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Research Article

Some Morphological and Pomological Characteristics of Local Mulberry (*Morus* spp.) Selections in Adıyaman

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Abstract

Mulberry species are counted in the fruit species that Turkey is in its origin area. Adıyaman is one of the provinces of Turkey located in the Southeastern Region of Anatolia that hosts local mulberry genotypes with different characteristics. In this study, a field survey in Adıyaman province was conducted to evaluate local mulberry genotypes and select promising ones for further evaluations. For this aim, some morphological and pomological properties of the evaluated genotypes were characterized, and totally 20 genotypes (12 white, 4 black, 4 red) were selected as promising. Fresh fruit weight varied between 1.8 and 6.2 g in white, 3.0 and 5.3 g in black, and 1.3 and 3.1 g in red mulberry genotypes. Dry fruit yield changed between 18.3 and 56.0% in the selected genotypes. As a result of the evaluations; seven white and two red mulberry genotypes were selected for drying, three white mulberries for syrup (pekmez), and three white and two red mulberries for table use, and black mulberries for fruit juice purposes.

Key words: Adıyaman, fruit quality, mulberry, selection, promising.

Adıyaman Yerel Dut (*Morus* spp.) Seleksiyonlarının Bazı Morfolojik ve Pomolojik Özellikleri

Özet

Dut türleri Türkiye'nin anavatanı sınırları içerisinde olduğu meyve türlerinden biri olarak kabul edilmektedir. Adıyaman, Türkiye'nin Güneydoğu Anadolu Bölgesi'nde yer alan illerinden biri olup, farklı özelliklerdeki dut genotiplerine ev sahipliği yapmaktadır. Bu çalışmada, yerel dut genotipleri değerlendirilerek, ümitvar olanların seçilmesi ve ileriki aşamalarda incelenmesi amacıyla Adıyaman ilinde arazi sürveyleri gerçekleştirilmiştir. Bu amaçla, incelenen genotiplerin bazı morfolojik ve pomolojik özellikleri karakterize edilmiş, toplamda üç türden 20 genotip seçilmiştir. Seçilen beyaz dutlarda taze meyve ağırlıkları 1.8 ile 6.2 g arasında, kara dutlarda 3.0 ile 5.3 g arasında, kırmızı dutlarda ise 1.3 ile 3.1 g arasında değişmiştir. İncelenen genotipler arasında kuru meyve randımanı ise %18.3 ile 56.0 arasında değişmiştir. İncelemeler sonucunda; yedi beyaz, iki kırmızı dut kurutma, üç beyaz genotip pekmez yapımı, üç beyaz ve iki kırmızı genotip taze tüketim, kara dutlar ise meyve suyu için uygun bulunmuştur.

Anahtar kelimeler: Adıyaman, meyve kalitesi, dut, seleksiyon, ümitvar.

Introduction

Mulberry (*Morus* spp.) is a genus of Moraceae family of Urticales order. There are more than 100 mulberry species in Morus genus distributed mainly temperate but also subtropical areas having various plant and fruit characteristics (De Candolle, 1967). In all those identified 10-12 species are grown for agricultural purposes, but especially *Morus alba* L. (white mulberry), *Morus nigra* L. (black mulberry), and *Morus rubra* L. (red mulberry) are the most common mulberry species (Ercisli, 2004; USDA, 2019).

Fruits of mulberry species are usually obtained from trees that grown in house gardens or roadsides, instead of professional agricultural orchards. However, together with the increasing

interest in mulberry fruits, production has started to become widespread in mulberry orchards. Although mulberry trees have a wide spread area in the world, they are generally considered as a plant which is used for silkworm cultivation rather than fruit. This would be the probable reason of why FAO (Food and Agriculture Organization) does not provide mulberry production facts. Nevertheless, Turkish Statistical Institute (TÜİK) reports mulberry fruit production facts of Turkey which was 66.647 tons in 2018 (TÜİK, 2019).

