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Full Length Research Paper

A selection study on oleaster (*Elaeagnus angustifolia* L.) grown in the campus area of Selcuk University in Konya, Turkey

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This study was conducted on the population of oleasters that were found in Selçuk Universty of Aladdin Keykubat Campus in 2005 to 2006 in order to determine the kinds of candidates of high quality fruits by the selection breeding method. In this survey, a total of 30 kinds of oleaster (*Elaeagnus angustifolia* L.) was examined and 12 kinds of olaester was chosen between them according to their fruit characteristics. The weight, length and width of fruits in the chosen ones were recorded to be between 1.55 and 1.82 g, 21.42 and 24.80 mm, and 15.44 and 17.72 mm, respectively, and the rate of seed/flesh was between 2.31 and 4.20. Finally, the rate of vitamin C for the different kinds of oleaster was determined to be between 1.86 and 5.03 mg/100 g.

Key words: Turkey, Konya, oleaster (*Elaeagnus angustifolia* L.), selection breeding.

INTRODUCTION

Since the time fruit growing began on earth, breeding of fruit has been practiced. It is probable that 95% of the fruit types that have spread all over the world have been selected through the simple selection method (Özbek, 1971; Güleryüz, 1988). The selection phase forms a significant portion of the breeding in a regular breeding programme (Dokuzoğuz and Gülcan, 1973).

The number of fruit types being grown in the world is about 138, 75 of which are grown in Turkey. Its geographical location and diverse climatic characteristics helped Turkey to become a gene centre and a spreading area for various fruit types, while it also helped fruit forms that are suitable for different ecological conditions to develop. Moreover, with the addition of new types brought from abroad, these existing types have been further enriched. This enabled Anatolia to harbour a rich variety of the different population types (Ülkümen, 1973; Özbek, 1977). Studies on possibilities of making use of naturally growing plants by cultivating them are almost non-existent in our country. There are varieties of fruits in Turkey that are not known by the public at large. In recent years, people have begun to take a great interest in minor varieties of fruit, which are valued as ornamental plants besides their economic worth. Most of these varieties contain highly nutritious substances and they yield raw materials that are suitable for the industrial sector. Besides such properties, they possess a tolerance limit in terms of their soil and climate requirements (Feucht and Schwalb, 1999). It is known that oleaster grows better in highly humid soil than dry areas (Lesica and Miles, 2001). Oleaster adapts to alkali or saline soil types better than other fruit varieties (Tuksan and Laughlin, 1991). Oleaster also provides such side benefits as controlling erosion and preventing snowslides. It provides nectar for bees and creates an attractive natural environment (Shaw, 1988; Hays, 1990). Oleaster has also been cherished as an ornamental plant in Europe and America because it causes fewer disease and insect problems (Krupinsky and Frank, 1986). Finally, it is commonly used as a medicinal and aromatic plant.

Oleaster is a plant that belongs to the Elaeagnaceae family of Rosales order, Magnoliopsida class and Magnoliophyta division (Anonymous, 2007a). It is a long-lived tree or a small, multi-rooted tree. It has a dark, smooth

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and ribbed bark. Its branches are flexible and encircled with rough pricks. The lengths of oleaster are 5 to 12 m with trunks that are 10 to 50 cm in width (Borell, 1971). Oleaster has temporarily shedding leaves with stalks on a series of successive twigs. The leaves of oleaster are 2 to 10 cm in length and 1 to 4 cm in width, having a shape of a lance or sometimes an ellipsis. The aromatic flowers of oleaster are generally 3 to 12 mm in length. The oval fruits, which resemble sour cherries, are 1 to 2 cm in length; although, each fruit is 6 to 13 mm in size (Klich, 2000; Weber, 1987).

The native lands of oleaster are Southern Europe, Central Asia and The Western Himalayas (Bailey, 1914). Oleaster was introduced to Northern America during colonialism (Elias, 1980), and it began to be used as an ornamental plant in many western cities in the 1940's (Van Dersal, 1939). Oleaster was first grown in the USA as a cultivated plant in Utah in 1924. Its cultivation rapidly spread to other states by 1954 (Knopf and Olson, 1984). It is grown in vineyards and orchards in Anatolia as fruit trees due to their sweet fruit. Its fruit is the size of an olive, yellowish-brown in colour and edible. It can be used as a remedy for intestinal disorders and mildew in the mouth (Anonymous, 2007b).

Although Turkey possesses a rich oleaster population, the number of orchards is extremely limited. The cultivation of oleaster is non-existent in Konya as of 2007 (Anonymous, 2007c). The need for this study emerged from all the aforementioned properties of oleaster and of minor fruit, due to the fact that they have not been cultivated. The present study aimed to determine the superior quality trees that can be used as a standard variety through the selection breeding method at the Aladdin Campus of Selcuk University in Konya, Turkey. According to the author, there is no enough literature in this subject. Thus, a step will be taken towards cultivating oleaster, and the fruit yield and quality will be increased by ensuring standardization. Consequently, contributions will be made to the national economy, the socio-economic conditions of the farmers and agriculture at large.

MATERIALS AND METHODS

The present study was conducted through the selection breeding method on plants that grow via seed cutting or separation from the root among the oleaster population found in the Aladdin Campus of Selcuk University from 2005 to 2006. Almost no cultural applications were implemented on these oleaster trees. As a result of the study, to determine the types that could qualify as a variety from among the superior quality oleaster trees, each selected tree was accepted as a type (Kalyoncu, 1996).

The research area is Selcuk University Aladdin Campus located within the borders of the Selcuklu District of the province of Konya on the highway between Konya and Afyon. It is 15 km from the city centre and is situated at an elevation of 1146 m from the sea level. The province of Konya is situated to the south of the Central Anatolia Region, which is in the middle of the Anatolian peninsula, and its southern and southwestern sections are included in the Mediterranean Region. Geographically, Konya is positioned between 36°01' and 46.96" northern latitudes and 32°30' and 34°85" eastern longitudes. The area of Konya is 38.257 km^{2}, which makes it Turkey's largest province in respect of land (Anonymous, 2007d).

Generally, a continental climate prevails in Konya, which is characterised by cold and harsh winters, and hot and dry summers. With an annual precipitation of 326 mm, Konya has the second lowest precipitation in Turkey, and with 81.5 days of precipitation, it is the fifth province that has the lowest mean number of wet days. The precipitation is in the form of convectional precipitation that falls mostly in spring (Anonymous, 2007d). The mean relative humidity in Konya is 60% (Anonymous, 2007f) and the mean annual temperature is 11.5°C. While the mean temperature in the month of July is 23°C, and the mean temperature in January is around 0°C. The maximum temperature has been measured as 40.0, while the minimum temperature has been measured as -28.2. The mean number of days when the temperature falls below 10°C is 10 days, whereas the number of days when frost is observed is about 100 (Anonymous, 2007g). With 99 frosty days, Konya is the 10th province that has the highest mean number of frosty days in Turkey and again with 7.29 h/day, it is the 10th province together with Isparta that has the highest number of sunny days (Anonymous, 2007e).

The present study, which began in 2005 to 2006, examined a total of 100 trees that complied with the stated conditions from among the oleaster population in the research area, excluding trees that did not bear fruit. These 100 trees were further examined visually to eliminate those with ineligible properties such as having pricks, very small fruit or insufficient fruit; and as a result of this selection process, 30 types were determined. 12 types were selected from among these 30 types as a result of a second selection and the selected types were defined after an investigation of their pomological, morphological and physiological properties.

