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Full Length Research Paper

Fruit performances of the selected fig types in Turkey

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In this study, fruit performances of some types of fig *(Ficus carica* L.*)* were determined in Dara and Yardere villages of Mardin, Turkey. Seven fig types were evaluated in the study for two years. A lot of pomological characteristics to determine the fruit performances of the these types were examined during the 2004 and 2005. According to the averages in two years, fruit weight ranged between 56.29 and 30.88 g, fruit length ranged from 41.80 to 31.97 mm, ostiolum width ranged between 3.90 and 2.44 mm, total soluble solids content (TSS) ranged between 23.40 and 18.25% and acidity ranged between 0.29 and 0.14%. 47-00-4, 47-00-6 and 47-00-7 types scored the highest in overall quality according to the results of the weighted ranked method.

Key words: *Ficus carica*, Southeast Anatolia region climate, fruit performance, table fig, selection.

INTRODUCTION

The world fig production was 1,056,820 tons according to Food and Agriculture Organization of the United Nations' (FAO) statistics. The world's largest fig producing country is Turkey. The fig production of Turkey was 285,000 tons, which was 27% of the world's total production. The fig export of Turkey was 177,900 tons, which represents 52% of total world fig exports (Anonymous, 2005). About 70% of Turkey's total fig production was for dry consumption (Aksoy et al., 2003). Because of environmental effects on the characteristics of the fruit performances, it was generally believed that the highest quality dried figs were grown in limited areas of the Big and Small Meander valleys where temperature, relative humidity and wind conditions were determined to be optimum for production of high quality dried figs (Ozbek, 1978). Fresh fig production, although still environmentally sensitive, appears to be less demanding in terms of climate characteristics. The figs are well adapted to some regions of the Southeast Anatolia region.

Bursa are the largest fresh fig region in Turkey with extensive fresh fig exports (Aksoy et al., 1992; Ozeker and Isfandiyaroğlu, 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). Turkey's fresh fig exports only increased from 150 tons in 1980 to 6123 tons in 1999 and to 10,376 tons in 2004 (Anonymous, 2004). To increase fig production, it will be necessary to extend the harvesting period by planting in diverse ecological regions to utilize cultivars that differ in their harvest period, and finally to improve quality and increase diversity. In Dara and Yardere villages, none of the fig trees is in solid orchards but is interplanted with almond trees. The objective of this study was to determine the performance and important characteristics of the selected types to increase the fig production and the export of Turkey. In this context, the Southeast Anatolia region and the Mediterranean shore of Turkey have suitable conditions for the fig production (Kaska et al., 1990). Because of increasing demand for fresh consumption types and cultivars, any method to increase the fig production would be of value (Aksoy et al., 1992).

MATERIALS AND METHODS

This study was carried out 2004 – 2005 in Dara and Yardere villages of Mardin province, which is located in the Southeast Anatolia region of Turkey. 7 fig types were included in the study. The fruit performances of the selected fig types were determined. In this context, 30 fruits were randomly selected from the each fig tree in each year. Harvested fruits were immediately transferred to ice boxes and then stored at 0°C. After that, they were analysed with 3 replication and 10 fruits in each replication for the each year. To provide positive contributions to the production and export of the fig, the quality evaluation of the types was performed according to a weighted ranked method (Table 1). The data were subjected to analysis of variance using JMP 5.0.1. The means were separated by Tukey's test at 0.05.

Fruit weight was measured with a scale sensitive to 0.01 g. The fruit length and width, neck length, ostiole width were measured with a digital compass. Total soluble solids were determined with a hand-held refractometer and pH of fruit juice was determined with

Table 1. Quality evaluation of the selected fig types according to the weighted ranked method.

Characteristics	Weighting factor (coeficient)	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	0.051-0.125%	6
		0.126-0.225%	8	0.226-0.300%	10
		> 0.301%	4		
Total	100				

a pH-meter. Titrable acidity was determined by titrating with 0.1 N NaOH to an endpoint of pH 8.10. The total soluble solid/titrable acidity ratio was calculated. The fruit shape index was calculated by dividing the width by length. In addition to the these characteristics, ease of peeling and fruit skin cracks were evaluated according to the fig descriptor of Aksoy (1991). The coordinates and altitudes of the types were determined with CPS tool.

