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Breeding by Selection Of Walnuts (Juglans regia L.) in Kahramanmaras

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ABSTRACT

This study was carried out in Kahramanmaraş province for two years. 126 types were determined primarily and were evaluated from about 3000 wild walnut trees. Based on the results of these evaluations, 11 walnut trees were selected as "promising types" with respect to fruit quality characteristics. In these selected types, average fruit weight ranged from 6.49 to 8.90 g; kernel percentage was ranged between 40.00-56.45% and shell thickness ranged from 1.2 to 1.9 mm. Flowering habits in these types, was determined as follows: 58.49 % protandrous, 28.30 % protogynous and 13.20 % homogomous.

Key Words: Walnut, breeding, selection, pomology

INTRODUCTION

Turkey, as a native country of walnut in the world, has a population of 4-million walnut trees, most of which are wild walnut trees grown from seeds. With this number of walnut trees and amount of production, Turkey is one of the top walnut producers in the world (1,2,3,4). Nevertheless, lack of standardization in these products may cause some problems in marketing. Furthermore, it may be stated that unless productivity is increased, standardization is provided in production of walnuts, and covered gardens are established with these standard varieties, some problems even in domestic consumption of these products will be inevitable in near future. This potential constitutes a very rich genetic source for our country. So, the first and the most impportant thing to do is to select the walnuts with highest fruit quality characteristics among these various types of walnuts by means of "selection", and to promote the plantation of these types throughout the country. In this aim, various studies carried out in several regions of the country for last 30 years have started to fructufy and some high quality standart domestic walnut types were obtained(5,6). Some walnut types like Franquette, Marbot, Parisienne, Corne, Sorrente, Sibisel and Payne, which are grown as standart types in several countries, were obtained by means of selection(7,8,9). This selection study carried out in Kahramanmaras, one of the most important regions in Turkey with respect to walnut cultivation, constitutes a part of these improvement studies. The results obtained from this study proved the importance of these selection studies.

MATERIAL AND METHODS

Material

This selection study was carried out in Kahramanmaras Province and villages which are rich in walnut tree population. All of the 3000 walnut trees analyzed under this study were wild walnut trees grown from seeds (10).

Methods

In this study, which lasted two years, 126 types were determined first year and samples were taken from these types during the harvest season. In this selection study, as different from other selection studies, "point selection' was used as a method and analysis were done sensitively and in-depthly in order to decrease the number of trees missed during the study as much as possible. After having analysed all these selected types according to their quality factors, 73 types were eliminated first year and samples were taken again from other 53 types for further analysis in harvest season of the second year. According to specifications of these walnuts, 11 types were selected via weighed classification method as "promising" types. After having taken the fruit samples from these types, green outer peelings were peeled and fruits were dried in a shade for a week. Fruit analysis were done after having them in a drying chamber at 30 ^{o}C for 24 hours in order to homogenise their humidity levels (6,11,12).

Physical characteristics

Fruit weight was found by weighting all 10 walnut fruits one by one on a scale sensitive to 0.1 g and by taking their average. Kernel weight was found by weighting the samples after breaking and taking their average with same order as used for fruit weight. Kernel ratios of fruits whose average fruit weights and kernel weights were determined were obtained by using the % efficiency formula(6,13) as below:

$$\text{Kernel ratio} = \frac{\text{Kernel weight}}{\text{Fruit weight}} \times 100$$

Shelll thicknesses of 10 fruits were obtained by measuring the thickness of the shell at the center by a caliper of 0.01 mm sensitiveness. Fruit's width, length and height were obtained by caliper of 0.01 mm sensitiveness. Fruits, whose dimensions were obtained as described above, were divided to two main groups of "**Oval"** and "**Circular"** by using following form index:

$$\text{Form index} = \frac{\text{Fruit length}}{\frac{\text{Fruit width} + \text{Fruit height}}{2}}$$

Fruits with form index of higher than 1.25 were called as "**Oval**" and those with form index of lower than 1.25 were called as "**Circular**" (6, 13,14). Unshelled walnut standart of Turkish Standarts Institute (TSE) was used while determining the fruit size (14). According to these standarts, circular walnuts with diameter of 27 mm. or higher are called as "**Extra**"; those with diameter of 24-27 mm, called as "first **class**" and those with diameter of 20-24 mm, called as "**second class**". Shell roughness, shell separation, shell color, shell stickiness, ratio of full and healthy inward, color and graininess of inward, volume and density were measured by scales determined by Sen(6-13).

