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Breeding by Selection of 'Yomra' and 'Demir' Apple Varieties (*Malus communis* L.) Grown in Arsin and Yomra Districts (Trabzon Province, Turkey)*

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Abstract

This study was carried out to breeding by selection of 'Yomra' and 'Demir' apple local varieties (*Malus communis* L.) grown in Arsin and Yomra districts of Trabzon (Turkey). In the study, fruit pomological characteristics of fifty-four 'Yomra' and fourty-four 'Demir' types were investigated in 2007-2008 years. "Weight-Ranked Method" was used in evaluating obtained data to select the promising apple local types. In the method, fruit weight, fruit diameter, total soluble solids, titratable acidity and firmness traits based to selection the promising types. In 5 'Yomra' types (61Y041, 61Y042 and 61Y001 as partial alternate bearing; 61Y005 and 61Y006 as alternate bearing, respectively) selected by "Weight-Ranked Method", fruit weight, fruit diameter, firmness, total soluble solids and titratable acidity varied from 100.21 g to 107.68 g; from 64.20 mm to 68.66 mm; from 6.60 lb to 8.40 lb; from 12% to 15%, and from 3.50% to 7.10%, respectively. In 5 'Demir' types (61DE36, 61DE20 and 61DE13 as partial alternate bearing; 61DE01 and 61DE12 as alternate bearing, respectively) selected by "Weight-Ranked Method", average values for fruit weight, fruit diameter, firmness, total soluble solids and titratable acidity varied from 100.16 g to 121.54 g; from 66.29 mm to 68.64 mm; from 6.80 lb to 8.75 lb; from 13.85% to 15.75%, and from 7.05% to 13.35%, respectively. As a result, it can be said that the 10 selected types in 'Yomra' and 'Demir' apples are promising types. These genotypes can be recommended for future breeding studies as table cultivars due to general quality characteristics.

Key Words: Apple, *Malus communis* L., breeding, selection, genotype

Arsin ve Yomra İlçelerinde (Trabzon, Türkiye) Yetiştirilen 'Yomra' ve 'Demir' Elması Çeşitlerinin Seleksiyon Yoluyla Islahı

Özet

Bu çalışma Trabzon'un Arsin ve Yomra ilçelerinde yetiştirilmekte olan 'Yomra' ve 'Demir' elma çeşitlerinin seleksiyon yoluyla ıslahı amacıyla yürütülmüştür. Çalışmada, 54 'Yomra' ve 44 'Demir' elmasına ait tiplerde 2007 ve 2008 yıllarına ait pomolojik özellikler belirlenmiştir. Ümitvar tiplerin belirlenmesinde tartılı derecelendirme yöntemi kullanılmıştır. Tartılı derecelendirmede meyve ağırlığı, meyve çapı, suda çözünür kuru madde miktarı, titre edilebilir asitlik ve meyve eti sertliği özellikleri esas alınmıştır. Seçilen 5 'Yomra' tipinde (Kısmi periyodisite gösteren 61Y041, 61Y042 ve 61Y001 ile mutlak periyodisite gösteren 61Y005 ve 61Y006) meyve ağırlığı, meyve çapı, meyve eti sertliği, suda çözünür kuru madde miktarı ve titre edilebilir asitlik değerleri, sırasıyla, 100.21 g ile 107.68 g; 64.20 mm ile 68.66 mm; 6.60 lb ile 8.40 lb; %12 ile %15 ve %3.50 ile %7.10 arasında değişmiştir. Seçilen 5 'Demir' tipinde (Kısmi periyodisite gösteren 61DE36, 61DE20 ve 61DE13 ile mutlak periyodisite gösteren 61DE01 ve 61DE12) bu değerler, sırasıyla, 100.16 g ile 121.54 g; 66.29 mm ile 68.64 mm; 6.80 lb ile 8.75 lb; %13.85 ile %15.75 ve %7.05 ile %13.35 arasında değişmiştir. Ümitvar olarak seçilen 10 'Yomra' ve 'Demir' tipi gelecekteki ıslah çalışmaları için genel kalite özellikleri dolayısıyla sofralık çeşit adayları olarak tavsiye edilebilir.

Anahtar Kelimeler: Elma, *Malus communis* L., ıslah, seleksiyon, genotip

1. Introduction

Anatolia is located within the homeland region of apple. Apple is fruit specie of temperate zone that grown for many years in Turkey, and grows in many parts of the world (Özbek, 1978).

Turkey is located in the front row in the major apple producing countries of the world. The reason of the high apple production in Turkey is appropriate ecological conditions (Kaşka, 1997).

According to FAO statistical data from the year 2012, important apple producer countries in the world are China (37.000.000 tons, 48.44%), USA (4.110.046 tons, 5.38%) and Turkey (2.889.000 ton, 3.78%), respectively (Anonymous, 2014).

This article was prepared by Master Thesis (Horticultural Department, Institute of Science, Ordu University 2010)

Local varieties are less grown varieties according to the needs of their narrow market in the each fruit growing region (Ağaoğlu et al., 2001). Whereas this population may be very important genetic material for the breeding studies. Promising varieties can be selected from these populations by selection breeding studies. This valuable genetic material may be lost over time due to various reasons such as removing or drying of tree. Therefore, conservation of these valuable genetic resources by selection studies is important. In addition, in the selection studies, results can be obtained in a shorter time according to hybridization studies (Bostan and Acar, 2009).

