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Oral Presentation

Comparison of pomological characteristics of some local olive genotypes

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Olive (*Olea europaea* L.) has a great genetic diversity in Turkey due to one of the genetic origin and its mainland. Olives have great variability through Southeast Anatolia region to Black Sea region for fruit and olive oil characteristics in Turkey. In addition, Turkey is one of the biggest producers of table olives and olive oils in the world. There are many local genotypes and landraces with different plant and fruit characteristics providing genetic variation. Pomological characteristics are particularly important in terms of olive breeding, olive industry and variety characterization.

The conservation, evaluation of genetic resources and consciously use in breeding studies is the common strategy of developed countries. From this point of view, researches on the rich genetic diversity of Turkey should be investigated and the protection of these resources should be ensured in Turkey.

Based on this, olive samples from little-known genotypes were taken from November to December. Yamalak Sarısı from the Aegean region; Gökçeada from the Marmara region; Adana Topağı, Beyrut, Çortak, Çöplüce, Gök Zeytini, Kargaburun, Silifke Yağlık from Mediterranean region; Butko, Otur, Sati from the Black Sea region; genotypes (12 pieces) were investigated and compared for their pomological characteristics. Fruit number (fruit/kg), fruit weight (g), fruit width (mm), fruit length (mm), fruit index (length/width), fruit shape, seed weight (g), seed width (mm), seed length (mm), flesh ratio (%) and maturity index were determined in genotypes used in research. According to the obtained results, fruit weight with the largest fruit (8,13 g) and the highest flesh ratio of fruit (89.18%) had been found in Yamalak Sarısı olive genotype. Butko had the smallest fruits (2,08 g) with the lowest fruit ratio (74,86%).

Keywords: *Olea europaea* L., pomology, quality, olive biodiversity

INTRODUCTION

Olive and olive oil is an agricultural product that has an important place in human nutrition and health from prehistoric times to this day. The existence of olive in the social, cultural and economic areas of the Mediterranean and Anatolian civilizations for centuries has been a good evidence of the historical depth and importance of this precious product. The date of the cultivated olive goes up to 6000 years ago. Olive, which is one of the first species to be cultured in the world, began to be cultivated before the discovery of writing. Although there are many opinions on the homeland of olive, in Asia Minor In other words, it is known that it has been cultivated in Anatolia for thousands of years. According to the results of the research, it is possible to say that the homeland of olive is Anatolia (Efe et al., 2011). Especially in the South-eastern Anatolia region, Hatay, Mardin and Maraş triangle were accepted as one of the genetic centre of olives. The olive was then an important source of economic income, spreading over a wide area, including the whole of the Mediterranean basin and from there to America. 19 million tons olive is produced from approximately 1 billion olive trees in 10,650,069 hectares of land on the World, of this about 2 million tons is process for table olives and the rest is separated for oil and an average of 3 million

tons of olive oil is obtained. 95% of world olive cultivation is a characteristic product in Mediterranean countries. Among the countries that have a prominent place in this production, Spain ranks first with a share of 34%, Greece with 12%, Italy with 11%, and our country with 1,730,000 tons and 9%. (FAO, 2018). Olive is a product of industrial importance among agricultural products. It constitutes the olive groves 3.56's% of the available agricultural area in Turkey. According to the statistics of 2016, there are 173,758,088 olive trees in approximately 845,452 hectares of land in our country. 147,403,130 (84.83%) of the existing olive trees in our country were at the fruit-bearing age, while 26,354,958 (15.17%) were at the age of non-fruiting and 1,730,000 tons of products were obtained from the olive groves. 430,000 tons of this product (24.85%) were treated as table olives and 1,300,000 tons (73.63%) as oil (TUİK, 2018). Since the presence of age of non-fruiting tree has an important rate of 15%, this production is expected to increase in the next 5 years.

Olive is one of the most abundant species. It is seen that some genotypes with superior properties have been lost while the varieties with more productive olives, large fruits, more lipid content, tolerance to biotic and abiotic stress conditions have been increased.

