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MASTER OF SCIENCE (MSc) DEGREE THESIS

DETERMINATION OF THE MORPHOLOGICAL, POMOLOGICAL, AND PHENOLOGICAL PROPERTIES OF SOME OLIVE VARIETIES GROWN IN THE NORTH IRAQ REGION

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LIST OF CONTENTS

Page No

ÖZET

Yüksek Lisans Tezi

KUZEY IRAK BÖLGESİNDE YETİŞTİRİLEN BAZI ZEYTİN ÇEŞİTLERİNİN (Olea europaea)MORFOLOJİK, POMOLOJİK ve FENOLOJİK ÖZELLİKLERİNİN BELİRLENMESİ

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Bu çalışma Kuzey Irak'ın Süleymaniye ilinin Kallar ilçesinde doğal olarak yetişen ve bölgeye iyi adapte olmuş zeytin genotiplerinin morfolojik, pomolojik ve fenolojik özelliklerinin belirlenmesi amacıyla 2021-2022 yılları arasında yürütülmüştür. Çalışmada incelenen çeşitler yörede doğal olarak yetişen Arbequina, Picual, Qaisi ve Sorani çeşitlerinin yetiştirildiği zeytinliklerden temin edilmiştir. Türkiye'ye getirilen zeytin örneklerinin pomolojik analizleri, Harran Üniversitesi'nde yapılmıştır. Araştırma sonucunda zeytin çeşitlerine ait meyve uzunluğunun 14.84 -19.84 mm, meyve genişliğinin 10.31 – 16.04 mm, meyve ağırlığının 98.26 - 298.13 g, çekirdek uzunluğunun 10.75 –14.49 mm, çekirdek genişliğinin 6.53 – 8.95 m, çekirdek ağırlığının 26.99 – 58.21 g, yaprak genişliğinin 12.18-17.73 mm ve yaprak uzunluğunun 49.27-67.42 mm arasında değiştiği belirlenmiştir. İncelenen çeşitlerin çiçeklenme dönemlerinin 15 Mart ve 15 Nisan arasında olduğu belirlenmiştir. Bölgede yetişen Qaisi ve Picual çeşidinin sofralık ve yağlık olarak ekonomik zeytin yetiştiriciliğine uygun olabileceği kanaatine varılmıştır. Arbequina çeşidinin ise yağlık olarak tüketilmesi önerilmektedir. Bu çalışmada araştırılan çeşitlerin iler ki dönemlerde daha ayrıntılı incelemelerin yapılması, bunların ekonomiye kazandırılmaları açısından önemlidir.

ANAHTAR KELIMELER: Arbequin, Sorani, Qaisi, Zeytin, Pomoloji.

ABSTRACT

MSc Thesis

DETERMINATION OF THE MORPHOLOGICAL, POMOLOGICAL AND PHENOLOGICAL PROPERTIES OF SOME OLIVE VARIETIES(Olea europaea) GROWN IN NORTH IRAQ REGION

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Year: 2022, Page: 53

This study was carried out between the years 2021-2022 in order to determine some morphological, pomological, and phenological characteristics of fruits belonging to olive genotypes that grow naturally in the Kallar district of Sulaymaniyah in Northern Iraq and are well adapted to the region. The varieties examined in the study were obtained from the olive groves where the naturally grown genotypes Arbequina, Picual, Qaisi, and Sorani were grown. Pomological analyzes of olive samples brought to Turkey were carried out at Şanlıurfa Harran University. As a result of the research, fruit length of olive varieties is 14.84 -19.84 mm, fruit width is 10.31 – 16.04 mm, fruit weight is 98.26 – 298.13 g, pit length is 10.75 –14.49 mm, pit width is 6.53 – 8.95 m, pit weight is 26.99 – 58.21 g, leaf width is 12.18 It was determined that -17.73 mm, and leaf length varied between 49.27-67.42 mm. Flowering periods of the examined cultivars were determined to be between March 15 and April 15. It has been concluded that the Qaisi and Picual varieties grown in the region may be suitable for economic olive cultivation as table and oil olives. On the other hand, the Arbequina variety is recommended to be consumed as oil. Therefore, it is important to examine the varieties investigated in this study in the future to bring them into the economy.

KEYWORDS: Arbequina, Sorani, Qaisi, Olive, Pomology.

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LIST OF FIGURES

Page No

LIST OF TABLES

Page No

LIST OF SYMBOLOS and ABBEVIATIONS

%	Percentage
°C	Degrees Celsius
cm	Centimeter
g	Gram
Kg	Kilogram
m	Meter
ml	Milliliter
mm	Millimeter
NaOH	Sodium Hydroxide
TURKSTAT	Turkish Statistical Institute
WSDM	Water Soluble Dry Matter ratio

1. INTRODUCTION

The olive fruit has represented hope and peace in different civilizations throughout history. The olive plant and its grain are considered sacred by some people. Therefore, few things in human life have attracted as much attention as olives. The olive fruit, which dates back ten thousand years, has been the source of many legends, from Greek athletes to saints and first doctors, being considered sacred by the gods and goddesses in Greek mythology (Ozyilkan et al., 2005).

When we examine the traditions from the past to the present, the leaves of the olive plant have been the symbol of victory, wisdom and peace. The dove that returned to Noah's ark with an olive branch in its mouth in Noah's flood was considered a sign that the great flood disaster had come to an end. It is not possible to see the historical traces of olives that much, except for the geography we live in, both in terms of history and its place in daily life (Ozyilkan et al., 2005; FAO, 2021).

There are two views on the emergence of olives: The first is that the olive first appeared in the Aegean, the Mediterranean parts of Anatolia, Lebanon and Syria, and the second view is that it was in the Atlas mountains of Egypt and North Africa. However, according to many scientific studies, the homeland of the olive plant is Hatay, Mardin and Kahramanmaraş in Anatolia. The Mesopotamian civilization, created by the Assyrians and Babylonians, met the olive plant and even traded it. It is seen that the pots found in the excavations in the Urla and Çeşme districts of İzmir were used in the production of olives and olive products, and their history dates back to the 3rd century B.C. Another thing revealed during the excavations is that the olive industry is at least 5000 years old. In the Hellenistic period of the Greeks, the olive tree was considered sacred. Those who cut down the olive tree were punished with death or exiled (Ay , 2018).

Olive grains are a product that can be processed as table and oil, and its by-products can be evaluated; its demand is increasing because it is very beneficial for

health. The cultivation of the olive plant is mostly carried out in countries with a coast to the Mediterranean (Syria, Morocco, France, Tunisia, Spain, Italy, Greece, Portugal and Turkey) due to climate selectivity. Today, approximately 93% of olive tree assets are still in these countries. As a result, 16.6 million tons of olives are produced in approximately 10.6 million hectares worldwide (F.A.O., 2021).

1.1. Morphological and Biological Characteristics of Olive Tree

The olive plant is different from other fruit trees because it is perennial and long-lived. If the olive tree dies due to any problem, a tiny piece of root or a small shoot is sufficient for the olive plant to reoccur (Toplu et al., 2009).

1.1.1. Root structure

Roots in seedlings consisting of steel or seed always tend to grow vertically until the third and fourth years. In the following periods, these roots are replaced by tubers, and a new root structure is formed, which becomes fringed. These roots are located on the lower surface of the soil. Soil structure has a great influence on the formation of the root system. Depending on the age and growth of the olive tree, the roots continue to grow and spread (Benlioğlu et al., 2000; Nergiz and Engez, 2000).

The part of the olive body under the ground is called a "radish", and the swelling around it is called a tuber. In arid conditions, the tubers are used for the propagation of olives. Any part of the olive tree can form roots. Nevertheless, tubers can form more roots. However, propagation by tuber is not economical for the olive plant (Benlioğlu et al., 2000).

1.1.2. Trunk and branches

Tubers that make up the root system also show the feature of forming shoots. As the olive tree ages, the trunk loses its roundness as the main part of the trunk expands differently over time. As a result, protrusions occur on the trunk, and cracks occur. The

area covered by the tree crown is 3-8 m in diameter. There are second and third-degree branches on the main branches. These branches are brittle and have a shiny surface, and are easily breakable. The upper surface of the leaves is light green, and the lower surface has a dull silvery colour. The tip axis of the leaves is rounded in some varieties. Although the leaves mostly change every three years, they can sometimes be shed earlier due to diseases (Benlioğlu et al., 2000).

1.1.3. Flowering

Thin and long twigs formed on the branches in spring and summer form branches that will bear fruit next year. Olive grains occur on the biennial branches. Olive flowers are white, the sepals are green, and they are found in clusters on biennial twigs. On average, 10-15 flowers and 25 flowers at the most in each inflorescence formed. (Benlioğlu et al., 2000). From April onwards, small twigs can grow depending on the climate and environmental conditions. Then, soma (flower buds) appear on the biennial branches. In dry and hot weather, the opening of the somaks starts on April 20 and continues until May 20. However, it can be seen until the middle of June in rainy and cool years. Suppose the weather conditions are not suitable for pollination in the period when the pods are opened. In that case, the fruit set is low despite abundant flowering (Benlioğlu et al., 2000).

1.1.4. Fruit set and maturity

For pollination to occur normally, pollen dust must be held on the stigma. For this, the air must be humid and warm. The white petals of the flowers, which complete their fertilization at the end of June, fall and small fruits appear. There are three, four, five or sometimes just one fruit on an inflorescence. The fruits, which are small in July, take the form of hazelnuts on August 15. After August, oil formation begins in the olive grains and the oil increases until a certain period. The change of fruit colour manifests the development of olive grains. Olives that are dark green at first turn into light green, light yellow, dark red and finally black. Olives take a long time to mature (Benlioğlu et al., 2000).

1.1.5. Periodicity

It is the condition that olive trees bear fruit every two years. This situation arises from both traditional and intensive cultivation. However, if tree growth, fruit development and yield are not interfered with, the degree of fluctuation in yield varies depending on environmental conditions, even if the periodicity is genetically controlled, climatic and cultural (Tuncer, 2019).

It depends on the applications and is especially affected by the weather conditions. Since the olive fruit is formed during the vegetative development of the previous season, this development period is the main actor that determines the yield potential of the next season. There is an inverse relationship between yield and vegetative growth in olives, and the potential for fruit formation is limited in the year following a year with abundant crops. Since the olive tree's power is spent on forming shoots in the absence of olives, most of the buds on the existing shoot turn into flower buds next year. This way, there will be a much higher flower and fruit set than the previous year. This high flower and fruit set causes poor vegetative development. This reduces the yield potential for the next year. The harvest period is also one of the factors affecting periodicity. Although delaying the harvest period is limited, it is very effective on the yield rate of the next period (Çulha, 2020).

Another important factor affecting periodicity is the seed. A product with many small fruits can increase periodicity more than one with a few large fruits. Therefore, reducing the amount of product by diluting the products on the annual shoots reduces not only the number of seeds but also spends some of the current energy of the tree on the development of shoots that will bear fruit next year. Therefore, early harvesting is one of the most important solutions (Tuncer, 2019).

1.2. Olive Growing Techniques

The olive plant adapts to all lands and has the power to grow in places where other products do not grow well. It can be grown on unproductive, constantly eroded lands and where the slope is high. Cultural processes for its cultivation and combating

diseases and pests increase plant growth and fruit yield and quality. However, it is difficult to come across these applications in extensive farming (Bignami et al., 1993).

1.2.1. Selection of cultivars

Adaptation to soil and climatic conditions, tolerance to diseases and pests, susceptibility to early yield, fruit quality and quantity, the tendency to periodicity, ripening time and suitability for mechanical harvest are genetic characteristics in cultivar selection (Tous et al., 1998; Trujillo et al., 1995)

1.2.2. Tree density and planting type

The tree has a leaf surface that can receive as much sunlight as possible. This suitable planting frequency can be achieved by planting shape, pruning and finishing. The tree density of the irrigated arid lands is quite different. Traditional cultivation shows less than 100 trees per acre, and 300 trees are planted per acre with precipitation above 700 mm (Ulaş, 2001).

1.2.3. Tillage

The purpose of tillage in olive cultivation is to destroy weeds growing in the soil, reduce water loss through evaporation, and preserve water to a large extent.

1.2.4. Fertilization

In the case of correct fertilization, it is to meet the plant's needs and to ensure that the amount of plant nutrients not taken from the soil is taken (Toplu et al., 2009).

