branches with 3.33. Çiftçi et al. (2004) reported that the number of branches in the plant varied between 2.2-4.1 and there was an inverse proportion between plant height and branch number in their study conducted for three years under Van conditions. Bakoğlu and Ayçiçek (2005) reported that the number of branches in the plant varied between 2.30-3.53 in the study they conducted with 8 registered chickpea varieties under dry conditions in Bingöl. The findings of the researcher and the findings obtained are similar.

Table 3. Averages of the studied characteristics of chickpea varieties and Duncan groups

Varieties	Plant height	First pod height	Number of branches	Number of pod per plant	Number of seed per plant	Grain yield	100 seed yield	Harvest index	Protein ratio	Oil ratio in seed
Yaşa-05	38.10 b	22.96 bcd	2.13 d	7.63 ab	8.00 a-d	96.53 a	34.33 de	40.00 a	22.50 c	4.31 de
Hisar	41.26 a	25.33 a	2.46 cd	5.90 abc	6.06 b-e	89.06 ab	38.33 b	29.33 def	22.27 cd	4.36 cde
Azkan	37.10 b	24.53 a	3.33 a	7.40 ab	7.66 a-e	90.40 ab	39.66 a	28.33 ef	24.35 a	4.01 g
Işık-05	31.16cde	19.13 h	2.63 a-d	8.33 a	8.46 ab	98.63 a	36.33 c	34.33 bcd	20.59 f	4.57 b
Seçkin	33.8 c	22.02 de	2.70 a-d	8.33 a	8.90 a	85.66 a-d	33.00 ef	37.66 ab	21.03 ef	4.54 b
İnci	31.26cde	22.00 cd	3.10 abc	5.93 abc	6.40 a-e	60.20 f	32.00 f	27.66 ef	22.72 bc	4.37 cde
Diyar-95	32.1 cde	23.33 b	3.20 ab	5.5 bc	5.60 de	70.30 ef	30.00 g	24.00 f	23.67 ab	4.93 a
Taek	29.9 de	19.70 gh	2.66 a-d	4.80 c	5.10 e	72.86 c-f	35.33 cd	32.00 cde	21.40 def	4.51 bc
Çağatay	31.7 cde	20.83 ef	2.56 bcd	5.63 bc	5.80 cde	78.53 b-e	35.00 cd	39.00 ab	21.18 ef	4.26 ef
Hasanbey	30.7 cde	20.53 efg	2.76 a-d	6.70 abc	6.90 a-e	86.20 abc	34.00 de	36.66 abc	21.85 cde	4.10 fg
Aksu	28.96 e	19.83 fgh	2.40 cd	5.93 abc	6.03 b-e	85.30 a-d	34.66 d	42.33 a	21.24 def	4.47 bcd
Çakır	30.8 cde	19.53 gh	2.63 a-d	8.10 a	8.23 abc	94.90 a	35.33 cd	42.33 a	20.47 f	4.84 a
Zuhal	32.5 cde	19.86 fgh	2.23 d	6.36 abc	6.50 a-e	73.53 def	35.33 cd	40.66 a	20.32 f	4.52 bc
İlgaz	32.13cde	21.03 de	2.46 cd	6.46 abc	6.66 a-e	78.90 b-e	34.33 de	42.33 a	22.04 cde	4.27 e

The average number of pods per plant of chickpea varieties varied between 4.80-8.33. While Taek variety had the lowest average with an average of 4.80 pods, Işık-05 and Seçkin varieties had the highest average with 8.33 pods, and the difference between them and Çakır variety was statistically insignificant. Çiftçi et al. (2004) reported in the chickpea adaptation study they conducted under Van conditions that the number of pods per plant varied between 6.5 and 18.4, although it varied by years. Although the findings obtained in the study are similar to the findings of the researchers, it is thought that the insufficient amount of rainfall during the growing season in which the study was conducted and the lack of irrigation caused the plants to bind less pods. Ağsakallı et al., (2001) reported that the most important factors affecting the grain yield of chickpeas are the number of pods and branches per plant, and it is necessary to focus on breeding tall chickpeas for machine harvesting and

coarse-grained chickpea breeding for industry.

The average number of grains per plant of chickpea varieties used in the study varied between 5.10-8.90. While the Taek variety has the lowest average number of grain per 5.10 plants, Seçkin variety has the highest average number of seeds per 8.90 plants. Babagil (2011) reported that the number of grains per plant varied between 26.2 and 31.1 in the study he conducted under Erzurum conditions. Karaköy (2008) reported that the number of grains per plant varied between 18-31.4 in the study he conducted under Adana conditions. The reason why the values obtained in the study were lower than the values of the researcher are thought to be due to the fact that the amount of rainfall during the growing season is very low and the experiment was conducted in dry conditions.

The average grain yield per unit area of chickpea varieties used in the experiment varied between 60.20-98.63 kg da⁻¹.