Mulberry fruits are demanded thanks to its high nutritive value and unique aroma. Especially the suitability of mulberry plants for organic growing and the richness of mulberry fruits in terms of phenolic compounds have increased this demand. Even though, fresh market of mulberry fruits is limited because of the challenges in post-harvest management, the fruit is consumed by drying or processed to food products such as molasses, fruit leather, biscuits, ice cream, jam which significantly expand the potential of the fruit (Erturk and Gecer, 2012; Karataş and Şengül, 2018).

Anatolia is home to many fruit species with its climatic characteristics and geographical location, and it is within the natural spreading areas of mulberry species. In Turkey, where mulberry has been cultivated for centuries, 95% of the mulberry trees are white mulberry, 3% is red mulberry, and 2% is black mulberry (Ercisli, 2004; Orhan, 2009). However, almost all of the mulberry trees grown in Turkey are non-registered local genotypes. Nevertheless, various registered varieties such as Ayaş, Ulukale, Potamia, Ekşi Kara and Tatlı Kara which are suitable for different purposes are listed in Turkish national variety list (TTSM, 2019).

Selection studies, based on investigation and selection of genetic resources which are suitable for different purposes, play significant roles in improving yield and quality in plant production. In addition, detailed characterization and preservation of genotypes with different characteristics from these genetic sources is important for the use of these genotypes as parents in cross breeding studies. In this context, some selection studies have been performed on local mulberry genotypes in Turkey, where constitutes an important genetic source for mulberry species. For example, Özgen et al. (2009) selected 86 mulberry genotypes from different regions of Turkey and investigated those genotypes in terms of their morphological, pomological and biochemical attributes. In another study, Çöçen (2017) characterized 75 mulberry genotypes selected from different regions of Turkey and preserved in a genetic resources collection orchard in Malatya. However, as far as the current knowledge, there are no previous reports on a selection study conducted in Adıyaman Province where is another important area for mulberry genetic resources with the local genotypes.

For all those reasons, this study was conducted to determine some morphological and pomological characteristics of local *Morus* selections grown in Adıyaman Province in Southeastern Region of Turkey. The results of the study can be used in the registration process of these local cultivars and may be taken into consideration in the selection of parents in future breeding programs.

Materials and Methods

This study was consisted of selection promising local mulberry genotypes from different parts of Adıyaman Province of Turkey (described in Table 1) in terms of fruit characteristics. Together with the fruit characteristics, tree growth habit and leaf characteristics were also noted. As part of the study, field surveys were conducted in 2019 and totally 20 genotypes (12 white, 4 red, 4 black) were found promising and characterized in terms of their leaf and fruit characteristics.

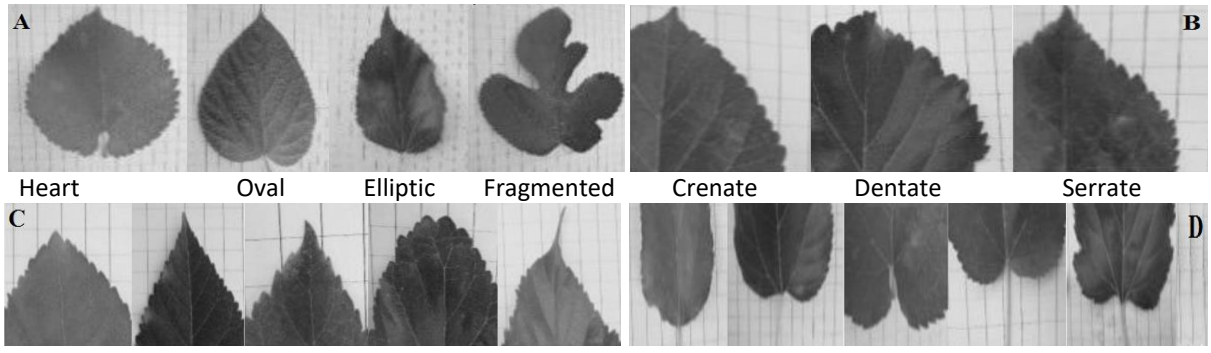

Figure 1. Classification of leaf part shapes.