Field work began in May 2005. Within this year, more than 100 oleaster trees were examined in order to determine the oleaster inventory on Aladdin Campus in Konya, and as a result, 30 types were determined. Then, a reselection process was applied on these 30 types in accordance with the criteria below and 12 of them were marked for the purpose of selection. These criteria are: the level of yield, fruit size, good vegetative development, and trees' being in good condition.

Studies were continued by taking 10 pieces of leaves, buds and fruit from each of these selected types. In naming the types, the number plate of the province, the initials of the place names where the selection work was performed and a number belonging to the type were written together. Fruit characteristics were examined through observation, and samples were taken from 30 trees which were at fruit-bearing age and they bore good fruit. The characteristics of the trees regarding yield and growth were determined according to Kalyoncu (1990) and Pirlak (1993) and the damage caused by cold, disease and pests was observed.

"The modified weighted grading method" was used in this study (Şen, 1986; Pirlak, 1993; Kalyoncu, 1990, 1996). The method was implemented in the following manner: an examination was begun on 30 oleaster trees in the field. Measurements were made on 10 pieces of fruit randomly selected from each oleaster tree. In the measurements, a hand caliper of A-0.05 mm precision, Harald Küpper's colour atlas "Farbenatlas" for determining colour (Küpper, 1987) and "Bosch PE 656" balance with a precision level of 0.001 g for measuring weights were used. "PLACOM Digital Planimeter" was used in calculating the area of a leaf, while sensorial measurements such as taste, aroma and firmness of the flesh were made through tasting (Kalyoncu, 1990). Fruit shape was determined according to Pirlak (1993), while other assessments were made through observation.

Analysis of vitamin C (Cemeroğlu, 1992) was performed and evaluated with a pH metre (pH) at a precision level of 0.01 according to Eşitken (1992). The values obtained regarding the characteristics of the fruit belonging to the types that were selected were subjected to

a statistical analysis (Düzgüneş and Kesici, 1983). These characteristics, which formed the basis of weighted grading, one of the selection improvement criteria, were scored and evaluated on the types of oleaster trees that were determined. When properties of the limbs in oleaster were examined, measurable properties were higlighted as much as possible and after evaluating the results with biometric methods, the mean values and variation values were calculated. Only the mean values were given for the limbs on which limited measurements were taken (Güleryüz, 1977). The figures obtained from the measured limbs were evaluated statistically (Düzgüneş and Kesici, 1983).

Examinations were conducted on the fruit taken from oleaster trees and an attempt was made to determine the superior quality types that could qualify as varieties. Weighted grading method was used in comparing the types (Gülcan, 1985). In selection of the oleaster types, the calculation of total weighted scores was performed as follows: the relative score of each characteristic was multiplied by the value score and the obtained scores were added. Profuse and regular yield, full and attractive fruit, high flesh/kernel ratio, good taste and aroma were determined as criteria in selection of the types that could qualify as varieties (Güleryüz, 1977; Eltez, 1983; Şen, 1986; Bolat, 1991; Tosun, 1991; Eriş et al., 1992; Pırlak, 1993; Kalyoncu, 1996). As a result of the selection process conducted on more than 100 oleaster trees, 12 superior quality types that received scores above 900 from among the 30 oleaster trees were selected and their definitions were made.

The inductively coupled plasma atomic emission spectrometer (ICP-AES) device was used to determine some other characteristics in selecting the types, such as the characteristics of trees, leaves, flowers, fruit and kernels and mineral analyses of the samples (Skujin, 1998). The analyses on the mineral materials were carried out by using ICP-AES, (Varian- Vista) on the selected types of oleaster fruit (mg/100 ml) (Soil Survey Laboratory Methods Manual, 2004).

RESULTS AND DISCUSSION

Since the beginning of their existence on earth, humans have struggled to meet their need for food by cultivating various plants found in their environment. Many plants have been cultivated and offered to be used by humans as a result of centuries-old nutritional habits. No matter how useful some fruits are, they are cultivated using traditional methods. Such fruit trees have been used as borderline markers, shades and greenery, rather than for food. The present study attempted to examine the yield and quality of oleaster, which is one of the fruit types that are of secondary importance for humans, and determine the quantities of nutrients and minerals it contain. It also sought to find ways for its cultivation and determine the characteristics of eligible varieties of oleaster.

In this study, which was conducted on Selcuk University Aladdin Campus, 30 types were selected out of more than 100 oleaster trees in the research area as a result of a preliminary selection, and the selection breeding method was applied on these 30 oleaster trees. The types that were thus determined were kept under observation for a year and their vegetative and generative developments were recorded. First, the characteristics of the oleaster trees and then the characteristics of their leaves, flowers and fruits were examined during their developmental process. Very few types of these oleaster trees can be irrigated and, apart from these, almost no other cultivation procedures can be performed on them. Technically, no horticultural activity exists in the area and its vicinity where the study was conducted. The oleaster trees in question were plants that grew after they were planted on the campus through seed cutting and separation from the root methods. They are used as shades on roadsides or between buildings or for the purpose of reforestation. Therefore, no cultivation activities such as pruning, fertilizing, disinfestation, irrigation and cultivating the land are applied. The data obtained were converted into a table and comparisons were made between them, then laboratory studies were included in the study. The study focused on characteristics such as profuse and regular yield, full and appealing fruit, flesh/kernel ratio, taste-aroma and vitamin C, which were some of the criteria for the selection process. The data obtained from the oleaster types were analyzed in laboratory conditions and all the data were brought together. The results were evaluated using the weighted grading method, and as a consequence of this evaluation, 12 oleaster types which received 900 or more scores were determined. As a result of the studies conducted, different ages of the trees were determined on the basis of their characteristics such as petal structure, growth characteristic and trunk diameter. After an examination of the growth strengths of the selected types, it was determined that 42-AKA-28, which had a mean petal height of 10 m, was the tallest tree with a trunk diameter of 0.30 m. The growth characteristics of the 12 types, on the other hand, were as follows: five types were vertical, four types were flat and three types were vertical-flat. Besides all these characteristics, other characteristics that were observed on the trees, such as trunk circumference, trunk length, branching, petal height, petal width and petal shape are given in Table 1.

Fruit characteristics according to the weighted grading method and the other investigated characteristics

Results concerning characteristics of shoots and leaves

The results concerning the characteristics of the shoots and leaves in the selected oleaster types are given in Tables 2 and 3. According to this, the type with the highest annual mean shoot length is 42-AK-19 with 139.73 mm and the one with the lowest is 42-AK-12 with 75.96 mm. The mean shoot length of the types was found to be 104.87 mm. The type with the highest annual shoot thickness was 42-AK-02 with 2.61 mm and the ones with the lowest were found to be 42-AK-25 and 42-AK-27 with 0.97 mm. The mean shoot thickness of the types was 1.39 mm. The type with the highest mean number of leaves on the shoot was 42-AK-23 with 21.80, while the one with the lowest was 42-AK-06 with 11.80. The mean number of leaves on the shoot in all of the selected types

Table 1. Oleaster tree body and crown of the selected types of properties.

