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Reclamation of the Strawberry Tree (*Arbutus unedo* L.) Genotypes Cultivated around Karasu, Sakarya

Turan Karadeniz[1], S. Vildan Ersoy[1], Emrah Güler[1], F. Ekmel Tekintaş[2]

[1]*Abant İzzet Baysal University, Natural Sciences Faculty, Bolu, Turkey*
[2]*Adnan Menderes University, Agriculture Faculty, Aydin, Turkey*

Abstract

This investigation was carried out during 2015-2016 in the Sakarya area. Strawberry trees were selected by including naturally growing trees. In this selection study, each tree was considered as a tree species and 50 species of strawberry trees were examined. In the study of phenological observation, pomological analysis and Weighted Grading method were applied on Strawberry tree genotypes. 100 fruit samples were collected during the research years of 2015 and 2016 and 10 fruits were studied because of the importance of each species. The fruit weight ranged between 1.70 g and 9.03 g, width from 11.42 mm to 30.52 mm, length 10,15 mm to 14.09 mm, and the handle thickness was 1.13 mm to 3.29 mm, the number of fruits in a bundle wass 3 to 8, the amount of soluble dry matter 15 to 32%, fruit juice pH 3,09 to 3.51. At the end of the study, 5 genotypes with superior characteristics were selected.

Key words: selection, pomology, phenology, weighted grading method, Karasu

Introduction

There are 12 species of the genus Strawberry tree distributed in the Mediterranean Region, North West and Central America (Karadeniz et al., 1996). *Arbutus unedo* L. and *Arbutus andrachne* L. are important species in the natural flora of Turkey (Anşin and Özkan, 1993). These species are grown in our country in the maki areas of the Mediterranean, Aegean, Marmara and Black Sea coasts (Yaltırık and Erdinç, 2002).

The strawberry tree has a wide geographical spread and grows together with wild olive trees, myrtle trees and shrubs and many other trees and typical species in all the regions of the Mediterranean where the Mediterranean climate is dominant, in the redwood forests and maquis vegetation (Karadeniz et al., 1996). The Black Sea Region is rich with regard to strawberry trees in coastal and high sections of Sinop, Trabzon, Ordu, Giresun, Zonguldak and Artvin provinces. They grow in the vicinity of Çanakkale, Balikesir, Bursa, Kocaeli, Sakarya, Bolu, Mersin, Hatay, Kahramanmaraş's Top Talk Mountains (300-500 m high), İzmir, Mugla, Antalya, Istanbul, Yakacık ridges and Trakya region (Davis, 1978; Karadeniz et al., 1996; Pilevneli, 1998; Varol, 2003).

In the regions mentioned naturally grown Strawberry tree fruit can usually be consumed fresh, but also as jam and marmalade. Leaves and shoots are also used as arrangements by florists.

The strawberry tree is high in vitamin C and dry matter content during winter months, and the value of maturation is quite high. Strawberry is an important fruit species for human health. Fruit is very rich in mineral elements, especially vitamin C (150-280 mg / 100 g) (Baytop, 1984). Leaves contain sucrose and phenolic substances such as tannin, arbutin and methylarbutine. Tree bark and roots contain tannins (45%) (Yaltırık and Erdinç, 2002).

In recent years, it has become increasingly important to cultivate wild fruit species and to spread their production and usage areas. However, as there are many wild species in Turkey, there is no commercial cultivation of strawberry trees and studies on this kind of fruit are very limited. As it is beneficial for health reasons, it should be evaluated as a species in the frame of preservation and breeding studies by selecting the types with superior characteristics of the moth, which is a different and important species with high fruit albinism. Cultural studies should be initiated and brought to the country's fruit and vegetable industry, and large consumer communities in search of innovation need to be informed about this fruit type. Thus, gardens can be set up with closed gardens, efficiency and quality can be increased, and thus the economic value will be increased. This will also contribute both to the local farmer who has limited livelihoods and to the country's economy.

For this reason, in this study, the aim was to choose the superior genotypes of *Arbutus unedo* L., which grows intensively in the Karasu province of Sakarya province in Turkey by selection.

Materials and Methods

This research was carried out in the Karasu district in the north of Sakarya region (Turkey) where the Marmara Region merges with the West Black Sea in 2015-2016. Each tree was accepted as a genotype in the study initiated in order to determine the genotypes having superior characteristics. Due to the lack of fruit yield in 2015 on 5 genotypes and in 2016 on 50 genotypes the study is to be continued.

During the research, the places where strawberry tree population is grown in the Karasu district were visited and the areas with high population density were determined and the selection of genotypes showing superior characteristics was started.