In terms of leaf characteristics; shape characteristics were score according to Figure 1; leaf shape (A), leaf margin shape (B), leaf tip shape (C), and leaf base shape (D) (Çöçen, 2017). Leaf samples were categorized according to leaf blade fragmentation status as entire (E), fragmented (F) or entire+fragmented (E+F). Besides, leaf blade length and width, petiole length and thickness were measured in mm using digital calipers.

Table 1. Definition of selection areas and codes of genotypes.

Genotype	Selected From		
	Morus alba		
Ataköy 1, 2, 3	Ataköy Village, Center/Adıyaman	N 37°45'36.13"	E 38°12'53.15"
Oluklu	Oluklu Village, Center/Adıyaman	N 37°50'09.45"	E 38°12'57.05"
Tut 1	Center, Tut/Adıyaman	N 37°47'59.18"	E 37°55'25.86"
Tut 2	Center, Tut/Adıyaman	N 37°47'15.51"	E 37°54'01.81"
Tut 3	Center, Tut/Adıyaman	N 37°48'24.32"	E 37°55'10.16"
Kaşlıca	Kaşlıca Village, Tut/Adıyaman	N 37°49'20.27"	E 37°59'01.01"
Karadut	Karadut Village, Kahta/Adıyaman	N 37°55'39.33"	E 38°47'27.52"
Bağözü	Bağözü Village, Kahta/Adıyaman	N 37°50'59.84"	E 38°36'01.02"
Bağlar	Bağlar Village, Kahta/Adıyaman	N 37°46'50.53"	E 38°34'28.39"
Konuklu	Konuklu Village, Besni/Adıyaman	N 37°35'54.63"	E 37°57'06.72"
	Morus nigra		
Dikilcik	Dikilcik Village, Merkez/Adıyaman	N 37°45'06.94"	E 38°13'30.74"
Oluklu	Oluklu Village, Merkez/Adıyaman	N 37°50'09.45"	E 38°12'57.05"
Tut	Center, Tut/Adıyaman	N 37°48'24.32"	E 37°55'10.16"
Karadut	Karadut Village, Kahta/Adıyaman	N 37°55'50.86"	E 38°46'54.77"
	Morus rubra		
Dikilcik	Dikilcik Village, Center/Adıyaman	N 37°44'50.13"	E 38°13'57.23"
Ataköy	Ataköy Village, Center/Adıyaman	N 37°45'36.13"	E 38°12'53.15"
Oluklu	Oluklu Village, Center/Adıyaman	N 37°50'10.29"	E 38°12'59.39"
Karadut	Karadut Village, Kahta/Adıyaman	N 37°55'50.86"	E 38°46'54.77"

Fruit samples were characterized in terms of shape, taste, juice yield, sizes, weight, and total soluble solids (TSS) content. Fruit shape was scored as oval, and short or long cylindrical. Fruit taste was scored as sweet, sweet-sourish, and sourish. Juice yield was scored as low (<50%), moderate (50-60%), and high (>50%) according to percentage of fruit juice obtained from 100 g of fresh fruit (Keskin, 2016). Fruit length and width were measured in mm with digital calipers. Fresh and dry fruit weights were measured by precision scales (0.1 g), and dry fruit yield percentage was obtained according to the proportion of dry fruit weight in fresh fruit weight. TSS content were detected by refractometer (ATC 0-32) and expressed in the value of percentage.

Scale assessments were performed by three agricultural professionals. All morphological and pomological characteristics were measured in multiple replicates for each selected genotype. The obtained results were evaluated according to Duncan's Multiple Range Test ($P \leq 0.05$) using SPSS 23.0 for Windows software.

Results and Discussion

In this study, different parts of Adıyaman Province of Turkey were surveyed to determine promising local genotypes for different purposes. For this aim, morphological and pomological characteristics of the surveyed genotypes were assessed and totally 20 genotypes from three species were selected for their different properties. The results of selected mulberry genotypes were reviewed separately for each species.