1.2.5. Pruning

In olive pruning, it aims to reach the highest yield potential in harmony with the tree's vitality and to shorten the unproductive period of the olive tree. However, some regression and ageing periods seen in the plant are shortened by pruning, which aims

to maintain the balance between vegetative and generative functions by extending the productive period.

1.2.6. Irrigation

The olive tree is a plant that grows in the Mediterranean climate zone. It grows well in the Mediterranean coastal zone, where winters are rainy and humid. Although the olive plant is a plant that has adapted to arid climate and soil conditions, it can also be grown in calcareous and rough lands where irrigation is not done. However, in terms of economic olive cultivation, it is known that irrigation in arid regions has an increasing effect on yield and quality (Toplu et al., 2009).

1.3. General Information About Northern Iraq

Iraq's extraordinary ecosystem and habitat diversity has resulted in significant species diversity. Since the beginning of agriculture in Mesopotamia, it has been the homeland of many plants and species. Iraq's fauna (animal diversity) is even greater than its flora (plant diversity). Today, these plants continue to exist and are used by people in Iraq. A large part of the Zagros Mountains in the north of Iraq is covered with oak forests and forms an ecological region. In the southern part of Iraq, there is distinctive desert biodiversity. The region is also home to Eurasian wildlife. Birds like the sparrow, henna partridge, quail, hoopoe, pigeon, wild pigeon, duck, wild duck, and common mountain nightingale live here. Therefore, Iraq's biodiversity varies from region to region. While the continental climate is dominant in the north of Iraq, the desert climate is dominant in the south (Selim et al., 1981; Noori, 2008; Ali et al., 2015).

This study aims to determine the morphological, pomological and phenological characteristics of some olive varieties grown in the Northern Iraq region, to make them a standard variety in the future and to shed light on the studies to be done.

2. LITERATURE REVIEW

Dölek (2003), the olive production of our country fluctuates frequently. The most important reason for this is planting varieties unsuitable for the region and ecology (inefficiency, need for cooling, and most importantly, varieties whose characteristics are not fully defined). In addition, there are many varieties of confusion in olive cultivation in Turkey. Changes in tree and fruit characteristics depending on ecological factors and cultural practices have led to the emergence of varieties with different names in different regions and even within the same region. The fact that the same variety grown in the same or different regions is called by different names and the synonyms are accepted as different varieties and named causes the varieties to be confused.

Trujillio et al., (1995), stated that olive oil production is an important factor in olive groves established for olive oil production, apart from the product and yield. Components related to oil yield are fruit weight, meat ratio and fat amount in meat. In addition, the genetic character of the variety, the conditions of the place where it is grown, and cultural practices affect the oil yield (Pansiot and Rebour, 1964).

Scramuzzi and Roselli (1986), fruit size has a highly variable structure, which is affected by environmental factors and the amount of product. Fruit size has a primary effect on table olives. It is also preferred in oily varieties, as it facilitates the traditional hand-picking and machine-harvesting.

Fanizza (1982), while meat weight showed the lowest heritability in table olive cultivars, fruit size, seed size and seed diameter had high heritability and were less affected by environmental conditions.

Scramuzzi and Roselli (1986), green table olives require a low-fat content for preservation and high reducing sugar for good lactic acid fermentation. Although meat

texture is also important in table olives, resistance to bruising is desirable besides the high meat-core ratio.

Pansiot and Rebour (1964), although the cultivars are seen as very productive under very suitable conditions, they can give the opposite result when taken to unsuitable places. There are many examples that the variety is not successful when taken out of the climatic region where it gives good results. In Turkey, pomological and phenological examinations of olive varieties belonging to different olive-growing regions and some foreign varieties were made (Cavusoglu, 1980; Aydın and Yüncüler, 1983; Salman et al., 1983; Canözer, 1991; Kaynas et al., 1992). However, the establishment of new plantations will be ensured by obtaining results that show the adaptability of the varieties outside their region (Kayahan, 1984).

Cetin et al. (2016), stated that black olives are understood when table olives are mentioned, and green olives are not considered. On the other hand, it is known that green olives are more fortunate in foreign sales. There is not yet a green table olive variety that can be recommended for the Marmara Region; it is stated that the Gemlik variety, which is widely produced, is not suitable for green processing and its grains are small.

Gündoğdu (2018), in her study on six different olive varieties, examined some pomological properties of olive fruits at different maturity stages to determine the pomological characteristics.

Cetin et al. (2016) researched to develop new table and oil olive varieties, and olive varieties are grown in Turkey. As a result, pomological characters of the Memecik x Uslu Hybrid (F1) olive genotype were determined.

Gözel (2018), selection studies of wild olives (Olea europaea spp. Oeaster) in İslahiye and Hassa regions of Hatay, and morphological, pomological and chemical characterizations, and genotypes that can be preserved as genetic resources and intended for olive oil-table consumption were determined.

Demir (2018), the fruit characteristics and biochemical properties of olive varieties "Uslu" from Manisa, "Rabbit Heart" from Antalya, "Saurani" from Hatay, "Sarı Ulak" from Mersin and "Derik Halhalı" from Mardin were investigated.

Özdağ (2017), investigated the phenological, morphological and fruit characteristics of Çiltopak olive cultivars grown in the Karaman region.

Nergis (2019), in this study, the fruit and oil characteristics of the Ayvalık olive variety, widely grown by 6×8 planting, were determined at different maturity stages.

Gündeşli (2019), determined the fruit quality characteristics and refrigeration requirements of nine olive varieties, namely Adana Topağı, Mavi, Memecik, Ayvalık, Çilli, Domat, Karamürsel Su, Gemlik and Manzanilla, and Arbequina, IRTA-18 olive clones.

Ulubeli (2019), determined the fruit characteristics of Memecik olive varieties grown at different altitudes, Çulha (2020) and Gemlik olive varieties grown at different altitudes. Tuncer (2019) determined the effect of periodicity in Memecik olive variety in terms of phenological, morphological and pomological characteristics. Generally, in pomological research; fruit index, fruit length (mm), fruit width (mm), seed shape, seed length (mm), seed width (mm), 100 seed weight (g), 100 seed weight (g), number of fruit per kg, pulp rate (%), fruit juice rate (%), maturity index and tree yield (kg) analysis (Tuncer, 2019).

Özen (2019), using Beylik olive varieties grown in Antalya province Manavgat region in 2017, investigated olive and olive oil properties at different maturation stages. It was stated that the maturity index was 2.68 in October and 6.93 in December. It was stated that the width and height values of the fruit increased depending on the increase in the maturity index. Accordingly, while the fruit pulp ratio was 82.41% in October, it was 80.46% in November and 85.47% in December, which was determined to be surplus.

Berk (2019), examined the Gemlik, Kilis Yalık and Manzanilla olive cultivars in Antakya ecological conditions. He suggested that the Gemlik and Kilis olive oil varieties be harvested as green table olives at the beginning of September and the Manzanilla variety from mid-September. For black table olives, he recommended that the Gemlik variety be harvested from the beginning of November and the Kilis Yaglik and Manzanilla varieties from mid-November. Since the oil rates of these varieties reached the highest level at the beginning of November, he stated that it was the most suitable harvest period.

Garcia et al. (1996), Arbequina, Blanqueta, Lechin, Villalonga and Verdial cultivars green, mottled, purple and black ripening periods in his study to determine the connection between oil quality; indicated that the total oil content of olives did not increase significantly when they were green, mottled, purple and black. He stated that the average oil content of Arbequina, Blanqueta and Villalonga cultivars was 47%. In comparison, the average oil content of Verdial and Lechin cultivars was 39%.

Uğurlu (2011), stated that in recent years, with the correct determination of the harvest time in olives, the demand for olive oils with lower fatty acid and peroxide values, longer shelf life and high quality, and the market value of the product have increased more.

Gödeli (2015), He determined that the undamaged olives contain the best quality and healthiest oils when not separated from the tree and that if the right environmental conditions are not provided from the moment of collection, they will lose their quality over time. For quality olive oil; It has been determined that the best way to transport the harvested olives is to use caged plastic crates with a height not exceeding 50-60 cm, which allow the air circulation to ensure the same processing of the olives without spoiling, and perforated from the bottom-side, and that the harvested product is processed within the same day is important for the preservation of the olive quality. Otherwise, it has been determined that product quality decreases due to rapid maturation (heating) caused by a temperature increase in an environment without air circulation.

Ilhan (2019), A delicious and unique aroma can be obtained after the olive grains are harvested at the optimum ripening stage, and the olives go through the right squeezing process. The biochemical values of olive oil vary according to the processes carried out during the olive oil production stages. Therefore, olive oil is classified according to these criteria.

Özen (2019), investigated the properties of olive oil at different maturation stages by using Beylik olive varieties grown in the Manavgat region of Antalya province in 2017. He stated that free fatty acids were 1.26% in October, 0.98% in November and 0.97% in December. Furthermore, it was stated that there was a decrease in the number of phenolic substances and free fatty acids with increasing ripening.

Kiritsakis (1998), determined that as the olive fruit reaches the appropriate maturity level, some changes occur in the fatty acid composition. As the ripening time increases, the linoleic acid/palmitic acid ratio increases while the oleic acid/palmitic acid ratio decreases. These fatty acid changes have been determined to affect olive oil's sensory criteria. It is reported that olive oil contains more oleic acid and less linoleic-linolenic acid than other vegetable oils.

Nergiz and Engez (2000), investigated the changes in oil content, fatty acid composition and nutrient content of Domat and Memecik cultivars at different maturation stages. They found that as ripening progressed, the oil content increased significantly, the ratio of oleic and palmitic acids in fatty acids decreased, and the ratio of linoleic acid increased.

Oktar and Çolakoğlu (1989) and Kiritsakis (1998), stated that the amount of linoleic acid increased as the harvest time was delayed in olives. In addition, they reported that oils from olives produced in regions with colder climates contain more oleic acid and lower amounts of linoleic acid than those obtained from regions with warmer climates.

Gambacorta et al. (2010), the amount of free fatty acids from 0.21% to 0.27% (as oleic acid) and the peroxide value of 3.65 meqO2 after the oils obtained from olives with two different maturity indices from Coratina olive varieties were stored for one year. He determined that from /kg oil to 9.04 meqO2./kg oil, the K232 value increased from 1.40 to 1.67, K270 value did not change to 0.13.

Fontanazza (1988), in his study, stated that the variety and agronomic factors affect olive oil quality together. For example, in cold weather conditions, the ripening of olive fruit is delayed, and the fruits reach physiological maturity.

He stated that he could not reach him. The oils obtained under these conditions contain high levels of peroxide, and he stated that the taste of olive oil is bad due to its sensory properties.

Kutlu and Şen (2011), many studies have been conducted on the fact that olive fruit weight increases during ripening. They stated that while olive fruit weight increased until mid-November, there was a decrease in fruit weight with water loss. The fruit pulp ratio of each variety is closely related to the fruit size and affects the yield.

Demirağ (2017), the Olive oil yield is proportional to the oil's maturity index. In general, the absence of green fruit on a tree has been accepted as a suitable time for harvest. However, many factors such as climatic conditions and altitude affect the maturity index. Free fatty acids (F.F.A.) are an important factor affecting olive oil's quality and fatty acid composition. The higher the fruit maturity index, the higher the F.F.A. ratio.

Kartal (2015), olive oils obtained from Halhalı, Gemlik, Karamani and Sarı Haşebi olive varieties collected in three maturation stages in Altınözü, Hatay, were examined according to variety and ripening time. Free fatty acids in olive oil are highest in Gemlik (0.20%) and lowest in Karamani (0.09%), peroxide value is highest in Sarı Hasebi (9.74 meq O2/kg) and lowest in Karamani (5.3 meq O2). He stated that

it is at /kg. The main fatty acids detected in olive oil samples were oleic acid (69.9-77.2%) and palmitic acid (12.1-16.1.1%). In terms of fatty acids, it was determined that the Kalamani variety had the highest oleic acid content and the oil content increased as the maturity increased, while the Khalil variety had the highest palmitic acid content and the oil content decreased as the maturity increased.