In October-November 2015, the first year of the study, genotypes were tried to be determined in the course of field studies. Due to the fact that the yield of the year 2015 was too low to be tested, the labelling of the genotypes was done according to the estimated type selection based on the characteristics such as fruit yield, juvenile number of shoots, number of branches, tree height, and body thickness. The labelling was performed with the following year in mind and the numbering started from 54 KR 01 respectively. Namely, 54 is a province traffic code, KR is a district name abbreviation and 01 is type sequence number.

Out of 70 genotypes labelled in the first year only fruits from 5 genotypes were obtained and fruit samples were taken from these genotypes. In the second year of the study, the genotypes labelled in October-November 2016 were examined and the yield was found to be better than the previous one. A total of 50 genotyped fruit samples were collected from each genotype, taking into consideration the fruit size and fruit yield characteristics of those genotypes. The fruit samples were kept at +4° C and physical and chemical analyses were performed on 10 fruits randomly selected for the parameters that are of priority importance to fruits within 5 days.

Characteristics such as fruit length and fruit stem size was measured by a digital calliper, fruit weight was measured at 0.1 with precision scales, fruit colour was read by a colorimeter (Chroma Minolta 400), the amount of total soluble solids was measured by a refractometer, pH was measured by a ph-meter, the number of fruits in a cluster, fruit appearance, fruit taste and roughness were determined as well.

The phenological observations of these genotypes were done by photographing in 2015, although research images were repeated in 2016 because the yield was not high enough in 2015.

The Weighed Grading method (Karadeniz, 1995) has been taken into account when ranking genotypes with different characteristics (Table 1). Determining the lowest and the highest limits of the findings based on the tardy rating and dividing the difference between these values by the number of classes.

Tab. 1. The Weighed Grading method

Features	Features of the Border	Coefficients	Severity Ratings
Fruit weight	≤ 4,04	1	25
	4,05 – 6,58	2	
	6,59 ≤	3	
Number of Fruits	≤4	1	10
	5-6	2	
	7≤	3	
Fruit Taste	≤ 1,97	1	10
	1,98- 3,12	2	
	3,13 ≤	3	
Juiciness	≤ 2,03	1	15
	2,04- 3,26	2	
	3,27 ≤	3	
Stoniness	≤ 2,1	3	10
	2,2- 3,41	2	
	3,40≤	1	
Appearance	1,9	1	10
	2,0- 2,99	2	
	3,0 ≤	3	
Roughness	≤ 2,17	3	10
	3,18- 3,52	2	
	3,53 ≤	1	
TSS	≤ 20,57	1	10
	20,58- 26,32	2	
	26,33	3	
TOTAL			100

Results and Discussion

Selection Studies in 2015

Fruit Properties

Only 5 genotypes were detected in the first year of the selection. In order to make fruit selection in other genotypes, fruit yield was very low. Fruit weight, fruit size, fruit shape index, fruit stalk size and fruit stalk dimensions were determined on total of 10 fruits randomly selected from 5 genotypes and given in Table 2.

Table 2. Fruit characteristics of selected genotypes

Genotype	Fruit Weight (g)	Fruit Height (mm)	Fruit Width (mm)	Fruit Index	Number of Fruits in a Cluster	Fruit Stem Length (mm)	Fruit Stem Thickness (mm)
54 KR 02	4.73	19.03	19.27	0.98	5.2	5.91	2.01
54 KR 03	4.53	15.81	15.96	0.99	4.0	5.83	2.21
54 KR 06	1.87	15.39	14.17	1.08	5.6	5.69	2.44
54 KR 09	3.56	11.62	9.82	1.18	5.2	5.78	2.79
54 KR 19	2.65	1.59	1.93	0.82	4.2	3.89	1.10

Sensory Properties

Properties such as fruit taste, fruit juice status, stoniness, fruit colour, appearance, roughness of the selected genotypes are given in Table 3.

Table 3. Sensory properties of selected types

Tip	Fruit Taste	Juiciness	Stoniness	Appearance	Roughness	Fruit colour
54 KR 02	1.2	1.4	3.80	2.4	2.4	Red
54 KR 03	1.0	1.2	3.60	2.0	4.2	Red
54 KR 06	1.2	1.4	3.80	1.8	2.2	Red
54 KR 09	3.2	4.4	2.25	2.0	2.7	Red
54 KR 19	1.5	1.7	3.10	2.6	2.9	Light Red

Chemical Properties

Total soluble solids (TSS) and pH quantities in the fruit juice of selected types are presented in Table 4. No weighed ratings were made in 2015.