Results of scale evaluations of leaf and fruit samples were presented in Table 2. Accordingly, almost all types of leaf shapes in scale (Figure 1) were observed in the selected genotypes indicating a high variation between the genotypes. In white mulberry genotypes, four different leaf shape types were observed, whereas all leaves of black mulberries were heart shapes, and oval and elliptic types were observed in red mulberries. Leaf margins of most of the white mulberries were noted as serrate, but dentate for black and red mulberries. Leaf tip shape varied between the genotypes, and the white mulberries presented four different leaf tip shape, while two different leaf tips in black mulberries and three different leaf tips in red mulberries were observed. M-shape was the main leaf base shape in white and red mulberries, whereas auriculate for black mulberry genotypes.

Table 2. Scale assessments of leaf and fruit samples of selected mulberry genotypes.

Genotype	LS	LMS	LTS	LBS	LBF	FS	FT	Juice	TGH
Morus alba (white (W) mulberry)									
Ataköy W1	Oval	Serrate	Rounded	M-shaped	E + F	Short	Sweet	Low	Umbrella
Ataköy W2	Oval	Serrate	Rounded	M-shaped	E + F	Oval	Sweet	High	Umbrella
Ataköy W3	Elliptic	Dentate	Aristulate	M-shaped	E	Long	Sweet	High	Weeping
Oluklu W	Oval	Serrate	Cuspidate	M-shaped	E	Short	Sweet	Low	Umbrella
Tut W1	Oval	Crenate	Aristulate	Cordate	E	Short	Sweet	Moderate	Half-Upright
Tut W2	Elliptic	Serrate	Aristulate	M-shaped	E	Short	Sweet	Moderate	Umbrella
Tut W3	Oval	Serrate	Aristulate	Cordate	E	Short	Sweet	Moderate	Half-Upright
Kaşlıca W	Heart	Crenate	Subacute	Subacute	E	Long	Sweet	High	Umbrella
Karadut W	Elliptic	Serrate	Aristulate	M-shaped	E	Short	Sweet	Low	Umbrella
Bağözü W	Elliptic	Dentate	Aristulate	M-shaped	E	Short	Sweet	Moderate	Half-Upright
Bağlar W	Oval	Serrate	Aristulate	M-shaped	E	Short	Sweet	Low	Umbrella
Konuklu W	Oval	Crenate	Subacute	Cordate	E	Short	Sweet	Moderate	Umbrella
Morus nigra (black (B) mulberry)									
Dikilcik B	Heart	Dentate	Cuspidate	Auriculate	E + F	Oval	Sweet-Sourish	High	Weeping
Oluklu B	Heart	Dentate	Cuspidate	Auriculate	E	Short	Sweet-Sourish	High	Weeping
Tut B	Heart	Serrate	Subacute	Auriculate	E	Oval	Sweet-Sourish	High	Weeping
Karadut B	Heart	Dentate	Subacute	Auriculate	E	Short	Sourish	High	Weeping
Morus rubra (red (R) mulberry)									
Dikilcik R	Oval	Crenate	Aristulate	Cordate	E	Short	Sweet-Sourish	High	Weeping
Ataköy R	Elliptic	Dentate	Aristate	M-shaped	E	Oval	Sweet-Sourish	Low	Half-Upright
Oluklu R	Oval	Dentate	Rounded	Rounded	E	Long	Sweet-Sourish	High	Half-Upright
Karadut R	Oval	Dentate	Aristate	M-shaped	E + F	Oval	Sweet-Sourish	Low	Weeping

LS: Leaf Shape, LMS: Leaf Margin Shape, LTS: Leaf Tip Shape, LBS: Leaf Base Shape, FS: Fruit Shape, FT: Fruit Taste, TGH: Tree Growth Habit.

Results of morphological and pomological measurements were given in Table 3 and significant differences between the results were signed with different letters. All of the assessed characters significantly varied between the genotypes, except dry fruit yield values of black mulberry genotypes.

Table 3. Results of morphological and pomological measurements of selected mulberry genotypes.