Type	Body around (m)	Body length (m)	Branch status	Shape height (m)	Shape width (m)	Shape of tree
42-AK-01	0.53	0.73	Dense	9.00	4.22	Spread
42-AK-02	0.91	0.51	Dense	11.00	6.00	Upright
42-AK-06	0.66	0.91	Dense	11.00	5.40	Upright
42-AK-08	0.95	0.89	Dense	9.00	6.00	Upright
42-AK-12	0.44	1.10	Weak	4.00	2.75	Upright-Spread
42-AK-15	0.55	0.40	Dense	6.50	4.20	Upright
42-AK-19	0.75	1.70	Weak	6.00	6.00	Spread
42-AK-21	0.77	1.80	Dense	9.00	7.80	Upright-Spread
42-AK-23	0.88	0.59	Dense	12.00	6.00	Upright-Spread
42-AK-25	0.37	0.54	Medium	4.00	4.00	Spread
42-AK-27	0.59	1.68	Dense	9.00	7.20	Upright
42-AK-28	0.97	2.60	Dense	15.00	7.80	Spread

Table 2. Measurements of shoots of selected types of oleaster.

Type	Shoot length (mm)	Shoot thickness (mm)	Shoot leaves number (number)	Shoot bud number (number)	Shoot color
42-AK-01	135.19 ± 22.67	2.35 ± 0.44	17.1 ± 0.99	24.6 ± 0.98	$S_{175}G_{04}Y_{11}$
42-AK-02	138.72 ± 13.06	2.61 ± 0.52	18.0 ± 1.76	18.2 ± 4.10	$S_{177}G_{04}Y_{11}$
42-AK-06	86.45 ± 7.06	1.34 ± 0.24	11.8 ± 1.23	21.8 ± 3.36	$S_{179}G_{07}Y_{1}$
42-AK-08	99.87 ± 11.36	1.31 ± 0.21	15.1 ± 2.28	22.9 ± 4.46	$S_{183}G_{07}Y_{20}$
42-AK-12	75.96 ± 8.72	0.99 ± 0.28	13.2 ± 1.75	20.3 ± 5.10	$S_{181}G_{07}Y_{20}$
42-AK-15	95.53 ± 28.64	1.14 ± 0.20	20.2 ± 2.04	50.1 ± 4.31	$S_{179}G_{04}Y_{20}$
42-AK-19	139.73 ± 13.22	1.18 ± 0.26	20.1 ± 1.85	24.2 ± 3.82	$S_{181}G_{07}Y_{15}$
42-AK-21	84.47 ± 10.23	1.06 ± 0.21	17.7 ± 2.87	40.7 ± 6.20	$S_{179}G_{07}Y_{26}$
42-AK-23	98.67 ± 5.96	1.61 ± 0.09	21.8 ± 3.26	43.8 ± 3.29	$S_{181}G_{07}Y_{11}$
42-AK-25	101.57 ± 1.81	0.97 ± 0.08	19.0 ± 3.23	41.8 ± 4.59	$S_{181}G_{04}Y_{15}$
42-AK-27	99.00 ± 4.10	0.97 ± 0.07	15.7 ± 2.06	49.0 ± 3.77	$S_{179}G_{07}Y_{20}$
42-AK-28	103.26 ± 5.14	1.25 ± 0.08	18.0 ± 3.06	47.3 ± 6.33	$S_{181}G_{07}Y_{15}$
Mean	104.87 ± 11.00	1.39 ± 0.22	17.31 ± 2.20	33.73 ± 4.19	-

was 17.31. The type with the highest mean number of buds on the shoot was 42-AK-15 with 50.1, while that with the lowest number was 42-AK-02 with 18.20. The mean number of buds on the shoot in the 12 selected oleaster types was 33.73 (Table 2). As it can be seen from Table 3, the longest leaf stem among the types was found in 42-AK-25 with 11.74 mm, whereas the shortest leaf stem was found in 42-AK-19 with 8.10 mm. The mean leaf stem length of the types was 9.82. The type with the thickest leaf stem was 42-AK-21 with 0.29 mm, whereas the one with the least leaf stem thickness was 42-AK-27 with 0.11 mm. The mean leaf stem thickness was 0.16 mm. The type with the highest mean leaf palm length was 42-AK-01 with 73.12 mm, whereas the one with the lowest was 42-AK-15 with 41.14 mm. The mean leaf blade length of the types was 56.32 mm. The type with the widest leaf palm was 42-AK-01 with 24.30 mm, while the one with the narrowest was 42-AK-15 with 11.71 mm. The mean palm width of the types was found as 18.67 mm. The shape of the leaf palm was described as length/width according to Kalyoncu (1996) and this ratio was the highest in 42-AK-8 with 4.14 and the lowest in 42-AK-23 with 2.81. The mean leaf palm shape of the types was found to be 3.08. Table 3 shows that the type with the lowest leaf width was 42-AK-15 (1.17 cm), the one with the highest was 42-AK-01 (7.35 cm), and the one with the shortest was 41-AK-15 (4.11 cm). The mean leaf length of the types was 5.60 cm. The type with the thickest leaf was 42-AK-21 with 0.29 mm, whereas the one with the thinnest leaf was 42-AK-8 with 0.11 mm. The mean leaf thickness of the types was 0.16 mm. When the number of veins of the oleaster types was examined, it was found that 42-AK-01 had the highest number of tracheas with 13.80, whereas 42AK-06 had the lowest number of tracheas with 7.80. However, the mean number of tracheas of the types was 10.98 (Table 3).

Table 3. Observations and measurements related to leaf of selected oleaster types.

Type	Leaf petiole length (mm)	Leaf petiole thickness (mm)	Leaf blade length (mm)	Leaf blade width (mm)	Shape index (U/G)	Leaf thickness (mm)	Leaf veins number	Leaf upper color	Leaf lower color
42-AK-01	11.11 ± 2.90	0.26 ± 0.05	73.12 ±12.28	24.30 ± 4.48	3.01 ± 0.70	0.26 ± 0.06	13.80 ± 2.04	$S_{191}G_{15}Y_{11}$	$S_{181}G_{07}Y_{04}$
42-AK-02	8.62 ± 1.23	0.19 ± 0.05	61.68 ± 12.80	20.95 ± 2.20	2.94 ± 0.59	0.19 ± 0.05	11.30 ± 2.67	$S_{191}G_{20}Y_{33}$	$S_{181}G_{04}Y_{07}$
42-AK-06	10.37 ± 1.10	0.16 ± 0.01	52.61 ± 9.30	15.37 ± 2.85	3.42 ± 0.78	0.16 ± 0.01	7.80 ± 2.04	$S_{191}G_{15}Y_{33}$	$S_{181}G_{11}Y_{11}$
42-AK-08	9.19 ± 0.81	0.12 ±0.02	63.33 ± 10.44	15.29 ± 2.56	4.14 ± 0.72	0.11 ± 0.02	12.10 ± 2.02	$S_{191}G_{20}Y_{20}$	$S_{179}G_{04}Y_{07}$
42-AK-12	10.48 ± 0.83	0.13 ± 0.02	56.52 ± 4.25	19.00 ± 1.58	2.97 ± 0.30	0.13 ± 0.02	11.90 ± 1.66	$S_{191}G_{15}Y_{11}$	$S_{183}G_{07}Y_{15}$
42-AK-15	9.05 ± 0.69	0.14 ± 0.02	41.14 ± 5.73	11.71 ± 1.30	3.51 ± 0.76	0.14 ± 0.02	11.20 ± 2.39	$S_{187}G_{11}Y_{15}$	$S_{179}G_{11}Y_{11}$
42-AK-19	8.10 ± 1.91	0.14 ± 0.02	62.23 ± 7.51	19.93 ± 2.55	3.12 ± 0.45	0.14 ± 0.02	11.00 ± 2.01	$S_{191}G_{20}Y_{33}$	$S_{183}G_{11}Y_{15}$
42-AK-21	10.37 ± 2.19	0.29 ± 0.06	70.48 ± 12.53	22.72 ± 3.99	3.10 ± 0.80	0.29 ± 0.10	11.10 ± 1.66	$S_{191}G_{20}Y_{33}$	$S_{185}G_{11}Y_{11}$
42-AK-23	9.35 ± 1.00	0.18 ± 0.02	46.08 ± 8.30	22.77 ± 4.96	2.02 ± 0.58	0.18 ± 0.05	11.50 ± 2.68	$S_{187}G_{11}Y_{33}$	$S_{183}G_{11}Y_{15}$
42-AK-25	11.74 ± 2.50	0.12 ± 0.01	58.35 ± 9.27	21.28 ± 3.84	2.74 ± 0.29	0.12 ± 0.02	10.00 ± 2.49	$S_{191}G_{26}Y_{50}$	$S_{185}G_{15}Y_{20}$
42-AK-27	8,64 ± 2.02	0.11 ± 0.01	43.53 ± 6.36	16.38 ± 3.40	2.66 ± 0.71	0.12 ± 0.02	10.30 ± 1.64	$S_{185}G_{15}Y_{15}$	$S_{185}G_{11}Y_{15}$
42-AK-28	10.78 ± 1.36	0.12 ± 0.01	46.77 ±6.33	14.30 ± 1.68	3.27 ± 0.59	0.12 ± 0.01	9.70 ± 1.34	$S_{193}G_{26}Y_{41}$	$S_{185}G_{07}Y_{11}$
Mean	9.82 ± 1.55	0.16 ± 0.03	56.32 ± 8.76	18.67 ± 2.94	3.08 ± 0.61	0.16 ± 0.03	10.98 ± 2.05	-	-