Yildirim et al. (2017), fatty acid composition, tocopherol content and some biochemical properties of "Ayvalık", "Memecik", and "Topakaşı" olive varieties grown in Sütçüler/Isparta in the Mediterranean region of Turkey were evaluated. According to the average, the highest oleic acid value (73.88%), which is the dominant acid in olive fruit, was found in Memecik. According to the information obtained from the study, the fatty acid composition and quality characteristics of olive oil depend on the harvest period, the method of obtaining the oil and the growing conditions. Therefore, according to the research, it would be more appropriate to carry out the second harvest in Memecik and the third harvest in Ayvalık and Topakaşı to provide quality olive oil conditions in olive cultivation in the Isparta milkmen region.

Trentacoste et al. (2018), In this study, the "Arauco" olive variety was harvested on different dates and seasons in the Central and Western Vadoza provinces of Argentina, and the differences in Arauco fruit and chemical properties were investigated. It was stated that the oil content was at the highest level and remained constant in the fruits harvested on time. However, with the delay of the harvest period and the loss of water, the oil content of the fruit increased. Harvest time affects oxidative stability, phenolic content, oil quality, and fruit maturity index. In contrast, fatty acid profiles were not consistently affected by harvest date. Environmental conditions, especially cold and frosty weather, affect fruit ripening and oil quality, delaying the harvest time. A maturity index of less than 2% until mid-May is the ideal harvest time to obtain productive and quality olive oil.

Al-Shdiefat (2018), in his study in Jordan, the fatty acid ratios of olive oil from 4 high regions with different altitudes above sea level caused a great difference in olive oil quality. Although olive oil quality is good in high-altitude regions, it has been stated that it has longer preservation properties than other oils. Therefore, it preserves its

chemical and physical properties and high nutritional value. Olive oils from regions below sea level are the most desirable and have the lowest quality of the four regions. Because the oils obtained from olives grown in regions below sea level undergo rapid oxidation and have low storage capacity. Considering the results of trials on quality issues, he recommended that olive trees not be planted below sea level in the Jordan Valley.

Kayahan and Tekin (2006), in their study, stated that the oleic acid content of oils is high, while the amount of linoleic, palmitic, palmitoleic, and stearic acids are lower due to lower temperatures at high altitudes.

Yazıcıoğlu (2019), The fruit oil properties of Ayvalık olive varieties obtained from different locations in the Ayvalık district of Çanakkale were examined, and it was determined that the lowest oleic acid ratio was in Belen and the highest location was in Küçükkuyu. The highest palmitoleic acid/linolenic acid ratio was found in Küçükkuyu, and the highest palmitoleic-linoleic acid ratio was found in Belen.

Arslan and Özcan (2013), The content of chlorophyll, carotenoids, tocopherols and phenolic compounds in olive oil obtained from Kilis Yaglik variety; peroxide and colour values, free acidity and fatty acid composition, were determined to differ depending on the harvest year and the conditions of the place where it was grown. They stated that olive oil produced from olives in high altitude and abundant rainy regions has high tocopherols and low oleic acid and phenolic substances.

3. MATERIAL and METHOD

This study was carried out in the olive groves of the Kallar district of Sulaymaniyah in Northern Iraq in 2021. Qaisi, Arbequina, Picual and Sorani olive varieties are grown naturally in this region.

The cultivars used in this study are 15 years old and have been selected by paying attention to the fact that they are trees at the yield age, healthy in terms of diseases and pests and homogeneous in terms of development. Routine maintenance and fertilization processes were carried out in the orchards with Qaisi, Arbequina, Picual and Sorani olive varieties, and no pesticides were applied when the samples were taken.

3.1. Material

3.1.1. Characteristics of olive cultivars used in the study

3.1.1.1. Arbequina

From the Spanish variety - the fruit is small, round, weighing 1-2 grams. The nucleus is soft and loose from the flesh. It constitutes 16% of the weight of the fruit. The oil content is from 17 to 20%. The fruits ripen from November to December and are used for oil extraction. It may be grown in northern Iraq and Mosul and needs hours of severe cold.

Between each 1.5-meter tree and each 4-meter line, Arbequina is a variety found mostly in the Katalonga region of Spain and California in the United States of America. Due to the small size of the trees, frequent planting is recommended. The fruits are small, early and of high oil quality. It can also be seen in some newly established facilities in our country.

3.1.1.2. Sorani

One of the best Syrian varieties due to the ability of this variety to adapt to drought conditions and tolerate salinity and extreme heat. The fruits are oblong, slightly floating, with a medium spire. A medium-sized, elongated tree. Fruit weight 3-4 g. The proportion of Sorani oil is 28-32%. Its fruits are suitable for green and black pickling. Shake the oil extract and its oil at the beginning of ripening. When coloured, the fruits give an attractive green colour and a pleasant aroma. It is hoped that it will spread in Iraq, similar to the Al-Bashiqi category, which was introduced in 2002.

3.1.1.3. Picual

Picual of the Spanish varieties - the medium-sized fruit tends to elongate, weighs from 3-7 g, the kernel is attached to the flesh and makes up 12% of the weight of the fruit, and the oil content is from 15-22%. The fruits are used in pickling quality and oil extraction, and maturity begins from October to January.

3.1.1.4. Qaisi

One of the Syrian varieties resistant to drought conditions, spherical fruits of large size, round shape, colour at maturity, weighing about 5 grams, suitable for green analysis. Required in the market, the proportion of oil in the fruit is 18%. It was successful in Iraq and entered the year 2002.

3.2. Methods

The Qaisi, Arbequina, Picual and Sorani olive varieties used in this study were harvested on 15.10.2021. For each variety, three trees were identified and marked as three replications. The pomological and phenological characteristics of the cultivars included in this study were determined by examining the fruit or leaf samples (50 fruit and leaves from each tree) taken from the marked trees. The properties examined in the study were evaluated according to Barronco and Trujillo (2000) and Sakar (2009).

Figure 3.1. Satellite image of the research area

3.2.1. Morphological, Pomological, Phenological Characteristics and Chemical Analysis

3.2.1.1. Morphological features

Within the scope of this study, trees belonging to the varieties were observed in July-August to determine their morphological characteristics in the orchards where Qaisi, Arbequina, Picual and Sorani olive varieties are grown. Tree features are:

3.2.1.1.1. Growth habit

As a result of the observations made in July-August, the growing power of the olive tree was classified as follows.

- Low
- Middle
- High

3.2.1.1.2. Crown structure

As a result of the observations made in July-August, the crown structure of the olive tree was classified as follows.

- Upright
- Semi-upright
- Widespread

3.2.1.1.3. Crown density

As a result of the observations made in July-August, the crown density of the olive tree was classified as follows.

- Dense
- Middle
- Messy

3.2.1.1.4. Leaf properties

In Qaisi, Arbequina, Picual and Sorani olive varieties, leaf samples were taken from the tree's 1.5-2 m height and the middle of 25 one-year shoots from 4 different directions in the first week of September. These measurements are made with a digital calliper with a precision of 0.01 mm according to the criteria below (Figure 3.2).

3.2.1.1.5. Leaf structure

Leaf samples taken from Qaisi, Arbequina, Picual and Sorani olive cultivars were classified based on length/width ratios.

- Elliptical (<4 cm)
- Elliptical long (4-6 cm)
- Long (>6 cm)

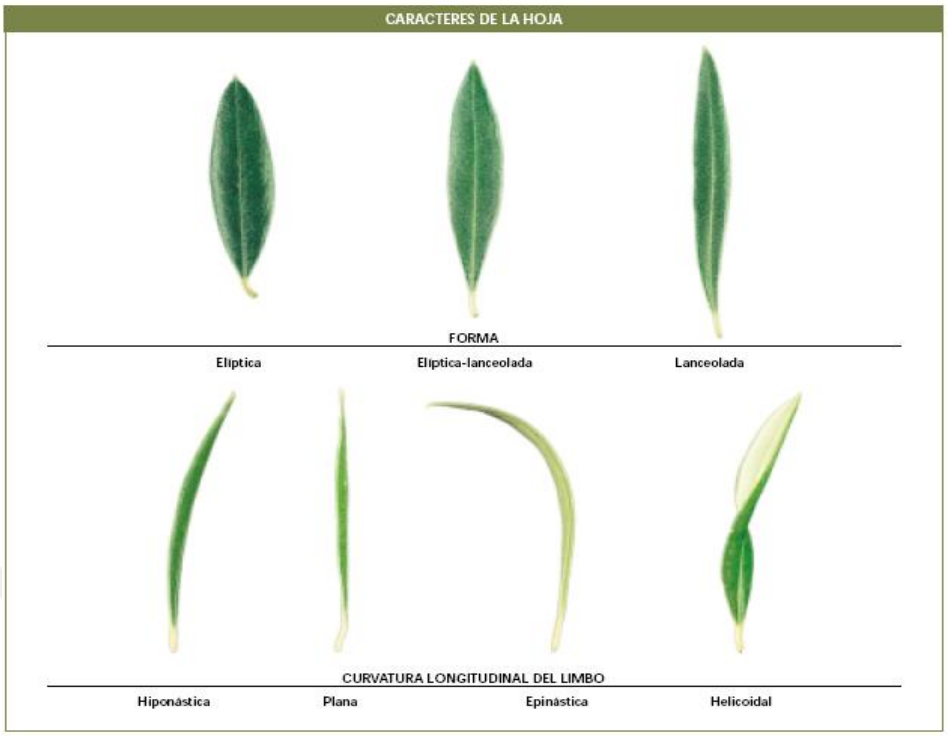

Figure 3.2. Leaf shape scale

3.2.1.1.6. Leaf length

The length of the leaves taken from Qaisi, Arbequina, Picual and Sorani olive cultivars was measured with a digital calliper with 0.01 mm precision, and the values obtained were classified as follows.

- Long (>7 cm)
- Medium (5-7 cm)
- Short (<5 cm)

3.2.1.1.7. Leaf width

The width of the leaves taken from Qaisi, Arbequina, Picual and Sorani olive cultivars was measured with a digital calliper with 0.01 mm precision, and the values obtained were classified as follows.

- Wide (>1.5 cm)
- Medium (1-15 cm)
- Narrow (<1 cm)

3.2.1.2 Pomological features

Fruit characteristics are:

3.2.1.2.1. Fruit weight (g)

From the trees marked in the Qaisi, Arbequina, Picual and Sorani olive cultivars, 50 healthy, unscathed fruits showing the characteristics of the cultivars were collected randomly from each replication. It was obtained from weighing these fruits on sensitive scales and averaging them. It is classified as follows.

- Low (<2 g)
- Medium (2-4 g)
- High (4-6 g)
- Very high (>6 g)

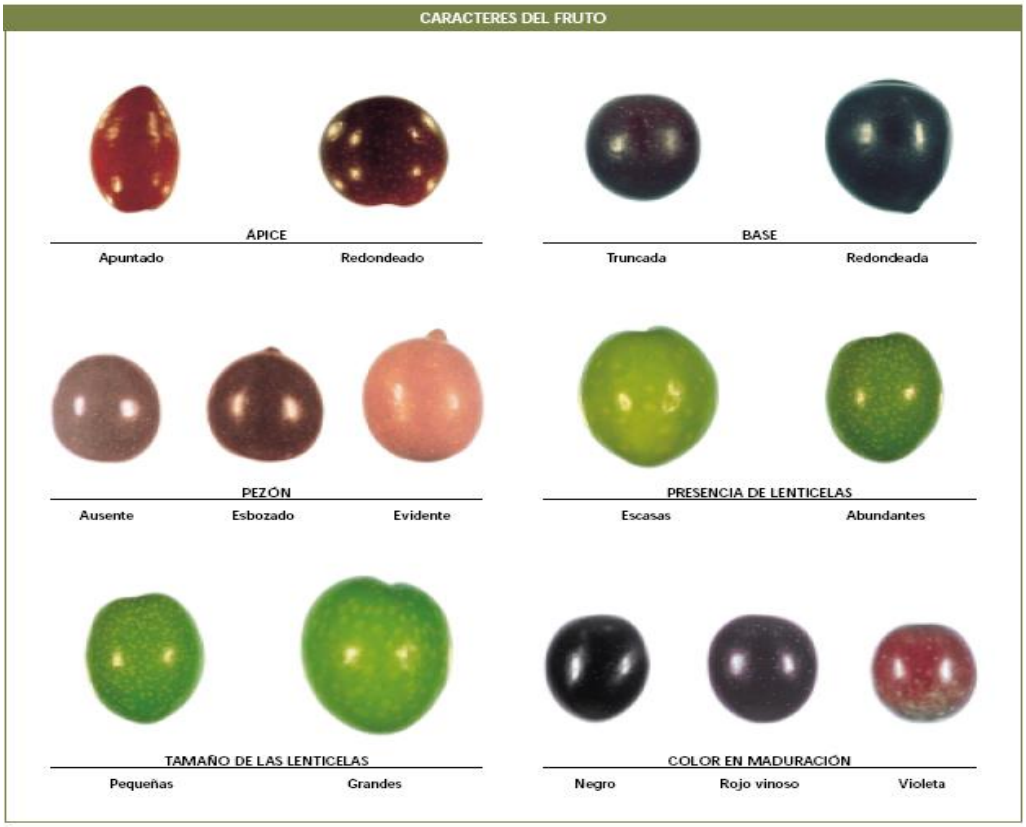

Figure 3.3. Juice of fruit characteristics

3.2.1.2.2. Fruit structure

The fruit sizes obtained by measuring the fruits of Qaisi, Arbequina, Picual and Sorani cultivars with a digital calliper were calculated using the length/width ratio and classified as follows.