Genotype	LL	LW	PL	PT	FL	FW	FSL	FFW	DFW	DFY	TSS
Morus alba (white (W) mulberry)											
Ataköy W1	78.4 e	53.6 e	39.8 def	1.4 de	21.2 e	12.2 fg	6.9 fg	1.8 f	0.9 bc	48.1 ab	27.1 ab
Ataköy W2	111.6 c	88.1 c	61.6 ab	2.2 c	28.2 b	19.5 a	6.6 g	5.2 b	1.7 a	33.1 c	20.9 cd
Ataköy W3	142.6 ab	92.1 bc	64.2 a	2.5 bc	32.3 a	17.1 b	7.6 efg	5.3 b	1.8 a	32.1 c	22.1 c
Oluklu W	88.3 de	52.3 e	34.7 ef	1.1 ef	21.8 de	13.2 ef	8.4 def	2.3 ef	0.9 bc	30.2 c	25.5 b
Tut W1	88.0 de	55.0 e	33.0 ef	1.3 def	22.8 cde	13.1 ef	13.4 a	2.0 f	0.6 c	31.7 c	28.9 a
Tut W2	97.1 cd	56.2 e	29.5 f	1.0 f	24.4 c	14.9 cd	7.6 efg	3.0 d	1.2 b	39.5 bc	30.2 a
Tut W3	136.1 b	85.4 cd	55.9 abc	2.5 bc	28.8 b	15.5c	6.1 g	4.2 c	1.6 a	37.5 bc	27.5 ab
Kaşlıca W	144.8 ab	133.5 a	38.4 def	3.5 a	32.4 a	16.1 bc	9.9 bcd	6.2 a	1.8 a	29.8 c	27.5 ab
Karadut W	103.9 cd	76.7 d	49.9 bcd	1.6 d	24.0 cd	13.5 def	11.3 b	2.9 de	1.2 b	43.4 abc	28.7 ab
Bağözü W	99.9 cd	50.3 e	33.5 ef	1.4 de	20.5 e	13.8 de	8.4 def	2.2 f	0.9 bc	38.9 bc	28.6 ab
Bağlar W	156.6 a	100.2 b	48.7 bcd	2.8 b	21.1 e	11.5 g	10.3 bc	1.8 f	1.0 bc	56.0 a	22.4 c
Konuklu W	101.6 cd	75.2 d	43.8 cde	1.7 d	20.7 e	12.6 efg	8.7 cde	2.1 f	0.9 bc	40.6 bc	18.7 d
Morus nigra (black (B) mulberry)											
Dikilcik B	128.5 a	138.5 a	21.7 ab	3.7 a	14.6 c	6.6 c	3.3 bc	3.0 b	0.7 b	22.6	21.0 a
Oluklu B	131.3 a	132.5 a	28.0 a	2.5 b	29.2 a	18.8 a	2.6 c	5.3 a	1.4 a	23.6	23.9 a
Tut B	112.8 ab	124.8 a	30.9 a	3.5 ab	25.4 b	17.3 a	5.8 a	3.7 b	0.8 b	22.8	23.3 a
Karadut B	88.5 c	99.5 b	16.8 b	2.6 ab	24.8 b	13.7 b	4.8 ab	3.0 b	0.6 b	18.6	15.7 b
Morus rubra (red (R) mulberry)											
Dikilcik R	135.3 a	86.8 a	34.0 b	2.2	23.8 b	14.8 a	8.5 b	2.0 b	0.4 b	18.3 b	20.7 a
Ataköy R	91.0 b	54.6 b	29.9 b	1.6	18.0 c	11.3 b	6.0 c	1.3 c	0.6 a	41.0 a	16.4 b
Oluklu R	99.7 b	63.9 b	50.1 a	3.6	27.4 a	13.8 a	11.9 a	3.1 a	0.8 a	25.3 b	20.9 a
Karadut R	127.4 a	99.0 a	62.4 a	2.0	17.1 c	10.8 b	9.8 b	1.3 c	0.6 ab	43.7 a	16.3 b

LL: Leaf Length, LW: Leaf Width, PL: Petiole Length, PT: Petiole Thickness, FL: Fruit Length, FW: Fruit Width, FSL: Fruit Stalk Length, FFW: Fresh Fruit Weight, DFW: Dry Fruit Weight, DFY: Dry Fruit Yield, TSS: Total Soluble Solids.

Differences between values signed with different letters within the rows of species are significant at $P \leq 0.05$.