Results of the observations and measurements concerning flowers

Phenological observations about flowering and the results of measurements and counting concerning flower organs are given in Tables 4 and 5. According to the observations that were made, flowering of the types began between May 21st and 25th. 42-AK-21, which was the type that flowered the earliest, flowered on May 21; while 42-AKA-01 and 42-AKA-15 (the types that flowered the latest) flowered on May 25. The duration of flowering of the types was between 18 and 21 days (Table 5). It was determined that the type with the shortest flower stem was 42-AK-27 (3.78 mm), while the one with the longest stem was 42-AK-02 (8.94 mm). The mean flower stem length was found to be 6.52 mm. The type with the lowest flower stem thickness was 42-AK-27 (0.43 mm), while the one with the highest was 42-AK-23 (0.94 mm). Again, the mean flower stem thickness of all the types was determined to be 0.67 mm. The types with the longest male organ were 42-AK-02 and 42-AK-06 (2.94 mm), while the type with the shortest organ was 42-AK-15 (1.81 mm). The mean male organ length of the types was 2.58 mm. The type with the thickest male organ was 42-AK-02 (0.97 mm), while the one with the thinnest was 42-AK-27 (0.39 mm). The mean male organ thickness of the types was 0.15 mm. Among the types, the type with the longest female organ was 42-AKA-25 (5.70 mm), while the one with the shortest was 42-AKA-15 (3.80 mm). The mean female organ length was 5.25 mm. It was found that the type with the thickest female organ was 42-AK-12 (0.65 mm), while the one with the thinnest was 42-AK-27 (0.38 mm). The mean female organ thickness of the types was 0.55 mm. The type with the longest flower petal was 42-AK-08 with 5.45 mm, while the one with the shortest was 42-AK-15 with 3.02 mm. The mean flower petal length of the types was 4.26 mm. Among the types, the type with the largest petal width was 42-AK-08 with 4.59 mm, while the one with the narrowest was 42-AK-27 with 2.51 mm. The mean flower petal width of the types was 3.47 mm. The type with the biggest floral receptacle diameter was 42-AK-01 with 2.26 mm, whereas the one with the smallest was 42-AK-27 with 1.11 mm. The mean receptacle of the types was 1.83 mm. The type with the biggest floral receptacle thickness was 42-AK-08 with 2.38 mm, while the one with the smallest was 42-AK-28 with 0.93 mm. The mean floral receptacle thickness of the types was 1.84 mm (Table 4).

When the flowering times of the types that were studied were examined, a five-day flowering time interval was found among the types (Table 4). Mohlenbrock (1986) reported in his study conducted in Illinois that oleasters began to flower in the months of May and June. On the other hand, Kartesz (1988) reported April and June for flowering in Nevada, Martin and Hutchins (1981)

Table 4. Observation and results related to flower selected from types of oleaster.

Type	Flower stalk length (mm)	Flower stalk thickness (mm)	Stamen length (mm)	Stamen thickness (mm)	Pistil length (mm)	Pistil thickness (mm)	Flower petal length (mm)	Flower petal width (mm)	Receptacle diameter (mm)	Receptacle thickness (mm)	Flower internal Color	Flower exterior color
42-AK-01	8.24 ± 0.56	0.70 ± 014	2.86 ± 0.32	0.90 ± 0.22	5.57 ± 0.39	0.61 ± 0.11	4.80 ± 0.36	3.80 ± 0.36	2.26 ± 0.24	2.26 ± 0.29	$S_{169}G_{00}Y_{99}$	$S_{169}G_{00}Y_{41}$
42-AK-02	8.94 ± 2.13	0.78 ± 0.15	2.94 ± 0.14	097 ± 0.15	5.20 ± 0.78	0.62 ± 0.13	4.51 ± 0.58	4.14 ± 0.38	2.24 ± 0.27	2.24 ± 0.24	$S_{169}G_{00}Y_{90}$	$S_{171}G_{00}Y_{50}$
42-AK-06	6.40 ± 1.21	0.74 ± 0.12	2.94 ± 0.32	0.83 ± 0.15	5.41 ± 0.81	0.61 ± 0.08	4.96 ± 0.60	3.60 ± 0.44	1.90 ± 0.18	1.72 ± 0.24	$S_{169}O_{26}Y_{90}$	$S_{169}G_{04}Y_{41}$
42-AK-08	8.83 ± 1.10	0.63 ± 0.14	2.86 ± 0.19	0.89 ± 0.18	5.60 ± 0.96	0.57 ± 0.11	5.45 ± 0.59	4.59 ± 0.66	2.38 ± 0.32	2.50 ± 0.43	$S_{169}G_{00}Y_{99}$	$S_{169}G_{00}Y_{26}$
42-AK-12	6.36 ± 1.36	0.73 ± 0.15	2.74 ± 0.35	0.65 ± 0.16	5.35 ± 0.42	0.65 ± 0.12	4.14 ± 0.29	3.42 ± 0.25	2.06 ± 0.25	2.08 ± 0.10	$S_{169}G_{00}Y_{99}$	$S_{169}G_{00}Y_{41}$
42-AK-15	5.58 ± 1.30	0.55 ± 0.13	1.81 ± 0.11	0.49 ± 0.14	3.80 ± 0.82	0.51 ± 0.14	3.02 ± 0.44	2.62 ± 0.20	1.54 ± 0.11	1.64 ± 0.15	$S_{169}O_{20}Y_{80}$	$S_{169}G_{00}Y_{50}$
42-AK-19	5.82 ± 0.84	0.64 ± 0.11	2.49 ± 0.21	0.54 ± 0.18	5.49 ± 0.64	0.48 ± 0.09	3.67 ± 0.35	3.22 ± 0.27	1.86 ± 0.15	1.92 ± 0.41	$S_{169}G_{00}Y_{41}$	$S_{169}G_{00}Y_{20}$
42-AK-21	7.28 ± 0.66	0.77 ± 0.13	2.74 ± 0.21	0.83 ± 0.26	5.48 ± 0.24	0.62 ± 0.11	4.82 ± 0.33	4.15 ± 0.53	1.88 ± 0.15	1.87 ± 0.09	$S_{169}G_{00}Y_{60}$	$S_{169}G_{00}Y_{26}$
42-AK-23	4.85 ± 1.03	0.94 ± 0.30	2.80 ± 0.25	0.84 ± 0.18	4.92 ± 0.39	0.56 ± 0.12	4.25 ± 0.30	3.08 ± 0.26	1.68 ± 0.15	1.63 ± 0.24	$S_{169}G_{00}Y_{80}$	$S_{169}G_{02}Y_{26}$
42-AK-25	6.78 ± 1.34	0.64 ± 0.08	2.53 ± 0.19	0.70 ± 0.12	5.70 ± 0.29	0.50 ± 0.08	4.57 ± 0.42	3.84 ± 0.69	1.77 ± 0.38	1.90 ± 0.31	$S_{169}O_{50}Y_{80}$	$S_{169}G_{00}Y_{50}$
42-AK-27	3.78 ± 0.24	0.43 ± 0.10	2.11 ± 0.23	0.39 ± 0.07	5.23 ± 0.19	0.38 ± 0.05	3.53 ± 0.29	2.51 ± 0.08	1.11 ± 0.16	1.38 ± 0.16	$S_{169}O_{26}Y_{70}$	$S_{171}O_{00}Y_{33}$
42-AK-28	5.34 ± 0.81	0.54 ± 0.03	2.06 ± 0.14	0.40 ± 0.12	5.25 ± 0.86	0.46 ± 0.07	3.40 ± 0.51	2.70 ± 0.16	1.24 ± 0.27	0.93 ± 0.29	$S_{169}O_{50}Y_{80}$	$S_{169}G_{00}Y_{50}$
Mean	7.06 ± 1.04	0.67 ± 0.13	2.58 ± 0.22	0.69 ± 0.15	5.25 ± 0.56	0.55 ± 0.11	4.26 ± 0.42	3.47 ± 0.36	1.83 ± 0.22	1.84 ± 0.25	-	-

