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DETERMINATION OF SOME AGRICULTURAL CHARACTERISTICS ON CHICKPEA (*Cicer arietinum* L.) GENOTYPES THAT ARE SOWN AS SECOND CROP

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MSc THESIS

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Firas Mohammed KNO tarafından hazırlanan "**Determination of Some Agricultural Characteristics on Chickpea (*Cicer arietinum* L.) Genotypes that are Sown as Second Crop"** "[İkinci Ürün Olarak Ekilen Nohut Genotiplerinin (*Cicer arietinum* L.)" Bazı Tarımsal Özelliklerinin Belirlenmesi]" adlı tez çalışması **02.05.2023** tarihinde aşağıdaki jüri tarafından **oy birliği** ile **Selçuk Üniversitesi Fen Bilimleri Enstitüsü Tarla Bitkileri Anabilim Dalı**'nda **YÜKSEK LİSANS TEZİ olarak kabul edilmiştir**.

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İmza

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Tarih: 02.05.2023

ÖZET

YÜKSEK LİSANS TEZİ

İKİNCİ ÜRÜN OLARAK EKILEN NOHUT GENOTIPLERININ (*Cicer arietinum* L.) BAZI TARIMSAL ÖZELLIKLERININ BELIRLENMESI

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Tarımsal sürdürülebilirlik konsepti bakımından öne çıkan temel bileşenlerden hem insan hem de hayvan beslenmesi için sürdürülebilir gıda üretiminin sağlanması, sürdürülebilir toprak yönetimi; sürdürülebilir kalkınma ve sürdürülebilir fonksiyonel gıda üretimi için nohut önem taşımaktadır.

Konya ekolojisinde gerçekleştirilen bu araştırma kapsamında, 2021 yılında vejetasyon döneminde arpa ve buğday hasadının ardından ikinci ürün olmak üzere 2 farklı zamanda (16 Haziran ve 01 Temmuz) ekilen 5 farklı nohut (*Cicer arietinum* L.) genotipi (Türkiye'den temin edilen: Canıtez isimli tescilli çeşit; Irak'tan temin edilen: Duhok, Erbil, Musul, Süleymaniye menşeili genotipler) yetiştirilerek bazı tarımsal özellikler incelenmiştir. Çalışmanın tarla denemeleri Tesadüf Bloklarında Bölünmüş Parseller Deneme Desenine göre 3 tekerrürlü olarak kurulmuştur. Ana parsellere ekim zamanları, alt parsellere ise nohut genotipleri yerleştirilmiştir.

Yapılan varyans analizi sonucunda araştırma kapsamında ele alınan faktörlerden ilk bakla yüksekliği, bin tane ağırlığı ve tane iriliği bakımından araştırmaya konu olan faktörlerin etkisi istatistiksel anlamda önemsiz çıkmıştır. Araştırma sonucunda daha erken tohum ekimi (16 Haziran) yapılması ile: Bitki boyu, ana dal sayısı, bitkide bakla sayısı, biyolojik verim, tane verimi, hasat indeksi, bin tane ağırlığı değerlerinin artış gösterdiği tespit edilmiştir.

Araştırma sonuçlarına göre incelenen özelliklere ait ortalama değerler interaksiyon bakımından şu şekildedir: çıkış süresi 8.67 gün – 11.67 gün, çiçeklenme süresi 41.33 gün – 44.00 gün, bakla bağlama süresi 60.33 gün – 65.67 gün, bitki boyu 39.40 cm – 70.90 cm, ilk bakla yüksekliği 17.50 cm – 20.03 cm, ana dal sayısı 1.53 adet/bitki ile 6.03 adet/bitki, bitkide bakla sayısı 4.57 adet/bitki – 26.93 adet/bitki, biyolojik verim 321.82 kg/da ile 529.24 kg/da, tane verimi 62.71 kg/da - 118.13 kg/da, hasat indeksi %18.33 - %25.67, bin tane ağırlığı 236.19 g – 251.58 g, tane iriliği 7.00 – 8.67 mm aralığında tespit edilmiştir.

Tez çalışması kapsamında incelenen özellikler bakımından öne çıkan veriler değerlendirildiğinde: ilk bakla yüksekliği için Duhok genotipi, biyolojik verim ile tane verimi için Süleymaniye genotipi, bin tane ağırlığı için Musul nohut genotipi en yüksek değerleri ortaya koymuştur.

Tek yıllık araştırma sonuçlarına dayalı olmak şartıyla, bu araştırmadan elde edilen bulgular ışığında münavebede çeşitlilik sağlanması, baklagil bitkisi yetiştiriciliğinin artırılması ve ikinci ürün seçiminde alternatif sunulabilmesi açısından nohut bitkisinin Konya ekolojisi için mümkün olabileceği görülmüştür. Araştırma bulgularına dayalı olarak: Arzu edilen özelliklerin seleksiyonuna yönelik ıslah çalışmalarında mevcut veriler değerlendirilebilir nitelikte olup, adaptasyon yeteneği ve çevre interaksiyonunu daha iyi belirlemek üzere farklı genotiplerin kullanılacağı daha uzun süreli çalışmaların gerçekleştirilerek, stabil verilerin elde edilmesine ihtiyaç olduğu söylenebilir.

Key Words: Agronomi, kültürel uygulamalar, münavebe, sürdürülebilir tarım.

ABSTRACT

MSc THESIS

DETERMINATION OF SOME AGRICULTURAL CHARACTERISTICS ON CHICKPEA (*Cicer arietinum* L.) GENOTYPES THAT ARE SOWN AS WINTER CROP

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THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCE OF SELÇUK UNIVERSITY
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Sustainability of food production for both human and animal nutrition, sustainable soil management; chickpea is important for sustainable development and sustainable functional food production.

As the aim of this research carried out in Konya ecology, 5 different chickpeas (*Cicer arietinum* L.) genotypes were sown at 2 different times (June 16 and July 01), as the second crop after barley and wheat harvest in the 2021 vegetation period (obtained from Turkey: named Canıtez - registered cultivar; Genotypes from Iraq: Duhok, Erbil, Mosul, Suleymaniye origin) were grown and some agricultural characteristics were examined. The field trials of the study were established according to the Trial Design of Split Plots in Randomized Blocks with 3 replications. Sowing times were placed on the main plots and chickpea genotypes were placed on the sub plots.

According to the result of the analysis of variance, the effect of the factors that are the subject of the research in terms of first pod height, thousand-grain weight and grain size, which are among the factors considered within the scope of the research, were found to be statistically insignificant. Consequently, it was determined that plant height, the number of main branches, number of pods per plant, biological yield, grain yield, harvest index and thousand-grain weight values increased with earlier planting of chickpeas (June 16).

According to the results of the research, the average values of the properties examined in terms of interaction are as follows: Emergence time 8.67 days - 11.67 days, flowering period 41.33 days - 44.00 days, pod setting time 60.33 days - 65.67 days, plant height 39.40 cm - 70.90 cm, first pod height 17.50 cm – 20.03 cm, the number of main branches 1.53 units/plant and 6.03 units/plant, the number of pods per plant 4.57 units/plant – 26.93 units/plant, biological yield 321.82 kg/da to 529.24 kg/da, seed yield 62.71 kg/da - 118.13 kg/da, harvest index 18.33% - 25.67%, thousand-grain weight 236.19 g - 251.58 g, grain size 7.00 - 8.67 mm.

Considering the prominent data in terms of the characteristics examined within the scope of the thesis study: the Duhok genotype for first pod height, the Suleymaniye genotype for biological yield and grain yield, Mosul chickpea genotype for thousand-grain weight revealed the highest values.

Based on the results of the one-year research, in the light of the findings obtained from this research, it has been seen that the chickpea plant is possible for the ecology of Konya in terms of

providing diversity in crop rotation, increasing legume plant cultivation and offering alternatives in the second product selection. Based on the research findings: the available data in breeding studies for the selection of desired traits can be evaluated and it can be said that there is a need to obtain stable data by conducting longer-term studies in which different genotypes will be used to better determine the adaptation ability and environment interaction.