Tab. 4. Chemical properties of selected genotypes

Genotype	TSS (%)	pH
54 KR 02	19	3,37
54 KR 03	19	3,09
54 KR 06	23	3,28
54 KR 09	26	3,32
54 KR 19	17	3,51

Selection Studies in 2016

The data obtained for the genotypes in 2016 as a result of the selection studies are given in Table 5. Genotypes with the same number are in the same group according to the weighed rating method.

The total scores obtained from the graded results of the scored genotypes are given in Table 6. The total weighted grading score ranged from 140 to 280. The genotypes that enter the top 10 according to the highest total score with graded rating are, 54 KR 27, 54 KR 49, 54 KR 11, 54 KR 08, 54 KR 23, 54 KR 29, 54 KR 20, 54 KR 41, 54 KR 44 and 54 KR 12.

Fruit weight according to weighed grading was highest at 54 KR 11 (75) and lowest at 54 KR 06 (25).

Fruit number in the cluster according to weighed grading ranged between 10 (54 KR 39) and 30 (54 KR 08) among genotypes.

The highest score in terms of fruit taste was 30 (54 KR 49) in this study. The 54 KR 06 and 54 KR 43 genotypes were the least tasty fruits according to weighed grading, being evaluated with 10 points.

According to juiciness 13 genotypes were highest with 45 points. 17 genotypes had least points in terms of juiciness. They had 15 points on this characteristic.

The TSS content in the fruit is a characteristic of the sweetening of the fruits. While the excess of TSS affects sweetness in the positive direction, its low level has adverse effects. The content of TSS varied between 28% and 32% among the promising types.

Tab. 5. Fruit characteristics of selected genotypes

Genotype	Fruit Weight (g)	Groups (*)	Fruit Length (mm)	Fruit Width (mm)	Fruit Shape Index	Number of Fruit in a Cluster	Coefficient	Fruit Stem Length (mm)	Fruit Stem Thickness
54 KR 01	5.10	2	20.37	19.98	1.01	5.4	2	6.34	2.01
54 KR 02	5.77	2	22.05	22.62	0.97	5.8	2	7.06	2.43
54 KR 03	5.75	2	16.56	16.80	0.98	5.6	2	6.49	3.29
54 KR 04	6.25	2	21.04	23.44	0.89	7.0	3	5.92	2.37
54 KR 05	2.71	1	15.01	17.85	0.84	4.2	1	4.85	2.89
54 KR 06	1.70	1	16.45	13.55	1.21	5.4	2	5.97	2.46
54 KR 07	2.34	1	15.98	18.02	0.88	4.4	1	6.52	1.97
54 KR 08	7.82	3	23.46	30.92	0.75	8.0	3	6.51	2.49
54 KR 09	4.28	2	20.21	20.42	0.98	6.2	2	5.78	2.79
54 KR 10	5.35	2	21.62	20.85	1.03	5.4	2	9.75	2.01
54 KR 11	9.03	3	28.57	25.55	1.11	6.0	2	7.71	2.17
54 KR 12	5.16	2	22.06	19.43	1.13	6.0	2	7.01	2.13
54 KR 13	2.03	1	14.74	16.25	0.90	5.4	2	6.04	1.24
54 KR 14	3.89	1	18.87	19.09	0.98	5.6	2	6.62	1.95
54 KR 15	3.76	1	18.74	19.86	0.94	5.4	2	9.24	2.17
54 KR 16	1.73	1	13.09	14.98	0.87	5.6	2	8.79	1.95
54 KR 17	4.13	2	18.42	21.19	0.86	6.2	2	6.67	2.17
54 KR 18	4.21	2	13.52	15.95	0.84	7.0	3	7.41	2.07
54 KR 19	2.64	1	17.52	18.14	0.96	4.2	1	5.07	1.87
54 KR 20	5.38	2	14.63	18.11	0.80	5.8	2	6.97	2.01
54 KR 21	4.43	2	21.41	22.39	0.95	6.2	2	8.17	1.97
54 KR 22	3.67	1	19.91	21.05	0.94	5.4	2	6.78	2.19
54 KR 23	6.41	2	19.74	24.59	0.80	7.0	3	6.95	2.49
54 KR 24	3.14	1	16.75	18.87	0.88	7.0	3	7.07	2.15
54 KR 25	2.71	1	17.02	17.29	0.98	6.2	2	4.69	1.25
54 KR 26	2.35	1	18.53	16.39	1.13	8.0	3	4.42	1.90
54 KR 27	8.14	3	21.23	24.86	0.85	7.0	3	6.80	2.41
54 KR 28	4.57	2	18.41	21.42	0.85	6.4	2	5.41	1.97
54 KR 29	5.65	2	20.33	24.03	0.84	5.6	2	14.09	2.34
54 KR 30	3.26	1	17.35	18.28	0.94	5.4	2	6.59	2.17
54 KR 31	3.37	1	19.01	18.89	1.00	7.0	3	7.82	1.89
54 KR 32	3.29	1	17.79	19.27	0.92	5.6	2	6.14	1.13
54 KR 33	4.81	2	19.92	21.72	0.91	8.0	3	5.63	2.03
54 KR 34	3.41	1	17.35	18.13	0.95	6.2	2	6.32	2.01
54 KR 35	5.63	2	10.15	11.42	0.88	6.0	2	7.22	2.37
54 KR 36	4.21	1	16.88	16.15	1.04	7.0	3	6.23	1.86
54 KR 37	5.59	2	20.26	22.43	0.90	4.2	1	5.87	2.13
54 KR 38	4.95	2	20.18	19.95	1.01	6.0	2	6.93	1.61