Fruit shape were mostly characterized as short cylindrical together with oval (1 white, 2 black, and 2 red) and long cylindrical (2 white, 1 red) fruit shaped genotypes. All white mulberries were sweet tasted, whereas all black and red mulberries were sweet-sourish, except one sourish black mulberry genotype. Fruit juice yields were high in all black mulberry genotypes. Three white and two red mulberry genotypes were also characterized as high juice yielding. There were no significant difference in tree growth habits of black mulberry genotypes, where as three habits (half-upright, umbrella, and weeping) in white and two habits (half-upright and weeping) in red mulberries were observed.

In white mulberry genotypes, leaf length and width varied between 78.4 mm (Ataköy W1) and 156.6 mm (Bağlar W), and 50.3 mm (Bağözü W) and 133.5 mm (Kaşlıca W), respectively. Petiole length and thickness were between 29.5 mm (Tut W2) and 64.2 mm (Ataköy W3), and 1.0 mm (Tut W2) and 3.5 mm (Kaşlıca W). Fruit length and width changed between 20.5 mm (Bağözü W) and 32.4 mm (Kaşlıca W), and 11.5 mm (Bağlar W) and 19.5 mm (Ataköy W2). The highest fruit stalk length was found in Tut W1 (13.4 mm), whereas Tut W3 presented the lowest value (6.1 mm). Kaşlıca W was the leading white mulberry genotype in terms of fresh and dry fruit weight with 6.2 and 1.8 g average weight values. Kaşlıca W was also in the leading dry fruit weight significance group together with Ataköy W3. However, instead of these genotypes Bağlar W gave the highest dry fruit yield with 56.0% dry fruit of unit fresh fruit weight. The highest total soluble solids content was found in Tut W2 and Tut W1 (30.2 and 28.9%).

Black mulberry genotypes presented bigger leaves when compared with other species in terms of leaf area. The difference in leaf length and width values between Dikilcik B, Oluklu B, and Tut B was not significant, whereas Karadut B presented significantly lower leaf length and width values (88.5 and 99.5, respectively). Petiole length varied between 16.8 and 30.9 mm (Karadut B and Tut B), and petiole thickness were between 2.6 and 3.7 mm (Karadut B and Dikilcik B). Fruits of Dikilcik B were smaller in terms of fruit length and width when compared to other black mulberry genotypes. Oluklu B was the highest fruit length and width (29.2 and 18.8 mm) presenting black mulberry. Fruit stalk length varied between 2.6 and 5.8 mm (Oluklu B and Tut B, respectively). Fresh and dry fruit weight were highest in Oluklu B (5.3 and 1.4 g, respectively), and the lowest in Karadut B (3.0 and 0.6 g, respectively), whereas the difference in dry fruit yield values were not found significant between the black mulberry genotypes. Total soluble solids content varied between 15.7 and 23.9% (Karadut B and Oluklu B, respectively).

Leaf length and width in red mulberry genotypes were highest in Dikilcik R and Karadut R (135.3 and 127.4 mm, and 86.8 and 99.0 mm, respectively). The highest petiole length values were found in Karadut R and Oluklu R (62.4 and 50.1 mm, respectively), whereas no significant difference between the red mulberry genotypes were detected in terms of petiole thickness. Oluklu R gave the highest fruit length value (27.4 mm), and stated in the leading fruit width genotypes together with Dikilcik R. Fruit stalk length varied between 6.0 and 11.9 mm (Ataköy R and Oluklu R, respectively). Oluklu R was the highest fresh and dry fruit weighted red mulberry genotype with the values of 3.1 g fresh and 0.8 g dry average fruit weight. On the other hand, Karadut W (43.7%) and Ataköy W (41.0%) were the highest dry fruit yielding red mulberry genotypes. Total soluble solids content varied between 16.3 and 20.9% (Karadut R and Oluklu R, respectively).