- Egg (<1.25 cm)
- Elliptical (1.25)

3.2.1.2.3. Fruit width (mm)

It was determined by measuring the widest distance vertically from the middle axis of the fruits taken from Qaisi, Arbequina, Picual and Sorani cultivars with a digital calliper.

3.2.1.2.4. Fruit length (mm)

It was determined by measuring the area between the stem and style tip of the fruits taken from Qaisi, Arbequina, Picual and Sorani varieties with a digital calliper.

3.2.1.2.5. Core features

Fifty fruits from Qaisi, Arbequina, Picual and Sorani cultivars were seeded, washed and saved at room temperature. Core features were evaluated according to the following criteria (Figure 3.4).

3.2.1.2.6. Core weight (g)

The seeds of 50 fruits were removed, dried and weighed on sensitive scales, and their averages were obtained and classified as follows.

- Low(<0.3 g)
- Medium(0.3-.45 g)
- High (0.45-0.70 g)

- Very high(>0.70 g)

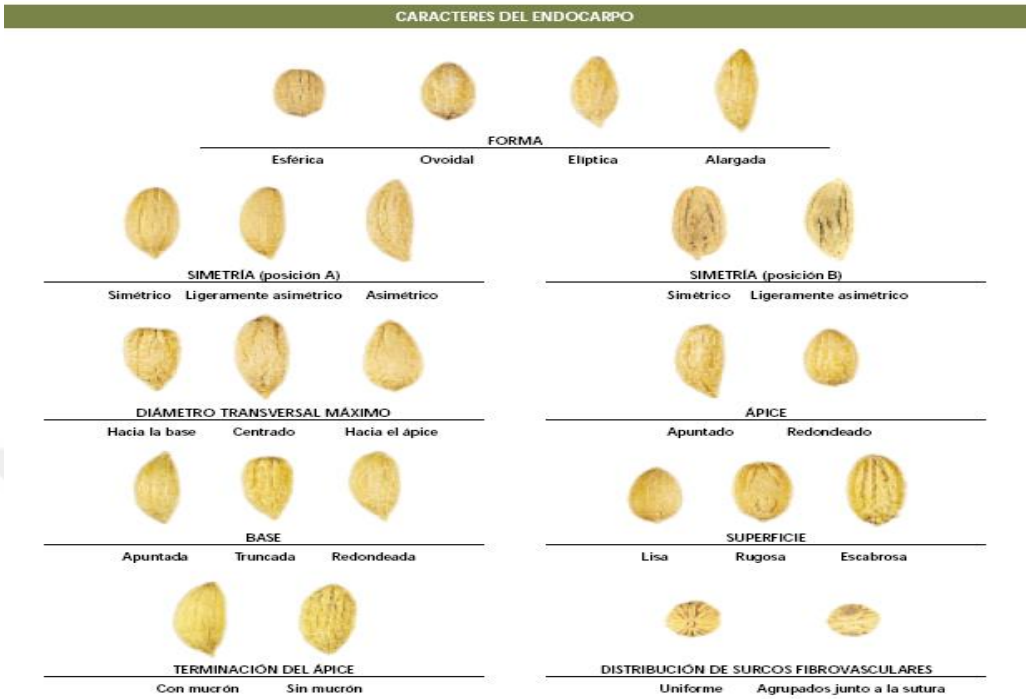

Figure 3.4. Ranking of kernel features

3.2.1.2.7. Core structure

The length and width of the beans were measured with a digital calliper, and the length/width ratio of the beans was calculated and classified as follows.

- Egg (<1.4 cm)
- Elliptical (1.4-2.2 cm)
- Pointed(>2.2 cm)

3.2.1.2.8. Core width (mm)

The seeds of 50 fruits were removed, dried, and the seeds were weighed on precision scales, and their averages were obtained and classified as follows. First, the largest diameter perpendicular to the core width axis was measured with a calliper.

3.2.1.2.9. Core length (mm)

The core length between the tip and the stem was measured with a calliper.

3.2.1.3. Phenological observations

The phenological characteristics of the cultivars were determined by observations made once a week as of 01.03.2021 in the gardens where the Qaisi, Arbequina, Picual and Sorani cultivars were used in the experiment were grown.

3.2.1.3.1. Beginning of flowering

It was accepted as the period when approximately 5% of the flowers of the Qaisi, Arbequina, Picual and Sorani cultivars opened.

3.2.1.3.2. Full bloom

It is when 70% of the flowers of the Qaisi, Arbequina, Picual and Sorani cultivars were accepted.

3.2.1.3.3. End of flowering

It has been accepted as the period when the flowers of Qaisi, Arbequina, Picual and Sorani varieties are fully opened.

3.2.1.4.Chemical analysis

The fruits, which were randomly picked from all directions from each tree whose harvest time was marked, were kept in 250 g polyethylene bags and ice molds in the field and placed in a deep freezer at -20 ºC until analysis.

3.2.1.4.1. Total fat percentage (%)

The seeds of the fruit samples of Arbequina, Picual, Sorani and Qaisi varieties were removed and left to dry in an oven at 80 °C for 48 hours. Dried fruit samples were ground in a dry food grinder. Then, 10 g of the samples were placed in glass crucibles and heated in a soxhlet device with 180 ml of hexane for 4-6 hours at 69-75 °C to be distilled. After the oil + hexane mixture collected at the end of the process was evaporated in the evaporator, the remaining oil was weighed, and the result was found.

3.2.1.4.2. Fatty acid compositions

Fatty acid determinations were made in Harran University HÜPTAM Laboratory.

4. RESULTS and DISCUSSION

4.1. Morphological, Pomological, Phenological Characteristics and Chemical Analysis

4.1.1. Morphological Features

4.1.1.1.Tree properties

Evaluations were made from the garden observations made in July-August in the closed olive grove in the Kallar district of Sulaymaniyah province in Northern Iraq.

4.1.1.1.1. Growth habit

The growing power of the trees belonging to Picual, Sorani, Qaisi and Arbequina olive varieties grown in the Kallar district of Sulaymaniyah province in Northern Iraq is medium vigorous. It appears to be Arbequina, and Picual varieties are dwarf varieties, and the growth is medium vigorous. Although the climate, which is effective in the growth of the trees, varies depending on the genetic structure of the tree, it has also affected the growth of cultural practices.

In a study by Ay in 2018 on local olive varieties grown in the Derik district of Mardin, he determined that the growing habit of the trees was strong and that the varieties that developed moderately vigorously in terms of growing habit among the varieties were very few.

İlhan (2019) defined the growth ability of the trees as "medium-strength" in his study on Round Halhalı, Kilis Yalık, Gemlik, Nizip Yaglik, Memecik, Saurani, Arbequina olive varieties.

4.1.1.1.2. Crown structure

As a result of the observations made in the research area, it was determined that the crown structure differs between the varieties. The study in Northern Iraq determined that the type of olive can be classified as upright, semi-erect and rounded. The crown structure of the cultivars was found upright in Qaisi, semi-erect in Picual, and round in Sorani and Arbequina cultivars.

A study conducted by Turanoğlu on the Ayvalık olive variety in 2015 stated that the branching was sparse, and the leaf density was low. Ay (2018), in a study on local olive varieties grown in the Derik district of Mardin, stated that the trees' crown structures differ. Therefore, it has been determined that the crown structure of Derik local olive varieties varies between upright (Belluti, Melkabazi, Mavi and Zoncuk), semi-erect (Derik anklet, Gulleki and Hursiki) and flat (Kejik).

Ulaş (2001) in his study on the crown structure in Adana, Hatay and Mersin (İcel district); Spread (Adana Topağı, Gemlik-1, Gemlik-2, Sarı Ulak (Adana), Kilis Yaglik (Icel), Sari Ulak (Icel), Silifke Yaglik, Gemlik, Kargaburnu and Kilis Yaglik (Hatay)) and Bulk (Edremit Yaglik, Blue, Yerli, Nizip Yağlık, Halhalı and Küncülü).

Figure 4.1. Crown structure of Sorani olive tree grown in Northern Iraq

Figure 4.2. Crown structure of the Qaesi olive tree grown in northern Iraq

Figure 4.3. Crown structure of Picual olive tree grown in Northern Iraq

Figure 4.4. Crown structure of Arbequina olive tree grown in Northern Iraq

4.1.1.1.3. Crown density

As a result of the observations made in the research area, it was determined that the crown density differs between the varieties. Crown density was high in Arbequina and Qaisi cultivars and medium in Sorani and Picual cultivars.

Ulaş (2001), in his study on the crown density in Adana, Hatay and Mersin (İcel district), varieties; Dense (Kargaburnu, Mavi, Silifke Yağlık, Adana Topağı, Sarı Ulak (Adana), Halhali and Kargaburnu) and Moderately Dense (Edremit Oil, Gemlik, Local, Kilis Oil, Nizip Oil, Sarı Ulak (İcel) and Küncülü) .

4.1.1.2. Leaf properties

4.1.1.2.1. Leaf structure

The leaf's structure (length/width) is classified based on it. As a result of the analysis, it was determined that the leaf structure changed between elliptical (Qaisi)

and elliptical long (Sorani, Picual and Arbequina). The characteristics of the leaf structure are given in Table 4.1.

Table 4.1. Leaf characteristics of Northern Iraqi olive cultivars

Kinds	Leaf length(mm)	Leaf width(mm)	Leaf length/width	Leaf shape
Sorani	58,71 b**	14,12 b**	4.15 elliptical long	Middle
Picual	57.80 b	13.28 bc	4,35 elliptical long	Middle
Qaisi	67,42 a	17,74 a	3,80 elliptical	Middle
Arbequin	49,27 c	12.18 c	4,04 elliptical long	Short