Genotype	Fruit Weight (g)	Groups (*)	Fruit Length (mm)	Fruit Width (mm)	Fruit Shape Index	Number of Fruit in a Cluster	Coefficient	Fruit Stem Length (mm)	Fruit Stem Thickness
54 KR 39	3.61	1	17.11	19.33	0.88	4.8	1	5.11	1.59
54 KR 40	5.23	2	20.13	17.08	1.17	5.6	2	7.14	1.65
54 KR 41	8.58	3	24.04	25.06	0.95	4.0	1	8.97	2.92
54 KR 42	4.34	2	17.97	19.98	0.89	4.2	1	4.53	1.99
54 KR 43	3.51	1	17.09	18.83	0.90	6.0	2	6.59	1.31
54 KR 44	4.09	2	25.24	18.91	1.33	5.4	2	4.53	1.97
54 KR 45	2.92	1	16.91	18.16	0.93	4.4	1	5.80	1.87
54 KR 46	3.41	1	17.57	17.09	1.02	5.4	2	5.95	1.97
54 KR 47	3.68	1	19.67	19.25	1.02	5.6	2	4.35	2.01
54 KR 48	4.42	2	20.05	24.30	0.82	5.4	2	6.23	1.79
54 KR 49	8.21	3	22.45	25.08	0.89	5.6	2	7.69	2.63
54 KR 50	3.46	1	17.39	20.61	0.84	5.8	2	7.41	1.59

** Genotypes with the same number are in the same group according to the weighed rating method.*

In our country, studies on strawberry tree (*Arbutus unedo L.*) in some regions of Çoruh valley and Eastern Black Sea Region have determined the content of TSS as 18.5-32.0 (Güleryüz et al. 1995; Karadeniz et al. 1996; Karadeniz and Şişman, 2004).

Tab. 6. Scores related to selection criteria on weighed grading

Genotypes	Fruit Weight (g)	Number of Fruits in a Cluster	Fruit Taste	Juiciness	Stoniness	Appearance	Roughness	TSS	Total Point
54 KR 01	50	20	10	45	30	10	20	10	195
54 KR 02	50	20	10	15	10	20	20	10	155
54 KR 03	50	20	10	15	10	20	10	10	145
54 KR 04	50	30	10	30	10	10	10	10	160
54 KR 05	25	10	10	30	30	20	20	20	165
54 KR 06	25	20	10	15	10	10	30	20	140
54 KR 07	25	10	30	45	10	20	20	30	190
54 KR 08	75	30	30	30	10	20	20	20	235
54 KR 09	50	20	20	30	30	20	10	20	200
54 KR 10	50	20	20	30	10	20	30	20	200
54 KR 11	75	20	20	45	30	20	10	30	250
54 KR 12	50	20	20	30	30	20	20	30	220
54 KR 13	25	20	10	15	20	30	20	30	170
54 KR 14	25	20	10	30	30	20	30	20	185
54 KR 15	25	20	10	15	20	10	20	20	140
54 KR 16	25	20	10	15	20	10	20	30	150