As a result of the overall fruit quality evaluations; Ataköy W1, Tut W2, Tut W3, Karadut W, Bağözü W, Bağlar W, Konuklu W, Ataköy R, and Karadut R were concluded to be suitable for drying purposes, and Ataköy W2, Ataköy W3, and Kaşlıca W for syrup (pekmez). Tut W1, Tut W3, Konuklu W, Dikilcik R, and Oluklu R were selected for table use. Black mulberry genotypes were selected for fruit juice.

One of the most comprehensive studies regarding morphological and pomological characterization of mulberry genotypes in Turkey has been performed by Çöçen (2017) who assessed more than 60 local mulberry genotypes (white, black and red mulberries) from different parts of Turkey and reported leaf length between 71.2 and 160.4 mm, leaf width between 48.6 and 121.1 mm, petiole length between 16.8 and 46.9 mm, and petiole thickness between 1.2 and 5.1 mm. Özkaya Erkaleli and Dalkılıç (2016) investigated leaf characteristics of black mulberry genotypes selected from Ulubey county of Uşak Province, and reported leaf length between 87.3 and 125.0 mm, leaf width between 81.0 and 119.0 mm, and petiole length between 17.7 and 28.3 mm which indicated smaller leaves when compared with our results. Uzun and Bayır (2009) surveyed black mulberry genotypes in Antalya Province and reported mean leaf length as 105.3 mm, leaf width as 84.4 cm, and petiole length as 28.7 mm. Orhan (2009) selected 26 mulberry genotypes from Olur and Oltu counties of Erzurum Province and leaf length were between 107.3 - 139.9 mm, leaf width 70.8 - 110.8 mm, petiole length 21.2 - 58.2 mm, and petiole thickness 1.6 - 2.9 mm. Our results

were within these results except leaf width and petiole length that genotypes with wider leaves and longer petioles reported as part of this study.

Fruit length and fruit width were reported between 16.4 - 32.0 mm and 8.9 - 18.3 mm by Çöçen (2017). Aslan (1998) surveyed Malatya Province and found white, black and red mulberry genotypes having fruit length between 18.4 - 24.4 mm and fruit width 9.9 - 21.1 mm. When compared with these results, longer and wider white mulberries were detected in our study. On the other hand, Yılmaz (2004) surveyed Adana Province of Turkey and found white, black and red mulberry genotypes having fruit length between 22.0 - 34.3 mm and fruit width between 15.0 - 21.0 mm which include longer and wider fruits when compared with our results. Fruit stalk length were measured between 1.3 and 11.1 mm by Çöçen (2017), whereas longer white and red mulberry genotypes were observed in our study.

The highest fresh fruit weight found in the previous white, black and red mulberry selection studies in Turkey was 8.7 g Güneş and Çekiç (2004), and 0.3 g Gündoğdu et al. (2012) was the lowest. Our results were within these limits. The highest dry fruit yield mentioned by Çöçen (2017) was 41.5%, and higher dry fruit yielding white mulberry genotypes were found in this current study.

In the previous studies, total soluble solid contents of mulberry selections varied between 5.1% (Gündoğdu et al., 2012) and 33% (Türemiş et al., 2004). Our results were within the limits of previous studies which were between 15.7% and 30.2%.

Conclusion

In this study local mulberry genotypes in different parts of Adıyaman Province of Turkey were evaluated in terms of their morphological and pomological characteristics. When compared to the previous mulberry selection studies performed in Turkey, this current study resulted with white, black and red mulberry genotypes having wider leaf blade, longer petioles and fruit stalk, and higher dry fruit yield were determined. As a result of this study, mulberry genotypes especially for drying purposes were remarked in the selected local white genotypes. Together with white mulberry genotypes, red mulberry genotypes that would be suitable for drying purposes were also distinguished which would be a new product for mulberry consumption market.

References

Aslan, M.M. 1998. Malatya, Elazığ, Erzincan ve Tunceli İllerine Bağlı İlçelerden Ümitvar Dut Tiplerinin Seçimi. Çukurova University, Institute of Science, Department of Horticulture, MSc Thesis, Adana.

Çöçen, 2017. Malatya Dut Genetik Kaynaklari Parselinde Bulunan Dut Genotiplerinin Fenolojik, Pomolojik ve Morfolojik Karakterizasyonu. Erciyes University, Institute of Science, Department of Horticulture, MSc Thesis, Kayseri.

