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Selection and determination of some significant properties of superior walnut genotypes

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This study was conducted to determine some significant characteristics and select superior walnut genotypes within seedling population of Mardin central district and Diyarbakir central districts and their villages during years 2008-2009. Although, Mardin and Diyarbakir central districts have rich walnut genotypes, no studies have been made about walnut trees in the areas up to now. Therefore, this research is very important with respect to be firsting on walnut genotypes in these areas. During this study, firstly about thousand walnut trees were surveyed. Three hundred marked and evaluated in the genotypes. Accoding to results of this research, twelve walnut trees were selected as ''promising genotypes'' with respect to fruit quality properies according to the weighted ranked method. In the physical properties of these walnut genotypes, it was determined that fruit weight, fruit length, fruit width, shell thickness, kernel weight and kernel ratio changed from 20.20 to 12.39 g, from 48.86 to 34.11 mm, from 36.71 to 30.45 mm, from 2.26 to 1.40 mm, from 9.55 to 6.73 g and from 58.04 to 40.85%, respectively. Based on the chemical properties of the selected genotypes, it was determined that protein, oil, moisture and ash contents changed from 20.80 to 13.98%, from 68.70 to 57.13%, 4.23 to 1.90% and 2.83 to 1.78%, respectively. In addition, based on the phenological properties of the these genotypes, it was observed that protandrous, protogynous and homogamouus ratios of flowering habits determined to be 50.00%, 33.33% and 16.16%, respectively.

Key words: Walnut, fruit properties, weighted ranked method, Diyarbakir, Mardin.

INTRODUCTION

The walnut (*Juglans regia* L.) is economically very important tree species cultivated throughout the world for their timber and nutritional value. The walnut species are found all over the world such as in the West Indies, Japan, China, Southern Asia from India and Turkey, South Eastern Europe to the Carpathian Mountains of Poland, the eastern and southern parts of the United States, Mexico and Central America from Colombia to Argentina (McGranahan and Leslie, 1990).

The Persian walnuts are the most economically significant member of the genus and the species is cultivated for its timber and edible nuts throughout the temperate regions of the world. This species is probably originated from the Afghanistan-Iran region. Then, it was introduced to China, Russia and Eastern Europe mainly by ancient tribes. Turkey with various eco-geographical regions is one of the major centers for Persian walnut diversity. Native walnut populations are widely present in this region (Jay-Allemand et al., 1996) and are found as scattered individuals or groups of several trees in the borders of agricultural lands, orchards or by the rivers, usually close to human settlements (Fernandez-lopez et al., 2003).

Anatolia has a population of 4.926.985 walnut trees (Anonim, 2007), most of which are wild walnut trees grown from seed. With this number of walnut trees, Anatolia is one of the top walnut producers in the world (Germain, 1986; Sen, 1988; Sen, 1998). Nevertheless, lack of standardization in these products may cause some problems in marketing and some problems even in domestic consumption of these products will be inevitable

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Table 1a. Fuit quality evaluation of the selected walnut genotypes according to the weighted ranked method.

Characteristics	Weighting factor (coeficient)	Classification and points		Characteristics	Weighting factor (coeficient)	Classifications and points	
		17 g <	25			50%<	20
Fruit weight	25	15-17 g	20	Kernel ratio	20	45 - 50%	15
		<15 g	15			< 45%	10
		Smooth	15			Light	15
Shell roughness	15	Medium	10	Peel color	15	Dark	10
		Roughness	5			Brown	5
Fruit width	5	35 mm<	5	Shell adhesion	5	Weak	5
		30-35 mm	3			Strong	3
Fullness ratio of kernel	5	90 - 100%	5	Wholeness ratio of kernel	5	90%-100%	5
		80 - 90%	3			80 - 90%	3
		< 80%	1			< 80%	1
		<1.2 mm	5				
Shell thickness	5	1.2 - 1.5 mm	3				
		1.5 mm <	1				

in the near future. This potential constitutes a very rich genetic source for Turkey. So, the first and the most important thing to do is to select the walnuts with the highest fruit bearing and fruit quality properties by using selection method and to promote the plantation of these genotypes all over the country. In this context, various studies were made in several regions of Turkey approximately 35-40 years ago. Walnut genotypes were obtained with high fruit bearing and fruit quality properties by several researchers (Olez, 1976; Akca and Sen, 1994; Askin and Gun, 1995; Kuden et al., 1995; Akca and Ayhan, 1996; Akca and Osmanoglu, 1996; Akça and Muratoglu, 1996; Karadeniz and Sahinbas, 1996; Beyhan, 2005; Simsek, 2010a; Simsek, 2010b; Simsek and Osmanoglu, 2010). Similarly, some walnut cultivars like Payne, Corne, Marbot, Parisienne and Sibisel were obtained by means of selection (Germain, 1980; Radicati et al., 1990; Hsu et al., 1969). In addition, these have been grown as standart varieties in several countries up to now.