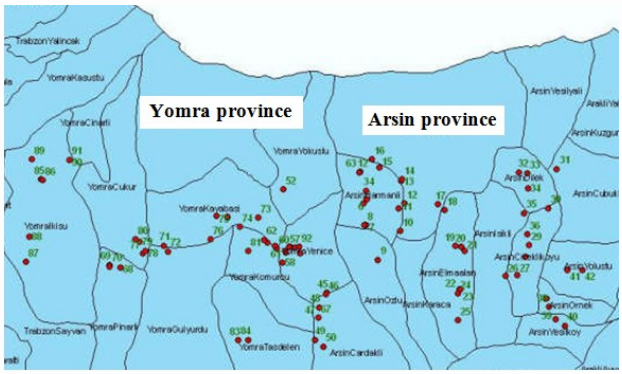

Figure 2. Evaluated types (red-colored spots) in Yomra and Arsin disricts of Trabzon province in the Eastern Black Sea Region of Turkey.

The aim of this study is breeding by selection of the promising apple types of 'Yomra' and 'Demir' local apple varieties grown in Trabzon province of Turkey.

2. Materials and Methods

This study was carried out to breeding by selection of types of local 'Yomra' and 'Demir' apple varieties grown in Arsin and Yomra districts and their surroundings in Trabzon province of the East Black Sea region of Turkey in 2007 and 2008 years. Trabzon is on the East Black Sea region coast of Turkey, and Yomra and Arsin districts are located in the east of the Center of Trabzon province (Figure 1). Both of the varieties are generally coextensive and in a narrow region (Figure 2). All 'Yomra' types were located between 32 - 339 m, all 'Demir' types 14 - 385 m altitudes (Table 1).

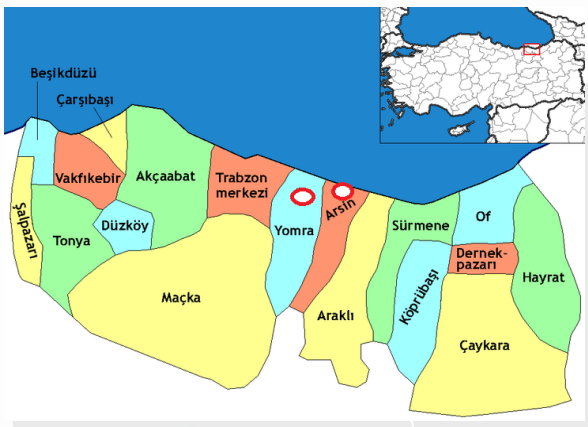

Figure 1. Study areas (Yomra and Arsin districts) in Trabzon province in the Eastern Black Sea Region of Turkey

In the promising 'Yomra' types (Figure 3), harvest period changed from late October to early November. Ages of the trees were between 20 - 35, in upright habits, resistant to disease based on observations, located in hazelnut orchards, and average yield per tree was 20-100 kg. In the promising 'Demir' types (Figure 3), harvest period changed from late October to early November. Ages of the trees were between 10 - 65, in upright habits, resistant to disease based on observations, located in hazelnut orchards, and average yield per tree was 70 - 220 kg.

Pomological analysis was performed on 20 fruit samples for each genotype at harvest maturity. Fruit weight (FWE, g), fruit diameter (FD, mm), fruit length (FL, mm), fruit shape index (FSI, fruit length/fruit diameter), calyx basin depth (CBD, mm), fruit stalk thickness (FST, the middle of the stalk, mm), seed number (SN), firmness (F, without skin, lb), total soluble solids (TSS, °Brix), pH, titratable acidity (TA, as malic acid, %) traits were determined.

"Weight-Ranked Method" were used to select promising types for fruit (Table 2). In the method, fruit weight, fruit diameter, total soluble solids, titratable acidity and firmness traits based to selection the promising types.

Analysis was based on the average values of two years. Total scores of types by the method were calculated by multiplying of relative scores and scores according to class values.