Keywords: Agronomy, cultural practices, crop rotation, sustainable agriculture.

PREFACE

Yüksek Lisans sürecimin başlangıcından itibaren gerek ilmi gerekse sosyal hayatımda her daim yardımlarını ve bilgi birikimlerini paylaşan gerek bilimsel olarak gerekse insani değerler yönünden kendisinden çok şey öğrendiğim, Sayın Doç. Dr. Ali KAHRAMAN'a ve Değerli Ailesine, yakın ilgisi ve destekleri ile emeği çok olan Sayın Hocam Prof. Dr. Mustafa ÖNDER ve Değerli Hocam Dr. Öğretim Üyesi Selçuk KODAZ'a,

Arazinin tedarikini sağlayarak çalışmayla ilgili ihtiyaçları karşılayan – her zaman yanımızda olan Değerli Büyüğümüz merhum Seyit Ali ATÇEKEN'e (Sarraf Altınekinli),

Yaşantımın her anında bana destek verip inancını yitirmeyen, Kıymetli Aileme sonsuz teşekkürlerimi bir borç bilirim.

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SYMBOLS AND ABBREVIATIONS

kg:	Kilogram
g:	Gram
m:	Meter
m^2:	Square meter
cm:	Centimeter
mm:	Millimeter
da:	Decare (Equal to 1000 m^2)
ha:	Hectare
Ca:	Calsium
Fe:	Iron
K_2O:	Potassium
P_2O_5:	Phosphorus Pentoxide
S:	Sulfur
$CaCO_3$:	Lime
^0C:	Degrees centigrade

F value on the tables by **: 1% statistically significance level ($p<0.01$)
F value on the tables by **: 5% statistically significance level ($p<0.05$)

1. INTRODUCTION

Nutrition is one of the most basic human needs. Therefore, food safety; is a concept that is constantly on the agenda due to factors such as population growth, famine, natural disasters and war. Countries produce policies for self-sufficiency and sustainable agriculture. The agriculture sector together with nutrition; it creates employment, provides raw materials for the industrial sector, creates demand for industrial products, contributes to exports with tradable products and contributes to the incomes of nations. However, the agricultural sector differs from other sectors in terms of production factors and the characteristics of these factors. Although these factors are the same as other economic activities (enterprising workforce, capital and land), the unique characteristics of the agricultural sector have different effects on the factors. The low flexibility of the supply of agricultural products in the short run, the limited use of capital-intensive technologies unlike the industry, and the supply of inputs from oligopoly or even monopoly markets while selling in a perfectly competitive market have a negative effect on entrepreneur and capital factors in the agricultural sector. In addition, since the execution of agricultural activities in open areas depends on seasonality, the inability to ensure continuity and the concentration in rural areas have a negative effect on the labor factor. As a production factor, agricultural land has different characteristics compared to other production factors and has structural problems. Land; is a non-produced, non-reproduced and limited natural asset (Topçu, 2012).

Chickpea, which is an important species in the legume family, is one of the rare plants that continues to be cultivated thousands of years ago. It is one of the first edible legumes cultivated. Turkey is a country that is among the homelands of chickpeas. *Cicer reticulatum*, known as the wild chickpea and improved, grows wild in the Southeastern Anatolian Region in our country. Although Turkey's Southeastern Anatolia Region is shown as its homeland, it is known that agriculture has been carried on for many years. Currently, it can be grown on land pieces between 0 and 5600 m altitude in many parts of the world. Chickpea, whose growth limit reaches up to the 52nd parallel in the north, can be grown in arid and semi-arid areas around the world. In terms of climate demands, it is the most tolerant of drought and heat among the edible legumes after lentils. Its roots can go deep. Its stem and leaves can be covered with a waxy layer such as the epidermis, as well as with hairs. Chickpeas can be grown quite

easily in places where other edible legumes are damaged by drought (Kalefetoğlu, 2006; Bayrak, 2010).

The rapid increase in the world population increases its nutritional needs, but the fact that agricultural land is limited due to its unplanned use and even going out of agriculture threatens sustainable food security. In countries with agricultural development, between 2000 and 2018, agricultural land; was determined that it contracted by 2.07% in the USA, 0.77% in Russia, 2.48% in Germany, 0.78% in India, 6.61% in Turkey, 6.85% in the Netherlands, and 32.08% in New Zealand (FAO, 2020).

As of 2020, Turkey has a total agricultural area of 37 million 762 thousand hectares. According to TUIK data (TUIK, 2020) Turkey's agricultural land has shrunk by 7.94% since 2001, the oldest data published by TUIK. It has been determined that the land assets of Ankara, Konya, Sivas and Şanlıurfa provinces, which have the largest agricultural areas in Turkey, have shrunk by 0.08%, 9.66%, 17.50% and 14.79%, respectively, in the last ten years. These data indicate that agricultural land is fragmented and the existence of agricultural land is gradually decreasing. This situation reduces agricultural productivity in our country and negatively affects sustainability.

Konya, located between 36°41' and 39°16' north latitudes and 31°14' and 34°26' east longitudes, is the province with the largest surface area (40,838 km^2) in Turkey. Administratively, there is Ankara in the north, Isparta, Afyonkarahisar, Eskişehir in the west, İçel, Karaman, Antalya in the south, and Niğde and Aksaray in the east. The average elevation of the province is 1,016 meters. The provincial borders area is located in the south of the tectonic plateau of the Middle East Anatolian Union, in the middle part of the tectonic plateau of the Taurus Mountains Union. As a result of various tectonic formations, there are very thick alluvial deposits in the Konya plain and in the Ereğli and Cihanbeyli plains as a continuation of this. Therefore, the province of Konya; has aluminum and magnesite deposits, coal, clay, cement raw materials, lead-zinc, barite mines and significant groundwater resources (KTB, 2021).

The oldest and most well-established sector that supports the development of Konya's economy from the past to the present is the agricultural sector. Çatalhöyük, located in the Çumra district of Konya province; is the oldest and most developed Neolithic period settlement known today. Knowing that the first food culture, agricultural activity, use of fire and settled life were seen in the settlement is an indicator of the historical infrastructure of agriculture in Konya (KTB, 2021). Large agricultural lands that allow agricultural development, different agro-ecological sub-

regions, geographical location make the province an important agricultural city today. According to 2020 data, the total cultivated agricultural area of Konya is 1,811,381 hectares. This amount constitutes 8.04% of the total cultivated agricultural area of Turkey. The cultivated agricultural area corresponds to 46.60% of the total area of the province. This ratio shows the high agricultural capacity of Konya province.

There is a total of 27 million decares of land in the province of Konya which covers 65% of the total provincial surface area. 55.15% of the land is reserved for field crops, 30.41% for pasture, 11.50% for fallow, 1.79% for fruit and 1.16% for vegetable cultivation. Ornamental plants are grown on a total area of 836 decares in the province. While 63.79% of the cultivated agricultural land in Konya is dry, 36.21% is irrigated land (Anonymous, 2022).

Chickpea (*Cicer arietinum* L.), is an annual and widely cultivated legume plant, and it is included in the systematic grouping as *Cicer* and *Monocicer*. In chickpeas, the grain color varies from cream to brown and green, and the grain shapes from white to black show quite a lot of colors and shapes from the wrinkled surface to the flat surface. Three subspecies are widely known, these are; chickpeas in cubed, ram head and pea-like types, and there are a total of 46 known variations from these 3 subspecies in the world (Van Der Maesen, 1972).

India is the world's largest chickpea importer and also the world's largest producer, accounting for 75% (9.44 million tons) of total chickpea production. As a matter of fact, chickpea production worldwide increased by 16% in 2018 and reached 17.2 million. Australia, the United States and Turkey are secondary producers of chickpea production (Anonymous, 2021).