Table 5. Observations and results on the flowering and maturation.

Type	First blooming time (day/months)	Full blooming time (day/months)	Blooming end time (day/months)	Blooming period (day)	First maturation time (day/month)	Maturation time (day)	Full blooming time to maturity (day)
42-AK-01	25 May	01 June	14 June	20	01 October	15	137
42-AK-02	22 May	30 May	10 June	19	01 October	13	137
42-AK-06	22 May	30 May	10 June	19	05 October	17	145
42-AK-08	22 May	30 May	10 June	19	05 October	10	138
42-AK-12	23 May	30 May	10 June	18	04 October	13	140
42-AK-15	25 May	03 June	12 June	18	01 October	14	134
42-AK-19	23 May	30 May	10 June	18	05 October	12	140
42-AK-21	21 May	29 May	10 June	20	06 October	18	148
42-AK-23	22 May	29 May	09 June	18	06 October	13	143
42-AK-25	22 May	30 May	12 June	21	03 October	16	142
42-AK-27	23 May	01 June	10 June	18	04 October	18	143
42-AK-28	22 May	29 May	10 June	19	02 October	19	145

reported May and June in Mexico, and Gleason and Cronquist (1991) reported June and July in Northern America.

Observations regarding ripening of the fruit

The fruit ripening time of the selected types was examined and it was determined that 42-AK-01, 42-AK-02 and 42-AK-15 were the types that began ripening the earliest, that is, on October 1, 2005. It was found that 42-AK-21 and 42-AK-23 were the types that began ripening the latest, which was on 6 October, 2005. When the ripening periods of the types were examined, it was found that the ripening time of AKA-8 and AKA-17 lasted shorter than the others (10 days), whereas AKA-28 was the type with the longest ripening period (19 days). However, the mean ripening time of the types was 16. The period that passed between full flowering and ripening of the fruit lasted a mean of 140 days. The type where this period was the shortest was 42-AK-15 (134 days), while the type with the longest was 42-AK- 21 (148 days) (Table 5). In a study conducted in California, Munz (1973) found that oleaster fruit began to ripen in the months of May and June. Vines (1960) reported that oleaster fruit began to ripen in Texas in the months of August to October, whereas Di Tomaso and Healy (2003) found that they began to ripen in North-western America in the months of September to November. The differences between the ripening times of oleaster in different places may have stemmed from the genetic differences observed in the types, as well as the differences in soil and ecology.

Yield

The yields of the oleaster trees in the research area were found to be between medium and high. However, yields of all the selected types were high, which means that they are materials that can be successfully used in selection studies.

The results of the observations and measurements concerning the fruit

As a result of the studies that were conducted, it is found that 42-AK-02 had the fullest fruit, considering the fruit length (24.80 mm), fruit width (15.51 mm) and fruit weight (1.66 g). It was also found that all the types included in the selection study had very large fruit size. The fruit values, fruit length, fruit width, fruit stem length, stem thickness, fruit peel, fruit flesh colour and fruit shape indices are given in Table 6. When the fruit weights of the types were examined, it was found that the heaviest was 42-AK-21 with 1.82 g, while the lightest was 42-AK-12 with 1.55 g. The mean fruit weight was 1.66 g. The type with the longest fruit was 42-AK-02 with 24.80 mm and the shortest one was 42-AK-12 with 21.42 mm. The mean fruit length was 23.35 mm. Among the selected oleaster trees, 42-AK-12 had medium/long fruit, while the others had long fruit. When the fruit widths of the types were examined, it was found that 42-AK-19 had the widest fruit with 17.72 mm, whereas 42-AK-12 had the narrowest with 15.44 mm. The mean fruit width, on the other hand, was 16.58 mm. It was found that the fruit of all the selected oleaster types had wide fruit (Table 6). When the fruit stem lengths of the types were examined, it was determined that the type with the longest stem was 42-AK-08 (8.08 mm), whereas the type with the shortest fruit stem was 42-AK-01 (5.54 mm). The mean fruit stem length was 6.49 mm. The type with the thickest fruit stem was 42-AK-02 (0.80 mm), while the one with the thinnest stem was 42-AK-12 (0.68 mm). The mean fruit stem thickness was 0.72 mm. It was found that the peel colours of the oleaster fruit exhibited a spectrum ranging from (yellowish-brown) light to dark. 42-AK-02 was lighter in colour in comparison to the other types, whereas 42-AK-19 was darker in colour. Regarding fruit flesh colour, on the other hand, 42-AK-21 had a lighter yellow when compared with the others, while 42-AK-27 had a darker yellow. The other types had similar colours (Table 6). The fruit shape index was found through dividing the fruit length by the fruit width. As a result of the calculations, it was found that among the selected types, five were oval (42-AK-06, 42-AK-12, 42-AK-15, 42-AK-19 and 42-AK-28), five were conical (42-AK-01, 42-AK-21, 42-AK-23, 42-AK-25 and 42-AK-27), and two were cylindrical (42-AK-02 and 42-AK-08) in shape. The results are given in Table 6.

The mean fruit weights of the selected oleaster types varied between 1.55 g (42-AK-12) and 1.82 g (42-AK-21). The fact that differences were observed in the types that were selected in terms of fruit characteristics indicates the need for implementation of a selection study in this field and in the breeding of oleaster.