** There is a statistical difference of 1% between the mean values expressed with different letters.

Figure 4.5. Leaves of the Sorani olive tree grown in northern Iraq

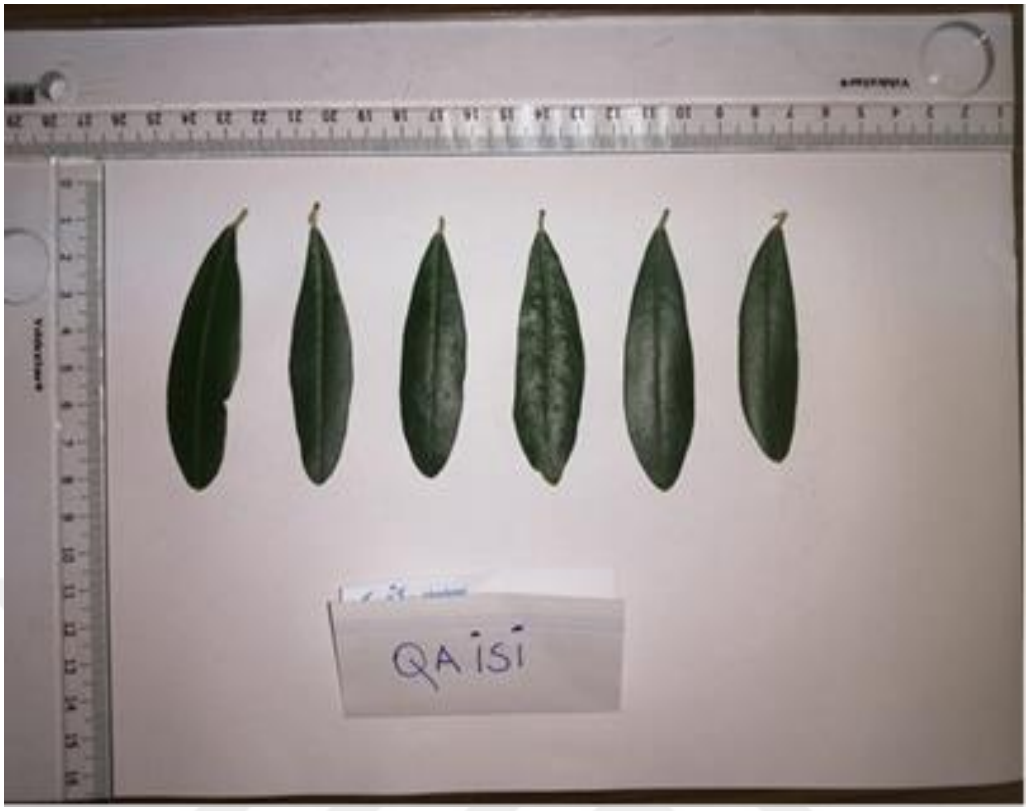

Figure 4.6. Leaves of the Qaisi olive tree grown in northern Iraq

Figure 4.7. Leaves of Picual olive tree grown in Northern Iraq

Figure 4.8. Leaf leaves of the Arbequina olive tree grown in Northern Iraq

4.1.1.2.2. Leaf width

Leaf width characteristics of Qaisi, Arbequina, Picual and Sorani cultivars are given in Table 4.1. As a result of the measurements of the leaves, it was determined that the average leaf width of 17.73 mm Qaisi had the widest leaf. On the other hand, the lowest leaf width was found in the 12.18 mm Arbequina cultivar. Ay (2018) stated that the leaf width varies between 10.46 mm and 18.83 mm in his study on eight local olive cultivars of the Derik district of Mardin.

Ulaş (2001) found that the lowest leaf width was 1.14 cm in the Nizip Yaglik olive cultivar and the highest at 1.71 cm in the Mavi cultivar in the study he conducted in Icel (Mersin) county, Hatay and Adana. In the Gemlik cultivar, the leaf width was 1.25 cm. In the study conducted by Özer (2018) on 8 Gemlik clones in Yalova between 2015 and 2016, the leaf width was determined as 1.23-1.42 cm in 2015 and 1.20-1.36 cm in 2016.

Özkul (2016) determined the leaf width as 9.6 mm in the leaf samples taken on October 25 in the study he carried out on the Arbequina cultivar in Şanlıurfa province. This ratio was determined as 12.18 mm in Arbequina leaf samples grown in Northern Iraq.

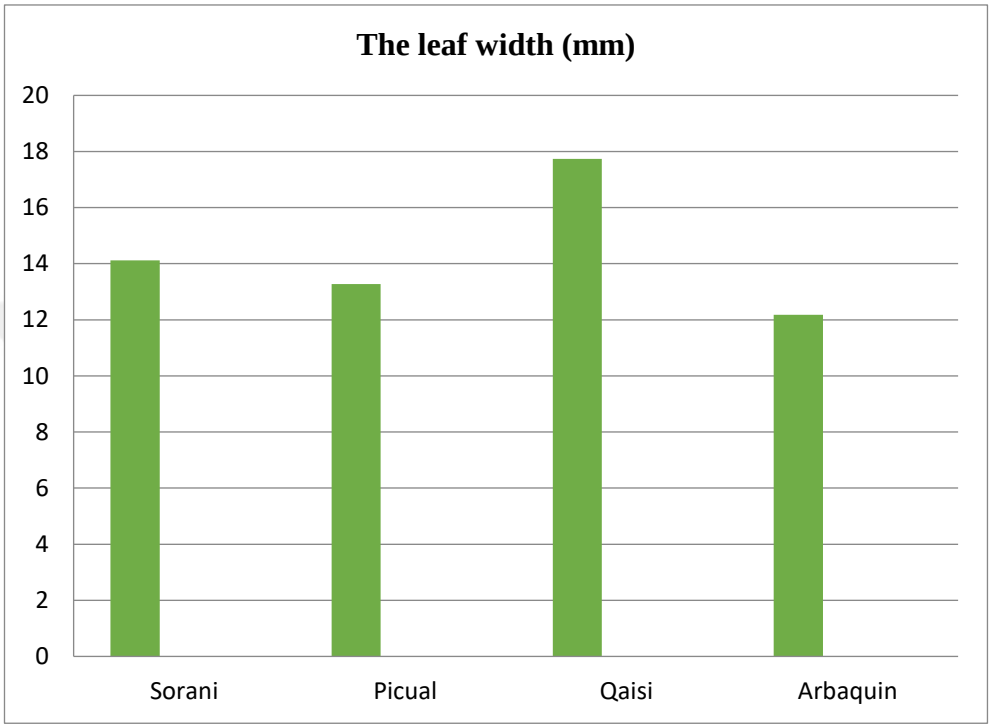

Figure 4.9. Graphical representation of leaf width

4.1.1.2.3. Leaf length

Leaf length characteristics of Qaisi, Arbequina, Picual and Sorani cultivars are given in Table 4.1. As a result of the measurements of the leaves, the highest average leaf length was observed in Qaisi with 67.42 mm, and the lowest leaf length was observed in the Arbequina variety with 49.27 mm.

Özkul (2016) determined the leaf length as 42.14 mm in the leaf samples taken on October 25 in the study he carried out on the Arbequina cultivar in Şanlıurfa province. This ratio was reported as 49.27 mm in Arbequina leaf samples grown in Northern Iraq.

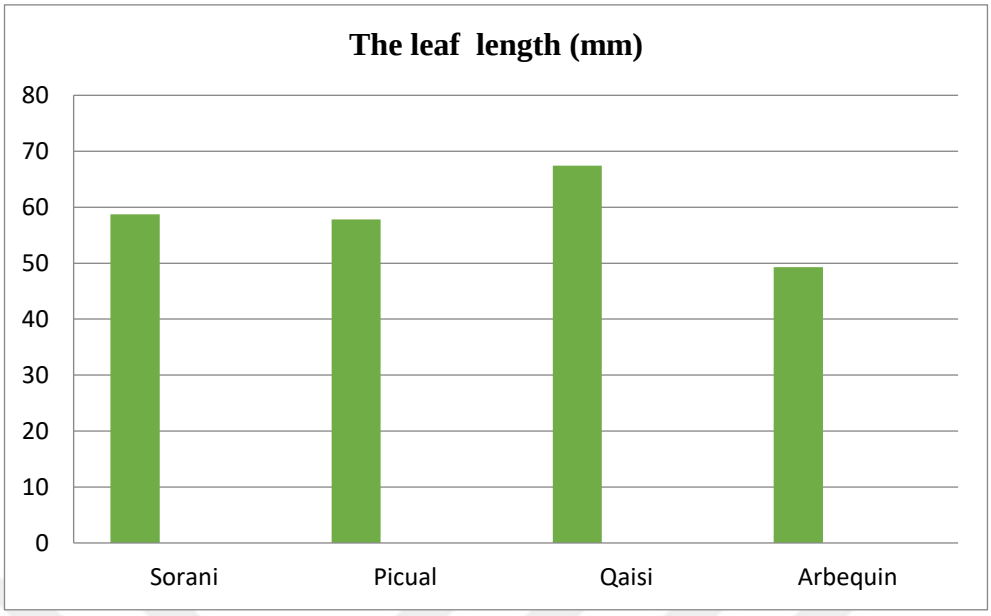

Figure 4.10. Graphical representation of leaf length

Ulaş (2001) stated that the leaf lengths were at least 5.33 cm in the Halhalı cultivar and 9.05 cm in Gemlik (Hatay) cultivar, at least in his study conducted in Icel (Mersin) county, Hatay and Adana. Özer (2018) stated that the leaf length was 4.94-5.85 cm in 2015 and 4.34-5.35 cm in 2016 in his study on 8 Gemlik clones in Yalova between 2015 and 2016.

4.1.2. Pomological features

4.1.2.1. Fruit properties

4.1.2.1.1. Fruit weight

In the measurements made by considering the weights of the fruits of Qaisi, Arbequina, Picual and Sorani varieties, the highest fruit weight was observed in the Qaisi variety with 298,132 g, and the lowest fruit weight was observed in the Arbequina variety with 98,268 g. Therefore, the data obtained are given in Table 4.2.

Özkul (2016) determined the fruit weight as 155.62 g in the fruit samples taken on October 25 in his study on the Arbequina variety in Şanlıurfa province. 100 fruit weight of Arbequina olive variety grown in Northern Iraq was determined as 98,268g.

Bolat and Güleryüz (1995) observed that the fruit weights of local varieties in the Coruh valley vary between 2.95 and 2.95 g - 6.25 g.

Sevgin ve Caner (2019) found that in olive genotypes grown in Mardin and Şırnak, the lowest 100-seed weight was 324.93 g in the Kumçatı genotype. However, their examinations of Ayvalık and Gemlik olive varieties stated that the 100-grain weight was 537.35 g, with the highest Gemlik variety.

Table 4.2. Fruit characteristics of Northern Iraqi olive varieties

Kinds	Fruit structure (length/width)	Fruit width(mm)	Fruit size(mm)	Fruit weight (gr)	Fruit shape
Qaisi	1.23	16.04 a**	19.84 a**	298.31 a**	Egg
Arbequina	1.40	10.31 c	14.84c	98.26 d	Elliptical
Sorani	1.19	12.95 b**	15.47 c**	158.13 c**	Egg
Picual	1.43	12.85 b	18.46 b	193.88 b	Elliptical

** There is a statistical difference of 1% between the mean values expressed with different letters.

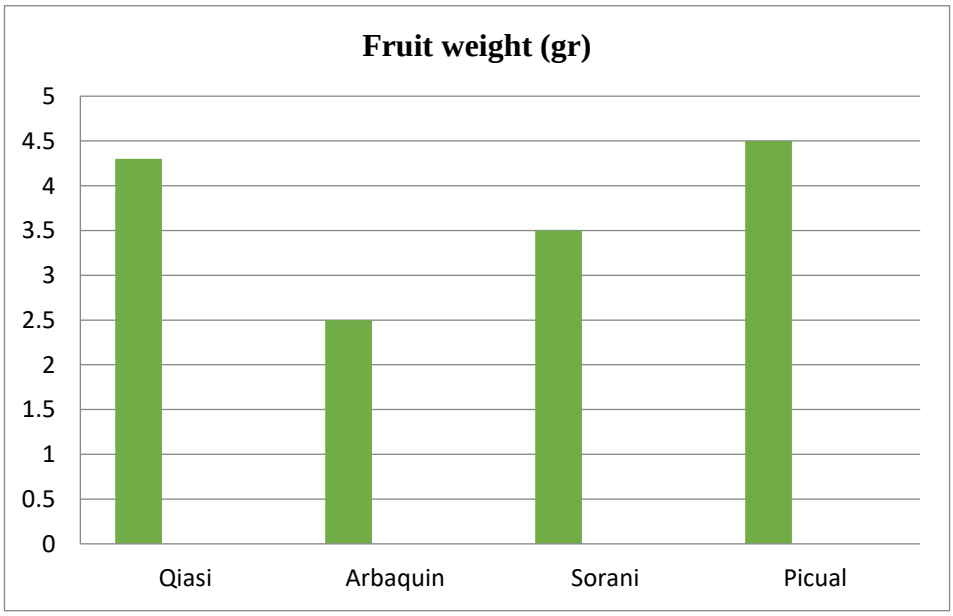

Figure 4.11. Graphical display of fruit weight

In the analyzes made, the highest fruit weight was found in the Qaisi (298.13 g) variety, followed by Picual (193.88 g), Sorani (158.13 g) and Arbequina (98.29 g) varieties, respectively (Table 4.2.).

Diez (1971) examined the structure of the olive fruit and stated that there are great differences between the varieties, and the weight of the olive grains is between 1.5 and 12 g according to the varieties. Gezerel (1980), in his investigations of six varieties grown in the Çukurova region, stated that fruit weights ranged from 4.24 to 6.64 g.