Beginning of maturition, full maturity, harvesting period, yield, fruit shape, fruit stalk shape, abscission of stalk from the twig, plant growth habit, tree vigor, number of lobes, leaves per shoot, tendency to form suckers, shoot colour, terminal bud colour, number of lobes per leaf, number of leaf per shoot, leaf shape, leaf magrin dentation, leaf venation, uniformity of fruit size, abnormal fruit formation, apical dormancy, density of hairs on leaf upper and lower surface, petiole colour, fruit cavity, fruit skin color, shape of the fruit stalk, pulp internal colour, colour of scales around the ostiolum, adhension of scales around the ostiolum, scale size around the ostiolum, drop at the eye and colour of liquid drop at the ostiole were determined based on the fig descriptor developed by Anonymous (2003).

RESULTS

Pomological variables

To determine the fruit performances in this study, some pomological characteristics of seven fig types were presented in Table 2. All pomological characteristics were significant at 5% level considering 2 years mean results (2004 and 2005).

According to the averages in the 2 years, 47-00-6 had the highest fruit weight (56.29 g) and 47-00-3 had the lowest fruit weight (30.88 g). Similarly, 47-00-6 had the highest fruit width (55.89 mm) and 47-00-3 had the lowest fruit width (41.05 mm). 47-00-7 had the highest fruit length (41.80 mm) and 47-00-3 had the lowest fruit length (31.97 mm). No neck was observed in 1 type (47-00-8), while the others had necks and the lengths of the neck were changed between 7.68 mm in 47-00-7 type and 3.93 mm in 47-00-3 type. The ostiolum width of the selected fig types ranged between 3.90 mm in 47-00-1 and 2.44 mm in 47-00-8.

The total soluble solids were highest for 47-00-6 (23.43%) and lowest for 47-00-1 (18.25%). The pH of the fruit juice was highest for 47-00-4 (6.04) and lowest for 47-00-9 (4.67). The titrable acidity was highest for 47-00-3 (0.29%) and lowest for 47-00-7 (0.14%). The TSS/titrable acidity was highest for 47-00-7 (137.03) and lowest for 47-00-03 (63.11).

Weighted characterization

When all the characteristics were evaluated together using the weighted analysis ‘47-00-4, 47-00-6 and 47-00-7’ was calculated as having the highest fruit quality (754 points). According to the weighed ranked method, it was determined that all the fig types had the fruit shape index 54 score, the skin cracks 100 score and the ostiolum width 40 score (average of years 2004-2005).

Table 2. Some pomological characteristics of the selected fig types in the Souheast Anatolia region (Average of years 2004-2005).

Accession no.	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)	Neck length (mm)	Ostiolum width (mm)	TSS (%)	Titrable acidity (%)	pH	TSS/ Titrable acidity
47-00-1	49.37 bc	38.42 a	51.51 b	5.40 c	3.90 a	18.25 b	0.27 ab	5.29 ab	68.89 c
47-00-3	30.88 e	31.97 b	41.05 e	3.93 d	3.29 b	18.40 b	0.29 a	5.79 a	63.11 c
47-00-4	52.17 ab	38.99 a	50.60 bc	5.36 c	3.78 a	20.20 b	0.24 b	6.04 a	84.53 bc
47-00-6	56.29 a	41.43 a	55.89 a	5.88 b	3.61 ab	23.43 a	0.23 b	5.70 a	100.70 b
47-00-7	50.58 b	41.80 a	52.06 ab	7.68 a	3.76 a	18.38 b	0.14 c	5.26 ab	137.03 a
47-00-8	44.24 c	34.22 b	47.52 cd	0.00 e	2.44 c	19.73 b	0.23 b	5.27 ab	87.19 bc
47-00-9	36.77 d	34.10 b	44.73 de	5.29 c	2.48 c	19.92 b	0.24 b	4.67 b	84.67 bc

