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A Study on Selection and Identification of Table Fig Types in East Edge of Firat River

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ABSTRACT

The objectives of this study were select, define, preserve and disseminate the productions of fig types of good quality for fresh consumption. Turkey has a great variation and distribution with respect to both cultivar and wild fig forms. Although East Edge of Fırat River has a special importance in respect to the fig genetic resources, no studies have been made about selection and identification of them in the area by researchers up to now. This study was carried out according to the weighted ranked method during years 2006-2007. According to this ranked method, in 60 fig types, seven fig types which had higher scores were selected and they were identificated in detail according to descriptors for fig of International Plant Genetic Resources Institute. In these types, it was determined that fruit weight was changed between 60.75 and 27.31 g, fruit width was changed between 54.41 and 35.12 mm and TSS ratio changed between 28.87 and 17.68%, titrable acidity was changed between 0.21 and 0.29%. These table fig types which had the higher scores were identificated as detail with respect to some properties such as tree growth habit, tree vigour, relative degree of branching, full maturity, ostiolum width, peeling of skin, scale size of scales around the ostiolum, fruit skin cracks, petiole color and pulp internal color.

Key words: *Ficus carica* L., weighted ranked method, fig descriptors of IPGRI, Sanliurfa

INTRODUCTION

Fig is one of the most significant fruit species grown in the Mediterranean countries (Condit, 1947). Some temperate fruit species of horticultural as well as figs are also originated in Turkey (Kuden, 1995). West, North and South regions of Turkey contain rich fig germplasm (Aksoy *et al*., 1992; Kuden *et al*., 1995; Bostan *et al*., 1997; Kuden and Tanriver, 1997). The fig is widely grown and extended to the South East Anatolia, the Aegean and the Mediterranean regions (Ilgin, 1995).

The total fig production of Turkey is 290.151 tons (Anonymous, 2006). In general, the fig has long been cultivated in Anatolia for dry consumption. Therefore, a lot of the research has been directed toward to the problems of dry fig culture. But, there has been a big demand for fresh figs in the European markets recently. Therefore, the fresh figs from Turkey should have a big market in the very near future (Polat and Ozkaya, 2005).

Bursa are the largest fresh fig region in Turkey with extensive fresh fig exports (Ozeker and Isfandiyaroglu, 1998). However, Turkey's fresh fig production has not yet fulfilled its export potential. Recently, the fresh fig trade, confined primarily to local markets, has gained international importance (Sahin, 1998). Bursa Siyahi is one of the best quality fresh fig cultivar grown in Turkey and there is an increase in its export (Caliskan, 2003). Therefore, the table fig selection studies have begun since 1990's with the experiments of Kaska *et al*. (1990) then continued Aksoy *et al*. (1992). After than, the fig studies was carried by a few researchers (Ilgin and Kuden, 1997; Polat and Ozkaya, 2005; Alper, 2006; Caliskan and Polat, 2008; Simsek and Kuden, 2008; Simsek, 2009a, b).

In fig cultivars for fresh consumption, emphasis has been placed on such factors as fruit shape, yellow or pink-red internal color, remaining fruit stalk attached to the shoot and flawor (Ozbek, 1978). In a 100 g edible portion, figs contain 80 calories, 20.3 g carbohydrates, 1.2 g proteins, 0.3 g fats and considerable amount of vitamin A and B (Westwood, 1978). As cultivars for fresh consumption possess less total soluble solid content, they are consumed more than dried fruits (Kabasakal, 1990).

Although East Edge of Firat River of Sanliurfa Province in the Southeast Anatolia Region of Turkey has a special importance in respect to table fig types, no studies have been made about selection and identification about them in this area by researchers up to now. Therefore, the aims of this study were select, define, preserve and disseminate the productions of fig types of good quality for fresh consumption in this area. Then, these types were to make their adaptations in the same ecological conditions with some fig types and varieties of domestic and foreign. Afterwards, it was to determine the best fig types and/or cultivars at the end of this adaptation study. Finally, it was to necessary to productions and produces of them.