The results concerning the seed

The results concerning kernel characteristics of the selected oleaster types are given in Table 7. Among the studied types, the one with the lowest seed weight was 42-AK-27 with 0.33 g, while the one with the highest was 42-AK-21 with 0.46 g. The mean seed weight of the types was 0.37 g. Among the types, the one with the longest seed was 42-AK-01 with 20.75 mm, while the one with the shortest was 42-AK-06 with 17.31 mm. The mean-seed length of the types was 19.23 mm. The seed width of the types was also investigated and it was found that 42-AK-15 was the one that had the smallest width with 4.33 mm, while 42-AK-27 had the biggest width with 6.14 mm. The mean seed width of the types was 5.28 mm. Among the types, the one with the highest flesh/seed ratio was 42-AK-27 (4.15), while the one with the lowest ratio was 42-AK-21 (2.31). The mean flesh/seed ratio of the types was 3.61 (Table 7).

The results of the pH, taste and aroma, and ascorbic

Table 6. Measurements related features of fruits in the types of selected oleaster.

Type	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)	Fruit stalk weight (mm)	Fruit stalk thickness (mm)	Shape index (U/G)	Fruit shell color	Fruit flesh color
42-AK-01	1.81 ± 0.29	23.61 ± 2.00	16.50 ± 1.15	5.54 ± 2.02	0.79 ± 0.07	1.43 ± 0.07	$S_{25}O_{80}Y_{60}$	$S_{13}O_{04}Y_{20}$
42-AK-02	1.66 ± 0.33	24.80 ± 2.14	15.51 ± 1.32	6.63 ± 2.28	0.80 ± 0.10	1.60 ± 0.14	$S_{21}O_{50}Y_{90}$	$S_{13}O_{07}Y_{15}$
42-AK-06	1.78 ± 0.16	23.33 ± 1.85	17.00 ± 0.91	5.77 ± 1.65	0.78 ± 0.08	1.37 ± 0.08	$S_{25}O_{60}Y_{60}$	$S_{13}O_{04}Y_{15}$
42-AK-08	1.67 ± 0.14	24.15 ± 1.20	15.81 ± 0.57	8.08 ± 0.94	0.70 ± 0.13	1.53 ± 0.10	$S_{27}O_{80}Y_{70}$	$S_{13}O_{07}Y_{33}$
42-AK-12	1.55 ± 0.18	21.42 ± 1.44	15.44 ± 0.87	7.05 ± 0.87	0.68 ± 0.09	1.39 ± 0.10	$S_{27}O_{80}Y_{50}$	$S_{13}O_{04}Y_{15}$
42-AK-15	1.75 ± 0.18	23.74 ± 1.04	17.19 ± 0.77	6.39 ± 1.28	0.72 ± 0.08	1.38 ± 0.08	$S_{23}O_{50}Y_{80}$	$S_{13}O_{15}Y_{33}$
42-AK-19	1.68 ± 0.34	23.96 ± 4.31	17.72 ± 1.42	5.92 ± 0.67	0.73 ± 0.16	1.35 ± 0.23	$S_{29}O_{90}Y_{80}$	$S_{13}O_{11}Y_{11}$
42-AK-21	1.82 ± 0.21	23.58 ± 1.64	16.74 ± 0.87	7.01 ± 1.67	0.71 ± 0.07	1.41 ± 0.09	$S_{27}O_{60}Y_{70}$	$S_{11}O_{00}Y_{33}$
42-AK-23	1.68 ± 0.22	23.81 ± 1.56	16.94 ± 1.06	5.88 ± 1.16	0.70 ± 0.08	1.41 ± 0.23	$S_{25}O_{70}Y_{70}$	$S_{13}O_{04}Y_{33}$
42-AK-25	1.64 ± 0.12	23.27 ± 1.66	16.40 ± 1.05	6.74 ± 1.34	0.74 ± 0.11	1.42 ± 0.09	$S_{23}O_{41}Y_{70}$	$S_{13}O_{07}Y_{26}$
42-AK-27	1.69 ± 0.16	23.75 ± 1.33	16.89 ± 0.72	6.43 ± 1.38	0.75 ± 0.13	1.41 ± 0.09	$S_{11}O_{11}Y_{50}$	$S_{27}O_{70}Y_{7O}$
42-AK-28	1.80 ± 0.14	23.52 ± 1.23	16.92 ± 0.98	6.49 ± 1.81	0.76 ± 0.10	1.39 ± 0.08	$S_{25}O_{99}Y_{90}$	$S_{13}O_{04}Y_{26}$
Mean	1.71 ± 0.21	23.35 ± 1.78	16.58 ± 0.97	6.49 ± 1.39	0.74 ± 0.10	1.42 ± 0.12	-	-

Table 7. Measurements of pH, taste, aroma and vitamin C relating to seed on the selected oleaster types.

Type	Seed weight (g)	Seed length (mm)	Seed width (mm)	Seed rate of fruit flesh (%)	pH	Taste and aroma	Vitamin C (mg/100g)
42-AK-01	0.39 ± 0.03	20.75 ± 1.47	5.81 ± 0.25	3.65 ± 0.51	5.10	8.30	3.36
42-AK-02	0.36 ± 0.07	19.73 ± 1.53	5.64 ± 0.29	3.61 ± 0.54	5.20	8.22	3.84
42-AK-06	0.34 ± 0.07	17.31 ± 1.23	6.00 ± 0.35	4.27 ± 0.52	5.14	8.24	1.87
42-AK-08	0.36 ± 0.05	19.98 ± 1.47	5.96 ± 0.41	3.63 ± 0.84	5.05	7.25	1.98
42-AK-12	0.38 ± 0.07	17.95 ± 1.58	4.61 ± 0.46	3.08 ± 0.50	5.13	8.10	4.32
42-AK-15	0.38 ± 0.03	19.12 ± 1.25	4.33 ± 0.56	3.60 ± 0.28	5.10	8.50	2.78
42-AK-19	0.36 ± 0.06	20.58 ± 2.40	5.61 ± 0.87	3.71 ± 0.31	5.17	8.10	3.13
42-AK-21	0.46 ± 0.05	18.44 ± 1.76	5.23 ± 0.53	2.93 ± 0.26	5.12	7.90	4.23
42-AK-23	0.39 ± 0.06	19.46 ± 1.44	5.12 ± 0.76	3.23 ± 0.24	5.15	7.84	4.19
42-AK-25	0.35 ± 0.03	18.51 ± 1.42	5.24 ± 0.64	3.67 ± 0.26	5.16	7.02	3.24
42-AK-27	0.33 ± 0.05	19.38 ± 1.34	6.14 ± 0.59	4.15 ± 0.30	5.15	6.99	5.03
42-AK-28	0.37 ± 0.04	19.53 ± 1.46	5.68 ± 0.61	3.84 ± 0.29	5.06	6.97	3.50
Mean	0.37 ± 0.08	19.23 ± 1.52	5.28 ± 0.66	3.61 ± 0.54	5.13	7.79	3.45

Table 8. Results of analysis of the mineral materials on the selected types of oleaster fruit (mg/100 ml).