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

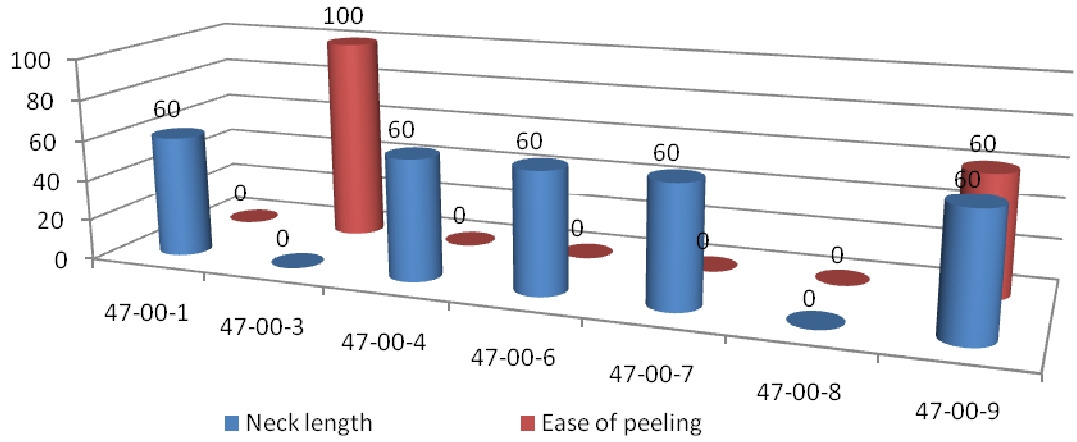

Figure 1. The scores of the neck length and the ease of peeling of all the fig types (average of years 2004-2005).

It was showed that the scores of the neck length and the ease of peeling off all the fig types were in Figure 1; the scores of the TSS and titrable asidity of them were Figure 2 and the scores of the fruit weight and the total points of them were Figure 3.

Fruit and plant characteristics

In this study, it was determined that all the fig types had the tendency to form suckers high, the shoot colour brown, the fruit cavity none, the pulp internal colour white, the colour of scales around the ostiolum different from skin, the uniformity of fruit size variable, the abnormal fruit formation scarce, the leaf venation apparent, the abscission of the stalk from the twig hard and the fruit skin cracks none.

Table 3 shows the other fruit and plant characteristics. In this context, the beginning of maturition of the fig types studied ranged between July 20 (early) and August 15 (mid-season). Full maturity of all types was in August (early or mid-season). The harvesting period was continued for at least 15-20 days (short) and at longest 41-60 days (long). In addition, because the selected fig types were in the gardens of the producers, the yield values of the types were not successfully obtained. Therefore, the yield values were determined as subjective with 1-5 assessment. In the result, ıt was observed to be medium efficiency (3) of 2 types, and good efficiency (4) of 3 types and very efficiency (5) of 2 types in the selected figs.

The fruit shape of all the fig types was oblate because the index was changed from 1.39 to 1.25. The fruit stalk shape was short and thick (J) for 3 types, long and slender (I) for 3 types and variously enlarged (A) for 1 type. The ease of peeling of the selected fig types were easy in 47-00-3 type and hard in others.

The plant growth habits were obtained as open for 47-00-1, weeping for 47-00-8, semi-erect for 47-00-7 and spreading for other types. The tree vigors were found low for 47-00-4, intermediate for 47-00-1 and 47-00-9 and high for other types.

The terminal bud colours were light green for 47-00-7 and green for other types. The number of lobes per leaf was evaluated with five lobes for 47-00-3, 47-00-4 and47-00-6. Other types were determined with seven lobes. The