MATERIALS AND METHODS

This study was carried out in East Edge of Firat River of Sanliurfa province in Turkey during 2006-2007. Thirty fig trees were determined primarily from about 80 trees as subjective. Then, in thirty types, seven fig types were selected according to the weighted ranked method (Table 1). In this study, thirty ruits were randomly selected from the each fig tree in each year. Harvested fruits were immediately transferred to ice boxes and stored at 0°C. Afterwards, they were analysed with 3 replication and 10 fruits in each replication for the each year. The data were subjected to analysis of variance using JMP 5.0.1. The means were separated by Tukey's test at 0.05 level. Fruit weight was measured with a scale sensitive to 0.01 g. The fruit length and width, neck length, ostiole

Table 1: Quality evaluation of the selected fig types according to the weighted ranked method (Aksoy, 1991)

Characteristics	Weighting factor (coefficient)	Classification and points			
Fruit weight	40	<20.0 g	0	20.1 -30.0 g	2
		30.1 -40.0 g	4	40.1 -50.0 g	6
		50.1 -60.0 g	8	> 60.0 g	10
Fruit shape index	9	I<0.9	8	I=0.9-1.1	10
		I>1.1	6		
Neck length	6	<5.0 mm	0	5.1-10.0 mm	10
		10.1-15.0 mm	6	>15.0 mm	2
Fruit skin cracks	10	None-little	10	Medium	6
		High	0		
Peeling of skin	10	Easy	10	Medium	6
		Difficult	0		
Ostiolum width	5	0.0-2.0 mm	10	2.1-4.0 mm	8
		4.1-6.0 mm	6	>6.1 mm	2
Total soluble solid content	10	< 13.0%	2	13.1-16.0%	4
		16.1-20.0%	10	20.1-25.1%	8
		> 25.1%	6		
Titrable acidity	10	< 0. 050%	0	0.051-125%	6
		0.126-0.225%	8	0.226-.300%	10
		> 0.301%	4		
Total	100				

width were measured by a digital compass. Total soluble solids were determined with a hand-held refractometer. Titrable acidity was determined by titrating with 0.1 N NaOH to an endpoint of pH 8.10. The fruit shape index was calculated by dividing the width by length. In addition, peeling of skin and fruit skin cracks also were evaluated. The coordinates and altitudes of the types were determined with GPS tool. The fig types were identify according to the fig descriptors of IPGRI (Anonymous, 2003). Some properties of the types such as tree growth habit, tree vigour, relative degree of branching, full maturity, ostiolum width, peeling of skin, scale size of scales around the ostiolum, fruit skin cracks, petiole color and pulp internal color were identificated as detail.

RESULTS AND DISCUSSION

Pomological characteristics: During this study, seven fig types were selected with special emphasis on the fruit quality characteristics. Considering two years mean results (2006 and 2007), the fruit weight, the fruit width, the fruit length, the ostiole width, the neck length, the fruit shape index, the TSS, the titrable acidity and the fruit juice pH of the fig types were determined statistically different from each other at 5% level (Table 2).

According to the averages in two years, the fruit weight was found to be lowest at 27.31 g in FRE-8 and highest at 60.75 g in FRE-14. The fruit width was found to be lowest at 35.12 mm in FRE-8 and highest at 50.41 mm in FRE-14. In addition, no neck was observed in 2 types (FRE-1 and FRE-4) while the others had necks and the their neck length was changed from 7.00 mm in FRE-3 to 4.31 mm in FRE-10. The ostiolum width changed between 1.58 mm in FRE-3 and 3.91 mm in FRE-14. The fruit shape index changed between 0.88 in FRE-8 and 1.41 in FRE-14. TSS ratio of the types was found to be lowest at 17.68% in FRE-12 and highest at 28.87% in FRE-1. The titrable acidity changed from 0.21 in FRE-8 to 0.29 in FRE-3. In addition, the fruit juice pH changed from 4.62 in FRE-3 to 6.05 in FRE-10.

Morphological and phenological characteristics: The number of leaves per shoot and the number of the lobes of selected fig types were shown (Fig. 1). According to the averages of the leaves in 10 shoots per the type in 2007, the number of leaves per shoot was found to be lowest at 5.7 in FRE-4 and highest at 13.5 in FRE-14. The number of the lobes of selected fig types changed between 3 and 7. In the phenological characteristics, the beginning of maturation was established in 1-15 August in 4 fig genotypes and 15-31 August in 3 fig genotypes in 2007. In addition, some other phenological characteristics of the selected fig types also were investigated during the this research (Table 3).