Mineral material	42-AK-01	42-AK-02	42-AK-06	42-AK-08	42-AK-12	42-AK-15	42-AK-19	42-AK-21	42-AK-23	42-AK-25	42-AK-27	42-AK-28	Mean
Al	0.1586	0.1756	0.1559	0.0842	0.1839	0.3825	0.1864	0.1357	0.1234	0.2509	0.1137	0.0731	0.1687
As	0.0189	0.0436	0.0395	0.0467	0.0294	0.0441	0.0754	0.0728	0.0462	0.0849	0.0643	0.0486	0.0512
B	14.475	14.837	14.696	14.671	15.723	14.610	14.758	15.114	14.624	14.893	14.854	14.341	14.800
Bi	0.0618	0.0866	0.0510	0.0203	0.0896	0.0153	0.0528	0.0372	0.0370	0.0000	0.0320	0.0696	0.0461
Cu	0.0078	0.0065	0.0078	0.0059	0.0103	0.0106	0.0067	0.0079	0.0067	0.0063	0.0165	0.0031	0.0080
Fe	0.0274	0.0191	0.0212	0.0111	0.0393	0.0266	0.0096	0.0292	0.0000	0.0154	0.0131	0.0000	0.0177
K	758.973	713.974	788.608	688.003	733.151	777.812	698.737	731.722	663.882	670.135	678.955	327.186	695.928
Mg	32.736	27.857	31.016	24.797	28.275	30.362	30.346	29.375	27.566	28.230	26.520	12.985	27.505
Na	34.363	35.839	37.499	25.046	36.346	68.199	44.626	36.993	34.421	48.432	36.021	22.383	38.347
P	90.795	97.882	100.006	73.054	91.168	154.127	101.259	89.807	80.534	116.311	72.930	45.700	92.798
S	42.668.400	55.247.600	55.623.300	56.223.300	56.227.300	56.031.700	55.893.400	55.961.800	56.761.700	56.249.000	55.708.300	56.263.600	54.904.950
Zn	0.0369	0.0289	0.0176	0.0120	0.0224	0.0618	0.0318	0.0214	0.0763	0.0397	0.0457	0.0000	0.0329
Co	0.0025	0.004	0.0035	0.0037	0.0033	0.002	0.004	0.0036	0.0012	0.0007	0.001	0.0006	0.0025
Cr	0.0042	0.0034	0.0016	0.0034	0.0027	0.0074	0.0033	0.0036	0	0.0044	0.0024	0	0.0030
Li	0.0019	0.0047	0.0056	0.0041	0.0061	0.0056	0.0039	0.0016	0.003	0.0025	0.0032	0.0017	0.0036
Ni	0.0078	0.0084	0.0094	0.009	0.0074	0.0066	0.0068	0.0019	0.0098	0.0043	0.0142	0.003	0.0074
Sr	0.0435	0.0382	0.0392	0.0407	0.0392	0.0412	0.0532	0.0459	0.0424	0.0409	0.0385	0.0206	0.0403
V	0.0015	0.0028	0.0009	0.0017	0.0025	0.0021	0.0019	0.003	0.0027	0.0007	0.0022	0.0013	0.0019

acid (vitamin C) analyses conducted on the 12 oleaster types are given in Table 7. The type with the lowest fruit juice pH was 42-AK-08 with 5.05, while 42-AK-02 with 5.20 was the type with the highest pH. It was found that the type that had the best fruit taste and aroma was 42-AK-15 with a score of 8.50, while 42-AK-28 had the lowest fruit taste and aroma with a score of 6.97. The mean fruit taste and aroma score of the types was 7.79. When the ascorbic acid (vitamin C) content of the selected types was examined, it was determined that 42-AK-27 had the highest content in this regard with 5.03 mg/100 g, while 42-AK-06 had the lowest content with 1.87 mg/100 g. Nonetheless, the mean ascorbic acid (vitamin C) content of the types was 3.45 mg/100 g (Table 7).

As a result of the study that was conducted, it was found that vitamin C contents of the selected types varied between 1.87 (42-AK-06) and 5.03 mg/100 g (42-AK-27). Although, oleaster contained vitamin C, this content is very low in comparison to other fruits, for example cornelian cherry. Kalyoncu (1996) found in the study he conducted on the cornelian cherries in Konya Beyşehir that vitamin C contents of the six cornelian cherry types varied between 48.39 and 73.11 mg/100 g. This is 10 to 20 times as much as the vitamin C content of oleaster. In selection of varieties, the highest importance is attached to fruit quality (Güleryüz, 1988). As it is the case with many fruit types, it is the sugar, acid and aroma that give oleaster its distinctive flavor (Kalyoncu, 1996). However, environmental factors also affect acidity, sugar and aroma of the fruit (Özbek, 1977). Mineral substance contents of the types that were studied were also examined and the obtained results are given in Table 8.

The results of weighted grading

The values that were obtained as a result of the aforementioned examinations and analyses conducted on the selected oleaster types were subjected to “weighted grading” and the total scores

Table 9. Total points taken by the oleaster types as a result of the weighted rating results on the types of selected oleaster.

Type	Large and showy fruit	Seed kernel flesh fruit rate	Taste and aroma	Yield	Vitamin C	Total weighted rating score
42-AK-01	300	250	100	250	70	970
42-AK-02	300	250	100	250	70	970
42-AK-06	300	250	100	250	30	930
42-AK-08	300	250	70	250	30	900
42-AK-12	300	175	100	250	100	925
42-AK-15	300	250	100	250	50	950
42-AK-19	300	250	100	250	50	950
42-AK-21	300	175	100	250	100	925
42-AK-23	300	175	100	250	100	925
42-AK-25	300	250	70	250	50	920
42-AK-27	300	250	70	250	100	970
42-AK-28	300	250	70	250	70	940

that each type received are given in Table 9. The types that received scores above 900 as a result of weighted grading were determined to be worth growing. According to this, 42-AK-01, 42-AK-02 and 42-AK-28 received the highest score (970), while 42-AK-08 received the lowest score (900) (Table 9).

Conclusion and suggestions

Since oleaster, which is grown over a large area in our country, is not given due importance, it still has not been cultivated. Unfortunately, this choice fruit, which has adapted to all climatic conditions in our country and which can grow in all kinds of soil, has not been cultivated and has not found favour with our farmers. Thus, it has been used only as a border-marking plant (in areas where farming is made), a shade or greenery. However, it has been found that oleaster is not grown in closed orchards in the research area as it is in the whole of our country.

The fact that it can grow even in inappropriate soil and climatic conditions without any cultivation techniques being applied presents a great advantage for agriculture in our country. When a plant that has such characteristics is cultivated, its characteristics will be improved and it will make significant contributions to the socio-economic situation of the farmers in the area, as well as the country's agriculture and economy. Besides our farmers, our researchers also have not paid proper attention to oleaster. The fact that there is no study on oleaster selection in our country at present is one of the obstacles in the breeding and spread of oleaster.

Oleaster is one of the fruit varieties that need to be highlighted by virtue of its nutrient content, tree characteristics and its potential in Turkey. Such fruit should be introduced to the market and promoted after they are grown in cultural conditions. Above all, farmers should be encouraged to use certified saplings obtained from selected oleasters.

REFERENCES

Anonymous (2007a). http://tr.wikipedia.org/wiki/Ku%C5%9F_i%C4%9Fdesi

Anonymous (2007b). http://www.bitkisel-tedavi.com/bitki/bitki(i1).htm

Anonymous (2007c). http://cks.tarim.gov.tr/main.htm

Anonymous (2007d). http://www.konya.gov.tr/konyam/iklim.htm

Anonymous (2007e). http://www.cografyasaati.com/index.phtml?id=330000#1060

Anonymous (2007f).http://www.meteor.gov.tr/2006/tahmin/tahminiller.aspx?secimNo=53

Anonymous (2007g). http://konya.meteor.gov.tr/bolgegrafi_dosyalar/image002.gif

Bolat S (1991). Konya İlinde Kaliteli Yazlık Elma Tiplerinin Seleksiyon Yoluyla ıslahı Üzerinde Bir Araştırma, Atatürk Üniv. Fen Bilimleri Enstitüsü Bahçe Bitkileri Anabilim Dalı. Erzurum (Basılmamış).