Table 1. Altitudes and coordinates of locations of evaluated types

'Yomra' genotypes				'Demir' genotypes			
Nr.	X	Y	Altitude (m)	Nr.	X	Y	Altitude (m)
61YO01	4530811.97	570051.36	297	61DE01	4530611.97	569051.36	260
61YO02	4530890.68	569765.70	308	61DE02	4533420.14	576582.77	54
61YO03	4530848.03	569756.28	308	61DE03	4533420.14	576582.77	54
61YO04	4531417.45	571249.70	275	61DE04	4533438.76	576593.80	58
61YO05	4531257.61	571367.73	287	61DE05	4532920.54	576760.54	95
61YO06	4532187.00	573815.00	97	61DE06	4532918.68	576759.16	100
61YO07	4531932.00	573318.00	61	61DE07	4532575.56	576682.76	156
61YO08	4532189.92	572966.93	53	61DE08	4532687.59	576779.81	172
61YO09	4532204.72	572966.79	64	61DE09	4531976.87	576761.97	188
61YO10	4532235.00	572674.00	121	61DE10	4531976.41	576718.47	173
61YO11	4531583.00	572516.00	261	61DE11	4531027.22	577077.82	255
61YO12	4531195.85	570681.77	150	61DE12	4310361.20	577200.25	259
61YO13	4531273.04	570742.50	131	61DE13	4318200.10	577684.15	179
61YO14	4531513.47	570576.00	122	61DE14	4532437.76	577657.99	158
61YO15	4531583.50	570469.23	145	61DE15	4532559.59	577805.43	162
61YO16	4531270.59	573552.46	169	61DE16	4533187.82	577720.22	55
61YO17	4528833.56	573547.32	164	61DE17	4533542.37	577124.43	23
61YO18	4528830.79	573268.53	256	61DE18	4533778.86	576912.92	14
61YO19	4528842.00	573279.37	275	61DE19	4532546.96	578706.38	37
61YO20	4534057.00	578548.00	32	61DE20	4532384.30	578894.74	70
61YO21	4533231.00	567897.00	321	61DE21	4531410.48	579191.47	146
61YO22	4533212.00	567946.00	275	61DE22	4531384.40	579347.52	180
61YO23	4532116.00	567733.20	295	61DE23	4531276.21	579438.51	176
61YO24	4530975.00	567484.00	336	61DE24	4530225.64	579308.08	243
61YO25	4531670.00	567587.00	339	61DE25	4530220.31	579329.19	247
61YO26	4533780.00	567648.00	109	61DE26	4530099.42	579271.54	240
61YO27	4533765.00	568678.00	109	61DE27	4529383.16	579256.79	385
61YO28	4533765.00	568678.00	109	61DE28	4530598.19	580558.82	224
61YO29	4530135.65	575679.35	193	61DE29	4530607.40	580892.75	218
61YO30	4530091.18	575674.19	194	61DE30	4531122.24	581100.42	216
61YO31	4529733.97	575484.16	253	61DE31	4531428.56	581191.07	224
61YO32	4529728.50	575492.63	246	61DE32	4532440.97	581714.52	213
61YO33	4529439.53	575461.91	247	61DE33	4533513.27	581963.57	192
61YO34	4528842.66	575358.52	323	61DE34	4533418.48	580922.20	143
61YO35	4528661.92	575597.62	303	61DE35	4533380.29	581151.31	169
61YO36	4531410.00	574965.13	238	61DE36	4532971.62	581754.60	159
61YO37	4531387.00	574931.00	226	61DE37	4332470.00	581070.58	203
61YO38	4531195.83	574948.52	234	61DE38	4531727.91	581154.09	242
61YO39	4532954.67	574499.88	197	61DE39	4529970.16	581667.55	169
61YO40	4531393.00	574696.72	217	61DE40	4529737.88	581741.72	180
61YO41	4531387.30	574671.52	211	61DE41	4529414.26	581930.60	197
61YO42	4531396.48	574664.41	217	61DE42	4529226.48	582182.57	218
61YO43	4531278.63	574537.90	192	61DE43	4530737.16	582249.93	142
61YO44	4531278.63	574537.90	192	61DE44	4530756.51	582656.73	177
61YO45	4531230.81	574566.45	194				
61YO46	4531366.60	574819.08	193				
61YO47	4530944.94	574476.72	246				
61YO48	4531497.85	574075.39	143				
61YO49	4531342.94	574309.90	184				
61YO50	4531412.96	574281.13	175				
61YO51	4531578.29	573977.75	142				
61YO52	4533420.14	576582.77	54				
61YO53	4532920.54	576760.54	95				
61YO54	4532918.68	576759.16	100				

Figure 3. Selected promising genotypes of 'Yomra' and 'Demir' local apple varieties

The different class values were used for alternate bearing and partial alternate bearing types both of the 'Yomra' and 'Demir' (Table 2).

3. Results and Discussion

Harvest periods of 'Yomra' types were from late October to early November, and 'Demir' genotypes were late October to mid-November.

'Yomra' local apple variety

'Yomra' variety is consumed as table cultivar. Its fruits are very few seeds or parthenocarpy, and fruits are medium size.

10 types (61YO05, 61YO06, 61YO10, 61YO11, 61YO23, 61YO25, 61YO26, 61YO27, 61YO34, 61YO44) showed alternate bearing character, and the others were partial alternate bearing.

In the partial alternate bearing types, average values for fruit weight, fruit diameter, firmness, total soluble solids and titratable acidity were 94.95 g; 63.31 mm; 7.10 lb; 12.90%, and 5.80%, respectively. Fruit weight varied from 72.19 g to 113.39 g; fruit diameter varied from 56.55 mm to 68.38 mm; firmness varied from 5.60 lb to 8.20 lb; total soluble solids varied from 10.55% to 15.00%, and titratable acidity varied from 3.58% to 8.20% (Table 3).

In 44 partial alternate bearing types, average weighted-ranked scores for fruit weight, fruit diameter, total soluble solids, titratable acidity, firmness and total score (general quality) were 61.09; 64.73; 34.39; 26; 12.14 and 198.34, respectively. Minimum and maximum values for these traits were between 32 - 96, 32 - 96, 17 - 51, 13 - 39, 6 - 18 and 13 - 294, respectively (Table 4).

In 10 alternate bearing types, average values for fruit weight, fruit diameter, firmness, total soluble solids and titratable acidity were 90.97 g; 63.31 mm; 8.48 lb; 13.38%, and 5.36%, respectively. Fruit weight varied from 69.05 g to 107.68 g; fruit diameter varied from

Table 2. Weight-Ranked traits and scores

Traits	Relative score	Class values				Score
		'Yomra' genotypes		'Demir' genotypes		
		Partial alternate bearing	Alternate bearing	Partial alternate bearing	Alternate bearing	
Fruit weight (g)	32	100.24 - 113.39	91.46 - 107.68	100.00 - 123.11	111.01 - 121.54	3
		90.88 - 100.23	86.75 - 91.45	90.01 - 99.99	100.01 - 111.00	2
		72.19 - 90.87	69.05 - 86.74	80.03 - 90.00	95.47 - 100.00	1
Fruit diameter (mm)	32	64.07 - 68.38	63.26 - 68.66	65.34 - 70.32	67.51 - 68.64	3
		62.60 - 64.06	62.17 - 63.25	62.94 - 65.33	65.51 - 67.50	2
		56.55 - 62.59	58.06 - 62.16	59.67 - 62.93	64.41 - 65.50	1
Total soluble solids (Brix, %)	17	13.26 - 15.00	14.01 - 14.60	14.11 - 15.25	15.21 - 15.75	3
		12.36 - 13.25	12.51 - 14.00	13.66 - 14.10	14.70 - 15.20	2
		10.55 - 12.35	10.75 - 12.50	12.65 - 13.65	14.10 - 14.69	1
Titratable acidity (malic acid, %)	13	3.58 - 5.18	3.50 - 4.60	6.80 - 8.83	10.00 - 11.00	3
		5.19 - 6.13	4.61 - 5.90	8.84 - 9.93	11.01 - 12.00	2
		6.14 - 8.20	5.91 - 6.53	9.94 - 11.83	12.01 - 13.35	1
Firmness (lb) (without skin)	6	7.46 - 8.20	8.71 - 9.30	8.31 - 9.60	9.01 - 9.70	3
		6.66 -7.45	8.21 - 8.70	7.36 - 8.30	8.01 - 9.00	2
		5.60 - 6.65	7.40 - 8.20	5.85 - 7.35	7.30 - 8.00	1

58.06 mm to 68.66 mm; firmness varied from 7.40 lb to 9.30 lb; total soluble solids varied from 10.75% to 14.60%, and titratable acidity varied from 3.50% to 6.53% (Table 5).