Table 2: Some pomological characteristics of the fig types (average values in 2006-2007)

Accession No.	Ave. fruit weight (g)	Ave. fruit width (mm)	Ave. fruit length (mm)	Ave. ostiole width (mm)	Ave. neck length (mm)	Ave. fruit shape index	Ave. TSS (%)	Ave. acidity (%)	Ave. pH
FRE-1	40.57bc	43.79bc	34.78bc	2.57c	0.00c	1.26ab	28.87a	0.25abc	5.22abc
FRE-3	42.52b	44.87b	42.60a	1.58d	7.00a	1.05bc	20.15c	0.29a	4.62c
FRE-4	29.00cd	40.15c	30.62c	2.38c	0.00c	1.32ab	24.35b	0.23bc	5.17bc
FRE-8	27.31d	35.12d	40.09ab	2.22c	4.38b	0.88c	24.64b	0.21c	5.59ab
FRE-10	37.73bcd	43.22bc	35.38abc	3.34b	4.31b	1.23ab	27.32a	0.28ab	6.05a
FRE-12	30.22cd	44.85b	37.34abc	2.49c	4.55b	1.22ab	17.68d	0.29ab	5.17bc
FRE-14	60.75a	54.41a	38.59ab	3.91a	5.31ab	1.41a	25.22b	0.27ab	4.90bc

Mean separation within columns by Tukey's test at 0.05 level

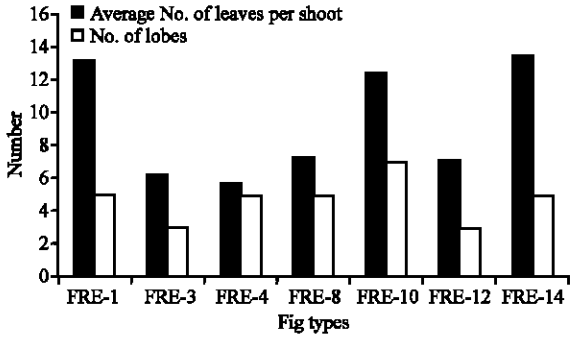

Fig. 1: Average numbers of leaves per shoot and number of lobes of the fig types in 2007

Table 3: Some phenological characteristics of the selected fig types in 2007

Accession No.	Beginning of maturation	Full maturity	Harvest period
FRE-1	15-31 August	1-30 September	41-60 day
FRE-3	1-15 August	11-31 August	21-40 day
FRE-4	1-15 August	11-31 August	21-40 day
FRE-8	15-31 August	1-30 September	41-60 day
FRE-10	1-15 August	11-31 August	21-40 day
FRE-12	15-31 August	1-30 September	41-60 day
FRE-14	15-31 August	1-30 September	41-60 day

Table 4: The names, the origins, the coordinates, ages and yield of the selected fig types in 2007

Accession No.	Names of types	Origins	Coordinates	Age of trees	Yields (1-5)
FRE-1	Mersin Inciri	East Edge of Firat River	37633277 E-4239171 N	25	Medinm efficiency (3)
FRE-3	Siyah Incir	East Edge of Firat River	37494025 E-4166781 N	24	Good efficiency (4)
FRE-4	Sari Incir	East Edge of Firat River	37494213 E-4166667 N	24	Medinm efficiency (3)
FRE-8	Incir	East Edge of Firat River	37495128 E-4168410 N	24	Good efficiency (4)
FRE-10	Sari Incir	East Edge of Firat River	37495113 E-4168426 N	23	Good efficiency (4)
FRE-12	Sari Incir	East Edge of Firat River	37495110 E-4168424 N	23	Medinm efficiency (3)
FRE-14	Incir	East Edge of Firat River	37495614 E-4167778 N	23	Good efficiency (4)

Names, origins, age, total points and coordinates: Names, origins, coordinates, ages of trees and yields of the selected fig genotypes were showed (Table 4). During this study, the origins of all the fig genotypes were selected in the East Edge of Fırat River of Sanliurfa in Turkey. Names of the fig types were Mersin inciri, Siyah incir, Sari incir and Incir. Ages of the trees of the fig types were changed between 23 and 25. Yields of the types were found to be good efficiency (4) or medium efficiency (3). Coordinates of FRE-1 which had the lowest accession number were found to be 37633277 E-4239171 N and coordinates of FRE-14 which had the highest accession number were found to be 37495614 E-4167778 N. The altitudes of the fig types were changed from 591 m to 554 m (Fig. 2). According to averages in the two years, the total point was found to be lowest at 512 in FRE-8 and highest at 914 in FRE-14.