To the best of our knowledge, no studies have been made about walnut trees in Mardin central district, Diyarbakir central districts and their villages up to now. Therefore, , this research is very important with respect to be firsting on walnut genotypes in these areas. In this context, the walnut genotypes with high fruit bearing and fruit quality in the regions were selected in this research. In addition, the physical, chemical and phenological properties of these superior genotypes were also determined. These genotypes may be used in plant breeding in the future. The physical, chemical and phenologic properties of these genotype may serves as guide to other studies on walnut genotypes and cultivars in the future. The results obtained from this study proved the importance of the study.

MATERIALS AND METHODS

This study was carried out during years 2008 and 2009 on walnut population naturally grown in Mardin central district, Diyarbakir central districts and their villages. During this study, firstly about thousand walnut trees were surveyed. Three hundred walnut genotypes were marked and evaluated in this population. İn first year, in three hundred walnut genotypes, hundred genotypes which had less than 10.00 g of the fruit weight, less than 6.00 g of kernel weight and less than 40.00% of kernel ratio were eleminated. In so doing, thirty fruits were randomly taken from the each walnut tree each year (sixty fruit for two years). After having taken the fruit samples from the genotypes, their husts were peeled and these fruits were dried in shade for a week. Then, they were dried in a drying chamber at 30℃ for 24 h in order to homogenise their moisture levels (Szentivanyi, 1990; Solar, 1990). After that, the fruits were analysed according to the randomly blocks design with 3 replication and ten fruits in each replication for each year. Then, investigated two hundred genotypes were evaluated.according to weighted ranked method. According to specifications of these walnuts, twelve superior genotypes were selected via weighted ranked method (Sen, 1980) and presented in Table 1. While determining the selected genotypes, the flower habits, opening time of male and female flowers, numbers of protogynous, protandrous and homogamous trees were taken into account in 2009. The fruit weight and the kernel weight were measured with a scale sensitive to 0.01 g. The fruit height,

Table 1b. Fuit quality evaluation of the selected walnut genotypes according to the weighted ranked method.

Characteristics	Weighting factor (coefficient)	Classifications and points		Characteristics	Weighting factor (coefficient)	Classifications and points	
Kernel weight	25	8.0 g <	25	Kernel ratio	20	50%<	20
		7 - 8 g	20			45 - 50%	15
		< 7.0 g	15			< 45%	10
Inward color	20	Light	20	Shell removal	15	Easy	15
		Dark yellow	15			Medium	10
		Brown	10			Hard	5
Fullness ratio of kernel	5	90 - 100%	5	Wholeness ratio of kernel	5	90 - 100%	5
		80 - 90%	3			80%-90%	3
		<80%	1			<80%	1
Ratio of non-sheriveling kernel	5	90 - 100%	5				
		80 - 90%	3				
		< 80%	1				

fruit length, fruit width and fruit thickness were measured by a digital compass. In addition, dry matter was determined by using a 5 ± 0.01 g sample and drying in a thermostat at 105˚C (24 h) to a constant weight. The moisture was calculated on a dry weight and fresh weight basis. The ash content was determined by using a ash furnace at 200˚C for 24h and then at 560˚C for 12 h. Protein content was determined by using kjeldahl method (Jung et al., 2003). The oil content of the samples was made by hexan extraction in a soxhlet extractor (Seung, 1981). Percent content of other matters was calculated with deriving from ash, oil and protein contents of walnut samples (Akyuz ve Kaya, 1992). The altitudes and coordinates of the genotypes were determined by using GPS tool. In addition, the data of the superior walnut genotypes were subjected to analysis of variance using JMP 5.0.1 program. The means were separated by Tukey's test at 0.05 levels..