In 10 alternate bearing types, average weighted-ranked scores for fruit weight, fruit diameter, total soluble solids, titratable acidity, firmness and total score (general quality) were 67.20; 67.20; 34.00; 26.00; 12.60 and 207, respectively. Minimum and maximum values for these traits were between 32 - 96, 32 - 96, 17 - 51, 13 - 39, 6 - 18 and 125-264, respectively and (Table 6).

'Demir' local apple variety

'Demir' local apple variety is consumed as table cultivar. Its fruits have medium quality. In this study, total 44 genotypes were examined.

3 types (61DE01, 61DE02 and 61DE12) showed alternate bearing character, and the others were partial alternate bearing.

In the partial alternate bearing types, average values for fruit weight, fruit diameter, firmness, total soluble solids and titratable acidity were 94.71 g; 64.19 mm; 7.84 lb; 13.98% and 9.27%, respectively. Fruit weight varied from 80.03 g to 123.11 g; fruit diameter varied from 59.67 mm to 70.32 mm; firmness varied from 5.85 lb to 9.60 lb; total soluble solids varied from 12.65% to 15.25%, and titratable acidity varied from 6.80% to 11.83% (Table 7).

In 41 partial alternate bearing types, average weighted-ranked scores for fruit weight, fruit diameter, total soluble solids, titratable acidity, firmness and total score (general quality) were 63.22; 63.22; 34.00; 26.63, 11.71 and 198.78, respectively. Minimum and maximum values for these traits were between 32 - 96, 32 - 96, 17 - 51, 13 - 39, 6 - 18 and 106 - 300, respectively and (Table 8).

In 3 alternate bearing types, average values for fruit weight, fruit diameter, firmness, total soluble solids and titratable acidity were 105.72 g; 66.45 mm; 8.37 lb; 14.95% and 11.50%, respectively. Fruit weight varied from 95.47 g to 121.54 g; fruit diameter varied from 64.41 mm to 68.64 mm; firmness varied from 7.30 lb to 9.70 lb; total soluble solids varied from 14.10% to 15.75%, and titratable acidity varied from 10% to 13.35% (Table 9).

In 3 alternate bearing types, average weighted-ranked scores for fruit weight, fruit diameter, total soluble solids, titratable acidity, firmness and total score (general quality) were 64; 64; 34; 26; 12 and 200, respectively. Minimum and maximum values for these traits were between 32 - 96, 32 - 96, 17 - 51, 13 - 39, 6-18 and 125 - 277, respectively and (Table 10).

Table 3. Pomological traits of partial alternate bearing genotypes of 'Yomra' apple for average values of two years