2. Botanical and phenological characteristics

While determining the selected types, fertility of trees, durability of trees against illnesses and other harmful insects, flower structures, blooming specifications, dates of blooming, male and female blooming dates, fruit numbers on clusters, ratios of Protogynous, Protandrous and Homogamous trees were taken into account (6).

RESULTS OF ANALYSIS

In this study, province of Kahramanmaras and some of its villages which are thought to be rich in walnut tree population were visited. Totally 3000 walnut trees were visited and fruit samples were taken from 126 trees among them according to their fruit and tree quality specifications. Data regarding the physical fruit specifications obtained from walnut types from which fruit samples were taken in first year's harvest season are given in Table 1.

Table 1. Fruit and bloom characteristics of walnut types from were taken in first year.

Characteristics	Average findings	Volatility (min - max)
Fruit weight (gr)	14.70	10.30-23.15
Kernel weight (gr)	7.08	6.05-10.48
Kernel Ratio (%)	49.08	40.00-60.08
Shell thickness (mm)	1.51	0.91-1.90
Fruit length (mm)	43.25	33.80-48.70
Fruit width (mm)	33.87	28.68-39.78
Fruit height (mm)	34.91	28.14-41.69
Date of male blooming		30 March-7 April
Date of female blooming		7 April-20 May
Protandrous (%)	58.59	
Protogynous (%)	28.30	
Homogamous (%)	13.20	

Table 2. The some fruit characteristics of walnut types analyzed in second year.

Fruit characteristics	Average values	Volatility (min - max)
Fruit weight (gr)	15.21	12.37-24.49
Kernel weight (gr)	7.29	6.01-10.05
Kernel ratio (%)	47.78	40.00-60.00
Shell thickness (mm)	1.49	0.93-1.93
Fruit length (mm)	41.80	34.98-50.08
Fruit width (mm)	33.54	28.21-40.44
Fruit height (mm)	34.17	28.95-40.07
Form index	1.23	1.02-1.49
Fruit (Largeness) class	Extra	Extra

As it is seen from the Table 1, fruit weight is 14.70 g, kernel weight is 7.08 g, kernel ratio is 49.08%, shell thickness is 1.51 mm., fruit length is 40.25 mm, fruit width is 33.87 mm. and fruit height is 34,91mm. in average terms. And volatility in these figures are as follows: fruit weight is between 10.30-23.15 gr., inward weight is between 6.05-10.48 gr., kernel ratio is between 40.00%-60.08%, shell thickness is between 0.91-1.90 mm. Phenological observations was made on these 126 walnut types in spring seasons. According to these observations, male and female blooms maturated during seasons between last week of March and second week of May, and between first week of April and third week of May, respectively. Among the analyzed types, 58.59% was of protandrous, 28.30% was of protogynous and 13.20% was of homogomous blooming type.

53 types were reselected in second year of the study among types which had been determined as "promising" in first year. Samples were taken from these 53 types and were analyzed. Results of these analysis are shown in Table 2 .

As it is seen from the Table 2, fruit weight is 15.21 g., inward weight is 7.29 gr., kernel ratio is 47.78%, shell thickness is 1.49 mm., fruit length is 41.80 mm., fruit width is 33.54 mm. and fruit height is 34.17mm.and form index is 1.23 in average terms and all analyzed types are to be classified as "Extra". Volatility in these specifications are as follows for second year's analysis: fruit weight is between 12.37-24.49 gr., kernel weight is between 6.01-10.05 gr., kernel ratio is between 40.00%-60.00%, shell thickness is between 0,93- 1,93 mm., fruit length is between 34.98-50.08 mm., fruit width is between 28.21-40.44 mm., fruit height is between 28.95-40.07 mm. and form index is between 1.02-1.46 for second year's analysis.