RESULTS AND DISCUSSION

Means and ranges (min-max) in first and second years

In this study, Mardin central district, Diyarbakir central districts and their villages thought to be rich in walnut tree population were visited and about 1000 walnut trees were observed and the the fruit samples were taken from 300 trees according to their fruit and tree traits in 2008. Out of three hundred walnut genotypes in the same year, 100 walnut genotypes, which had less than 12.00 g of the fruit weight, less than 6.00 g of the kernel weight and less than 40.00% of the kernel ratio were eliminated. Data regarding some fruit properties were obtained from 200 walnut genotypes in years 2008 and 2009 and are given in Table 2.

According to the means of the first year, it was determined that the fruit weight, the kernel weight, the kernel ratio, the shell thickness, the fruit length, the fruit width, and the fruit height of the walnut genotypes were changed to be 15.47 g, 7.69 g, 50.40%, 1.69 mm, 41.63 mm, 33.77 mm and 1.23, respectively. In the same year, it was determined that the minimum and maximum ranges in these figures were changed from 11.07 to 19.90 g, from 6.80 to 9.93 g, from 40.69 to 63.23%, from 1.03 to 2.44 mm, from 32.00 to 49.98 mm, from 30.00 to 37.45 mm, from 30.00 to 40.36 mm and from 1.01 to 1.49, respectively. In the first year, Beyhan and Ozatar (2007) determined that the fruit weight, the kernel weight, the kernel ratio, the shell thickness, the fruit length, the fruit width and the fruit height according to the means of superior walnut types were seen to be 14.70 g, 7.08 g, 49.08%, 1.51 mm, 40.25 mm, 33.87 mm and 34.91 mm, respectively. In addition, they determined that the minimum and maximum ranges in these figures were changed from 10.30 to 23.15 g, from 6.05 to 10.48 g, from 40.00 to 60.08%, from 0.91 to 1.90 mm, from 34.98 to 50.08 mm, from 28.21 to 40.44 mm and from 28.95 to 40.07 mm, respectively.

According to the means in the second year, it was determined that the fruit weight, the kernel weight, the kernel ratio, the shell thickness, the fruit length, the fruit width, the fruit height and the form index of the selected genotypes were determined to be 15.30 g, 7.50 gr, 49.62%, 1.62 mm, 41.52 mm, 33.53 mm, 33.89 mm and 1.24, respectively. In the same year, it was determined that the minimum and maximum ranges in these figures were changed from 12.00 to 21.70 g, from 6.43 to 9.97 g, from 39.47 to 64.11%, from 1.27 to 2.24 mm, from 33.70 to 49.68 mm, from 28.05 to 37.55 mm, from 30.05

Table 2. Some fruit properties of the selected walnut genotypes.

Properties	Means (2008)	Range (min-max) (2008)	Means (2009)	Range(min - max) (2009)
Fruit weight (gr)	15.47	11.07 - 19.90	15.30	12.00 - 21.70
Fruit length (mm)	41.63	32.00 - 49.98	41.52	33.70 - 49.68
Fruit width (mm)	33.77	30.00 - 37.45	33.53	28.05 - 37.55
Fruit height (mm)	33.77	30.00 - 40.36	33.89	30.05 - 40.19
Shell thickness (mm)	1.69	1.03 - 2.44	1.62	1.27 - 2.24
Kernel weight (gr)	7.69	6.80 - 9.93	7.50	6.43 - 9.97
Kernel ratio (%)	50.40	40.69 - 63.23	49.62	39.47 - 64.11
Form index	1.23	1.01 - 1.49	1.24	1.01 - 1.43

Note: Genotypes numbers is not included in Table 2.

Table 3. Some physical properties of superior walnut genotypes.