De Candolle, A.1967. Origin of Cultivated Plants. New York and London. p. 149-153.

Ercisli, S. 2004. A short review of the fruit germplasm resources of Turkey. *Genetic Resources and Crop Evolution*, 51(4); 419-435.

Erturk Y.E., Gecer M.K. 2012. Economy of berries. IV. National Berry Symposium, 3-5 October, Antalya.

Gündoğdu, M., Yılmaz, H., Geçer, M.K., Kayakeser, U. 2012. Van Gölü Havzasındaki dut türlerinin farklı olgunluk dönemlerindeki (*Morus nigra* L., *Morus alba* L. ve *Morus rubra* L.) bazı fizikokimyasal özelliklerinin belirlenmesi. IV. National Berry Symposium, 3-5 October, Antalya.

Güneş, M., Çekiç, Ç. 2004. Tokat yöresinde yetiştirilen farklı dut türlerinin fenolojik ve pomolojik özelliklerinin belirlenmesi. Symposium of Kiwifruit and Small Fruits, 23-25 October, Ordu.

Karataş, N., Şengül, M. 2018. Dut pekmezinin bazı kimyasal ve fiziksel özellikleri ile antioksidan aktivitesi üzerine depolamanın etkisi. Türk *Tarım ve Doğa Bilimleri Dergisi*, 5(1): 34-43.

Keskin, S. 2016. Gümüşhane İli Dutlarının (*Morus* spp.) Seleksiyonu ve Moleküler Karakterizasyonu, Gaziosmanpaşa University, Institute of Science, Department of Horticulture, Phd Thesis, Tokat.

Orhan, E. 2009. Oltu ve Olur İlçelerinde Yetiştirilen Dutların (*Morus* Spp.) Seleksiyon Yoluyla Seçimi Ve Seçilen Tiplerde Genetik Akrabalığın Rapd Yöntemiyle Belirlenmesi, Atatürk University, Institute of Science, Department of Horticulture, Phd Thesis, Erzurum.

Özgen, M., Günec, M., Akça, Y., Türemiş, N., Ilgın, M., Kızılcı, G., Erdoğan, Ü., Serçe, S. 2009. Morphological characterization of several Morus species from Turkey. *Horticulture, Environment and Biotechnology*, 50(1): 9-13.

Özkaya Erkaleli, Z., Dalkiliç, Z. 2016. Uşak ili Ulubey ilçesinde yetişen karadutlarin (*Morus nigra* L.) morfolojik, fenolojik ve pomolojik özelliklerinin belirlenmesi. *Adnan Menderes Üniversitesi Ziraat Fakültesi Dergisi*, 13(1); 89-106.

TTSM, 2019. Registration List. Republic of Turkey Ministry of Agriculture and Forestry Variety Registration and Seed Certification Center. https://www.tarimorman.gov.tr/BUGEM/TTSM/Menu/30/Kayit-Listeleri (Available Date: 16.07.2019)

Türemiş, N., Pırlak, L., Eşitgen, A., Erdoğan, Ü., Tümer, A., İmrak, B. 2004. Akdeniz ve Doğu Anadolu' da Yetişen Dutların Seleksiyonu ve Seçilen Tiplerin Muhafazası, TÜBİTAK Proje Sonuç Raporu, Proje No: TOGTAG-2600.

USDA, 2019. Classification for Kingdom Plantae Down to Genus *Morus* L. https://plants.usda.gov/java/ClassificationServlet?source=display&classid=MORUS (Available Date: 16.07.2019)

Uzun, H.İ., Bayır, A. 2009. Farklı dut genotiplerinin bazı kimyasal özellikleri ve antiradikal aktiviteleri. III. National Berry Symposium, 10-12 June, Kahramanmaraş.

Yılmaz, A. 2004. Adana İli ve Çevre İlçelerinde Yetişen Sofralık ve Sanayiye Uygun Dutların Seleksiyonu. Çukurova University, Institute of Science, Department of Horticulture, MSc Thesis, Adana.