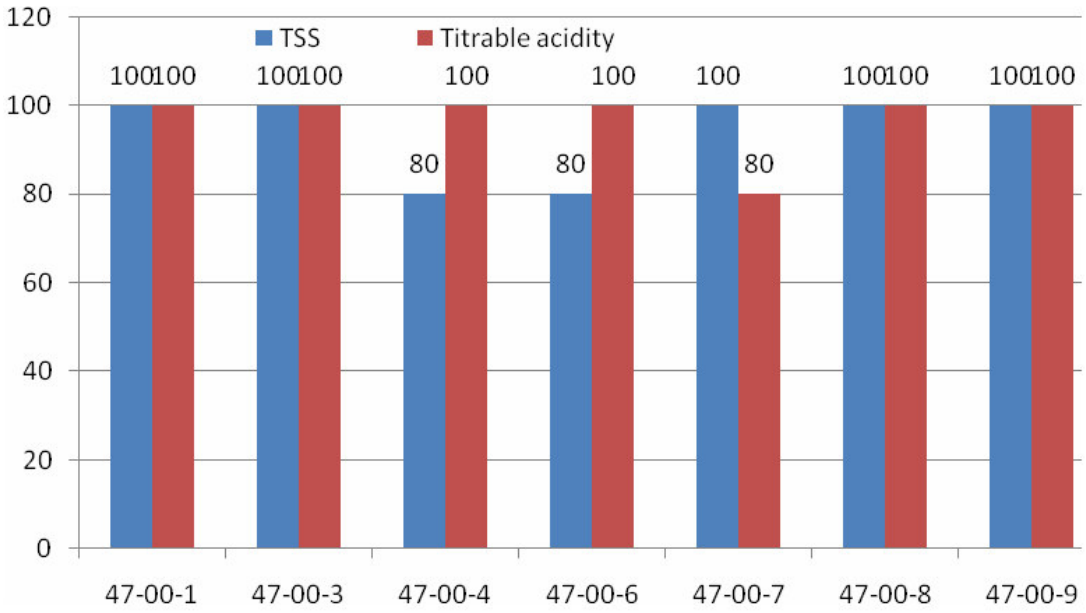

Figure 2. The scors of the titrable acidity and the TSS of all the fig types (average of years 2004-2005).

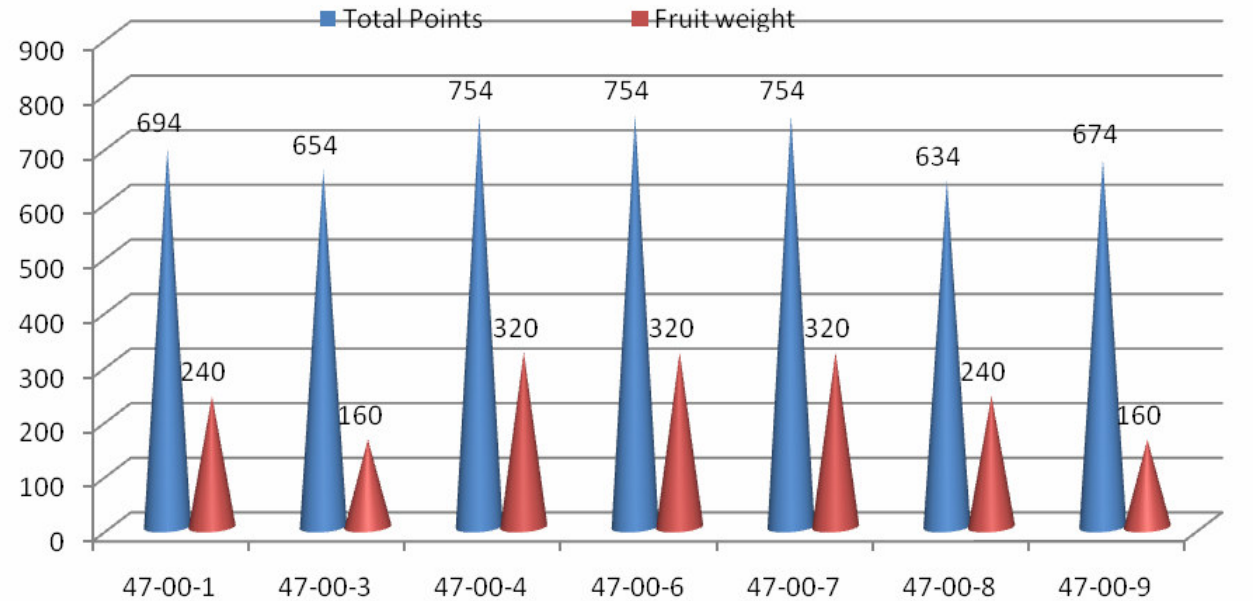

Figure 3. The scores of the fruit weight and the total points of all the fig types (average of years 2004-2005).