Tous et al. (1998), in their 10-year study in Spain, determined that Arbequina and Picual varieties were superior in terms of productivity and quality. The highest yield was obtained from Arbequina (148.6 kg/tree) and Picual (122.5 kg/tree). While the largest fruits (4.06 g) were obtained from the Manzanilla variety, the smallest fruits were obtained from the Arbequina (1.63 g) variety.

Figure 4.12. Fruit image of Sorani olive variety grown in Northern Iraq

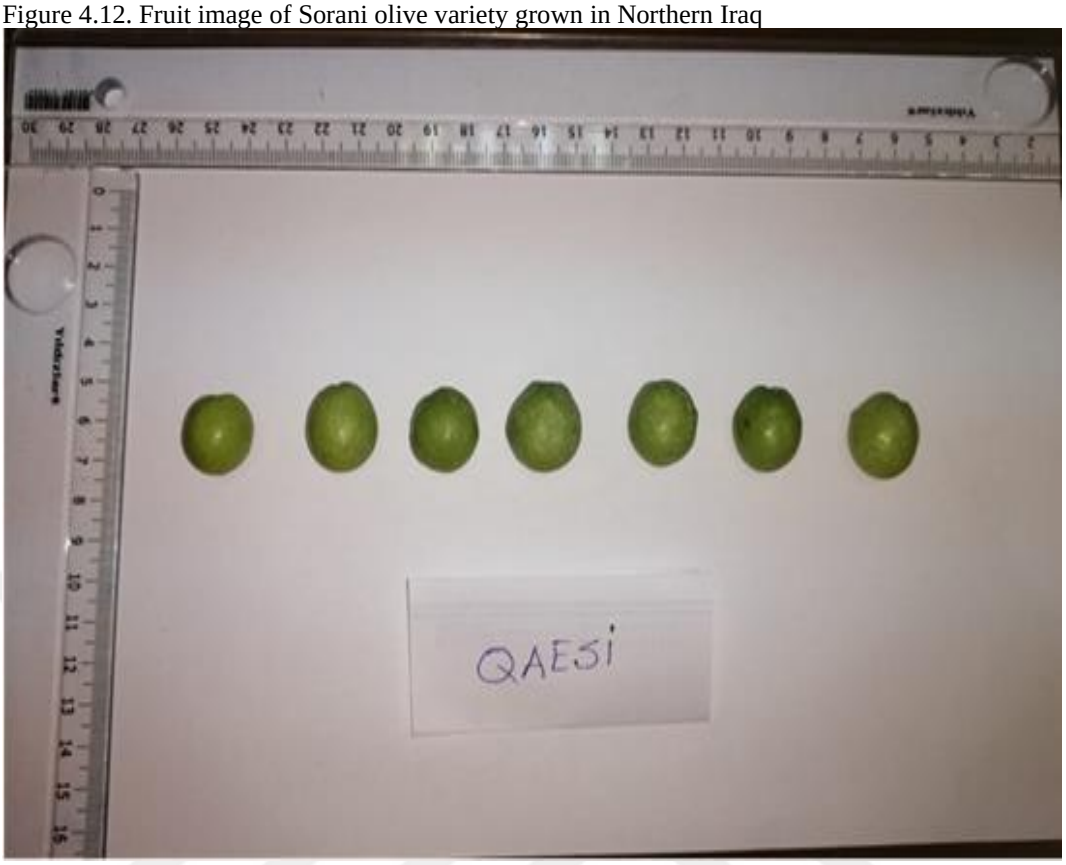

Figure 4.13. Fruit image of the Qaisi olive variety grown in Northern Iraq

Figure 4.14. Fruit image of Arbequina olive variety grown in Northern Iraq

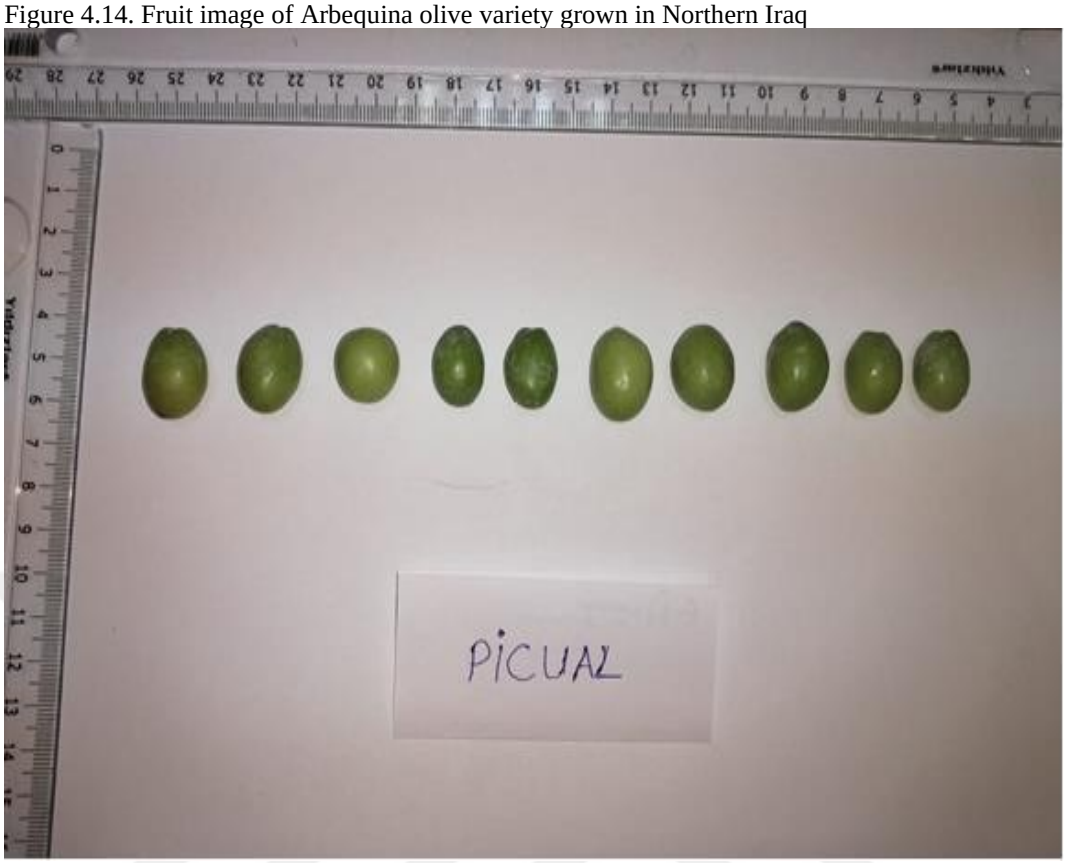

Figure 4.15. Fruit image of the Picual olive variety grown in Northern Iraq

4.1.2.1.2. Fruit length (mm)

Among the varieties of Qaisi, Arbequina, Picual and Sorani, the olive variety with the largest fruit size is Qaisi (19.84 mm). This variety was followed by Picual (18.46 mm), Sorani (15.47 mm) and Arbequina (14.84 mm) varieties (Table 4.2).

Özkul (2016) determined the fruit size as 13.18 mm in the fruit samples taken on October 25 in the study he carried out on the Arbequina variety in Şanlıurfa province. The fruit length of the Arbequina olive variety grown in Northern Iraq was 14.84 mm.

Bulk et al. (2009), in their study in Hatay, it was determined that the Gemlik variety had 22.86 mm fruit length, Sarı Ulak variety had 23.37 mm and Silifke

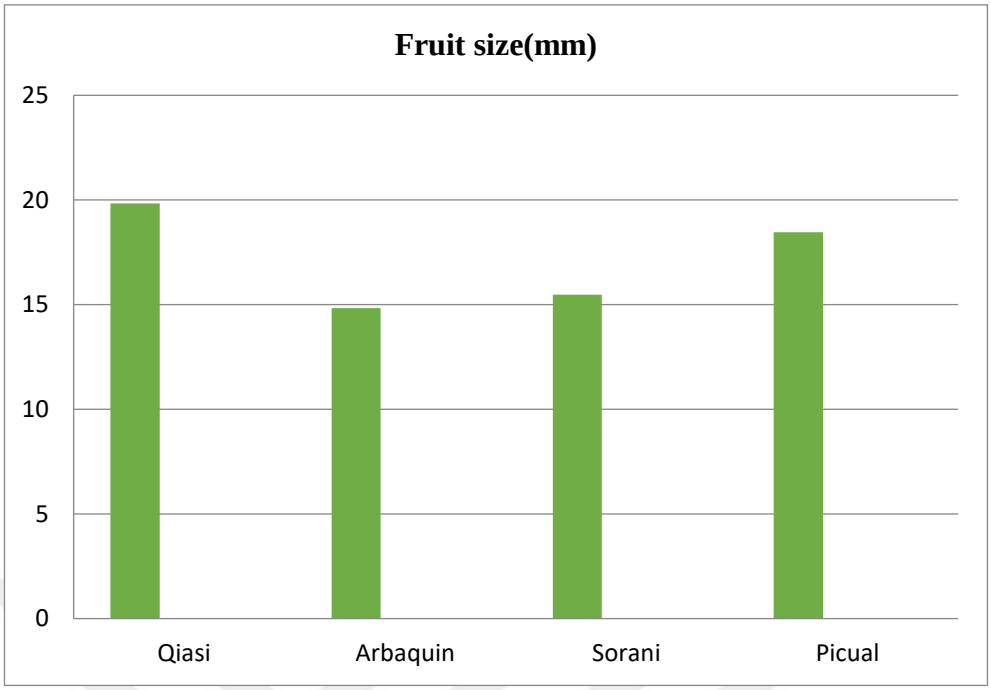

Figure 4.16. Graphic display of fruit size

4.1.2.1.3. Fruit width (mm)

The fruit width values of Qaisi, Arbequina, Picual and Sorani cultivars were examined, and the olive cultivar with the highest fruit width was Qaisi (16.04 mm). Sorani (12.95 mm), Picual (12.85 mm), and Arbequina (10.31 mm) varieties followed (Table 4.2).

Özkul (2016) determined the fruit width as 10.22 mm in the fruit samples taken on October 25 in his study on the Arbequina variety in Şanlıurfa province. He stated the fruit width as 13.31 mm in the Arbequina olive variety grown in Northern Iraq.

Dölek (2003) found the highest value in terms of fruit width in the variety Sarı Ulak (15.10 mm) and reached higher values in Gemlik (17.51mm) and Silifke Yağık variety (18.19 mm).