Genotype No	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)	Fruit height (mm)	Kernel weight(g)	Kernel ratio(%)	Shell thickness (mm)	Form index
MR-13	16.75 bc	46.42 ab	34.51 c	34.75 bc	7.60 cd	45.41 cd	1.72 bc	1.34 ab
MR-45	15.98 c	45.81 b	33.97 cd	34.83 bc	7.52 d	47.12 bcd	1.40 c	1.33 ab
MR-82	15.31 cde	45.80 b	34.13 c	33.23 cd	7.08 de	46.29 bcd	1.58 bc	1.36 a
MR-117	15.38 cd	48.86 a	34.78 bc	35.96 b	7.65 cd	49.75 abc	1.65 bc	1.38 a
MR-134	20.02 a*	42.29 c	34.94 bc	36.30 b	8.18 bc	40.85 d	2.26 a	1.19 cd
MR-146	13.84 efg	38.92 d	31.92 ef	31.04 de	6.85 e	49.58 abc	1.43 c	1.24 bc
DYB-20	12.39 g	34.11 e	31.36 ef	31.38 de	7.16 de	58.04 a	1.62 bc	1.09 de
DYB-62	16.54 bc	38.71 d	36.19 ab	38.94 a	8.62 b	52.14 abc	1.49 c	1.03 e
DYB-90	13.20 fg	38.34 d	32.41 de	30.72 e	7.12 de	54.03 ab	1.55 bc	1.21 c
DYB-114	17.73 b	39.01 d	36.71 a	38.63 a	9.55 a	53.90 ab	1.60 bc	1.04 e
DYB-137	13.20 fg	38.12 d	32.41 de	30.71 e	7.12 de	54.11 ab	1.67 bc	1.21 c
DYB-148	14.28 def	42.51 c	30.45 f	31.47 de	6.73 e	47.32 bcd	1.91 b	1.37 a
LSD	1.52	2.70	1.57	2.21	0.64	8.48	0.40	0.11

*p <0.05, there are some significant differences among the genotypes to all parameters measured by Tukey’s test at level.

to 40.19 mm and from 1.01 to 1.43, respectively. Beyhan (2005) determined that the fruit weight, the kernel weight, the kernel ratio, the shell thickness, the fruit length, the fruit width, the fruit height and the form index according to the means of superior walnut types were determined to be 14.22 g, 7.45 g, 52.73%, 1.09 mm, 43.06 mm, 35.16 mm and 36.95 mm, respectively. In addition, He determined that the minimum and maximum ranges in these figures were changed from 11.16 to 16.00 g, from 6.18 to 9.88 g, from 43.43 to 67.73%, from 0.66 to 1.33 mm, from 39.38 to 44 - 56 mm, from 2.92 to 37.25 mm and from 34.26 to 40.26 mm, respectively. The reason for difference partly between the results of these studies can change according to properties such as genetic characteristics, the maintenance requirements and the ecolojical conditions.

Physical properties

According to the average values of years 2008 and 2009, some physical properties of the superior genotypes were shown in Table 3. According to the results, it was determined that the fruit weight, the fruit length, the fruit width, the fruit height, the shell thickness, the kernel weight, the kernel ratio and the form index of the selected genotypes changed from 12.39 to 20.02 g, from 34.11 to 48.86 mm, from 30.45 to 36.71 mm, from 30.71 to 38.63 mm, from 1.40 to 2.26 mm, from 6.73 to 9.55 g, from 40.85 to 58.00% and from 1.03 to 1.38, rspectively. Kuden et al. (1995) determined that the kernel ratio changed from 51.29 to 56.25% except D-1 (41.44%). Akca and Sen (2001) determined that the fruit weight, the kernel weight, the shell thickness, the fruit width and the fruit length changed from 7.49 to 13.93 g, from 2.61 to 5.73 g, from 1.32 to 2.45 mm, from 22.30 to 32.26 mm and from 32.90 to 49.25 mm, respectively. Oguz and Askin (2007) determined that the fruit height changed from 27.95 to 33.25 mm. Beyhan and Ozatar (2007) determined that the form index changed from 1.03 to 1.52. Simsek and Osmanoglu (2010) determined that the fruit weight, the fruit length,

Table 4. Some other physical properties of the genotypes.

Genotype no	Shell roughness	Internal core status	Internalratio of non-shrink (%)	Kernel colour	Peel colour
MR-13	Smooth	Smooth	100	Light	Light
MR-45	Smooth	Coreless	100	Brown	Dark
MR-82	Smooth	Smooth	100	Brown	Dark
MR-117	Smooth	Smooth	100	Amber	Light
MR-134	Medium	Smooth	90	Light	Dark
MR-146	Smooth	Smooth	100	Amber	Light
DYB-20	Smooth	Smooth	100	Amber	Light
DYB-62	Smooth	Smooth	100	Brown	Dark
DYB-90	Smooth	Coreless	100	Brown	Light
DYB-114	Medium	Coreless	90	Brown	Dark
DYB-137	Smooth	Coreless	100	Brown	Light
DYB-148	Medium	Smooth	90	Brown	Dark

Table 5. Chemical properties of superior walnut genotypes (average of years 2008 and 2009).