Genotypes	Fruit Weight (g)	Number of Fruits in a Cluster	Fruit Taste	Juiciness	Stoniness	Appearance	Roughness	TSS	Total Point
54 KR 17	50	20	10	30	20	10	10	10	160
54 KR 18	50	30	10	15	10	10	10	20	155
54 KR 19	25	10	10	15	20	20	20	20	140
54 KR 20	50	20	10	45	30	10	30	30	225
54 KR 21	50	20	10	30	10	20	10	20	170
54 KR 22	25	20	20	30	10	20	10	20	155
54 KR 23	50	30	20	45	20	30	30	10	235
54 KR 24	25	30	10	15	20	20	30	30	180
54 KR 25	25	20	20	15	20	10	30	20	160
54 KR 26	25	30	10	15	30	10	30	30	180
54 KR 27	75	30	30	45	20	30	30	20	280
54 KR 28	50	20	20	15	10	30	10	20	175
54 KR 29	50	20	20	45	30	20	10	30	225
54 KR 30	25	20	30	45	30	10	30	30	220
54 KR 31	25	30	30	45	20	10	30	30	220
54 KR 32	25	20	20	30	10	10	10	20	145
54 KR 33	50	30	20	30	10	30	30	20	220
54 KR 34	25	20	10	15	20	20	20	20	150
54 KR 35	50	20	10	30	20	20	10	10	170
54 KR 36	25	30	20	45	20	30	30	20	220
54 KR 37	50	10	20	15	20	30	10	20	175
54 KR 38	50	20	10	15	10	20	20	20	165
54 KR 39	25	10	20	45	30	20	20	30	200
54 KR 40	50	20	10	15	10	30	30	20	185
54 KR 41	75	10	10	30	30	20	30	20	225
54 KR 42	50	10	10	30	20	30	30	20	200
54 KR 43	25	20	10	45	20	30	30	10	190
54 KR 44	50	20	20	45	30	10	30	20	225
54 KR 45	25	10	10	15	30	10	30	20	150
54 KR 46	25	20	10	15	30	10	20	20	150
54 KR 47	25	20	10	15	10	10	30	30	150
54 KR 48	50	20	20	45	30	10	30	10	215
54 KR 49	75	20	30	45	30	30	20	20	270
54 KR 50	25	20	20	45	20	30	20	20	200

In 2016 the average fruit width was between 22.62 mm and 30.92 mm, the fruit length was between 21.23 mm and 28.57 mm, and the fruit shape index between 1.01 and 1.33 in the selected promising genotypes. Karadeniz et al. (2003) determined fruit width at 17.92-37.95 mm and fruit length at 15.02-34.43 mm in Trabzon. The fruit size of our genotypes was lower compared to those types (Figure 1).

Figure 1. a) Flowers and matured fruits on tree, b) Matured fruits

The pH values of the promising genotypes range from 3.49 to 3.66. Karadeniz et al. (2003) determined these values in the study around Trabzon to be between 3.41 and 4.25. In the study conducted around Blacksea and Giresun pH values were 3.5 on average (Karadeniz and Şişman, 2004). When the pH values are compared with our genotypes, it will be seen that the values in the vicinity of Trabzon are higher than our values and the values in the province of Giresun were similar to ours.

Conclusion

The Black Sea region offers a suitable ecology for Strawberry trees. There have been limited studies carried out on strawberry trees, and yet a variety of this fruit has not been developed. However, in terms of both health and landscape, this type of fruit is very valuable. We are in the hope that a valuable genotype will be developed as a result of similar studies in the Black Sea region. In this study, which we conducted on 50 genotypes in the Karasu district of the Sakarya province, this opinion becomes meaningful. Because 10 genotypes were found to be promising in the Karasu district, we will continue this work with selection stage 2 and we will continue to work on the kind of development.

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Селекција генотипова магиње (*Arbutus unedo* L.) гајених у Карасу, покрајина Сакарја

Туран Карадениз[1], С. Вилдан Ерсој[1], Емрах Гулер[1], Ф. Екмел Текинташ[2]

[1]*Abant İzzet Baysal Универзитет, Факултет природних наука, Болу, Турска*
[2]*Adnan Menderes Универзитет, Пољопривредни факултет, Ајдин, Турска*

Сажетак

Истраживање је спроведено током периода 2015-2016 у покрајини Сакарја. Стабла магиње су из природних популација овој покрајини. У ово селекционо истраживање, укључено је укупно 50 генотипова магиње. У циљу фенолошких посматрања, помолошка анализа и метод тежинских коефицијената је примјењен за анализу 50 генотипова магиње. Укупно 100 узорака плодова је прикупљено током испитиваних година 2015 и 2016, од чега је за даље анализе кориштено по 10 плодова. Маса плода кретала се у распону од 1,70 g и 9.03 g, ширина плода од 11,42 mm до 30,52 mm, дужина плода од 10,15 до 14,09 mm, ширина петељке од 1,13 до 3,29 mm, број плодова у грозду 3 до 8, количина растворљиве суве материје 15 до 32 %, pH воћног сока 3,09 до 3,51. На крају истраживања, одабрано је пет генотипова са најбољим особинама.

Кључне ријечи: селекција, помологија, фенологија, WG метод, Карасу

Turan Karadeniz
E–mail: *turankaradeniz@hotmail.com*

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