Identifications: According to the 2006-2007 average values, some characteristics of the fig genotypes were identificated as detail. In this study, it was determined that all the fig types had short fruit length. Fruit width of FRE-8 was small and fruit width of FRE-14 was large. Fruit width of the other types was medium. Ostiole widths of types (FRE-10 and FRE-14) were large and ostiole

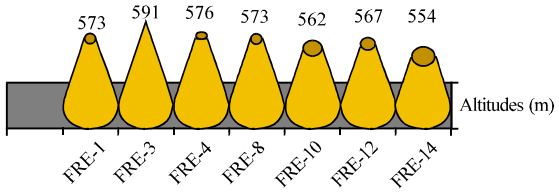

Fig. 2: Altitudes of the fig types in the 2007

widths of the other types were medium. TSS of the types was high and TSS of the other types were very high. No neck had FRE-1 and FRE-4. But, the neck lengths of FRE-3 and FRE-14 were medium and the neck lengths of the other types were short. Although fruit shape of FRE-3 was globose and fruit shape of FRE-8 was oblong, fruit shape of the other types was oblate. Identification of other characteristics of the fig types were determined in detail (Table 5).

Fig is grown in nearly all subtropical climates. In Turkey, a number of wild and cultivated forms of fig can be primarily found with a great diversity of shape, flavor and color for fresh consumption (Ozbek, 1978). The east edge of Firat River has suitable conditions for fresh fig production. Because of increasing demand for fresh consumption fig production would be of value (Aksoy *et al*., 1 992). In this study, the fruit weight is one of the most significant components for determining size of the fruits. The results with respect to fruit weight in this study were found partly lower than those of Simsek and Kuden (2008) and Simsek (2009a). They and he determined the fruit weight was ranked between 23.66 and 76.85 g and between 71.77 and 43.29 g, respectively. The results with respect to fruit width in the study were higher than those of Kuden *et al.* (2008). They determined the fruit width was ranged between 49.97 and 32.97 mm. The results with respect to fruit length in the study were found partly higher than those of Bostan *et al.* (1997). They determined the fruit length was ranged from 62.00 to 38.50 mm. For precise quantification, the length, width and fruit size were measured as well as the fruit weight (Eisen, 1901; Condit, 1941). The uniformities of the fig types in terms of the fruit size are desirable because they can be sold with a good price in the market. In addition, these results with respect to neck length were between those of Polat and Ozkaya (2005). The fruits with neck that are too long one not desired by the table fig industry. The neck length, width and length of fig types and cultivars can change according to the characteristics, maintenance requirements and the ecological conditions. In general, a large ostiole on fig types and cultivars is an undesirable characteristic as pests and pathogens enter the fruit (Can, 1993).

The fruit shape index (width/length) is of great importance in packing and transportation (Condit, 1941). The results with respect to fruit shape index were some different from those of all the Abbas types of Ilgin (1995). The fruit shape index can change according to the genetic characteristics. The results with respect to TSS ratio were found the higher than those of Koyuncu (1997). High quality table figs in term of the TSS contents are better if they are in between 13.0 and 25.1% (Aksoy, 1991). The TSS ratio of the types can chance according to properties such as genetic characteristics, the maintenance requirements and the ecological conditions. The results with respect to titrable acidity were found lower than those of Kuden *et al.* (2008). High quality table figs with respect to the titrable acidity are best if they are between 0.226 and 0.300% (Aksoy, 1991). The titrable acidity can change according to the charactetistics, harvested early or later and the ecological conditions. Aksoy *et al.* (1994) determined the fruit juice pH was changed between 2.00 and 5.50. Kuden *et al.* (2008) determined the fruit juice pH was changed between 4.53 and

Table 5: Identifications of the characteristics of the selected fig types

	Characterisations and identification							
Accession No.	Tree growth habit	Tree vigour	Relative degree of branching	Tendency to form suckers	Petiole color	Pulp internal color	Pulp flavour	Fruit skin ground color
FRE-1	Open	High	Medium	Low	Light green	Pink	Aromatic	Yellow
FRE-3	Open	Medium	Medium	High	Green	Red	Strong	Black
FRE-4	Weeping	High	Sparse	High	Light green	Red	Aromatic	Yellow
FRE-8	Spreading	High	Medium	High	Light green	Pink	Little flavour	Yellow green
FRE-10	Spreading	Medium	Sparse	High	Light green	Dark red	Little flavour	Yellow
FRE-12	Spreading	Medium	Sparse	High	Green	Dark Red	Aromatic	Yellow
FRE-14	Spreading	Medium	Medium	High	Green	Amber	Aromatic	Yellow green