Genotype no	Protein (%)	Oil (%)	Moisture (%)	Ash (%)	Other matters (%)
MR-13	18.30	64.99	2.98	2.25	11.48
MR-45	20.80	66.60	2.40	2.16	7.04
MR-82	14.65	68.70	2.41	2.31	12.93
MR-117	15.70	68.40	4.12	2.12	9.66
MR-134	18.45	64.87	3.90	1.78	11.00
MR-146	18.34	67.10	3.26	1.87	9.43
DYB-20	15.53	59.60	3.45	2.83	18.59
DYB-62	18.33	67.08	3.28	1.84	9.47
DYB-90	15.87	59.4	4.11	2.47	18.15
DYB-114	15.54	61.21	1.90	2.37	19.00
DYB-137	13.98	57.13	3.30	1.79	23.80
DYB-148	16.78	61.39	4.23	2.50	15.10

the fruit width, the fruit height, the shell thickness, the kernel weight, the Kernel ratio and the form index changed from 10.28 to 14.55 g, from 35.64 to 42.02 mm, from 29.78 to 34.46 mm, from 29.69 to 35.56 mm, from 1.27 to 1.90 mm, from 5.55 to 7.22 g, from 43.58 to 63.10% and from 1.12 to 1.31 to, respectively. The results in this research were different partly from the other studies. The reason of these differences also can change according to properties such as genetic characteristics, the maintenance requirements and the ecolojical conditions.

Some other physical properties of the selected superior walnut genotypes also were given in Table 4. The shell roughness is one of the most significant criteria for the fruit quality properties. The shell roughness of three genotypes was smooth and other genotypes were medium. The kernel color of the genotypes was light, amber or brown. The peel colours were light yellow for 50% and dark for other 50%. The internal core status was smooth for 8 genotypes and coreless for 4 genotypes. The internal ratio of non-shrink was 90% for 3 genotypes and 100% for 9 genotypes. Beyhan and Ozatar (2007) determined that the internal ratios of non-shrink were observed to be dark or light peel color, light yellow, yellow, yellow brown and brown kernel color and higher than 80% internal ratio of non-shrink of the walnut types. In addition, it was determined that all the genotypes had easy shell removal, strong shell adhesion, no empty fruit ratios, 100% wholeness and fullness ratios of kernel and no internal decayness. Kernel colour and peel colour of the genotypes can change according to the genetic properties and light density.

Chemical properties of superior walnut genotypes

According to the average values of years 2008 and 2009, the chemical properties of the selected superior walnut genotypes were given in Table 5. It was determined that the protein, oil, moisture, ash and other

Table 6. Some phenological properties of superior walnut genotypes.

Genotype No	First Leafing time	Flower habit	Opening time of male flowers	Opening time of female flowers	First bud breaking	Time of full flowering	Fruit bearing in the lateral shoots (%)	Harvest time
MR-13	4-5 April	PA	13 April	18 April	15-16 April	22-23 April	85	20-30 September
MR-45	4-5 April	PA	13 April	19 April	15-16 April	23-24 April	90	25-30 September
MR-82	2-3 April	PO	12 April	9 April	7-8 April	17-18 April	78	25-30 September
MR-117	5-6 April	HO	15 April	15 April	14-16 April	24-25 April	80	15-25 September
MR-134	2-3 April	PO	11 April	7 April	4-5 April	13-14 April	65	20-25 September
MR-146	11-12 April	HO	20 April	20 April	20-21 April	29-30 April	88	20-30 September
DYB-20	1-2 April	PA	10 April	17 April	13-14 April	21-22 April	75	20-25 September
DYB-62	1-2 April	PO	10 April	7 April	4-5 April	12-13 April	90	20-25 September
DYB-90	1-2 April	PA	10 April	17 April	14-15 April	13-14 April	90	20-25 September
DYB-114	5-6 April	PO	14 April	10 April	8-9 April	16-17 April	80	1-10 October
DYB-137	1-2 April	PA	9 April	14 April	12-13 April	20-21 April	88	20-25 September
DYB-148	3-4 April	PA	12 April	17 April	14-15 April	21-22 April	75	20-25 September

Note: PO = protogynous, PA = protandrous, HO = homogamous.

matter contents of the walnut genotypes changed from 13.98 to 20.80%, from 57.13 to 68.70%, from 1.90 to 4.23%, from 1.78 to 2.83% and from 7.04 to 23.80%, respectively. Dogan and Akgul (2005) determined that the oil content changed from 65.00 to 70.00%. Oguz and Askin (2007) determined that the protein, oil, moisture and ash contents were changed from from 12.11 to 20.75%, from 54.07 to 67.63%, from 2.70 to 3.79% and from 1.00 to 2.22%, respectively The protein, oil, moisture and ash contents were mostly similar to the results of the other researchers. Moreover, the chemical contents (the protein, the oil, the moisture and the ash) of the genotypes in this study were different from each other. The chemical contents of walnut types and cultivars can change according to the genetic characteristics, maintenance requirements and ecological conditions.