After the production of beans in the world, the most planted edible legume is the chickpea (Çevik, 2015). The protein rate (18.24-27.57%) in chickpea grains is quite high (Yücel et al., 2017 Chickpeas, which is one of the vegetable varieties of the legumes family, consist of 22% protein and 7% carbohydrates in 100 g chickpeas in terms of protein ratios (Mart et al., 2017). Chickpeas are consumed as dried grains in meals, in cooking by boiling and in various types of chickpeas in Turkey, the Middle East and Asian countries (Biçer et al., 2017). In Turkey, in addition to these, it is consumed in the shell or without shell (Sayar and Çalışkantürk Karataş, 2017).

Genotype x-environment interaction is evident in the trials for yield performance. In addition, the main goal of carrying out yield studies is to have an insight into the qualities of the best genotype for the future by using the available items.

Genotype x environment interaction affects yield and production as a genotype remains active in different environments and often hinders the identification and selection of stable genotypes (Khomari et al., 2017; Ansarifard et al., 2020).

Due to the ability of chickpea as a legume plant to benefit from nitrogen in the air, it can increase soil fertility for the plants to be planted after it by adding nitrogen to the soil (Morsy et al., 2015) and fertilizer savings. Therefore, chickpea is considered one of the most suitable plants for crop rotation.

In order to increase the success in chickpea production, in which ecologies the existing genotypes perform better, the quality of the grains obtained from the genotypes and their performance in second crop production should be investigated in different ecologies. As a result of such studies, genotypes with superior performance in regional conditions can be recommended to farmers in different regions. With the cultivation of genotypes suitable for the region, chickpea production will be carried out more efficiently, resources will be provided for both human and animal nutrition, an alternative will be offered for rotation, soil quality will be improved with legume plant cultivation and a contribution to sustainable agriculture will be provided with the effect of all these basic factors.

Important factors such as planting date, harvest date, vegetation period, soil temperature, day and night air temperatures, humidity and precipitation differ in main crop and secondary crop farming in the same area. Different conditions occurring in the second crop period are factors that can significantly affect the productivity and quality of genotypes.

Konya closed basin has an important place in agricultural production in Turkey. Alternative plants are needed in the region both to include different plants in the alternation and to evaluate them as a second product. This thesis, it was aimed to determine the yield and some agronomic characteristics of 5 different chickpea genotypes sown on two different dates in Konya ecological condition, and to determine the efficient and preferable chickpea genotypes as the second crop under regional conditions.

2. LITERATURE REVIEW

Saxena (1981), by planting the ILC-482 chickpea variety in three locations in the north of Syria for two years, stated that a grain yield of 178.2 kg / da was obtained in early sowing and 98.0 kg / da in late sowing.

Chickpeas can be grown in environments with different soil structures. Differences in soil lead to the emergence of some differences in the life of plants. Plants with short stature and few branches grow in light and dry soils; they bloom in a short time and tie pods. In moist and heavy textured soils where vegetative development is high; flowering time and pod setting time are delayed. Due to the excess moisture in the soil, pod setting is less in very fertile soils (Şehirali, 1988).

Eser et al. (1989), in a study by Chickpea; 47-61 days of the flowering period, 24.2-42.0 cm plant height, 13.0-33.6 cm height of the first node, seed number in 1.00-1.23 pods, 126-481 grams thousand-grain weight were determined.

Güner and Sepetoğlu (1994), chickpea grown in Bornova ecology in 3 different plant frequencies both in summer and winter; reported that the number of pods per plant (18.4-38.9 average 26.3 pieces/plant), grain yield (132-281, average 217 kg/da) and 1000 seed weight (258-279, average 267 g) values changed.

Hossain et al., (2003), defined yield, which is the most important factor, as a complex feature affected by genetic and environmental factors.

Pedersen and Lauer (2004), reported that early sowing in soybean provided higher pod/plant, grain/plant and harvest index than late sowing, but reduced the number of grains in pods.

Karasu and Vural (2006), in studies on the adaptation of some chickpea genotypes to Isparta conditions, 11 varieties were used and the trial continued for two years. The obtained data were evaluated with multivariate statistical analysis methods. According to the observed results, it was observed that there were differences in the characteristics of all cultivars. In terms of grain yield, Spanish chickpea yielded the highest yield at 125.6 kg/da and the lowest chickpea grain yield was observed to vary between 104.6-115.3 kg/da.

Tayyar et al. (2008), 14 chickpea genotypes were grown in the northwest of Turkey in autumn and spring. Sowing time had a significant effect on all examined traits. While the yield was determined as 205 kg/da in the plots planted in autumn, the

grain yield was determined as 158 kg/da in the spring planting. In the research, the 99-59C line was determined as the highest efficient line.

Gürbüz et al. (2009), In studies on grain size, chickpea seeds of different sizes 7mm, 8mm and 9mm were used, and the effects of grains on germination were examined. As a result of the research, it was reported that the germination percentage, average germination time and germination index of chickpeas of different sizes were different. In this study, the water absorption capacity of 7mm grains was found to be higher at 80.9%. The germination rate of each of the 7, 8 and 9 mm seeds was found to be 100%.

Babagil (2010), in a study conducted by Muş in arid conditions in ecology; the highest grain yield was determined as 132.8 kg/da and the lowest as 91.9 kg/da. In the study, plant height between 36.7-43.1 cm, first pod height of 19.8-26.5 cm, 3.1-3.3 the number of branches/plant, 21.6-25.5 pods/plant, and 407-439 grams thousand grain weight values were determined.

Biçer and Şakar (2012) in a study conducted by chickpea, its effects on grain size, plant height, the height of the first pod, number of main branches and pods in the plant, grain yield per unit area of the plant and hundred-seed weight were investigated. In the experiment, it was observed that the yields of large seeds were low. Because the large seeds have a longer length and the grain is large, the number of pods in the main branch and plant is less. Smaller seeds, on the other hand, are more productive but have a low market value, so they can be considered as chickpeas. In this study, the plant height is 28.7- 48.8 cm, the number of main branches is between 2.3-3.5, the number of pods per plant is between 8.42-18.92, the thousand-grain weight is 306.3-376.0 g, the results of laboratory analyzes are 9mm and above, 8mm, 7.1 mm and 6.3 mm. It was stated that there were four different sizes.

Hu and Wiatrak (2012), stated that sowing time affects the growth and development of soybean and thus affects the content of protein, oil, carbohydrates and other chemical compounds in the seed.

Kayan (2012), four different chickpea varieties were used in the experiment established in Eskişehir in order to examine the yield and characteristics of irrigation application in different periods of chickpea. In the study, it was revealed that the phenological periods were prolonged with irrigation and the height of the plants, the height of the first pod, the total number of pods in the plant and the grain yield per unit

area increased. It gave the best Akçin variety for irrigation. In this study, he reported that the flowering period was 62.5-69.9 days.

Bayrak et al. (2015) in a study conducted by Konya Ecology, the effects of chickpea cultivars on yield were examined and a total of 5 chickpea seeds, 2 of which were registered, were used. The longest flowering period of 56.5 days, the shortest vegetation period of 88.25 days, 43.25 cm plant height, 29.5 cm first pod height and the highest grain yield of 132.52 kg/da were determined in the experiment.

Bayrak and Önder (2017), in the project, which was collected from chickpea varieties grown in Konya ecology, a study was carried out to determine its agricultural, technological and nutritional characteristics, 21 chickpea populations and 5 registered varieties were used in the study. It was concluded that the used materials had a vegetation period between 90.33 and 105.33 days, plant height between 30.45 and 40.05 cm, number of pods between 20.12 and 30.42 and grain yield between 78.14 and 154.12 kg/da.