	Characterisations and identification							
Accession No.	Fruit Skin over color (regular bands)	Shape of the fruit stalk	Pulp internal color	Pulp flavour	Fruit skin ground color	Ostiole width	Drop at the eye	Color of liquid drop at the ostiolum
FRE-1	Green	Short and thick (L)	Pink	Aromatic	Yellow	Medium	Absent	Absent
FRE-3	Absent	Short and thick (L)	Ped	Strong	Black	Medium	Absent	Absent
FRE-4	Absent	Short and thick (L)	Red	Aromatic	Yellow	Medium	Absent	Absent
FRE-8	Green	Variously (B)	Pink	Little flavour	Yellow green	Medium	Absent	Absent
FRE-10	Green	Variously (D)	Dark red	Little flavour	Yellow	Large	Absent	Absent
FRE-12	Green	Short and thick (L)	Dark red	Aromatic	Yellow	Medium	Absent	Absent
FRE-14	Green	Short and thick (L)	Amber	Aromatic	Yellow green	Large	Present	Transparent

	Characterisations and identification							
Accession No.	Scale size around the ostiolum	Color of scales around the ostiolum	Adhesion of scales around the ostiolum	Abscission of the stalk from the twig	Peeling of skin	Fruit skin cracks	Begiuming of maturation	Full maturity
FRE-1	Small	Same of skin	Detached	Easy	Easy	Little	Late	Late
FRE-3	Medium	Different from skin	Detached	Easy	Medium	Little	Medium	Medium
FRE-4	Small	Same of skin	Detached	Easy	Medium	None	Medium	Medium
FRE-8	Small	Same of skin	Detached	Easy	Medium	None	Late	Late
FRE-10	Large	Same of skin	Semi-adhered	Easy	Easy	Little	Medium	Medium
FRE-12	Small	Same of skin	Detached	Easy	Easy	None	Late	Late
FRE-14	Medium	Same of skin	Semi-adhered	Hard	Easy	None	Late	Late

	Characterisations and identification					
Accession No.	Harvest period	Tree vigour	Tree growth habit	Pulp internal color	Leaf shape	Relative degree of branching
FRE-1	Long	High	Open	Pink	Base calcarate, lobes latate (D)	Medium
FRE-3	Medium	Medium	Open	Red	Base decurrent (G)	Medium
FRE-4	Medium	High	Weeping	Red	Base calcarate, lobes lyrate (C)	Sparse
FRE-8	Long	High	Spreading	Pink	Base calcarate, lobes lyrate (C)	Medium
FRE-10	Medium	Medium	Spreading	Dark red	Base calcarate, lobes linear (A)	Sparse
FRE-12	Long	Medium	Spreading	Dark red	Base decurrent (G)	Sparse
FRE-14	Long	Medium	Spreading	Amber	Base calcarate, lobes latate (D)	Medium

Table 5: Continued

	Characterisations and identification						
Accession No.	Tendency to form suckers	Petiole color	Pulp internal color	Pulp flavour	Fruit skin ground color	Fruit skin over color (regnlar bands)	Shape of the fruit stalk
FRE-1	Low	Light green	Pink	Aromatic	Yellow	Green	Short and thick (L)
FRE-3	High	Green	Red	Strong	Black	Absent	Short and thick (L)
FRE-4	High	Light green	Red	Aromatic	Yellow	Absent	Short and thick (L)
FRE-8	High	Light green	Pink	Little flavour	Yellow green	Green	Variously (B)
FRE-10	High	Light green	Dark red	Little flavour	Yellow	Green	Variously (D)
FRE-12	High	Green	Dark Red	Aromatic	Yellow	Green	Short and thick (L)
FRE-14	High	Green	Amber	Aromatic	Yellow green	Green	Short and thick (L)

	Characterisations and identification						
Accession No.	Pulp flavour	Fruit skin ground color	Ostiole width	Drop at the eye	Color of liquid drop at the ostiolum	Scale size around the ostiolum	Color of scales around the ostiolum
FRE-1	Aromatic	Yellow	Medium	Absent	Absent	Small	Same of skin
FRE-3	Strong	Black	Medium	Absent	Absent	Medium	Different from skin
FRE-4	Aromatic	Yellow	Medium	Absent	Absent	Small	Same of skin
FRE-8	Little flavour	Yellow green	Medium	Absent	Absent	Small	Same of skin
FRE-10	Little flavour	Yellow	Large	Absent	Absent	Large	Same of skin
FRE-12	Aromatic	Yellow	Medium	Absent	Absent	Small	Same of skin
FRE-14	Aromatic	Yellow green	Large	Present	Transparent	Medium	Same of skin