lobes. The number of leaf per shoot was ranged from 11.4 to 4.8. Highest number of leaf per shoot for 47-00-6 was 11.4. The lowest number of leaf per shoot were observed as 4.8 for 47-00-1. The leaf shapes was found as base calcarate, lobes latate (D) for 47-00-3 and base calcarate, lobes latate (C) for 47-00-4 and 47-00-6. Other types were found as base calcarate, lobes linear (A). The leaf magrin dentations were observed as lobes sides completely dented for 47-00-1 and 47-00-6. Other types were determined with only upper margins dented.

The apical dormancy was present for 47-00-7. Other types were determined with absent. The density of hairs on leaf upper surface was intermediate for 47-00-7 and sparse for other types. The density of hairs on leaf lower surface was intermediate for 47-00-8, none for 47-00-4 and 47-00-6 and sparse for other types. The petiole colour was green for 47-00-1, 47-00-4 and 47-00-7 and light green for other types. The fruit skin colour was yellow

Table 3. Some fruit and plant characteristics of the selected fig types in the Souheast Anatolia region (Average of years 2004-2005).

Characters	Accession numbers and their properties of types						
	47-00-1	47-00-3	47-00-4	47-00-6	47-00-7	47-00-8	47-00-9
Tree growth habit	Open	Spreading	Spreading	Spreading	Semi-erect	Weeping	Spreading
Tree vigour	Intermediate	High	High	High	High	High	Intermediate
Terminal bud colour	Green	Green	Green	Green	Light green	Green	Green
Density of hairs on leaf upper surface	Sparse	Sparse	Sparse	Sparse	Intermediate	Sparse	Sparse
Density of hairs on leaf lower surface	Sparse	Sparse	None	None	Sparse	Intermediate	Sparse
Petiole colour	Green	Light green	Green	Light green	Green	Light green	Light green
Fruit skin colour	Yellow	Light green	Light green	Yellow	Light green	Yellow	Light green
Shape of the fruit stalk	Long and slender (I)	Variously enlarged (A)	Short and thick (J)	Long and slender (I)	Short and thick (J)	Long and slender (I)	Short and thick (J)
Drop at the eye	Absent	Present	Present	Absent	Absent	Present	Absent
Colour of Liquid Drop at the Ostiole	Absent	Transparent	Transparent	Absent	Absent	Transparent	Absent
Scale size around the ostiolum	Medium	Small	Small	Medium	Medium	Small	Small
Adhesion of scales around the ostiolum	Adhered	Adhered	Detached	Adhered	Adhered	Adhered	Adhered
Apical dominancy	Absent	Absent	Absent	Absent	Present	Absent	Absent
Yields (1-5)	Medium efficiency (3)	Good efficiency (4)	Good efficiency (4)	Very efficient (5)	Medium efficiency (3)	Very efficient (5)	Good efficiency (4)
Beginning of maturation	Mid-season (1-15 August)	Early (20-31 July)	Mid-season (1-15 August)	Mid-season (1-15 August)	Early (20-31 July)	Early (20-31 July)	Mid-season (1-15 August)
Full maturity	Mid-season (11-31 August)	Mid-season (11-31 August)	Mid-season (11-31 August)	Mid-season (11-31 August)	Mid-season (11-31 August)	Early (1-10 August)	Mid-season (11-31 August)
Harvest period	Medium (21-40 days)	Long (41-60 days)	Medium (21-40 days)	Medium (21-40 days)	Long (41-60 days)	Short (15-20 days)	Medium (21-40 days)
Ease of peeling	Difficult	Easy	Difficult	Difficult	Difficult	Difficult	Difficult
Leaf shape	Base calcarate, lobes linear (A)	Base calcarate, lobes latate (D)	Base calcarate, lobes latate (C)	Base calcarate, lobes latate (C)	Base calcarate, lobes linear (A)	Base calcarate, lobes linear (A)	Base calcarate, lobes linear (A)
Leaf margin dentation	Lobes sides completely dented	Only upper margins dented	Only upper margins dented	Lobes sides completely dented	Only upper margins dented	Only upper margins dented	Only upper margins dented
Number of lobes	7	5	5	5	7	7	7
Number of leaves per shoot	4.8	11.2	7.3	11.4	7.8	6.6	10.4
Fruit shape index	1.34	1.28	1.3	1.35	1.25	1.39	1.31
Fruit shape	Oblate	Oblate	Oblate	Oblate	Oblate	Oblate	Oblate

Table 4. Names of fig types, origins, coordinates and altitudes of the selected fig types in the Souheast Anatolia Region (Average of years 2004-2005).