Mart et al. (2017), in the experiment carried out in Çukurova conditions, evaluations were made for the cultivation of chickpeas in the winter period, and yield and some yield components were studied. In the study, the lowest value for grain yield was determined as 169.59 kg/da, while the highest value was determined as 364.55 kg/da. The first flowering period was between 53.67-61.00 days, the plant height values were found between 63.83-78.3 cm, the first pod height values were measured as 28.87-41.07 cm, and the thousand-grain weight value was evaluated as 353-500 g.

Güngör and Dumlupınar (2018), a study consisting of 36 lines and 24 varieties was carried out in order to evaluate the yield of chickpea in the trial conducted by Kırklareli. In the study, while the Azkan variety gave the highest grain yield at 160 kg/da, the lowest yield was the Akçin 91 variety with 54.6 kg/da. In this study, flowering time values between 28.5 and 34.5 days, plant height values between 41.2 and 51.8 cm, first pod height values between 21.9 and 30.0 cm, total number of branches between 8.2 and 15.5, number of pods per plant between 9.2 and 32.5, The number of grains per plant was between 12.8 and 35.2 per plant, and the weight of 1000 grains was between 249 and 446 g.

Nazlıcan (2018) stated that the yield in soybean is 300-400 kg/da as the first product and 250-350 kg/da for the second product under normal conditions. He stated that planting should not be left until July, except for very early varieties in second-crop

agriculture. Delayed sowing reduces yield, shortens first pod height and plant height, and also causes drying problems by delaying harvest maturity.

Dönder (2019), investigated the changes in some yield and yield components in chickpeas, where different doses of humic acid and potassium were applied. It was observed that potassium applications at different doses changed the average plant height of chickpea from 48.9 cm to 51.5 cm. The highest value for plant height was determined at 51.5 cm from the plots without the application of potassium, and the lowest amount was obtained at 48.9 cm at 10 kg/da potassium application. When we look at the reaction of potassium applications to seed/plant in chickpea, the maximum value is 32.2 pieces/plant and 20 kg/da of potassium, the minimum number of grains in the plant is 28.6 pieces/plant and 10 kg/da of potassium implementation is found in the same group, although it is obtained from the plots that do not apply potassium. The amount of seed/plant; is affected by cultural practices as well as genetic traits. It is understood from the aforementioned findings that potassium treatments increase the seed/plant, similar to the pod/plant values.

Kabakçı (2019), anthracnose, one of the most important pathogens of chickpeas (*Ascochyta rabiei*), stated that it is common in every area where chickpea is cultivated in the world. The blight disease caused by the agent starts with small necrotic spots and under suitable conditions, the spots coalesce to form large lesions in leaves, branches and pods with pycnids, which are fructification organs. In severe infections, the factor that causes branch and trunk breakage and sudden death causes significant economic losses. Due to the importance of the use of resistant cultivars in control, many studies have been carried out in our country and in the world for the phenotypic separation of factor isolates and the breeding of resistant cultivars, taking into account the host-pathogen relationship.

Keerthana et al. (2021), reported that soybean is very sensitive to stress factors such as global warming, drought and flooding, which occur due to climatic change. They also stated that these stress factors cause significant losses, especially during flowering and grain-filling periods. The number of main branches was 4.83-8.18, the number of seeds per pod was 2.79-3.11, the grain yield was 247.23-401.88 kg/da, the biological yield was 514.00-731.00 kg/da, the harvest index ranged between 28.37% and 39.03% in the soybean they planted at different frequencies. As a result of the study, the researchers recommended the sowing frequency of soybeans as 7 kg/da.

Bakhoum et al. (2022), boron and/or potassium application in chickpea; stated that chlorophyll a, chlorophyll b, carotenoids, endogenous indole acetic acid and total soluble sugar content led to significant increases in yield and seed quality. However, they stated that potassium application (500 mg/l) caused more increase in all parameters studied compared to boron application.

Buğdaylı (2022), investigated the possibility of growing chickpeas as a second crop for two years in the Ulubey district of Uşak. At the end of the study, it was determined that the emergence period of the plants was 17.17-23.00 days, the pod setting time was 72.67-80.17 days, the grain yield was 35.41 - 130.16 kg / da, the grain size was between 6.83 - 9.00 mm.

Irshad et al. (2022), in chickpea production, extreme climatic conditions (irregular precipitation, extreme high and low temperatures) are important limiting factors. Optimum sowing time; is recognized as an important factor for addressing climate change and achieving maximum efficiency. It has been reported that potassium (K) application to the leaves also increases resistance to abiotic stresses.

Kumar and Mehera (2022), in addition to obtaining the highest seed yield in chickpeas; it was stated that cultural practices are of great importance to ensure maximum gross return, net return and cost-benefit ratio.

Lohitha and Dutta (2022), as a result of the research that they stated that priming application increases the grain yield in chickpea, the flowering period is 76.75-80.50 days, the plant height is 19.63-38.67 cm, the number of pods per plant is 39.72-72.71 pieces/plant, the grain yield is 111.02-206.02 kg/da, and the thousand-grain weight is 171.2-214.2 grams were detected in the range.

Yaşar and Sezgin (2022), determined the grain yield performance of 9 soybean varieties by cultivating them as second crops in 2 different locations for 2 years. As a result of the research, they determined that the grain yield was in the range of 283.6-385.0 kg/da as a general average. Researchers reported that grain yield may vary depending on the genetic structure of the genotypes used. They stated that the genotypes showing high performance in terms of grain yield were registered in the breeding studies. For this reason, they emphasized that the characteristics of the new varieties developed are expected to be stable and to show the same performance without being affected by different environmental conditions.

3. MATERIAL AND METHOD

3.1. Material

In this research, a total of 5 different chickpea genotypes, including 1 registered chickpea cultivar (Canıtez) obtained from the Department of Field Crops of the Faculty of Agriculture of Selçuk University, and 4 different chickpea genotypes (originated from Duhok, Erbil, Mosul, Suleymaniye) obtained from Iraq were used as material.

Seeds of chickpea genotypes were manually cleaned from broken and damaged grains and foreign materials before sowing, and then they were made ready for sowing.

In order to ensure integrity within the scope of the thesis, all of the chickpeas used as material were named "genotype".

3.2. Method

This work was planned to investigate the possibilities of growing chickpea genotypes in Konya ecology in winter. As a matter of fact, the method part was applied step by step as it was presented as a thesis proposal. However, due to the hard winter conditions and cold weather during the vegetation period; an acceptable level of healthy plants and seeds could not be obtained. Therefore, the subject of the research is; instead of evaluating some agronomic characteristics of chickpea genotypes by growing them in winter, it was carried out to determine some agronomic characteristics of chickpea genotypes by growing them as a second crop.

The field trial of the research was established in Altınekin – Konya (Turkey) in 2021, with three replications according to the Trial Design of Split Plots in Randomized Blocks. 5 chickpea genotypes were used as material in the research; it was sown by hand at two different times, on 16 June 2021 and 01 July 2021. Sowing times were placed in the main blocks and chickpea genotypes were placed in the sub-blocks.

It was prepared in accordance with the field method where barley was planted in the previous year. The plots are 3 meters long and 2 m wide, and 5 rows of seeds were planted, leaving 40 cm row spacing and 10 cm row spacing for each parcel. All parcels were created in the same size, with each parcel having an area of 6 m^2.

Before planting, 15 kg/da of DAP fertilizer was applied to the soil, mixed with the soil with the help of a harrow and leveled.

After the parcellation process was completed, the seeds of the chickpea genotypes were sown by hand in the annealed soil. After the seeds were planted, the soil was pressed with a foot in order to ensure the contact of the seed with the soil.

To provide tempering in the soil; irrigation was made before both seeds were planted, and a total of 3 times of sprinkler irrigation was applied to meet the needs of the plants during cultivation.

Weed control was done twice by hand hoeing. Harvesting was done by hand plucking and threshing when the pod maturity was observed in 95% of the pods formed by the plants in each plot.

While measurements and observations were taken for all the features discussed in the research, the necessary measurements and observations were not taken from these parts, since 50 cm sections were removed from the beginning and end of the remaining rows as well as the first and last rows in each plot.