	Characterisations and identification						
Accession No.	Abscission of the stalk from the twig	Peeling of skin	Fruit skin cracks	Begiuning of maturation	Full maturity	Harvest period	Density of hairs or spicnles on leaf lower surface
FRE-1	Easy	Easy	Little	Late	Late	Long	Dense
FRE-3	Easy	Medium	Little	Medium	Medium	Medium	Medium
FRE-4	Easy	Medium	None	Medium	Medium	Medium	Sparse
FRE-8	Easy	Medium	None	Late	Late	Long	Medium
FRE-10	Easy	Easy	Little	Medium	Medium	Medium	Medium
FRE-12	Easy	Easy	None	Late	Late	Long	Sparse
FRE-14	Hard	Easy	None	Late	Late	Long	Medium

	Characterisations and identification				
Accession No.	Density of hairs or spicules on leaf lower surface	Adhesion of scales around the ostiolum	Density of hairs or spicnles on leaf upper surface	Leaf shape	Leaf margin dentation
FRE-1	Dense	Detached	Medium	Base calcarate, lobes latate (D)	Only upper margins dented
FRE-3	Medium	Detached	Medium	Base decurrent (G)	Lobes sides completely dented
FRE-4	Sparse	Detached	Medium	Base calcarate, lobes lyrate (C)	Only upper margins dented
FRE-8	Medium	Detached	Medium	Base calcarate, lobes lyrate (C)	Only upper margins dented
FRE-10	Medium	Semi-adhered	Medium	Base calcarate, lobes linear (A)	Only upper margins dented
FRE-12	Sparse	Detached	Medium	Base decurrent (G)	Only upper margins dented
FRE-14	Medium	Semi-adhered	Sparse	Base calcarate, lobes latate (D)	Only upper margins dented

5.65 in 3 years experiment. The fruit juice pH can change according to the genetic charactetistics, harvested early or later and the ecological conditions.

Kuden *et al.* (2008) determined the number of leaves per shoot was changed between 6.7 and 10.5 and Simsek (2009a) determined the number of leaves per shoot was changed between 4.50 and 11.37, respectively. The results with respect to number of the lobes of selected fig types were similar to Simsek (2009a) but were partly different from Simsek (2009b). Simsek (2009a) determined the number of lobes was changed between 3 and 7. But, Simsek (2009b) determined the number of lobes was changed between 5 and 7. The number of leaves per shoot and the number of lobes of the genotypes can change according to the genetic charactetistics and the ecological conditions. Simsek (2009b) determined the beginning of maturation of the fig types were changed between in 20-31 July and 1-15 August. The beginning of maturation of the genotypes can change according to the genetic characteristics and the ecological conditions.

Simsek (2009a, b) determined the coordinates and the altitudes of fig types. Coordinates and altitudes of fig types and cultivars is change according to their location grown. Simsek and Kuden (2008) determined the total point was changed between 950 and 559 and Simsek (2009b) determined the total point was changed between 754 and 634 in two years. The total point can say the fruit quality characteristics, maintenance and environmental conditions. Simsek (2009a, b) determined many identifications about characteristics of fig types. Identification of fig types and cultivars can change according to the genetic characteristics, maintenance and ecological conditions. The abscission of stalk from the twig is an important feature for table figs. During harvest, if the abscission of stalk from the twig is easy, it is very good. The peeling skin is critical for local and global customer preferences (Can, 1993; Ilgın, 1995). The fig types and cultivars of the fruit cavity and the abnormal fruit formation are undesirable.

CONCLUSIONS

Turkey is the world's largest fig producing country. The country represents more than half of the world fig export. To increase in the fig export, in addition to transportation and packaging, its quality should be good, too. East Edge of Firat River in Turkey are one of the most important centres of fig types. The fruit quality characteristics of the fig types in the country should be determined and quality fig types in the region should be export to increase revenue in Turkey. Additionally, the fig is a very important fruit species for the world. It can be consumed in several ways, can easily be propagated, is adaptable to various conditions and very nutritional for the consumers. If the selected fig types are taken into conservation, the world will get the opportunity to produce and consume this fruit and have their nutritional advantages, which is especially advantages for poorer parts of the world.

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