Borell AE (1971). Russian-olive for wildlife and other conservation uses. Leaflet 292. Washington, DC: U.S. Department of Agriculture. p. 8

Cemeroğlu B (1992). Meyve ve Sebze İşletme Endüstrisinde Temel Analiz Metotları, Biltav Yayınları, s. 381, Ankara

Dokuzoğuz M, Gülcan R (1973). Ege Bölgesi Bademlerinin Seleksiyon Yoluyla Islahı ve Seçilmiş Tiplerin Adaptasyonu Üzerinde Araştırmalar. TÜBİTAK, TOAG Yayınları Sayı, 22: 28.

Düzgüneş O, Kesici T (1983).İstatistik Metotları, Ankara Üniv. Ziraat Fak. Yay. 861, Ders Kitabı 229: 28.

Elias TS (1980). The complete trees of North America: Field guide and natural history. Van Nostrand Reinhold Co. New York, NY. p. 948

Eltez M (1983). Niğde Yöresinde Üstün Özellikli ve Özellikle Meyve Peryotisitesi Göstermeyen Amasya Elme Tiplerinin Seleksiyonu. Doktora Tezi Çukurova Üniv. Fen Bilimleri Enstitüsü Bahçe Bitkileri Anabilim Dalı, Adana, (Basılmamış).

Eriş A, Soylu A, Barut E, Dalkılıç Z (1992). Bursa Yöresinde Yetişmekte Olan Kızılcık Çeşitlerinde Seleksiyon Çalışmaları, Türkiye I. Ulusal Bahçe Bit. Kong. (13-16 Ekim 1992), Cilt I (Meyve), 499-502, Ege Üniv. Ziraat Fak. Bornova-İzmir.

Eşitken A (1992). Erzincan'da Yetiştirilen Hasanbey, Şalak, Şekerpare Kayısı Çeşitlerinde Meyvede Meydana Gelen Fiziksel ve Kimyasal Değişmeler ile Hasat Kriterlerinin Saptanması Üzerinde Bir Araştırma, Atatürk Üniv. Fen Bilimleri Enstitüsü Bahçe Bitkileri Anabilim Dalı Y. Lisans Tezi, (Basılmamış), p. 85.

Feucht W, Schwalb P (1999). Changes in the concentration of phenolic

substances in the bark during the annual development of the cherry tree (*Prunus avium* L.). Adv. Hortic. Sci. 13: 71
Gleason HA, Croquist A (1991). Manual of vascular plants of northeastern United States and adjacent Canada. 2nd ed. New York: New York Botanical Garden. p. 910
Güleryüz M (1977). Erzincan'da Yetiştirilen Bazı Önemli Elma ve Armut Çeşitlerinin Pomolojileri İle Döllenme Biyolojileri Üzerinde Araştırmalar. Atatürk Üniv. Erzurum. 483(229): 180
Güleryüz M (1988). Meyve ve Sebze Islahı Ders Notları. Atatürk Üniv. Ziraat Fak. Bahçe Bitkileri Bölümü, Erzurum, p. 189,
Hays JF Jr (1990). Wildlife considerations in windbreak renovation. In: Great Plains Agricultural Council, compiler. Windbreaks: Living with the wind: Proceedings, windbreak renovation workshop; 1990 October 23-25; Hutchinson, KS. Great Plains Agriculture Council Publ. No. 133. Manhattan, KS: Kansas State University, Cooperative Extension Service: pp. 35-41.
Kalyoncu İH (1990). Konya Apa Baraj Gölü Çevresinde Yetiştirilen Üstün Özellikli Badem *(Prunus amygdalus* L.*)* Tiplerinin Belirlenmesi Üzerine Bir Seleksiyon Çalışması, O.M.Ü. Fen Bilimleri Enstitüsü. Bahçe Bitkileri Anabilim Dalı Yüksek Lisans Tezi (Basılmamış), Samsun.
Kalyoncu İH (1996). Konya Yöresindeki Kızılcık *(Cornus mas* L.*)* Tiplerinin Bazı Özellikleri ve Farklı Nem Ortamlarındaki Köklenme Durumu Üzerine Bir Araştırma, Selçuk Üniv. Tarımsal Yapılar ve Sulama Anabilim Dalı Doktora Tezi, Konya.
Knopf FL, Olson TE (1984). Naturalization of Russian-olive: implications to Rocky Mountain wildlife. Wildl. Soc. Bull. 12: 289-298
Krupinsky JM, Frank AB (1986). Effects of water stress on *Tubercularia* canker of Russian olive. Montana State Univ. Coop. Ext. 117: 171-172.
Küppers H (1987). DerGrobe Küppers-Farbenatlas Varlag Georg D.W. Collwey GmbH, München, p. 224.
Lesica P, Miles S (2001). Natural history and invasion of Russian olive along eastern Montana Rivers. Western North Am. Nat. 61(1): 1-10.
Martin NWC, Hutchins CR (1981). A flora of New Mexico. Germany: J. Cramer, 2: 2589
Mohlenbrock RH (1986). [Revised edition]. Guide to the vascular flora of Illinois. Carbondale, IL: Southern Illinois University Press. p. 507
Munz PA (1973). A California flora and supplement. Berkeley, CA: University of California Press. p. 1905
Özbek S (1971). Bağ- Bahçe Bitkilerinin Islahı, Ankara Üniv.Ziraat Fak.Yay.:419, Yardımcı Ders Kitabı: Ankara, 146: 263.
Özbek S (1977). Genel Meyvecilik. Çukurova Üniv. Ziraat Fak. Yayınları, 111: 6.
Pırlak L (1993). Uzundere, Tortum ve Oltu İlçelerinde Doğal Olarak Yetişen Kızılcıkların *(Cornus mas* L.*)* Seleksiyon Yoluyla Islahı Üzerinde Bir Araştırma. Atatürk Üniv. Fen Bil.Enst. Bahçe Bitkileri Anabilim Dalı, Doktora Tezi (Yayımlanmamış), Erzurum.
Shaw DL (1988). The design and use of living snow fences in North America. Agriculture, Ecosyst. Environ. 22-23: 351-362.
Skujin S (1998). Handbook for ICP- AES (Varian-Vista). A short guide to Vista Series ICP-AES operation. Version 1.0, Varian Int. AG, Zug.
Soil Survey Laboratory Methods Manual (2004). Soil Survey Investigation Report United States Department of Agriculture Natural Resources Conservation Sevice No:42.
Şen SM (1986). Kuzeydoğu Anadolu ve Doğu Karadeniz Bölgesi Cevizlerinin (*Juglans regia* L.*)* Seleksiyon Yoluyla Islahı Üzerinde Araştırmalar, Atatürk Üniv. Ziraat Fak. Bahçe Bitkileri Böl. (Doçentlik Tezi Basılmamış).
Tosun F (1991). Tarımda Uygulamalı İstatistik Metotları. O.M.Ü.Ziraat Fak. Teksir Bürosu, Ders Notu:1, Samsun.
Tuskan GA, Laughlin K (1991). Windbreak species performance and management practices as reported by Montana and North Dakota landowners. J. Soil and Water Conserv. 46(3): 225-228.
Ülkümen L (1973). Bağ-Bahçe Ziraati, Atatürk Üniv. Yay. No: 275, Ziraat Fak. Yay. 128, Ders Kitapları Serisi, 22: 415.
Van Dersal WR (1939). Birds that feed on Russian olive. Auk. 56: 483-484.
Vines RA (1960). Trees, shrubs, and woody vines of the Southwest. Austin, TX:University of Texas Press.p. 1104.