Olive fruit contains 1-2% fruit peel (epicarp), 63-86% fruit flesh (mesocarp), 10-30% fruit seed (endocarp) and 2-6% core. In olive fruit, 40% water and 20-35% fat are found in fruit flesh (mesocarp). Only 1% of the total fat in the olive fruit is found in parts of the fruit other than the mesocarp (Hoffmann, 1989).

In our country, olive, Aegean Turkey, Marmara, Mediterranean, Southeast Anatolia and the Black Sea are made in a wide area of olive cultivation in the region. Olive cultivation in our country, Aegean, Marmara, Southeast Anatolia, Mediterranean and Black Sea Regions were made in 29 provinces and there are a total of 88 different varieties found. 51% of our total olive assets are in the Aegean and only 18% of our olive assets are in the province of Aydın.

The Aegean Region is the most important olive cultivated region of our country and meets 51% of the total production with 874,625 tons. 77% of the region's production is in oil and 23% in table production. Marmara Region of Turkey realizes 21% production by 365,055 tonnes. Table olive productions are very important in olive growing. The Mediterranean Region has a share of 26% with 445,949 tons and is ranked 2nd. Most of the production in this region (72%) is considered as oil (TUIK, 2018).

This study was carried out between 2004 and 2007 years and the pomological characteristics of each less known genotype were screened and compared. Researches on pomological characteristics composition of olive genotypes grown in Turkey with respect to geographical origin and variety are very limited. Therefore, Turkey's rich genetic resources conservation, evaluation, use in breeding studies and to contribute to studies on the rich genetic diversity of our country is intended.

MATERIALS AND METHODS

Sampling

Twelve grown ecotypes of olive were collected from trees cultivated in four geographical regions of Turkey. The varieties were 'Gökçeada' from Çanakkale (Marmara Region); 'Yamalak Sarısı' from Aydın (South Aegean Region); 'Adana Topağı', 'Beyrut', 'Çortak', 'Çöplüce', 'Gök Zeytini', 'Kargaburun' and 'Silifke Yağlık' from Adana, Mersin and Hatay (East Mediterranean Region); 'Butko', 'Otur' and 'Sati' from Artvin (Black Sea Region).

All the varieties are widely cultivated in the mentioned regions. Fruit samples have been manually harvested from three different orchards for each variety in one region. All the trees for sample preparation were more than 20 years old and under optimum management techniques. A total of 100 fruit samples from each trees

of the varieties were collected from the beginning of December to the end of January in 2004-2005 and 2005-2006. Trees of the same variety were harvested on the same day.

General Characteristics of Olive Genotypes Used in Research

Adana Topağı: Fruits are large, round, soft fruit flesh. Fruits that are fleshy and tasty are mostly considered as green table. The samples of Adana Topaz fruit used in the study were taken from Adana Merkez (Abdioğlu Village) and Ceyhan district

Beyrut; Also known as Beyrut Aşısı. It is an ecotype where widely grown in the town of Mut-Mersin, especially in Esençay Village. It is used as oil and green table olive. The samples of Beyrut variety used in the study were taken from Mersin (Esençay village, Mut district).

Çortak; It is said that this type of olive cultivated in Çortak Village of Mersin-Mut district came from the Aegean region. Fruits are very large. It is used as green table olive. The samples of Çortak olives used in the study were taken from Mersin (Çortak village, Mut district).

Çöplüce (Çöpaşı); Also known as Çöpaşı and Çöplü Zeytin. It is widely grown in the district of Silifke. It is considered as green table and oil. The samples of Çöplüce olives used in the study were taken from Mersin (Silifke district).

Gök Zeytini; It is widely cultivated in Çiriş, Batı Sandal, Doğulu and Sarıyer villages of Erdemli district. It is considered as green table and oil. Gök Zeytini olive samples used in the study were taken from Mersin (Erdemli district).

Kargaburnu; This species originating from the province of Hatay is widespread especially in the central district. It is used as an oil because of its high oil yield. It is also used as table olive for family need consumption. Kargaburnu samples used in this study were taken from Hatay (Samandağ and Altınözü districts).