3. Entire Results in Selected Types:

3.1. Location and altitudes of selected walnut types

The conclusion of two years study, 11 walnut types were selected as "promising" according to scaled classification method. Locations and altitudes of these types are given in Chart-3. Altitudes of selected types range between 607-1400 m.

Chart- 3: Locations and Altitudes of Selected Types

Type No	Location	Altitude (m)
09	Üngüt	607
17	Üngüt	611
20	Üngüt	617
33	Üngüt	607
51	Gafarlı	1100
84	Kemallı	1100
110	Beşenli	1350
115	Küçüknacar	1125
123	Küçüknacar	1150
126	Boylu	1450
136	Boylu	1400

3.2. Physical characteristics of fruits:

Both average values and volatilities in physical specifications of selected walnut types are given in Chart-4, and specific values of each of selected types are given in Chart-5 below:

Table 4. The some fruit characteristics of selected walnut types

Fruit characteristics	Average values	Volatility (min - max)
Fruit weight (gr)	15.43	12.98-20.24
Kernel weight (gr)	7.51	6.49-8.90
Kernel ratio (%)	49.34	41.80-56.45
Shell thickness (mm)	1.28	0.98-1.46
Fruit length (mm)	42.14	36.95-50.08
Fruit width (mm)	33.03	28.85-36.52
Fruit height (mm)	35.40	30.93-41.61
Form Index	1.21	1.08-1.52
Fruit Largeness	Extra	Extra

The conclusion of two years study which were seen in Table 4 and 5 in selected types, fruit weight is 15.43 gr., Kernel weight is 7.51 gr., Kernel ratio is 49.34%, shell thickness is 1.28 mm., fruit length is 42.14 mm., fruit width is 33.03 mm. and fruit height is 35.40 mm.and form index is 1.21 in average terms. Volatility in these specifications are as follows for selected types: fruit weight 12.98-20.24 gr., kernel weight 6.49-8.90 gr., Kernel ratio 41.80%-56.58 %, shell thickness 0.8- 1.46 mm., fruit length 36.95-50.08 mm., fruit width 28.85-36.52 mm., fruit height 30.93-41.61 mm. and form index 1.08-1.52. Fruits of all types are classified as "Extra". Some other physical characteristics of selected walnut types are given in Chart-6.

4. Botanical and Phenological Characteristics of Selected Walnut Types

Ages of the selected walnut trees are predicted to be ranging between 9-35 years, branching heights are between 104-150 cm., and trunk diameters are ranging from 67 to 150 cm. Productivity of side-branches is found to be low in 40.0%, to be fair in 20.0%, and to be high in 40.0% of the selected walnut trees. Harvest season continues until last week of October starting from the begining of September, depending on the types. Among the selected types, 58.49% of trees are classified as "Protandrous", 28.30% are as "Protogynous", and 13.20% are as "Homogamous".

CONCLUSION

In this study, some very important results have been obtained with regard to the physical fruit characteristics which are important measures as "selection criteria". Thus, according to average of two-years measured of selected walnut types; fruit weight, kernel weight and kernel ratio are ranging from 12.67

Chart-5: Some fruit characteristics of selected walnut types

Type No	Fruit weight (g)	Kernel weight (g)	Kernel ratio (%)	Shell thickness (mm)	Fruit length (mm)	Fruit width (mm)	Fruit height (mm)	Form Index
09	14.23	6.49	47.00	1.27	34.95	31.76	34.06	1.12
19	12.98	7.11	56.45	1.31	39.29	32.20	32.82	1.21
20	14.84	7.64	51.49	1.24	39.03	30.78	34.95	1.18
33	15.27	7.39	48.39	1.46	50.08	33.43	32.05	1.52
51	19.04	7.97	41.80	1.39	44.05	36.52	38.61	1.17
84	14.91	7.14	50.79	1.37	42.06	33.50	33.16	1.26
110	15.89	8.52	53.64	1.20	38.80	35.10	39.87	1.03
115	13.26	7.02	52.92	0.98	45.67	30.98	30.93	1.47
123	14.22	7.08	49.91	1.23	43.86	34.41	35.55	1.25
126	14.97	7.24	48.39	1.29	40.00	35.87	35.87	1.11
136	20.24	8.90	42.00	1.34	43.75	28.85	41.61	1.08