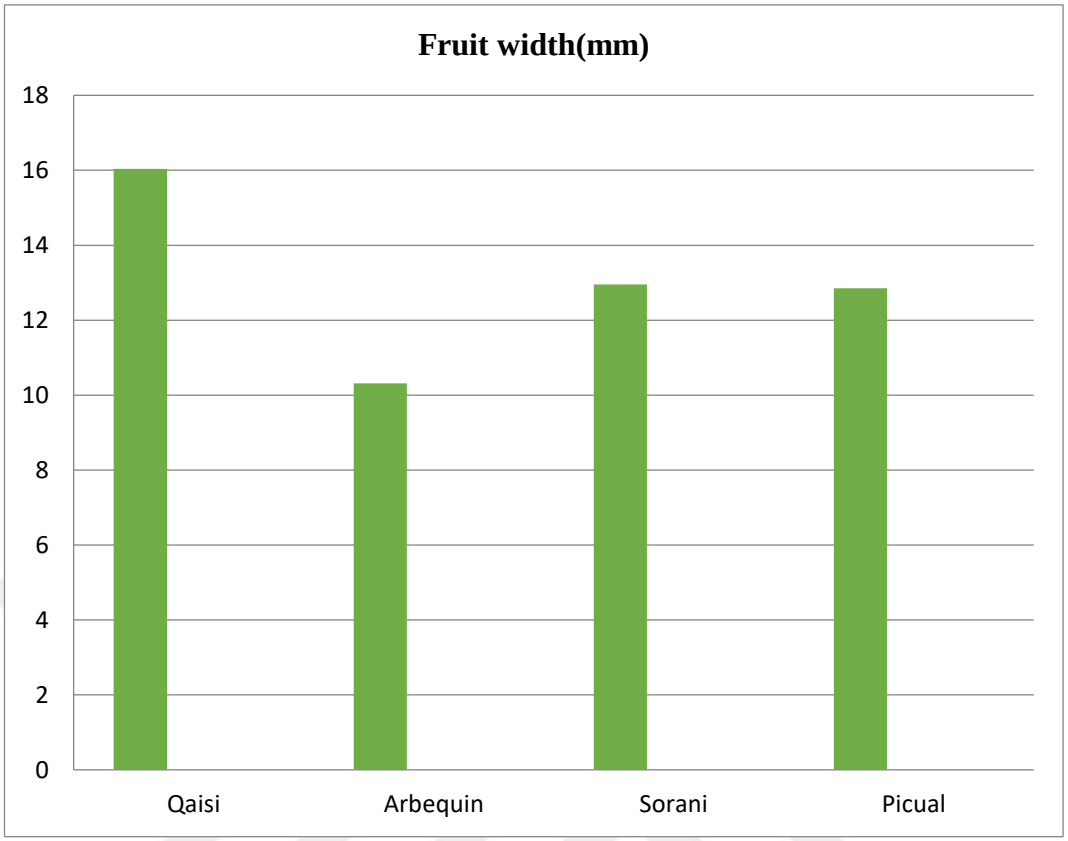

Figure 4.17. Graphic display of fruit width

4.1.2.1.4. Fruit index length/width (mm)

Fruit index was determined by taking the average length/width of the fruit. (Fig. 4.2). Fruit index was determined as 1.19 mm for Sorani variety, 1.23 mm for Qaisi variety, 1.40 mm for Arbequina variety and 1.43 mm for Picual variety. In Hatay's research, Koleksiyon (2000) obtained a fruit index of 1.27 in the Gemlik cultivar. In Hatay-Kırıkhan conditions, the fruit index of the Gemlik cultivar was close to 1.24 oval fruit shape, Sarı Ulak cultivar had 1.53 long oval or long cylindrical fruit shape, and Silifke Yaglik cultivar was 1.35' has an oval fruit shape. The values we determined for the cylindrical Qaisi, Picual and Arbequina cultivars are within the ranges specified in the literature for other olive cultivars. On the other hand, the value we determined in the Sorani cultivar was lower than in the literature. The reason for this difference may be the genotypic origin. There may also be differences in the ecology of cultivation or the cultural processes applied in the garden.

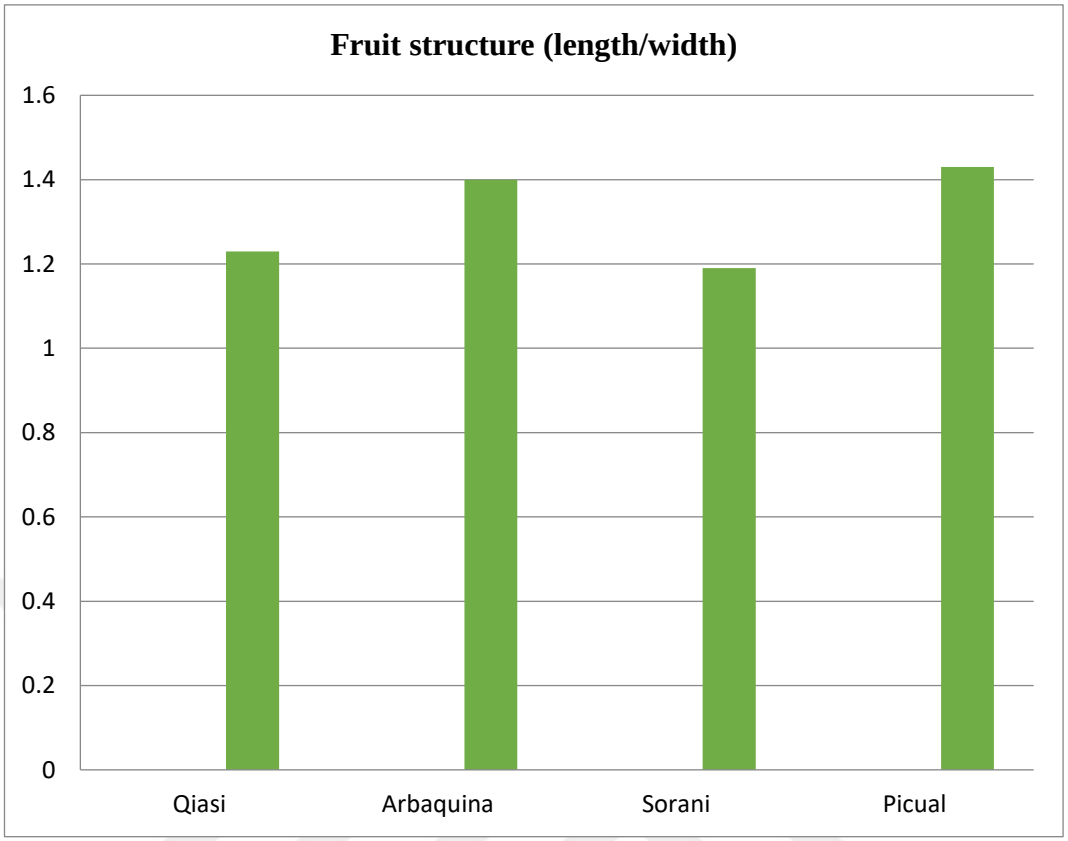

Figure 4.18. Graphic representation of fruit structure

4.1.2.1.5. Fruit shape

Fruit shape of olive varieties grown in Northern Iraq; It was found as egg-shaped in Sorani and Qaisi cultivars and elliptical in Picual and Arbequina cultivars.

4.1.2.2. Kernel features

4.1.2.2.1. Core weight (gr)

Among the examined varieties, Qaisi (58.20 g) had the heaviest seed weight, followed by Picual (43.66 g), Sorani (35.06 g) and Arbequina (26.99 g) olive varieties.

Bulk et al. (2009) stated that the seed weight of the Gemlik variety is 0.57 grams, the Sarı Ulak variety is 0.87 grams, and the Silifke Yaglik variety is 0.61 grams in Hatay. However, results from the cultivars Qaisi, Arbequina, Picual and Sorani, Toplu

et al. (2009) are above the stated value. This difference is due to the different climate and soil characteristics of the regions where cultivation is made, and sometimes it may cause differences in the pomological characteristics of a certain variety.

Table 4. 3. Chart Kernel characteristics of Northern Iraq olive cultivars

Kinds	Core Weight (gr)	Core Size	Core Width	Core structure (length/width)	Core shape
Qaisi	58,2090 a	13,3857 b	8,95150 a	1.49	Elliptical
Sorani	35,0687 c**	10,7546 d**	7,38283 b**	1.45	Elliptical
Arbequina	26,9977 d	12,0335 c	6,53567 c	1.84	Elliptical
Picual	43,6670 b	14,4904 a	7,73700 b	1.87	Elliptical

** Means shown with different letters are statistically different by 1%.

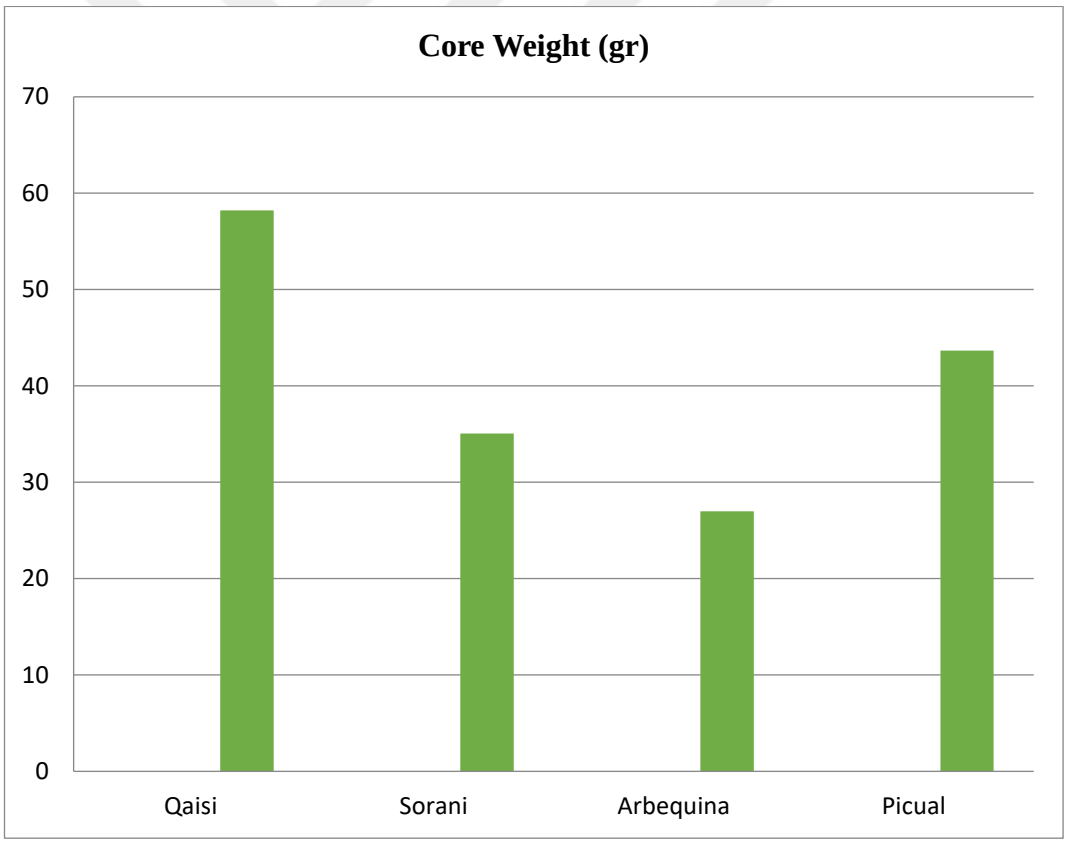

Figure 4. 19. Graphical display of the core weight

Figure 4.20. Seed and fruit image of Sorani variety

Figure 4.21. Seed and fruit image of the Qaisi variety

Figure 4.22. The seed and fruit image of the Picual variety

Figure 4.23. Seed and fruit image of Arbequina variety

4.1.2.2.2. Core length (mm)

The highest value in seed length measurements was found in Picual (14.49 mm) cultivar, followed by Qaisi (13.38 mm), Arbequina (12.03 mm) and Sorani (10.75 mm) cultivars, respectively.

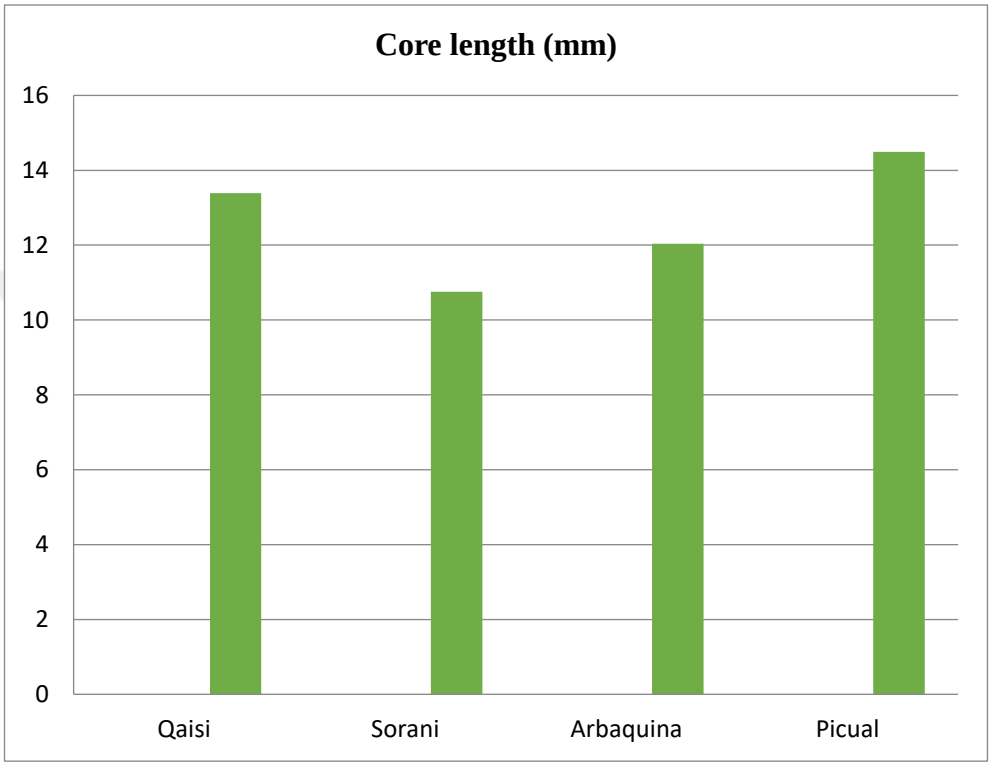

Figure 4.24. Graphical representation of core length

4.1.2.2.3. Core width (mm)

The highest values were determined in the Qaisi (8.95 mm) olive cultivars in the width measurement of the seeds, and Picual (7.73 mm), Sorani (7.38 mm), and Arbequina (6.53 mm) cultivars followed each other, respectively.