Genotypes	FWE (g)	FD (mm)	FL (mm)	FSI	CBD (mm)	FST (mm)	SN	F (lb)	TSS (%)	pH	TA (%)
61YO01	101.25	65.52	55.99	0.86	10.39	2.99	0.5	7.85	13.45	3.91	7.10
61YO02	89.76	62.64	55.82	0.89	8.73	2.93	0.5	7.70	13.28	3.84	7.60
61YO03	95.99	62.76	52.14	0.83	10.64	3.27	0.3	8.00	13.25	3.82	7.25
61YO04	95.11	63.29	53.89	0.85	10.37	3.16	0.1	6.60	13.28	4.08	4.65
61YO07	86.17	61.86	51.48	0.84	9.00	3.28	0.0	7.95	13.35	3.82	6.33
61YO08	99.57	61.24	52.69	0.89	9.15	2.60	0.4	8.00	12.70	3.96	5.20
61YO09	99.22	64.23	53.66	0.84	9.71	2.89	0.0	5.70	11.50	3.87	6.13
61YO12	111.31	68.38	60.24	0.89	10.13	2.91	0.5	6.25	10.55	3.94	5.98
61YO13	81.91	60.05	52.80	0.88	7.98	2.62	1.2	7.05	13.00	3.79	7.63
61YO14	91.93	61.97	53.41	0.87	9.69	2.87	0.3	8.10	11.60	3.84	5.10
61YO15	72.19	58.14	49.58	0.86	10.24	3.01	0.1	7.25	13.10	4.08	5.93
61YO16	74.98	56.55	50.22	0.89	9.29	2.61	0.1	7.60	13.05	4.06	7.20
61YO17	78.12	59.43	49.59	0.84	10.17	3.13	0.0	7.60	13.75	3.87	8.20
61YO18	113.03	67.96	55.61	0.82	10.53	2.60	0.4	6.30	11.15	4.03	5.03
61YO19	92.29	62.66	52.29	0.84	10.09	2.86	0.1	7.70	12.20	3.83	5.58
61YO20	88.04	63.01	52.21	0.83	9.47	3.13	0.1	8.00	12.30	4.01	5.18
61YO21	98.65	62.59	57.06	0.91	9.66	2.57	0.5	7.05	12.90	4.50	4.85
61YO22	113.39	67.03	58.02	0.87	10.25	2.83	1.8	7.60	11.60	3.89	5.80
61YO24	80.48	60.06	50.86	0.85	8.34	2.80	0.5	7.65	13.30	3.89	3.93
61YO28	95.97	63.52	54.50	0.86	11.02	2.94	0.3	6.80	12.35	4.06	3.58
61YO29	94.36	62.90	56.22	0.90	10.29	2.31	1.4	6.30	12.20	4.02	6.68
61YO30	99.53	64.06	56.39	0.88	9.98	2.51	0.7	7.05	12.20	4.31	7.33
61YO31	110.76	66.22	57.44	0.87	10.56	2.67	0.3	6.30	12.60	3.91	6.70
61YO32	103.83	65.10	56.62	0.87	11.34	2.65	0.0	6.65	13.00	4.07	4.45
61YO33	98.73	64.03	56.77	0.89	9.14	2.54	0.9	7.60	11.90	4.01	5.65
61YO35	108.24	66.98	58.01	0.87	10.24	2.76	0.2	7.30	12.40	4.10	5.20
61YO36	100.99	64.71	55.30	0.85	9.59	2.78	0.2	6.90	13.10	4.31	5.60
61YO37	101.37	64.94	55.37	0.85	9.77	2.77	0.4	7.60	12.10	4.32	4.48
61YO38	95.95	63.14	54.19	0.86	10.26	2.94	0.3	6.55	12.90	4.09	5.53
61YO39	77.38	59.22	49.87	0.85	8.93	2.99	0.3	7.25	13.30	4.13	6.53
61YO40	87.14	63.37	52.11	0.82	9.56	3.16	0.5	7.90	14.90	4.17	6.88
61YO41	100.24	65.03	55.42	0.85	9.77	2.93	0.2	7.10	13.75	4.51	5.03
61YO42	106.95	67.16	54.74	0.82	8.94	2.98	0.3	6.60	15.00	4.40	4.13
61YO43	89.73	62.29	51.42	0.83	8.70	2.55	0.0	8.20	14.85	4.12	4.73
61YO45	93.66	63.16	53.30	0.85	9.38	2.94	0.2	6.55	11.80	4.21	4.73
61YO46	78.77	60.29	51.44	0.86	10.25	2.75	0.7	7.45	12.85	4.12	6.10
61YO47	104.80	66.39	57.98	0.88	9.61	2.34	0.5	6.35	12.00	3.92	5.80
61YO48	84.94	60.75	51.41	0.85	8.96	2.47	0.7	6.65	13.10	4.03	5.88
61YO49	100.58	63.40	56.62	0.89	9.03	2.72	0.2	7.05	13.05	3.96	4.85
61YO50	90.88	61.97	54.50	0.88	8.74	2.87	0.3	6.35	12.60	4.14	5.38
61YO51	101.72	64.15	54.36	0.85	10.55	3.09	0.5	6.80	14.20	4.00	5.18
61YO52	97.83	63.95	53.76	0.84	10.24	3.02	0.2	5.60	14.70	3.82	7.15
61YO53	89.93	64.05	53.41	0.83	10.88	2.86	0.2	7.10	14.25	4.00	6.38
61YO54	100.24	65.43	57.53	0.88	9.66	2.93	1.3	6.65	13.35	3.89	6.43
Average	**94.95**	**63.31**	**54.23**	**0.86**	**9.76**	**2.83**	**0.41**	**7.10**	**12.90**	**4.04**	**5.80**
Minimum	**72.19**	**56.55**	**49.58**	**0.82**	**7.98**	**2.31**	**0.00**	**5.60**	**10.55**	**3.79**	**3.58**
Maximum	**113.39**	**68.38**	**60.24**	**0.91**	**11.34**	**3.28**	**1.80**	**8.20**	**15.00**	**4.51**	**8.20**

Table 4. Weight-Ranked scores of partial alternate bearing genotypes of 'Yomra' apple

Genotypes	FWE	FD	TSS	TA	F	Total score
61YO01	96	96	51	13	18	274
61YO02	96	64	51	13	18	242
61YO03	96	64	34	13	18	225
61YO04	64	64	51	39	6	224
61YO07	96	32	51	13	18	210
61YO08	32	32	34	26	18	142
61YO09	32	96	17	26	6	177
61YO12	96	96	17	26	6	241
61YO13	32	32	34	13	12	123
61YO14	64	32	17	39	18	170
61YO15	32	32	34	26	12	136
61YO16	32	32	34	13	18	129
61YO17	64	32	51	13	18	178
61YO18	96	96	17	39	6	254
61YO19	64	64	17	26	18	189
61YO20	32	64	17	39	18	170
61YO21	64	32	34	39	12	181
61YO22	96	96	17	26	18	253
61YO24	32	32	51	39	18	172
61YO28	64	64	17	39	12	196
61YO29	64	64	17	13	6	164
61YO30	96	64	17	13	12	202
61YO31	96	96	34	13	6	245
61YO32	64	96	34	39	6	239
61YO33	96	64	17	26	18	221
61YO35	64	96	34	26	12	232
61YO36	32	96	34	26	12	200
61YO37	96	96	17	39	18	266
61YO38	32	64	34	26	6	162
61YO39	32	32	51	13	12	140
61YO40	64	64	51	13	18	210
61YO41	96	96	51	39	12	294
61YO42	96	96	51	39	6	288
61YO43	32	32	51	39	18	172
61YO45	32	64	17	39	6	158
61YO46	32	32	34	26	12	136
61YO47	96	96	17	26	6	241
61YO48	32	32	34	26	6	130
61YO49	32	64	34	39	12	181
61YO50	32	32	34	26	6	130
61YO51	64	96	51	39	12	262
61YO52	32	64	51	13	6	166
61YO53	32	64	51	13	12	172
61YO54	64	96	51	13	6	230
Average	**61.09**	**64.73**	**34.39**	**26.00**	**12.14**	**198.34**
Minimum	**32**	**32**	**17**	**13**	**6**	**123**
Maximum	**96**	**96**	**51**	**39**	**18**	**294**