Phenological properties

Phenological properties of selected superior walnut genotypes were given in Table 6. According to the Table 6, it was determined that first leafing time, opening time of male and female flowers, first bud breaking, time of full flowering, the fruit bearing in the lateral shoots and harvest time of the selected genotypes were changed from 1 - 2 April to 11 - 12 April, from 9 April to 20 April, from 9 April to 20 April, from 4 - 5 April to 20 - 21 April, from 12 - 13 April to 29 - 30 April, from 65 to 90% and from 15 - 20 September to 1 - 10 October, respectively. In addition, it was determined that the protandrous, protogynous and homogomous of the selected genotypes were determined to be 50.00%, 33.33% and 16.16%, respectively. Simsek and Osmanoglu (2010) determined that first leafing time, opening time of male and female flowers and harvest time of the selected genotypes were changed from 2 - 3 April to 4 - 5 April, from 11 - 14 April to 9 - 19 April, and from 15 - 20 September to 20 - 30 October, respectively. Beyhan and Ozatar (2007) determined that the flowering habits were found to be 58.59% protandrous, 28.30% protogynous and 13.20% homogomous. In addition, Oguz and Askin (2007) studied on first leafing time, the flower habit, the opening time of the male and the female flowers, the first bud breaking and the time of full flowering, the fruit bearing in the lateral shoots and harvest time of the walnut types in Ermenek. The results in this study were partly different from the those of the other researchers. In addition, the phenological properties of the selected genotypes in this study were different partly from each other. Many phenological properties of walnut genotypes and cultivars can change according to the genetic characteristics and the climatic conditions.

Botanical properties

Botanical properties of superior walnut genotypes were shown in Table 7. It was determined that the estimated age of tree, branching height and trunk circumferences of the selected genotypes were changed from 10 to 80, from 200 to 450 cm and from 55 to 380 cm, respectively. In addition, the tree habits of the genotypes were determined to be erect for 3 genotypes, semi-erect for 3 genotypes, weeping for 3 genotypes, spreading for 2 genotypes and open for 1 genotype. Ozatar (1996) determined that ages of the walnut trees, the brancing height and the trunk circumference of the walnut types were observed to be from 9 to 35, from 104 to 350 cm and from 67 to 150 cm, respectively. The botanical properties of the selected genotypes in this study were

Table 7. Some botanical properties of superior walnut genotypes.

Genotype no	Estimated age of tree	Brancing height (cm)	Tree habit	Trunk circumference (cm)
MR-13	45	450	Erect	180
MR-45	40	420	Erect	130
MR-82	30	200	Spreading	119
MR-117	50	310	Semi-erect	150
MR-134	15	240	Semi-erect	103
MR-146	10	200	Semi-erect	55
DYB-20	80	430	Weeping	245
DYB-62	70	400	Weeping	206
DYB-90	80	360	Weeping	380
DYB-114	25	310	Spreading	105
DYB-137	25	280	Erect	90
DYB-148	60	250	Open	200