İlhan (2019) found the highest seed width in Memecik (9.34 mm) variety and the lowest in Nizip Yağlık (7.27 mm) variety in his study conducted in Şanlıurfa. In the Gemlik cultivar, this value was found to be 8.71 mm.

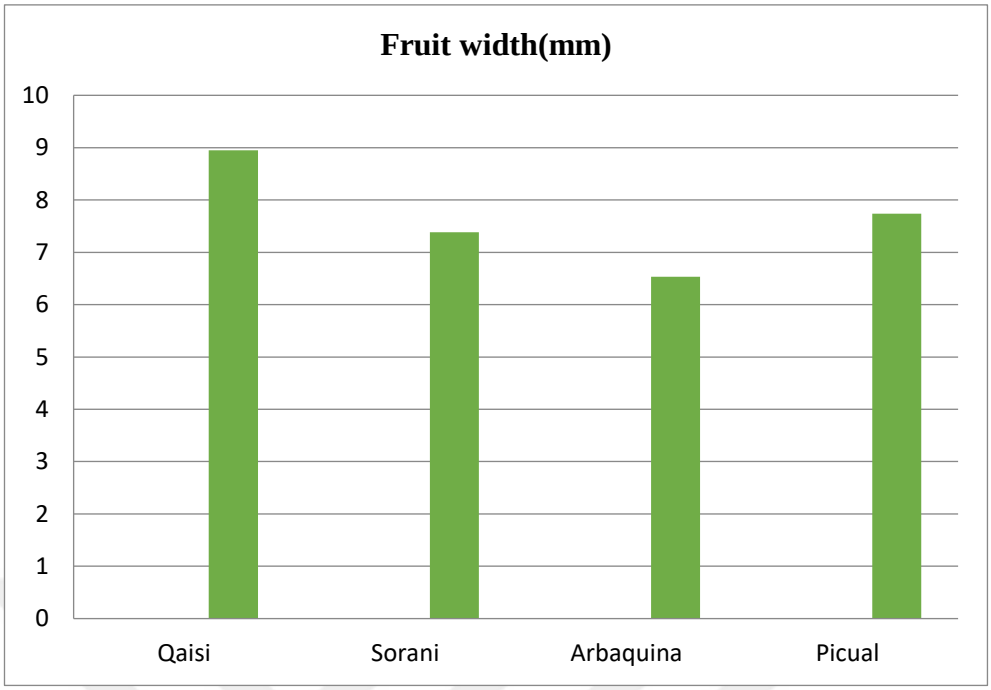

Figure 4.25. Graphical representation of core width

4.1.2.2.4. Core index (mm)

As a result of the examination of the structure of the nucleus, Sorani (1.45 mm), Qaisi (1.49 mm), Picual (1.87 mm) and Arbequina (1.84 mm) were determined.

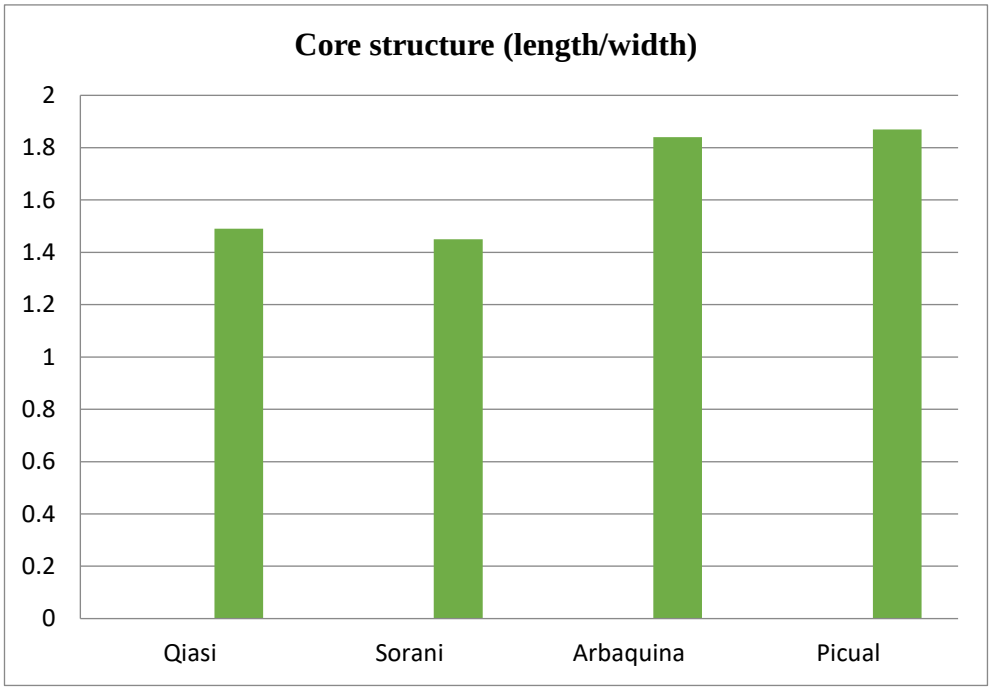

Figure 4. 26. Graphical representation of the kernel index

4.1.2.2.5. Core shape

The core shape of olive varieties grown in Northern Iraq; was found elliptical in Sorani, Qaisi, Picual and Arbequina cultivars.

4.1.2.3. Phenological observations

As a result of the observations made at least once a week as of 01.03.2020, the phenological characteristics of the varieties were determined.

4.1.2.3.1. Beginning of flowering

There are differences at the beginning of flowering in Arbequina, Qaisi Sorani and Picual olive cultivars grown in Northern Iraq. Picual and Qaisi Flowers bloomed on April 1, Arbequina variety on March 15, and Sorani variety on April 15. The flowering date of the varieties was determined when 5% of the flowers opened. Bignami et al (1993) and others are among the researchers studying different species and ecology. They are stated that when the temperature is above 2oC, the flowering date will change, but at the same time, the fruit will ripen.

4.1.2.3.2. Full bloom

There are differences in the full flowering period of olive varieties grown in Northern Iraq. For example, full flowering in Qaisi started on April 10, Sorani on April 15, and Arbequina and Picual varieties on April 15. However, in his study on local olive varieties grown in the Derik district of Mardin in 2018, Ay stated that full flowering started in mid-May.

4.1.2.3.3. End of flowering

It was accepted as the period when all the flowers opened. All flowers opened on May 20 in the variety Qaisi, on May 25 in the Sorani variety, on June 1 in the Picual variety and on June 20 in the Arbequina variety.

In his study on local olive varieties grown in the Derik district of Mardin in 2018, Ay stated that the end of flowering occurs in late May and early June.

4.1.3. Chemical Analysis

4.1.3.1. Total fat percentage (%)

The oil analysis of Arbequina, Sorani, Qaisi, and Picual fruit characteristics determined that the average total oil content varies between 10%-40%.

4.1.3.2. Fatty acid compositions

The highest oleic acid value was determined in the Sorani variety, 75.40% and the lowest value in the Arbequina variety, 51.52. The highest linoleic acid value was determined in the Arbequina variety with 20.33% and the lowest in Sorani variety with 3.41%. The highest palmitic acid value was determined in 25.03% Arbequina cultivar and the lowest at 17.61% in Sorani cultivar.

Beltran et al. (2004) found that linoleic acid in the Picual variety in Spain was 3.37%, and the amount of linoleic acid increased as the maturity index increased. Oktar and Çolakoğlu (1989) determined the amount of oleic acid in the cultivars between 70.46% and 73.40%. Bulu (2000) stated the amount of oleic acid belonging to the Gemlik variety as 70.61% in Hatay conditions.

Table 4.4. Fatty acid compositions of olive varieties grown in Northern Iraq

Kinds	C16:0 Palmitic Acid	C16:1 Palmitoleic Acid	C18:0 Stearic Acid	C18:1n9c Cis-oleic acid	C18:2n6c Cis-linoleic acid	C20:1 Cis-11-eicosenoic acid	C24:1 Nervonic Acid
ARBEQUİN	25,03	1,73	0,53	51,52	20,33	0,71	0,11
SORANİ	17,61	1,67	0,84	75,40	3,41	0,92	0,13
PİCUAL	23,47	1,72	0,78	61,50	12,21	0,29	0,29
QAİSİ	24,59	1,35	0,96	54,771	17,47	0,65	0,17

5. CONCLUSIONS and RECOMMENDATIONS

In this study, we aimed to determine the morphological and pomological characteristics of the Olive varieties in the Kalar region, which are well adapted to the region. The research sampled fruits from Picual, Sorani, Qaisi, and Arbequina cultivars grown in the region and brought to Turkey for pomology.

As a result of the observations made in July-August, the growing power of the olive tree was classified as (low, medium and high), and the crown structure of the olive tree was classified as (Upright, Semi-upright, and Widespread). In addition, the crown density of the olive tree was classified as (dense, middle, and messy).

Fruit weight, fruit length, and fruit width were examined in pomological measurements. Fruit weight was determined as 298.21 g in Qaisi, 193.88 g in Picual, 153.13 g in Sorani, and 98.26 g in Arbequina. Fruit length was determined as 18.84 mm in Qaisi, 18.46 mm in Picual, 15.47 mm in Sorani, and 14.84 mm in Arbequina. Fruit width was determined as Qaisi 16.04 mm, Picual 12.85 mm, Sorani 12.95 mm, and Arbequina 10.31 mm. Among these cultivars grown in Northern Iraq, the highest fruit weight, width, and length were found in Qaisi cultivar. The Qaisi olive variety has commercial value as table olives.

Especially the Arbequina variety; the potential for cultivation in the region is high due to the stunted trees, early fruiting, and high olive oil yield. In addition, the Sorani variety is a Syrian origin variety, and this variety is also important for table and oil olive cultivation.

Arbequina Variety, which has low value, was found in the region. Arbequina and Picual varieties, on the other hand, are Spanish-origin varieties, but their performance and adaptation values in the region are high. Therefore, the economic potential of Arbequina and Picual olive varieties is high, and these varieties should be examined in more detail. Although Arbequina and Picual olive varieties have small-

grained fruits, it is predicted that they can be used in olive oil production in the region in the coming years. Especially the Arbequina variety; The cultivation potential in the region is very high due to the stunted tree, early fruiting, and high olive oil yield. Sorani variety is of Syrian origin and is important in table and olive oil cultivation.

In the morphological analysis, leaf length and width were examined. Leaf length was found as Qaisi 67.42 mm, Sorani 58.71 mm, Picual 57.80 mm, and Arbequina 49.27 mm. Leaf width was found as Qaisi 17.74 mm, Sorani 14.12 mm, Picual 13.28 mm, and Arbequina 12.18 mm. The highest values were found in Qaisi cultivar in terms of these traits. It has been observed that there is a linear relationship between fruit and leaf sizes.

Olives have an important significance in northern Iraq, and it is a product with a high value because it is one of the scarce products that can have rich oil extracted from its fruit, which can also be used as cooking oil or be drunk. Its leftovers can be used as fertilizer. Another use for olives is their usefulness in making appetizers and types of vinegar. The nutritional value is of very high value, and this is because of the large amounts of bitterness, which helps prevent and alleviate symptoms of many human diseases. It is also an important ingredient in plant-based medicines that help diabetes patients. Besides these facts, olives are a tasty and delightful fruit—the benefits of olives and northern Iraq's fitting weather and soil.

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