Table 5. Pomological traits of alternate bearing genotypes of 'Yomra' apple for 2007 year

Genotypes	FEW (g)	FD (mm)	FL (mm)	FSI	CBD (mm)	FST (mm)	SN	F (lb)	TSS (%)	pH	TA (%)
61YO05	100.21	64.20	51.96	0.81	11.61	2.52	1.0	8.40	13.75	3.99	5.90
61YO06	107.68	68.66	50.14	0.73	9.34	3.64	2.2	7.80	12.00	4.27	3.50
61YO10	86.74	62.16	49.73	0.80	11.27	2.94	0.6	8.80	10.75	4.02	5.30
61YO11	90.45	65.31	50.91	0.78	13.60	3.46	0.8	7.40	12.50	4.00	4.55
61YO23	91.45	64.09	53.47	0.83	12.15	2.70	0.4	9.30	14.40	4.02	6.53
61YO25	94.49	62.69	51.46	0.82	13.74	2.53	0.0	8.90	13.40	4.27	5.15
61YO26	91.37	63.12	55.68	0.88	11.21	2.75	0.0	8.50	14.60	4.22	4.60
61YO27	83.77	61.57	49.92	0.81	15.32	2.95	0.0	8.70	14.00	4.08	5.50
61YO34	69.05	58.06	46.37	0.80	9.58	2.08	0.0	8.20	14.40	3.98	6.50
61YO44	94.51	63.25	53.94	0.85	10.99	2.74	0.6	8.80	14.00	4.56	6.10
Average	**90.97**	**63.31**	**51.36**	**0.81**	**11.88**	**2.83**	**0.56**	**8.48**	**13.38**	**4.14**	**5.36**
Minimum	**69.05**	**58.06**	**46.37**	**0.73**	**9.34**	**2.08**	**0.00**	**7.40**	**10.75**	**3.98**	**3.50**
Maximum	**107.68**	**68.66**	**55.68**	**0.88**	**15.32**	**3.64**	**2.20**	**9.30**	**14.60**	**4.56**	**6.53**

Table 6. Weight-Ranked scores of alternate bearing genotypes of 'Yomra' apple

Genotypes	FWE	FD	TSS	TA	F	Total score
61YO05	96	96	34	26	12	264
61YO06	96	96	17	39	6	254
61YO10	32	32	17	26	18	125
61YO11	64	96	17	39	6	222
61YO23	64	96	51	13	18	242
61YO25	96	64	34	26	18	238
61YO26	64	64	51	39	12	230
61YO27	32	32	34	26	12	136
61YO34	32	32	51	13	6	134
61YO44	96	64	34	13	18	225
Average	**67.20**	**67.20**	**34.00**	**26.00**	**12.60**	**207.00**
Minimum	**32**	**32**	**17**	**13**	**6**	**125**
Maximum	**96**	**96**	**51**	**39**	**18**	**264**

In the result of the evaluations, three partial alternate bearing types that have 274 and above total scores, and two alternate bearing types that have 254 and above total scores were selected as promising types from 'Yomra' apple. Three partial alternate bearing genotypes that have 288 and above total scores and two alternate bearing types that have 198 and above total scores were selected as promising genotypes from 'Demir' apple. As a result, 5 types were selected from each two varieties.

In 5 'Yomra' types (61YO41, 61YO42 and 61YO01 as partial alternate bearing; 61YO05 and 61YO06 as alternate bearing, respectively) selected by "Weight-Ranked Method", fruit weight, fruit diameter, firmness, total soluble solids and titratable acidity varied from 100.21 g to 107.68 g; from 64.20 mm to 68.66 mm; from 6.60 lb 8.40 to lb; from 12% to 15%, and from 3.50% to 7.10%, respectively.

In 5 'Demir' types (61DE36, 61DE20 and 61DE13 as partial alternate bearing; 61DE01 and 61DE12 as alternate bearing, respectively) selected by "Weight-Ranked Method", average values for fruit weight, fruit diameter, firmness, total soluble solids and titratable acidity varied from 100.16 g to 121.54 g; from 66.29 mm to 68.64 mm; from 6.80 lb to 8.75 lb; from 13.85% to 15.75%, and from 7.05% to 13.35%, respectively.

In selected total 10 types of 'Yomra' and 'Demir' apples, fruit weight varied from 100.16 g to 121.54 g. In the other studies that were carried out in different local apple varieties and in different ecologies in Turkey fruit weight values were 60.84 g - 242.24 g for local varieties in Trabzon province (Bostan, 2009); 59.79 g - 273.41 g for local varieties in Ünye (Ordu province) district (Bostan and Acar, 2009); 49.62 g - 304.41 g for local varieties in İskilip (Çorum province) district (Çorumlu, 2010); 17.52 g - 258.68 g for local varieties in Çoruh valley (Erdoğan and Bolat, 2002); 76.24 g - 247.23 g for local varieties in Ordu (Kırkaya, 2013); 49.5 g - 152.2 g for genotypes in Erzurum province (Pırlak et al., 1997); in Serbia, 165 g - 238 g for selections (Lukic et al., 2009). Our selected types performed generally mean values from point of fruit weight compared with other results.