Although the highest grain yield per unit area was obtained from Işık -05 variety with 98.63 kg da⁻¹, the difference between Yaşa-05 and Çakır varieties was statistically insignificant. The lowest value was obtained from İnci variety with 60.20 kg da⁻¹. Babagil (2011) reported that they obtained the highest grain yield from Işık-05 variety and the lowest value from Çağatay variety in their study under Erzurum arid conditions. Bakoğlu and Ayçiçek (2005), in the study they conducted with 8 registered chickpea varieties in Bingöl dry conditions, the grain yield varied between 49.79 kg da⁻¹ and 98.67 kg da⁻¹, and in the study conducted by Bakoğlu (2009) under Elazığ conditions, the grain yield varied between 61.57-109.93 kg da⁻¹, Çiftçi et al. (2004) reported that the three-year average grain yield ranged between 42.0-80.7 kg da⁻¹. Togay et al (2005) obtained the highest grain yield per unit area in van conditions from the parcels irrigated with 95.4 kg da⁻¹ and 92.5 kg da⁻¹ in 2003 and 2004, respectively, while the lowest unit area grain yield was 58.7 kg da⁻¹ and 52.6 kg da⁻¹. They reported that they bought from parcels without irrigation. Since the varieties and ecological factors used by the researchers in their studies are partially similar, the grain yields per unit area obtained in this study are consistent with the results of the researchers. On the other hand, in the study conducted by Türk and Koç (2003) in Diyarbakır conditions, the grain yield was 129.9-273.1 kg da⁻¹, Mart et al. (2005) stated that the grain yield varied between 149.34-287.74 kg da⁻¹ in their study under Adana conditions and 91.0-211.0 kg da⁻¹ in the study conducted by Karaköy (2008) under Adana conditions. It was found to be lower than the findings of the researchers with the findings. These results show how important ecological factors and summer and winter planting times are in terms of yield in chickpea cultivation.

The average 100 seed weight of chickpea varieties used in the study varied between 32.00-39.66 g. The İnci variety was found

to have the lowest 100 seed weight, with an average of 32.00 g 100 seed weight. The highest 100 seed weight average was obtained from Azkan variety with 39.66 g. Türk and Koç (2003) stated that 1000 seed weight of chickpeas grown in dry conditions ranged between 338.7-467.0 g, Karaköy (2008) ranged between 37.6-51.5 g in 100 seed weight Çiftçi et al. (2004) reported that the 1000 seed weight varied between 240.1-395.7 g. While some of the findings obtained in this study were in accordance with the findings of the researchers, some of them were different. This is thought to be due to the different varieties and ecological conditions.

The average harvest index of chickpea varieties used in the study varied between 40.00-42.33%. While Diyar-95 variety had the lowest average harvest index, the highest average harvest index was obtained from Ilgaz, Çakır and Aksu varieties, and the difference between Zuhul and Yaşa-05 varieties was statistically insignificant. Öztaş et al. (2007) reported that the harvest index varied between 46-53% in his study under the conditions of the Harran plain. He also stated that most of the varieties registered in recent years have high harvest index values as a result of selection for large grain and high yield.

As can be seen from Table 3, the average protein ratio in the grains of the varieties varied between 20.32-24.35%, while the lowest protein ratio was obtained from Zuhul variety, the difference between Çakır and Işık-05 varieties was found to be statistically insignificant. The highest protein ratio was obtained from Azkan variety. Dry seeds of chickpeas are very rich in protein and carbohydrates, these two substances make up 80% of the dry weight of the seed. The protein ratio of dry seeds is between 12.4-31.5% (average 23%) (Özdemir, 2006). In this study, the protein ratio values in the grain obtained were found to be around the average value. Karasu et al. (2006) reported that the protein ratio in grain varied between 18.64-23.25% in the adaptation study conducted under

Isparta conditions, and Doğan (2014) reported that the highest protein ratio per grain was obtained from Canitez variety with 27.1% among the varieties used in the study conducted under Mardin conditions. The findings of the researchers and the findings obtained in this study are partially similar.

As can be seen in Table 3, the oil content of chickpea varieties in the grain varies between 4.01-4.93%. While the lowest oil ratio was obtained from Azkan variety, the highest oil content was obtained from Diyar-95 variety, but the difference between them and the Çakır variety was not statistically significant. The oil content of edible legumes is generally low. It is about 5% in the highest chickpea (Özdemir, 2006).

CONCLUSION

The features examined on the varieties used in the experiment highlight some varieties. Hisar variety gave the highest value in terms of plant height criterion, while the highest value in terms of pod number per plant was obtained from Işık-05, Seçkin and Çakır varieties, and the highest value in terms of grain number was obtained from Seçkin variety. The highest grain yield per unit area was obtained from Işık-05 with 98.63 kg da⁻¹, Yaşa-05 with 96.53 kg da⁻¹ and Çakır with 94.90 kg da⁻¹, while the lowest unit area grain yield was obtained from İnci with 60.20 kg da⁻¹. Conducting the study in dry conditions and in summer conditions and the low amount of rainfall during vegetation period caused the yield criteria directly related to yield and thus low grain yield. It is thought that the irrigation to be done during the pod binding period, where chickpeas need water most, will increase the efficiency.

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