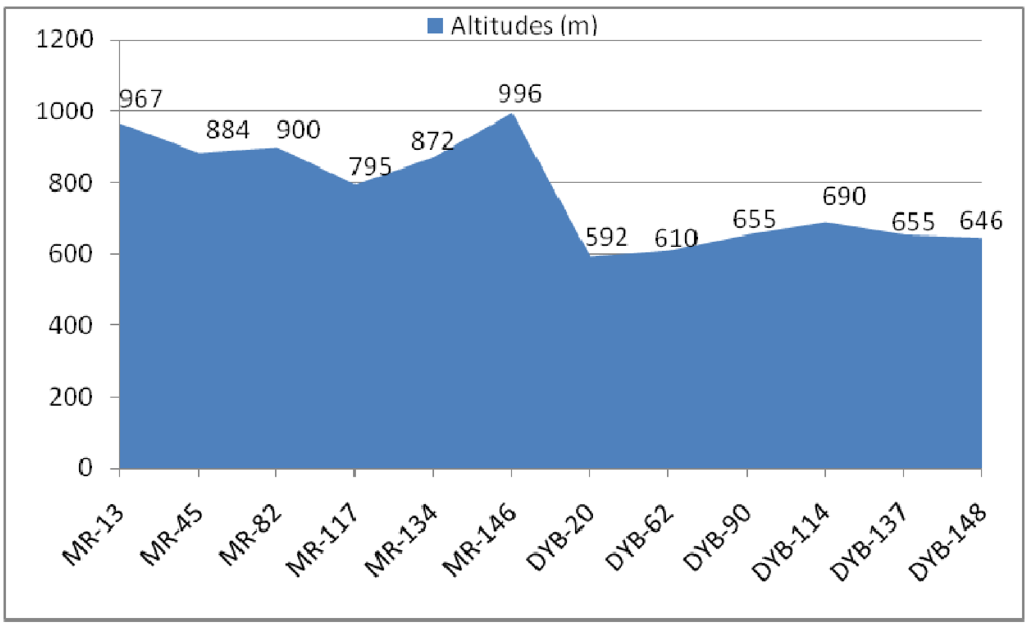

Figure 1. The altitudes of the superior walnut genotypes.

different partly from each other. The branching height, the tree habit and the trunk circumference of walnut genotypes and cultivars can change according to the genetic characteristics, maintenance requirements and ecological conditions.

Locations, coordinates and altitudes

In this study, the altitudes and coordinates of the selected genotypes were given in Figures 1 and 2, respectively. The altitudes of the genotypes were changed from 592 to 996 m. Although MR–13, MR–13, MR–82, MR–117, MR–134 and MR–146 genotypes were selected in Mardin central district. DYB–20, DYB–62, DYB–90, DYB–114, DYB–137 and DYB–148 genotypes were selected in Diyarbakir central districts. The coordinates of MR–13, which had the smallest of genotype number were 37656793 E- 4132412 N and the coordinates of DYB–148, which had the highest of genotype number were 37607337 E- 4191649 N. In the other study, the coordinates and the altitudes of the selected walnut genotypes were determined by Simsek and Osmanoglu (2010). In addition, the coordinates and altitudes of walnut types were determined by Simsek (2010a) and Simsek (2010b). The coordinates and altitudes of trees

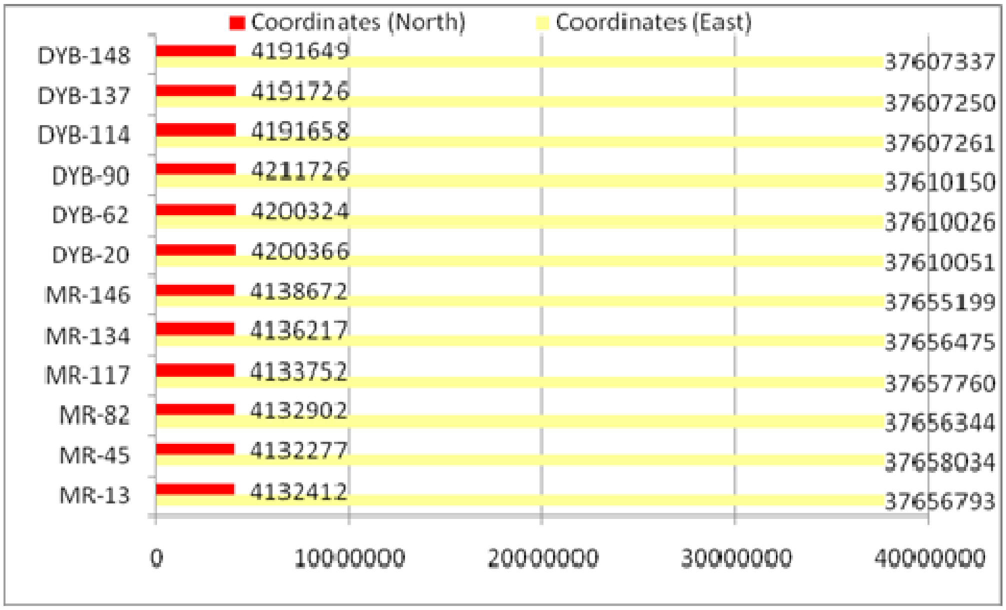

Figure 2. The coordinates of the superior walnut genotypes.