All plots were matured at the same time and harvested on 05 October 2021.

It was determined that all of the pods formed in the plants were fertile.

No pods contaminated with anthracnose were found.

Measurements, observations and analyzes made within the scope of the research are given below.

3.2.1. Emergence time (day)

The time elapsed from sowing to the time of 50% exit in the parcels was determined as “days” (Biçer and Anlarsal, 2004).

3.2.2. Flowering time (day)

The time elapsed from the date of sowing to the date of the first flower on the plants was determined as “days” (Gençkan, 1958).

3.2.3. Pod setting time (day)

The time from planting to 50% pod setting period of the plants in each plot was recorded as “days” (Anlarsal et al., 2000).

3.2.4. Plant height (cm)

The distance from the soil level to the tip of the plant was measured and the average of 10 randomly selected plants from each plot was recorded in “cm” (Sadhuram et al., 2010).

3.2.5. First pod height (cm)

During the harvest maturity period, the distance from the soil surface to the lowest pod of 10 randomly selected plants from each plot was measured and recorded in “cm” (Çoban and Önder, 2014).

3.2.6. Number of the main branch (units/plant)

The branches on the 10 randomly selected plants from each plot were counted and averaged, expressed in terms of “units/plant” (Katar et al., 2012).

3.2.7. Number of pod (units/plant)

All of the pods in 10 randomly selected plants from each plot were counted and averaged and recorded as units/plant (Karahoca and Kırıcı, 2005).

3.2.8. Biological yield (kg/da)

The plants whose edge effect was removed from each plot were weighed on a scale with a sensitivity of 0.01 g and recorded as “kg/da” (Yıldırım and Önder, 2016).

3.2.9. Grain yield (kg/da)

Harvested and cleaned seeds belonging to each plot were weighed on a scale with a precision of 0.01 g and recorded as “kg/da” (Sadhuram et al., 2010).

3.2.10. Harvest index (%)

Grain yield was determined as “%” by dividing the stem yield + grain yield (Biological yield) (Çoban and Önder, 2014).

3.2.11. Thousand-grain weight (g)

From the seeds obtained from each plot, 100 seeds were weighed on a scale with a sensitivity of 0.001 g, with 4 replications, and the record was recorded in “g” (Katar et al., 2012).

3.2.12. Grain size (mm)

200 g of the seeds obtained from each plot were weighed and passed through the sieve, the seeds remaining on the 8 mm sieve were weighed separately and their ratio to the total seed amount was determined as “%” (Bayrak, 2010).

3.2.13. Statistical analyses

Variance analysis was performed on the data obtained as a result of the study, using the computer-based statistical analysis program "JUMP", and grouping was made with the "Student's t-test" at the 5% level in order to compare the mean values whose "F" test was significant (Yıldırım and Önder, 2016).

Photographs of the study are given under the heading “Figures”.

FIGURES

Figure 3.1. Tillage

Figure 3.2. Tillage

Figure 3.3. Designing of trial and irrigation

Figure 3.4. Seed bed and sowing

Figure 3.5. Sprink irrigation

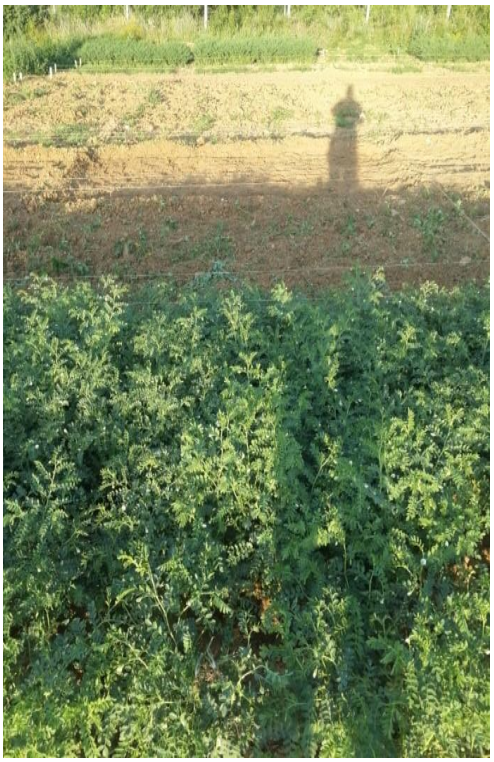

Figure 3.6. Emergence

Figure 3.7. Transportation of harvested plants

Figure 3.8. Transfer of plants for drying

4. CLIMATE AND SOIL CHARACTERISTICS OF THE RESEARCH LOCATION

Regarding the thesis, in this section, the soil and climatic characteristics of the region of the trial field in Altınekin - Konya (Turkey) where the field trial took place are given.

4.1. Climatic Conditions

The climate data of the period in which the field studies of the research were carried out were obtained from the website of the Regional Directorate of Meteorology and are given in Table 4.1.

Table 4.1. Some climatic values of the vegetation period and long years (Data: General Directorate of Meteorology)

Months	2021 Vegetation Period			Long Terms (1929-2020)		
	Temperature (°C)	Precipitation (mm)	Rel. humid (%)	Aylar (°C)	Aylar (mm)	Rel. humid (%)
June	19,1	47,1	53,3	20,1	25,7	49
July	24,4	46,3	39,3	23,5	7,0	41
August	24,2	9,8	37,5	23,3	6,3	41
September	17,9	29,1	50,7	18,8	13,4	47
October	12,6	2,7	48,9	12,8	29,8	60
Average	19,6		45,9	19,7		47,6
Total		135,0			82,2	

When Table 4.1 is examined; in terms of average temperature values, it is seen that the year in which the research was carried out and the averages of long years are almost the same.

During the vegetation period of the study, the total precipitation for 5 months was 135.0 mm, and it was approximately 52.8 mm more than the total precipitation for long years (82.2 mm). During the period of this study, the highest monthly precipitation value was determined in June with 47.1 mm. Considering the total amount of precipitation recorded during the vegetation period in which this study took place, it was seen that the distribution of precipitation to months was much more irregular than the average of long years.

When the relative humidity values are examined; in the vegetation period in which the research was carried out, there was a general similarity in terms of average value compared to long years, and it can be said that the relative humidity value of the vegetation in October is lower compared to long years.

4.2. Soil Characteristics

Considering the results of the analysis of the soil where the field trial of the research was established; it was determined that clayey-loam, slightly alkaline pH, salt-free structure, low organic matter level (1.24%), high phosphorus amount, sufficient potassium, rich in calcium, deficient in iron content and excessive calcareous structure (Table 4.2).

Table 4.2. Results of the analysis of the soil

Analyse name	**Unit**	**Method**	**Results**	**Comment**
pH		Saturation mud	7,87	Slightly alkaline
EC	dS m^{-1}	Saturation mud	0,41	
Salt	%	Saturation mud	0,0157	Saltless
Organic matter	%	W. Black	1,24	Low
Phosphorus (P_2O_5)	kg da^{-1}	$NaHCO_3$ ext.	13,42	Much
Potassium (K_2O)	kg da^{-1}	A. Ac ext.	115,19	Enough
Calcium (Ca)	mg kg^{-1}	A. Ac ext.	6417	Rich
Magnesium (Mg)	mg kg^{-1}	A. Ac ext.	407,3	Good
Iron (Fe)	mg kg^{-1}	DTPA ext.	0,823	Deficient
Zinc (Zn)	mg kg^{-1}	DTPA ext.	1,4	Enough
Manganese (Mn)	mg kg^{-1}	DTPA ext.	3,412	Enough
Lime ($CaCO_3$)	mg kg^{-1}	Calcimeter	19,79	Much limy
Structure	%	Saturation mud	54,6	Clay-Loamy

5. RESULTS AND DISCUSSION

The results of this research, in which 5 different chickpea genotypes (*Cicer arietinum* L.) were grown as a second crop at 2 different times (June 16 and July 01) in 2021 under Konya ecological conditions, are given in this section.