Gökçeada; Ladolia (Koroneiki), which is of Greek origin in general, is a leading type of Greece with high yields and excellent oil quality. It can be adapted to dry and moist areas. The tree gives very high amounts of fruit in bad conditions and less with irrigation. Gökçeada olives used in the study were taken from Çanakkale (Gökçeada, ELTA Agricultural Enterprise).

Butko; It is a local genotype, also known as Yusuefeli olives, used as table and oil in Artvin. Butko olive samples used in the study were taken from Artvin (Demirkent village of Yusufeli district).

Otur; It is an ecotype which is used as oil in Artvin and also known as the "Saçaklı Otur" olive. It exhibits a coarse grained and pointed feature. The samples of Otur olive used in the study were taken from Artvin (Demirkent village of Yusufeli district). It is grown for both olive oil and breakfast purposes.

Sati; It is a local type used as table olives in Artvin. The Sati olive samples used in the study were taken from Artvin (Demirkent village of Yusufeli district).

Silifke Yağlık; It is a locally grown type of olive commonly grown in the district of Silifke. They are usually produced in the form of monoculture orchard. Fruits are medium in size and high in fat. It is considered as green table and oil. Silifke used olive oil samples were taken from Mersin (Silifke district).

Yamalak Sarısı; is also called Yamalak Kabası, Kaba and Kabaağaç and it is considered as green table olives. The samples of Yamalak Sarisi used in the study were taken from Aydın (Kuyucak District).

Methods

In this experiment fruit width (mm), fruit length (mm), fruits weight (g of 100 fruits), fruit flesh ratio (%) and maturity index were determined.

Fruit width, fruit length, seed width and seed length (mm) were measured by digital caliper with longitudinal and equatorial diameters of the whole fruit. These measurements were carried out with 3 replicates and each replicate had 30 olive fruits. Fruit weight (g 100 fruits^{-1}) was determined by digital balance (Sartorius, Germany). After determining fruit and seed weight, fruit flesh ratio was calculated by formula:

Fruit flesh ratio = [(100 fruit weight – 100 seed weight)*(100) / (100 fruit weight)]

Maturity index (MI) equation was applied according to IOOC (2007). In this system, a group of 100 olives was separated in different categories according to the skin and pulp color (Figure 1): 0-Deep green; 1-Yellow green; 2-Turning color with reddish spots; 3-Turning color with red or light purple color in all the fruit; 4-Black, without color under the skin; 5-Black, with color in less than the half of the pulp; 6-Black, with color in more than the half, but not in the stone; 7-Black, with color in all the pulp.

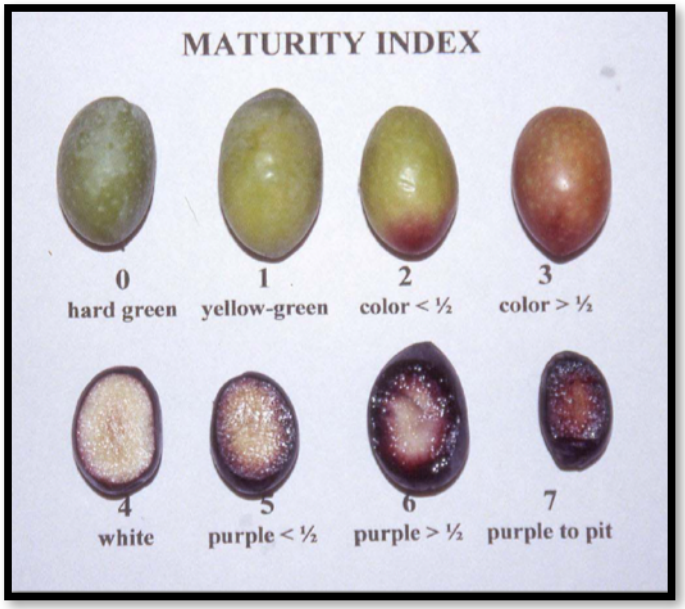


Figure 1. Color scale used to calculate the maturity index in olive samples

RESULTS AND DISCUSSION

The average results of olive pomological analyzes performed in 2004-2005 and 2005-2006 periods are given in **Table 1.** According to the regions, the genotype, which contains the least fruit at 1 kg and the largest fruits with 8,13 g fruit weight, was the Yamalak Sarisi olive variety from the Aegean Region (123 fruit kg^{-1}). Butko one of the types of Artvin region (546,45 fruit kg^{-1}), the highest number of fruits in 1 kg. The highest fruits weight of the local olives selected from the regions was the Yamalak Sarisi (8,13 g), followed by the Çortak (7,81 g) from the Mediterranean Region.