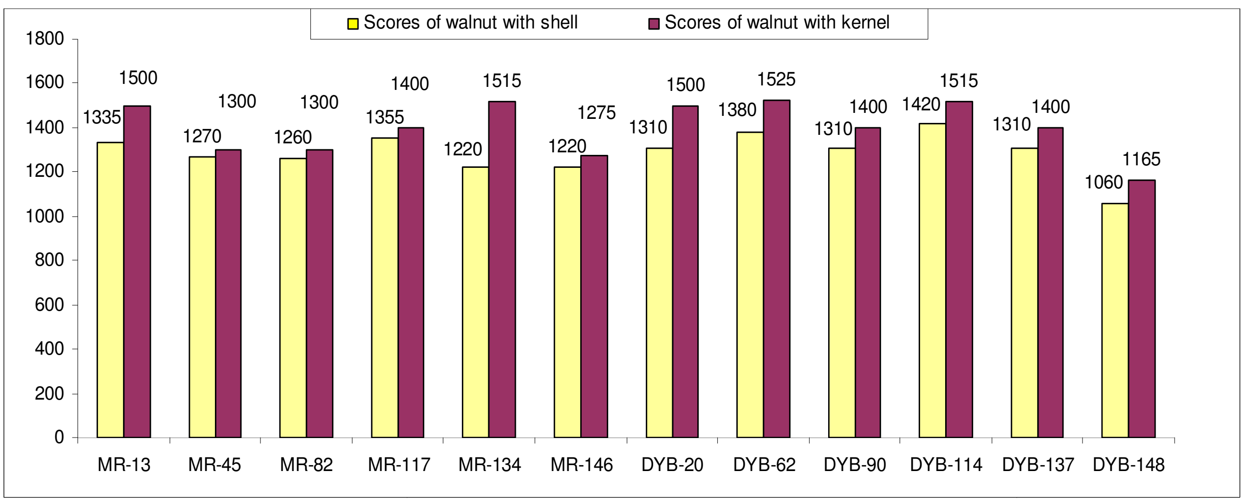

Figure 3. The scores of walnut with kernel and shell in the superior genotypes (mean of years 2008–2009).

can change according to the point in their locations.

Total scores

The total scores of walnut with kernel and shell of the superior genotypes were given in Table 3. According to the mean of the two years, the total score of walnut with kernel was changed from the lowest at 1165 (DYB–148) to the highest at 1525 (DYB–62). In addition, the total score of walnut with shell was changed from the lowest at 1060 (DYB–148) to the highest at 1420 (DYB-62). The results of the scores in this research were partly diffetent genotypes. In this study, the selected genotypes within seedling population of Mardin central district, Diyarbakir from those of Ozatar (1996). He determined that both total scores central districts and their bound villages were seen of walnut with kernel and walnut with shell in their outperformance point of walnut properties were changed from 1320 to 1475, from 1070 to 1290, and some significant results were obtained with respectively. Scores of walnut types and cultivars can regard to the physical properties which had important change according to the genetic characteristics, measures as "selection criteria". This could be explained maintenance requirements and

Table 8. Scores of walnut with kernel and shell in the superior genotypes (Averages of years 2008-2009).

Scores	Genotypes no.											
	MR-13	MR-45	MR-82	MR-117	MR-134	MR-146	DYB-20	DYB-62	DYB-90	DYB-114	DYB-137	DYB-148
Walnut with shell	1335	1270	1260	1355	1220	1220	1310	1380	1310	1420	1310	1060
Walnut with kernel	1599	1300	1300	1400	1515	1275	1500	1525	1400	1515	1400	1165

ecological conditions.

Conclusion

According to the scores of walnut with kernel and walnut with shell, the best types were DYB-62 and DYB-114 genotypes. In this study, the selected genotypes within seedling population of Mardin central district, Diyarbakir central districts and their bound villages in Turkey were seen in their outperformance point of walnut properties and some very important results were obtained with regard to the physical properties, which had important measures as “selection criteria”. This could be explained by the fact that ecological factors do not solely affect the composition of walnut genetic factors and horticultural applications might also be responsible for their composition. In addition, these genotypes should be done for their adaptations in the same ecological conditions with standard walnut genotypes and cultivars. Then, as a result of adaptation, the most superior walnut genotypes and cultivars can produce and may contribute to the economy of Turkey. Conclusively, we are of the opinion that if the production and growing processes of the walnut genotypes with high fruit bearing and fruit quality are controlled scientifically, these results can be much more satisfactory.

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