The variance analysis table of the characteristics examined within the scope of the study is given in Table 5.1.

Table 5.1. The "F" values determined for the investigated characteristics in chickpea genotypes grown as a second crop

Characteristics	***Sowing time***	***Genotype***	***Sowing time X Genotype***
Emergence time	6,1266	13,1333**	8,8667**
Flowering time	0,0412	2,7033	4,2418*
Pod setting time	17,8145	1,2143	5,5000**
Plant height	10,3830	8,6739**	9,1114**
First pod height	0,4990	1,1760	0,2866
Main branch	27,5026*	4,6152*	2,3009
Pod / Plant	80,6192*	3,7751*	6,7443**
Biological yield	42,3394*	2,5497	2,7660
Seed yield	1045,645**	3,8647*	1,6542
Harvest index	14,7692	4,5600*	10,4267**
Thousand-grain weight	4,3746	0,9667	2,0876
Grain size	3,5714	0,7213	1,9672

**: %1 significance level *: %5 significance level

The interpretation of the results of Table 5.1 was carried out under the relevant headings.

5.1. Emergence Time

The average values of emergence time determined in chickpea genotypes grown in Konya as a second crop are given in Table 5.2.

According to the results of the analysis of variance, the difference between sowing times in chickpea genotypes was insignificant, while the genotype and interaction of sowing time x genotype was significant at the level of 1% (Table 5.1).

In terms of emergence time, values varied between 9.50 days (Duhok genotype) and 11.33 days (Erbil genotype).

Considering the interaction values (Table 5.2), the emergence time showed a difference in the range of 8.33 – 11.67 days.

Table 5.2. Values of emergence time (days) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	10,00 c	8,67 d	11,33 a	10,33 bc	8,33 d	9,73
01 July	11,00 ab	10,33 bc	11,33 a	11,67 a	11,67 a	11,20
Average	10,50 bc	9,50 d	11,33 a	11,00 ab	10,00 cd	10,47

Chickpea emergence time, in Uşak ecological conditions, in another study investigating the possibility of growing chickpeas as a second product; was detected between 17.17 days and 23.00 days. It can be said that the difference in question arises as a result of the difference between the ecological conditions and genetic structure, as well as the planting times.

5.2. Flowering Time

The average values of the flowering time determined in this study carried out in the ecology of Konya, where chickpea genotypes are planted as the second crop, are shown in Table 5.3.

Table 5.3. Values of flowering time (days) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	43,00 abc	42,00 bcd	44,00 a	41,33 d	41,33 d	42,33
01 July	42,00 bcd	41,67 cd	42,67 a-d	43,33 ab	42,67 a-d	42,47
Average	42,50	41,83	43,33	42,33	42,00	42,40

According to the results of the analysis of variance in terms of flowering time in chickpea genotypes (Table 5.1), the genotype x sowing time interaction, which is the subject of this research, was significant at the level of 5%, while the other factors in the study were insignificant.

In terms of the interaction, which is the subject of this study, the flowering period was determined between 41.33 and 44.00 days (Table 5.3).

In the studies, the flowering period in chickpea is 47-61 days (Eser et al., 1989), 62.5- 69.9 days (Kayan, 2012), the longest in Konya ecology is 56.5 days (Bayrak, 2015), 53.67-61.00 days (Mart et al., 2017), 28.5-34.5 days (Güngör and Dumlupınar, 2018), 76.75-80.50 days (Lohitha and Dutta, 2022). As a result of the examination of the mentioned findings, it can be said that the flowering period of the chickpea plant shows a wide variation.

5.3. Pod Setting Time

In this study, which was conducted to examine some characteristics of chickpea genotypes planted at two different times as a second crop under Konya ecological conditions, the average values obtained for the pod setting time are presented in Table 5.4.

According to the results of the analysis of variance in terms of pod setting time, the interactive effect was significant at the 1% level, while other factors were found to be insignificant.

Table 5.4. Values of pod setting time (days) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	62,33 cd	60,67 de	62,67 c	60,33 e	60,67 de	61,33
01 July	63,67 bc	63,67 bc	64,00 abc	65,67 a	65,33 ab	64,47
Average	63,00	62,17	63,33	63,00	63,00	62,90

In chickpea genotypes, the average values of the pod setting time in terms of genotype x sowing time interaction were determined in the range of 60.33 – 65.67 days (Table 5.4). In another study conducted with chickpeas (Buğdaylı, 2022), the pod setting time was determined as 72.67-80.17 days. In a study on legumes (Hu and Wiatrak, 2012), it was stated that the time of planting the seeds affects the growing and development of soybean, which is also a legume plant, and thus affects the content of protein, carbohydrates, oil and other chemical compounds in the seed.

5.4. Plant Height

The average values obtained for the plant height examined within the scope of the research in chickpea genotypes grown in Konya as the second crop are given in Table 5.5.

Table 5.5. Values of plant height (cm) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	53,20 bcd	55,93 bc	45,37 de	70,90 a	61,37 b	57,35
01 July	54,07 bcd	51,90 cd	39,40 e	39,97 e	55,23 bc	48,11
Average	53,63 a	53,92 a	42,38 b	55,43 a	58,30 a	52,73

As a result of the statistical analyzes made in this study, the genotype and interaction of genotype x sowing time was significant in terms of plant height ($p<0.01$).

Values in terms of plant height were found in the range of 42.38 cm (Erbil) – 58.30 cm (Suleymaniye).

In terms of interactive effect, plant height was determined in the range of 39.40 cm – 70.90 cm in chickpea genotypes (Table 5.5).

As a result of various researches on chickpea plant, plant height values (Unit: cm); 24.2-42.0 (Eser et al., 1989), 36.7-43.1 (Babagil, 2010), 28.7- 48.8 (Biçer and Şakar, 2012), 43.25 (Bayrak et al., 2015) and 30.45-40.05 (Bayrak and Önder, 2017), 63.83-78.3 (March et al., 2017), 41.2-51.8 (Güngör and Dumlupınar, 2018), 48.9-51.5 (Dönder, 2019), 19.63-38.67 (Lohitha and Dutta, 2022) determined. It is seen that the mentioned findings vary greatly and the results of this research are among the mentioned values.

5.5. First Pod Height

The average values of the first pod height are given in Table 5.6 within the scope of this study, in which the effects of growing chickpea genotypes as a second crop in Konya ecology, where planting is carried out at two different times.

As a result of the analysis of variance performed in terms of first pod height, it was determined that the factors subject to this study were statistically insignificant.

In the study, the height of the first pod of the genotypes was determined as 18.02 cm (Suleymaniye) – 19.62 cm (Canıtez) (Table 5.6).

When the averages of the interaction in terms of first pod height were evaluated (Table 5.6), it was determined that the result changed between 17.50 cm and 20.03 cm.

Table 5.6. Values of first pod height (cm) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	19,20	19,27	18,10	17,50	17,87	18,39
01 July	20,03	18,93	18,53	18,97	18,17	18,93
Average	19,62	19,10	18,32	18,23	18,02	18,66

According to the results of previous research on chickpea plant, the first pod height (Unit: cm); 13.0-33.6 (Eser et al., 1989), 19.8-26.5 (Babagil, 2010), 29.5 in Konya ecology (Bayrak et al., 2015), 28.87-41.07 (March et al., 2017), 21.9-30.0 (Güngör and Dumlupınar, 2018). It has been determined that these findings are largely in agreement with the results of this research. The height of the first pod is important for suitability for machine harvesting and for the reduction of grain loss during harvest, and it is an important feature taken into account in breeding studies.

5.6. Number of Main Branch

Within the scope of this research carried out in Konya ecology, the effects of cultivation as a second crop on chickpea genotypes planted at two different times were examined, and the average values of the number of main branches are given in Table 5.7.