In selected total 10 types of 'Yomra' and 'Demir' apples, fruit diameter varied from 64.20 mm to 68.66 mm. In the other studies, fruit diameter

Table 7. Pomological traits of partial alternate bearing genotypes of 'Demir' apple for average values of two years

Genotypes	FWE (g)	FD (mm)	FL (mm)	FSI	CBD (mm)	FST (mm)	SN	F (lb)	TSS (%)	pH	TA (%)
61DE03	101.53	65.52	51.48	0.78	8.80	2.31	2.4	8.30	13.80	3.58	11.28
61DE04	83.96	61.55	48.17	0.78	7.01	2.22	4.1	8.15	13.85	3.69	8.33
61DE05	96.87	65.87	48.67	0.74	7.32	2.21	4.0	7.00	13.30	3.71	7.24
61DE06	93.54	59.88	46.34	0.78	7.16	2.05	3.6	8.40	14.60	3.66	11.03
61DE07	103.99	65.67	52.89	0.81	7.45	2.38	4.2	8.25	14.00	3.78	9.93
61DE08	98.80	64.93	51.06	0.79	7.60	2.07	4.2	8.40	13.95	3.57	8.83
61DE09	96.49	65.33	49.53	0.76	7.99	2.16	2.5	7.80	14.15	3.77	10.93
61DE10	108.18	67.81	52.70	0.78	7.15	2.31	1.9	8.25	14.05	3.98	10.13
61DE11	92.62	62.93	49.12	0.79	7.32	2.24	3.5	9.45	13.50	3.71	9.15
61DE13	107.70	67.85	51.45	0.76	8.51	2.34	2.6	7.35	14.85	3.62	8.73
61DE14	102.57	66.90	52.85	0.79	8.02	2.54	3.0	9.00	13.20	3.72	9.65
61DE15	94.84	63.33	49.99	0.79	7.78	2.23	5.0	7.80	14.70	3.82	9.05
61DE16	93.82	63.59	50.56	0.80	7.21	2.11	1.7	8.35	14.50	3.65	9.09
61DE17	89.61	64.45	48.80	0.76	7.72	1.91	3.2	8.70	15.10	3.57	8.40
61DE18	123.11	70.32	52.76	0.75	9.07	2.50	1.8	6.50	14.75	3.71	9.43
61DE19	87.96	62.99	49.93	0.79	6.73	2.15	1.8	7.20	12.85	3.61	10.08
61DE20	108.64	67.89	52.59	0.78	8.28	2.20	2.3	6.80	15.25	3.66	8.40
61DE21	85.46	60.72	49.78	0.82	7.23	2.23	3.7	8.55	14.50	3.66	9.60
61DE22	109.73	68.62	52.17	0.76	7.73	2.33	4.5	7.35	14.05	4.13	7.13
61DE23	106.03	67.78	51.76	0.76	8.12	2.29	3.6	7.20	13.67	3.69	9.35
61DE24	86.09	61.94	47.50	0.77	7.16	2.16	3.2	9.40	13.45	3.70	9.13
61DE25	96.39	64.74	51.13	0.79	7.61	2.26	2.7	7.30	14.40	3.62	10.30
61DE26	100.00	67.17	52.71	0.79	7.56	2.15	3.0	7.05	13.40	3.47	10.65
61DE27	92.63	63.80	49.71	0.78	6.26	2.23	3.4	7.60	13.85	3.89	7.23
61DE28	83.44	62.66	48.20	0.77	7.25	2.32	4.2	7.55	13.88	3.70	8.65
61DE29	107.33	67.58	52.48	0.78	8.12	2.16	4.9	7.15	13.60	3.71	10.40
61DE30	88.52	63.25	49.65	0.79	8.11	2.11	3.4	5.85	12.65	3.71	9.05
61DE31	82.51	60.42	48.30	0.80	7.55	2.23	4.3	8.05	13.60	3.72	10.48
61DE32	91.99	64.16	49.81	0.78	7.25	2.26	3.7	8.35	13.65	3.73	8.88
61DE33	83.78	62.85	46.80	0.75	8.02	2.32	4.0	9.00	15.10	3.67	10.45
61DE34	86.07	63.31	47.34	0.75	6.73	1.93	1.7	8.20	14.70	3.89	7.55
61DE35	100.46	65.31	52.04	0.80	8.52	1.91	2.3	7.65	13.50	3.71	8.83
61DE36	102.28	66.62	50.70	0.76	8.35	2.15	3.5	8.75	14.30	3.71	7.05
61DE37	84.80	62.20	48.09	0.78	6.98	2.05	3.1	8.75	13.63	3.65	10.80
61DE38	80.67	60.95	47.73	0.78	7.32	2.16	2.8	6.65	15.00	3.67	11.83
61DE39	91.04	62.74	50.06	0.80	7.23	2.21	4.6	7.25	13.70	3.79	8.33
61DE40	94.20	62.94	50.56	0.81	7.60	2.28	5.1	7.40	14.10	3.68	9.50
61DE41	91.87	62.38	50.69	0.81	7.61	2.19	5.5	7.55	13.70	3.71	9.25
61DE42	83.44	59.67	48.07	0.81	7.06	2.28	2.7	9.60	14.10	3.64	8.78
61DE43	90.26	62.94	48.58	0.78	7.47	2.24	4.2	7.30	13.55	3.81	10.53
61DE44	80.03	60.20	47.24	0.79	7.47	2.01	4.7	6.40	12.65	3.86	6.80
Average	**94.71**	**64.19**	**50.00**	**0.78**	**7.60**	**2.20**	**3.4**	**7.84**	**13.98**	**3.72**	**9.27**
Minimum	**80.03**	**59.67**	**46.34**	**0.74**	**6.26**	**1.91**	**1.7**	**5.85**	**12.65**	**3.47**	**6.80**
Maximum	**123.11**	**70.32**	**52.89**	**0.82**	**9.07**	**2.54**	**5.5**	**9.60**	**15.25**	**4.13**	**11.83**

Table 8. Weight-Ranked scores of partial alternate bearing genotypes of 'Demir' apple