Chart-6: Some Physical Specifications of Selected Types:

Type No	Shell roughness	Peel Color	Fullness ratio of kernel	Wholeness ratio of kernel	Graininess	Inward color
09	Fair	Dark	100	80	High	Yellow-brown
17	Smooth	Light	100	100	High	Yellow
20	Fair	Dark	100	100	Low	Yellow
33	Smooth	Light	90	90	Fair	Brown
51	Fair	Light	100	100	Low	Yellow
84	Fair	Light	100	100	Low	Yellow
110	Fair	Dark	90	80	Fair	Yellow
115	Fair	Light	100	100	Low	Light yellow
123	Fair	Dark	90	90	High	Yellow-brown
126	Fair	Dark	100	100	Fair	Light yellow
136	Smooth	Light	90	90	Fair	Light yellow

to 20.24 gr., from 6.49 to 90 gr. and from 40.0% to 56.45%, respectively. These values are similar to and even higher than the values found by other studies carried out in Turkey. Thus, fruit weight, kernel weight and kernel ratio are ranging from 12.39 to 18.49 gr., from 6.50 to 9.88 gr. and from 42.06% to 67.72% respectively in Darende restricts (15). In selection study carried out by BEYHAN (1992), fruit weight, inward weight and kernel ratio are ranging between 8.90-15.68 gr, 5.40-8.16 gr. and 49.26%-63.07%, respectively (6). In other researches, fruit weight was between 10.0 and 21.8 gr., kernel weight 5.3 and 10.1 gr. and kernel ratio 42.8 and 56.0% in Marmara Region(5). Main fruit specifications of selected types are higher than the results of previous studies carried out in foreign countries, and even higher than the values of the types grown as a standart types. Thus, in some walnut types of Europe as like Franquette, Mayette, Perisienne, Corne and Marbot, fruit weight is between 10.0 and 10.75 gr., kernel weight 3.75 and 4.95 gr., and kernel ratio 37.5% and 46.0%.(7,8,9,11) Characteristics of walnut types of Chico and Hartley grown in the U.S, those of Siliststra and Mikrovski grown in Bulgaria, and of Vujan, Oujar and Amigo grown in Serbia and Montenegro are much lower than values of the selected types in this study.(16,17,18,19,20). Thus,in this selected types in Europe and America, the average fruit weights ranged from 6.40 to 16.10 gr., kernel weight from 3.75 to 7.90 gr., and kernel ratio from 37.50 % to 55.22 % (17,18,19,20).

Shell thicknesses of the selected types, which affects the kernel ratio of the fruits directly and is one of the most important criteria for the fruit quality, are also so close to those of both previous selection studies and of standart walnut types. Thus, in this study, peel thickness of selected walnut types ranges from 1.20 to 1.90 mm. In his study, BEYHAN had found this thickness between 0.66 and 1.56 mm (15), and in another study carried out by SEN , it is found between 0.53 and 1.77mm.(21). According to studies carried out in Europe, peel thickness of high quality walnuts is supposed to be between 0.70 and 1.50 mm. And most of the selected types in this study are within these limits(20).

With regard to the blooming characteristics, 58.49 % of the selected types are Protandrous; 28.30% are Protogynous and 13.20% are Homogamous. These specifications are in conformity with the general trend. Thus, most of the other studies have similar results to those we got in this study. In OLEZ's selection study, for example, 50.0 % of the selected types are Protandrous; 40.0% are Protogynous and 10.0% are Homogamous.(5) In other study, made by BEYHAN, 68.66 % of the selected types are Protandrous; 25.37% are Protogynous and 5.97% are Homogamous.(15) Either blooming characteristics or blooming dates are determined by altitudes of trees, geographical locations of trees and climate features. (22,23)

As a conclusion, results obtained from these wild and self-growing walnut trees are very important. We are of the opinion that if their production and growing processes are controlled scientifically, these results will be much more satisfactory.

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