Table 5.7. Values of number of main branch (units/plant) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	5,30	5,37	6,03	3,37	3,13	4,64 a
01 July	3,63	1,53	2,67	1,73	2,27	2,37 b
Average	4,47 a	3,45 ab	4,35 a	2,55 b	2,70 b	3,51

According to the results of the variance analysis made in terms of the number of main branches in chickpea genotypes, it was seen that the genotype and sowing time factors were significant at the 5% level.

It was observed that the number of main branches in chickpea genotypes decreased as a result of delaying planting (4.64 units/plant versus 2.37 units/plant) (Table 5.7).

The lowest number of main branches detected in chickpea genotypes was determined in the Mosul genotype with a value of 2.55 units/plant, and the highest value of 4.47 units/plant was determined in the Canıtez genotype.

It was found that the number of main branches of the interaction varied between 1.53 units/plant and 6.03 units/plant.

In previous studies on chickpea, the number of main branches per plant (Unit: Units / Plant); is stated that values are between 3.1-3.3 (Babagil, 2010), 2.3-3.5 (Biçer and Şakar, 2012). Previous findings on the number of main branches in chickpeas partially overlap with the results of this study. As it is known, in addition to genetic structure, ecological conditions and cultural practices are of great importance in the growth and development of plants.

5.7. Number of Pod

In the study, the average values obtained for the number of pods per plant in chickpea are shown in Table 5.8.

Table 5.8. Values of number of pod (units/plant) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	22,30 ab	17,33 bc	18,33 bc	26,93 a	19,77 b	20,93 a
01 July	6,40 d	4,57 d	9,13 d	5,13 d	14,37 c	7,92 b
Average	14,35 ab	10,95 b	13,73 ab	16,03 a	17,07 a	14,43

According to the results of the analysis of variance for the number of pods per plant in chickpea, sowing time and genotype factors, which are the subject of this research, were significant at the 5% level, while the interaction was significant at the 1% level.

As a result of this research, it was determined that the number of pods per plant decreased from 20.93 per plant (June 16) to 7.92 per plant (July 01) with delayed planting.

It was observed that the values of the number of pods per plant varied between 10.95 units/plant (Duhok) and 17.07 units/plant (Suleymaniye) on the basis of genotypes (Table 5.8).

It was determined that the number of pods per plant in chickpea genotypes differed between 4.57 and 26.93 units/plant in terms of the average values of the interaction.

As a result of various studies on chickpea, the number of pods per plant (Unit: Units / Plant): 18.4-38.9 (Güner and Sepetoğlu, 1994), 21.6-25.5 (Babagil, 2010), 8.42-18.92 (Biçer and Şakar, 2012), in Konya ecology 20.12-30.42 (Bayrak and Önder, 2017), 12.8-35.2 (Güngör and Dumlupınar, 2018), 39.72-72.71 (Lohitha and Dutta, 2022). When a general evaluation is made, it is seen that the number of pods per plant in chickpea varies in a wide range. As a matter of fact, the values obtained within the scope of this thesis study were within the range of previous findings.

5.8. Biological Yield

In this study, in which chickpea genotypes sown in 2 different periods as a second crop in Konya's ecology were grown, the average values determined for biological yield are given in Table 5.9.

Table 5.9. Values of biological yield (kg/da) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	462,61	460,71	405,00	452,22	529,24	461,96 a
01 July	321,82	343,50	342,40	322,91	337,29	333,58 b
Average	392,22	402,10	373,70	387,57	433,27	397,77

In this study, in which some agronomic characteristics were examined in five different chickpea genotypes planted at two different times as a second crop under Konya ecological conditions, only the differences between sowing times, which were

the subject of the research, were significant at the level of 5% in terms of biological yield, while other factors were found to be insignificant (Table 5.9).

In terms of biological yield, the biological yield in chickpea was 461.96 kg/da as a result of sowing on June 16, and the biological yield was 333.58 kg/da as a result of sowing on July 01. The change in question; corresponds to 38.49%.

When the averages of biological yield values in chickpea genotypes were examined, the lowest value was determined in the Erbil genotype with a value of 373.70 kg/da and the highest value was found in the Suleymaniye genotype with a value of 433.27 kg/da.

When the average values of biological yield obtained as a result of this study were evaluated in terms of interaction, they varied between 321.82 kg/da and 529.24 kg/da values.

As reported in a study (Dönder, 2019), the seed/plant value is thrilled by both genetic characteristics and cultural applications. It seems according to the obtained results that the application of potassium cause higher values for seed/plant in similar to the pod/plant amount. Similarly, in another study (Bakhoum et al., 2022), it was stated that potassium application (500 mg/l) in chickpea provided a greater increase for all properties examined in the study when compared to boron application. It has been stated that the soybean, which is also a legume, is an extremely sensitive plant to climatic change (Keerthana et al., 2021). They stated that the most suitable planting frequency for soybeans, which they planted at different frequencies, was 7 kg/da and the biological yield was in the range of 514.00-731.00 kg/da value.

5.9. Seed Yield

In this study, in which a total of 5 different chickpea genotypes were grown as a second crop on 2 different dates in Konya ecology, the average values obtained in terms of seed yield are presented in Table 5.10.

As a result of this research carried out in Konya ecology, the difference between sowing times in terms of seed yield in chickpea genotypes grown as a second crop at different times was statistically significant at the 1% level, while the difference between genotypes was significant at the 5% level. As a result of the analysis of variance, the effect of sowing time x genotype, which is the subject of this research, was found to be insignificant.

Table 5.10. Values of seed yield (kg/da) in chickpea genotypes grown as a second crop

Sowing time	Genotype					
	Canıtez	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	106,59	113,81	103,76	86,06	118,13	105,67 a
01 July	65,43	62,95	62,71	63,50	75,20	65,96 b
Average	86,01 abc	88,38 ab	83,24 bc	74,78 c	96,66 a	85,82

Seed yield of five chickpea genotypes planted at two different times as the second crop; while it was 105.67 kg/da in the first sowing time (June 16), the seed yield was determined as 65.96 kg/da in the second sowing time (01 July). Accordingly, as a result of delayed sowing in chickpeas, the grain yield decreased by 62.42% (Table 5.10). As a result, it was seen that delayed sowing caused a decrease in grain yield in chickpea.

Within the scope of the thesis study, 5 different chickpea genotypes grown in Konya were grown as the second product at 2 different times, when the seed yield values were examined (Table 5.12), the lowest value was determined as 74.78 kg/da in Mosul genotype, followed by Erbil genotype (83.24 kg/da), Canıtez genotype (86.01 kg/da) and Duhok genotype (88.38 kg/da) followed by increasing. As a result of the study, the highest seed yield value was determined in the Suleymaniye genotype with a value of 96.66 kg/da. According to these results, the difference between the lowest value and the highest value in terms of grain yield corresponded to 22.64%.

In this study, which was carried out with five different chickpea genotypes grown in Konya ecology at two different times as the second crop, when the averages of seed yield values regarding the interactive effect were examined (Table 5.10), the findings varied between 62.71 kg/da and 118.13 kg/da values. The said difference was determined as 46.91%.

The yield values obtained as a result of previous studies on chickpeas can be summarized as follows (Unit: kg/da): 98.0-178.2 (Saxena, 1981), 217 (Güner and Sepetoğlu, 1994), 104.6-115.3 (Karasu and Vural, 2006), 158-205 (Tayyar et al., 2008), 91.9-132.8 (Babagil, 2010), the highest in Konya ecology is 132.52 (Bayrak et al., 2015), and in another study 78.14-154.12 (Bayrak and Önder, 2017), 169.59-364.55 (March et al., 2017), 54.6-160.0 (Güngör and Dumlupınar, 2018), 35.41–130.16 (Buğdaylı, 2022), 111.02-206.02 (Lohitha and Dutta, 2022).