A graph of the comparison of fruit weights of olive varieties is shown in **Table 1**. As can be seen in the table, "Yamalak Sarisi" genotypes have been included as a large genotype with a fruit weight of more than 8 grams. These genotypes should be used especially in breeding large varieties. Diez (1971) stated that the olive fruit has a weight of between 1,5-2 g and 10-12 g. Canözer (1991) found that the fruit weight of olive

varieties grown in our country ranged between 1.76 g and 7.50 g and the number of fruits in 1 kg ranged from 133 to 460 g. Pannelli et al. (1993) determined the fruit weights of local varieties ranged between 1,23 g and 3, 12 g in Italy. As a result of the measurements made the most fruit width Yamalak Sarısı variety (22,33 mm); at least the fruit width has Butko (11,51 mm) and Sati (12, 51 mm) genotypes. Canözer (1991) investigated the pomological characteristics of varieties and found that the fruit width was 17,91 mm in the Gemlik variety, 16,09 mm in the Halhalı variety and 16,12 mm in the Savrani variety. Özilbey (2011) stated that the fruit width of the Otur variety is 21.2 mm, whereas the fruits of the Butko and Sati varieties were 17.4 mm and 17.00 mm, respectively. Bolat and Güleryüz (1995) stated that while the fruit width of Otur variety was 20.2 mm, the vareties of the Sati and Butko were 19.3 mm and 17.2 mm, respectively.

Table 2. Significant pomological characteristics of some domestic olive genotypes (averages of 2004-2005 and 2005-2006 periods)

GENOTYPE	Number of fruits (fruit kg^{-1})	Fruit Weight (g)	Fruit Width (mm)	Fruit Length (mm)	Seed Weight (g)	Seed Width (mm)	Seed Length (mm)	Fruit Flesh Ratio (%)	Maturity Index
Adana Topağı	207.90	4.81	22.10	24.10	0.58	8.56	14.43	87.94	1.86
Beyrut	190.11	5.26	17.40	25.18	0.83	7.69	17.18	84.22	1.56
Butko	546.45	1.83	11.51	17.14	0.46	7.40	12.36	74.86	3.42
Çöplüce	272.48	3.67	15.43	21.21	0.58	7.45	14.93	84.20	2.41
Çortak	128.04	7.81	21.38	31.63	1.19	9.83	20.11	84.76	1.68
Gökçeada	253.17	3.95	16.65	25.83	0.80	7.84	18.49	79.75	1.52
Gök Zeytini	247.53	4.04	17.91	21.56	0.68	7.50	15.11	83.17	1.87
Kargaburnu	374.53	2.67	14.84	21.27	0.50	8.11	15.13	81.27	2.12
Otur	254.45	3.93	15.11	24.77	0.87	8.81	17.89	77.86	3.50
Sati	480.77	2.08	12.51	18.87	0.52	7.48	13.96	75.00	3.10
Silifke Yağlık	265.25	3.77	13.66	23.24	0.97	10.87	17.91	74.27	2.04
Yamalak Sarısı	123.00	8.13	22.33	26.41	0.88	9.11	16.18	89.18	1.87

As a result of the measurements made, the longest fruits have the type of Çortak (31.63 mm); the shortest fruits were found in the Black Sea Region olive type Butko (17,14 mm). Canözer (1991) was determined the fruit length as 22.33 mm in Gemlik variety, 19.54 mm in the Halhalı variety and 21.72 mm in Savrani variety. Kaynaş et al. (1996), was determined fruit length (mm) of Gemlik cultivar (20.60 mm) and Halhali cultivar (18.90 mm).