Genotypes	FWE	FD	TSS	TA	F	Total score
61DE03	96	96	34	13	12	251
61DE04	32	32	34	39	12	149
61DE05	64	96	17	39	6	222
61DE06	64	32	51	13	18	178
61DE07	96	96	34	26	12	264
61DE08	64	64	34	39	18	219
61DE09	64	64	51	13	12	204
61DE10	96	96	34	13	12	251
61DE11	64	32	17	26	18	157
61DE13	96	96	51	39	6	288
61DE14	96	96	17	26	18	253
61DE15	64	64	51	26	12	217
61DE16	64	64	51	26	18	223
61DE17	32	64	51	39	18	204
61DE18	96	96	17	26	6	241
61DE19	32	64	51	13	6	166
61DE20	96	96	51	39	6	288
61DE21	32	32	51	26	18	159
61DE22	96	96	34	39	6	271
61DE23	96	96	34	26	6	258
61DE24	32	32	17	26	18	125
61DE25	64	64	51	13	6	198
61DE26	96	96	17	13	6	228
61DE27	64	64	34	39	12	213
61DE28	32	32	34	39	12	149
61DE29	96	96	17	13	6	228
61DE30	32	64	17	26	6	145
61DE31	32	32	17	13	12	106
61DE32	64	64	17	26	18	189
61DE33	32	32	51	13	18	146
61DE34	32	64	51	39	12	198
61DE35	96	64	17	39	12	228
61DE36	96	96	51	39	18	300
61DE37	32	32	17	13	18	112
61DE38	32	32	51	13	6	134
61DE39	64	32	34	39	6	175
61DE40	64	64	34	26	12	200
61DE41	64	32	34	26	12	168
61DE42	32	32	34	39	18	155
61DE43	64	64	17	13	6	164
61DE44	32	32	17	39	6	126
Average	**63.22**	**63.22**	**34.00**	**26.63**	**11.71**	**198.78**
Minimum	**32**	**32**	**17**	**13**	**6**	**106**
Maximum	**96**	**96**	**51**	**39**	**18**	**300**

Table 10. Weight-Ranked scores of alternate bearing genotypes of 'Demir' apple

Genotypes	FWE	FD	TSS	TA	F	Total score
61DE01	96	96	34	13	12	277
61DE02	32	32	17	26	18	125
61DE12	64	64	51	39	6	198
Average	**64.00**	**64.00**	**34.00**	**26.00**	**12.00**	**200.00**
Minimum	**32**	**32**	**17**	**13**	**6**	**125**
Maximum	**96**	**96**	**51**	**39**	**18**	**277**

were determined as 59.30mm - 92 mm for local varieties in Van (Akça and Şen, 1990); 40.01 mm - 87.34 mm (Bostan, 2009); 53.40 mm - 86.60 mm (Bostan and Acar, 2009); 52.46 mm - 93.49 mm (Çorumlu, 2010); 58.38 mm - 89.03 mm (Kırkaya, 2013) and 71 mm - 79 mm (Lukic et al., 2009). Our selected types performed generally mean values from point of fruit diameter compared with other results.

In selected total 10 types of 'Yomra' and 'Demir' apples, firmness varied from 6.60 lb to 8.75 lb. In the other studies, firmness was determined as 12 lb - 19.80 lb for local varieties in Van (Balta and Kaya, 2007) and 6.99 lb - 12.83 lb (Kırkaya, 2013). Our selected types performed generally lower values from point of firmness compared with other results.

In selected total 10 types of 'Yomra' and 'Demir' apples, total soluble solids varied from 12% to 15.75%. In the other studies, this value was determined as 10% - 14% (Balta and Kaya, 2007); 10.50% - 15% (Bostan, 2009); 13.50% - 9.50% (Bostan and Acar, 2009); 9.3% - 16.65% (Çorumlu, 2010); for types 9.4% - 14.9% in Erzincan province (Doğan and Güleryüz, 2007); 11.50% - 14.50% (Erdoğan and Bolat, 2002); 9.01% - 13.75% (Kırkaya, 2013); 12.5% - 16.2% (Lukic et al., 2009) and 10.3% - 13.8% (Pırlak et al., 1997). Our selected types performed parallel

Table 9. Pomological traits of alternate bearing genotypes of "Demir" apple for 2007 year

Genotypes	FWE (g)	FD (mm)	FL (mm)	FSI	CBD (mm)	FST (mm)	SN	F (lb)	TSS (%)	pH	TA (%)
61DE01	121.54	68.64	54.89	0.80	10.41	2.52	1.4	8.10	15.00	3.85	10.00
61DE02	95.47	64.41	50.42	0.78	8.34	2.14	3.8	9.70	14.10	4.19	11.16
61DE12	100.16	66.29	50.63	0.76	8.29	1.84	2.0	7.30	15.75	3.84	13.35
Average	**105.72**	**66.45**	**51.98**	**0.78**	**9.01**	**2.17**	**2.40**	**8.37**	**14.95**	**3.96**	**11.50**
Minimum	**95.47**	**64.41**	**50.42**	**0.76**	**8.29**	**1.84**	**1.40**	**7.30**	**14.10**	**3.84**	**10.00**
Maximum	**121.54**	**68.64**	**54.89**	**0.80**	**10.41**	**2.52**	**3.80**	**9.70**	**15.75**	**4.19**	**13.35**

values from point of total soluble solids compared with other results.

In selected total 10 types of 'Yomra' and 'Demir' apples, titratable acidity varied from 3.50% to 13.35%. In the other studies, 0.1% - 1.5% (Aygün and Ülgen, 2009); 0.221% - 0.310% (Balta and Kaya, 2007); 1.50% - 11.88% (Bostan and Acar, 2009); 0.281% - 1.045% (Doğan and Güleryüz, 2007); 0.40% - 1.64% (Kırkaya, 2013); 0.1% - 0.7% (Lukic et al., 2009); 0.19% - 1.43% (Pırlak et al., 1997) and 0.2% - 1.3% (Serdar et al., 2007). Our selected types performed generally higher values from point of titratable acidity compared with other results.

As a result, it can be said that the 10 selected types in 'Yomra' and 'Demir' apples are promising types. These types can be recommended for future breeding studies as table cultivars.

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