Researcher Hossain et al. (2003) yield, which is known as the most important element in plant production; is expressed as a complex trait affected by genetic and environmental factors. In another study (Pedersen and Lauer, 2004), it was stated that early sowing of soybean, which is also a legume plant, provides more pod/plant, grain/plant and harvest index compared to late sowing, while it causes a reduce for the seed per pod. Nazlıcan (2018), in his research on a legume plant, stated that soil preparation in soybean cultivation as a second crop is more difficult than the main crop due to extreme temperatures and less time. He emphasized that tillage should be completed as soon as possible, against the risk that high temperatures will adversely affect soil tempering since the grain harvest is carried out in June. According to the common results of many previous studies on this subject, it is known that planting directly with stubble seeders with minimal tillage or without tilling the soil provides higher yields. Yaşar and Sezgin (2022) reported that the data obtained as a result of different studies may be different from others, while they are in harmony with some studies. It is expected that the main reasons for these differences may be due to different locations, different climate and soil characteristics, or differences in the genetic structures of the genotypes used.

5.10. Harvest Index

In this study, in which chickpea genotypes were grown as a second crop in Konya ecology at two different times, the average values obtained in terms of harvest index are presented in Table 5.11.

Çizelge 5.11. Values of harvest index (%) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	23,33 ab	24,67 ab	25,67 a	19,00 d	22,33 bc	23,00
01 July	20,33 cd	18,33 d	18,33 d	19,67 d	22,33 bc	19,80
Average	21,83 a	21,50 a	22,00 a	19,33 b	22,33 a	21,40

As a result of the research, when the results of the analysis of variance were examined (Table 5.1), while the difference between sowing times was insignificant for

the average values determined in terms of harvest index, it was significant at the level of 5% in terms of genotype factor and significant at the level of 1% in terms of interaction.

As a result of the study, the genotype with the lowest harvest index value was determined in the Mosul genotype with a value of 19.33%, while the highest harvest index value was found in the Suleymaniye genotype with a value of 22.33%.

The average values of the interaction in terms of harvest index value in chickpea genotypes varied between 18.33% and 25.67% (Table 5.11).

In another study, researchers (Keerthana et al., 2021) determined the harvest index as 28.37%-39.03% as a result of the study that they cultivated the soybean variety in the medium maturity group named JS 20-98 in India.

In a study (Irshad et al., 2022), on chickpea production; it is stated that there are some important and limiting factors such as unexpected extreme climatic conditions (irregular precipitation, extreme high and low temperature). Realization of the most suitable planting time; has been emphasized as an important factor to achieve the highest efficiency by taking into account the climatic changes. In another study (Kumar and Mehera, 2022), it was stated that the desired benefit-cost ratio can be achieved in chickpeas with the most appropriate implementation of cultural practices.

5.11. Thousand-Grain Weight

Within the scope of this research carried out in Konya ecology, the effects of growing chickpea genotypes planted at two different times as a second crop were examined, and the average values of thousand-grain weight are given in Table 5.12.

Table 5.12. Values of thousand-grain weight (g) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	245,67	240,00	238,00	244,03	251,60	243,86
01 July	242,60	241,40	239,83	244,83	236,20	240,97
Average	244,13	240,70	238,92	244,43	243,90	242,42

In this study, in which 5 different chickpea genotypes were sown as a second crop at 2 different times in Konya ecological conditions, the factors that were the

subject of the study were found to be statistically insignificant according to the results of the analysis of variance (Table 5.1).

In this study, a thousand-grain weight was determined as 243.86 g at the first sowing time (June 16), and 240.97 g at the second planting time (01 July).

As a result of the study, average values in terms of thousand-grain weight were determined between 236.20 g (Suleymaniye genotype) and 244.43 g (Mosul genotype).

The average values determined for the thousand-grain weight of the interaction were found in the range of 238.00 g – 251.60 g (Table 5.12).

In previous studies on the subject, thousand-grain weight values in chickpeas (Unit: g): 126-481 (Eser et al., 1989), 267 (Güner and Sepetoğlu, 1994), 407-439 (Babagil, 2010), 306.3- 376.0 (Biçer and Şakar, 2012), 353-500 (March et al., 2017), 249-446 (Güngör and Dumlupınar, 2018), 171.2-214.2 (Lohitha and Dutta, 2022).

5.12. Grain Size

In this study, in which field studies were carried out in Konya ecological conditions, five different chickpea genotypes were grown as a second crop at two different times and the average values of grain size are given in Table 5.13.

Table 5.13. Values of grain size (mm) in chickpea genotypes grown as a second crop

	Genotype					
Sowing time	**Canıtez**	**Duhok**	**Erbil**	**Mosul**	**Suleymaniye**	**Average**
16 June	7,00	8,00	8,33	8,00	7,67	7,80
01 July	8,33	8,67	7,67	7,67	8,33	8,13
Average	7,67	8,33	8,00	7,83	8,00	7,97

In this study, in which 5 different chickpea genotypes were planted at 2 different times as a second crop in Konya ecological conditions, the factors that were the subject of the study were found to be statistically insignificant in terms of grain size values, according to the results of the analysis of variance (Table 5.1).

In this study, the grain size was determined as 7.80 mm in the first sowing time (June 16) and 8.13 mm in the second planting time (01 July).

As a result of the study, average values in terms of grain size were determined between 7.67 mm (Canıtez) and 8.33 mm (Duhok).

The average values determined for the grain size of the interaction were determined in the range of 7.00 mm - 8.67 mm.

In connection with this issue, in a study on the grain size of chickpeas, the effects of grains on germination were investigated by using seeds of chickpeas of different sizes (7mm, 8mm and 9mm). As a result of the study, the water uptake capacity was found to be higher with a value of 80.9% in grains of 7 mm size. In addition, the germination rate of all seeds (7, 8 and 9 mm) was found to be 100%. In another study (Biçer and Şakar, (2012), it was stated that there are grains of four different sizes, 9mm and above, 8mm, 7.1 mm and 6.3 mm in chickpeas. It was detected in the range of 6.83-9.00 mm. The findings of this study are in accordance with the relevant literature.

6. CONCLUSIONS

Within the scope of this research, in which 5 different chickpea genotypes sown at 2 different times in 2021 under the ecological conditions of Konya were grown as a second product, it was aimed to determine the effects of genetic structure and sowing time on some agricultural characteristics of chickpea. Field trials were carried out in 3 replications according to the Split Plots Trial Design in Randomized Blocks. Sowing times were placed on the main blocks and chickpea genotypes were placed on the sub-blocks.

According to the results of the analysis of variance made within the scope of the statistical analyzes carried out within the scope of the research, the first pod height, thousand-grain weight and grain size were found to be insignificant among the characteristics examined for the thesis study.

As a result of this study, when chickpeas were sown earlier (June 16): plant height, number of main branches, number of pods per plant, biological yield, seed yield, harvest index, thousand-grain weight values increased.

As a result of the research, the highest value for the first pod height was determined in the Duhok genotype, the highest value for biological yield was determined in the Suleymaniye genotype, and the highest value for thousand-grain weight was determined in the chickpea genotype named Mosul.

Today, concentrated researches are focused on improvement the amount of yield to be obtained from a unit area. Increasing productivity and quality in agricultural production; it is of great importance that the plant needs to be provided at the most appropriate level and that sustainable systems are based on the needs of humans and animals.

In order to solve the main problems encountered in the production of alternative rotation plants, it is essential to develop new seed varieties besides the determination of the environmental interactions of existing genotypes with the breeding programs and introduce the findings to the farmers and to make extension studies more comprehensive and effective.

In order to disseminate alternative plants and production systems, systems to encourage legume agriculture should be implemented by giving government support, a product pattern suitable for the region should be created, alternative legumes should be included in crop rotation systems and it is important to expand the cultivation of legumes in particular. In addition, it is essential to open the way to becoming a self-

sufficient country in plant production and export its surplus by working on plants that will be used to reduce the deficit of legumes with a planned and programmed study, supporting research and development projects on breeding as a second crop with high economic value.

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