According to the average of the two-year values, while the highest seed weight (1.19 g) Çortak variety were determined, the lightest seeds were obtained from Butko (0, 46 g) variety. Gezerel (1980) examined the seed weights of cultivars and found that these varieties varied according to varieties, determined seed weight that Adana Topağı was 1.18 g and Nizip Yağlık variety was 0.50 g. Canözer (1991) stated that the seed weights were 0.659 g in the Halhalı cultivar and 0.390 g in the Savrani cultivar. Bolat and Güleryüz (1995) in their study with the local varieties in the Coruh valley determined that the seed weight of the varieties between 0.29 g and 0.92 g. Kaynaş et al. (1996) stated that seed weights vary according to varieties and this is 0,480 g in Gemlik and 0,660 g in Halhalı cultivar. The findings obtained from this study are similar to the findings of the researchers. However, both Canözer (1991) and Kaynaş et al. (1996)'s work is smaller seeds than of Gemlik variety, while Halhalı variety of similar weight have been obtained from the seeds. The reason for this is that different types of reactions to ecologies and maintenance conditions and changes in fruit sizes can be shown.

Fruit flesh ratios showed great differences between varieties and they ranged from 74.27% to 89.18%. According to the average of the two-year values, the highest fruit flesh ratios were found in Yamalak Sarısı and Adana Topağı genotypes (89.18% and 87.94%) while the lowest values were in Butko (74.86%) genotype. The high rate of fruit flesh of Yamalak Sarısı olive variety is seen as an important factor in the evaluation of this variety as a table olives and it is processed as a pickled green olive. In fact, Kaynaş et al. (1996) stated that the rate of fruit meat has a high share in such a variety of weighed ratings and this should

be higher in table olive variety. Diez (1971), who investigated the fruit meat content of varieties, stated that fruit flesh ratio ranged between 70-88%. Canözer (1991) found fruit flesh ratio as 85.86% in Gemlik, 82.79% in Halhalı variety and 86.61% in Savrani variety. Bolat and Güleryüz (1995) stated that fruit flesh ratio varies between 85.20% and 91.30% in their study with local varieties. Aydın and Nizamoğlu (1995) reported that fruit flesh ratio of the Silifke Yağlık genotype were between 79.80% and 85.30%. Kaynaş et al. (1996) found that the rate of fruit meat was 87.36% in Gemlik and 78.28% in Halhalı variety. Maturity values of varieties ranged from 1.52 to 3.61. The most important reason for this parameter to be realized in a wide range is caused by ecological differences. Beyrut (1,56) and Gökçeada (1,52) varieties were found to be most immature fruits with yellow and green shades compared to other varieties when fruit samples were taken. On the other hand, Otur (3,50), Butko (3,42) and Sati (3,10) forms a group in which the color of the peel is turning black.

CONCLUSIONS

The genotypes of Yamalak Sarisi and Çortak were identified as large varieties with fruit weight of more than 7 grams. These genotypes should be used especially in breeding of large varieties of table. Furthermore, Yamalak Sarisi genotype, which is frequently encountered in Aydın and Denizli provinces and which can be used as green table or filled olives, needs to be evaluated more. It was remarkable that this ecotype was very fruitful and the trees were very fertile.

Due to the fact that olive varieties in the Eastern Black Sea region are resistant to cold, their performances should be examined in regions having passages which are under the influence of winter cold in every 3 to 4 years as North Aegean. Gökçeada genotype is well adapted to the island's harsh climate and therefore it can be tested in other regions due to its resistance to cold. These local genotypes should be directed to boutique olive cultivation because they are very well adapted to the area they grow and are tolerant to the abiotic stress conditions of that area.

In this completed study, comprehensive information about the richness of olive genotypes and their properties was obtained. The findings of this research will shed light on all institutions and organizations to plan new researches on these olive genotypes. Researches on the identification of olive genotypes and varieties with superior properties in different regions of our country should be increased. The beginning of these Research & Development studies should be the creation of the modern "Olive Genetic Resources Center".

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