Accession no.	Names of fig types	Origins	Coordinates	Altitudes (m)
47-00-1	Peteği	Mardin-Dara	37673672 E-4118488 N	599
47-00-3	Zeytuni	Mardin-Dara	37673616 E-4118439 N	598
47-00-4	Peteği	Mardin-Dara	37673647 E-4118458 N	601
47-00-6	Peteği	Mardin-Dara	37673634 E-4118449 N	590
47-00-7	Hejir	Mardin-Yardere	37674259 E-4120096 N	622
47-00-8	Hejir	Mardin-Yardere	37642252 E-4120106 N	630
47-00-9	Zekaki	Mardin-Yardere	37674252 E-4120117 N	642

for 3 types and light green for other types. The shape of the fruit stalk was long and slender (I) in 47-00-1 and 47-00-8, short and thick (J) for 47-00-4, 47-00-7 and 47-00-9 and variously enlarged (A) for 47-00-3.

The adhension of scales around the ostiolum was detached for 47-00-4 and adhered for other types. The scale size around the ostiolum was medium for 47-00-1, 47-00-6 and 47-00-7 and small for other types. The drop at the eye was present for 47-00-3, 47-00-4 and 47-00-8 and absent for other types. The colour of liquid drop at the ostiole was transparent for 47-00-3, 47-00-4 and 47-00-8 absent for other types.

Names, Origins, Coordinates and Altitudes

Names, origins, coordinates and altitudes of all the fig types were showed in Table 4. All the these types was selected in Dara and Yardere villages of Mardin. The local names of the types were Peteği, Zeytuni, Hejir and Zekaki. The coordinates of 47-00-1 were 37673672 E-4118488 N and the coordinates of 47-00-9 were 37674252 E-4120117 N. 47-00-6 had lowest altitude (590 m) and 47-00-9 had highest altitude (642 m). In addition, Map of Turkey and its areas of some fig types or the cultivars were showed in Figure 4.

DISCUSSION

Fig is grown in nearly all subtropical climates. In Turkey, a number of wild and cultivated forms of fig can be found with a great diversity of shape, flavor and color, primarily for fresh consumption (Ozbek, 1978). The Southeast Anatolia region and mediterranean shore have suitable conditions for fresh fig production (Kaşka et al.,1990).

Because of increasing demand for fresh consumption types and cultivars, any method to increase fig production would be of value (Aksoy et al., 1992).

In this study, the fruit weight is very important for fresh consumption in figs (Aksoy et al., 1992). The fruit weight values ranged from 56.29 to 30.88 g. In similar studies of fig types or cultivars, the fruit weight ranged from 30 to 90 g (Ozeker and Isfandiyaroglu, 1998), 24 to 92 g (Sahin et al., 2001), and 28 to 107 g (Polat and Ozkaya, 2005).

The fruit width values ranged from 55.89 to 41.05 mm. In addition, the fruit length values ranged from 41.80 to 31.97 mm. For precise quantification, the length, width, and fruit size were measured as well as the fruit weight (Eisen, 1901; Condit, 1941; Aksoy et al., 1992). In this study, results concerning the fruit width were higher than those of Polat and Ozkaya (2005) but the fruit length were lower than those of them. The fruit shape index (width/length) is of great importance in packing and transportation (Condit, 1941).

The neck length was longest on 47-00-7 (7.68 mm) and 47-00-6 (5.88 mm). In other studies, the longest neck was 8.86 mm (Calışkan and Polat, 2008), 14.5 mm (Ilgın, 1995), 8.70 mm (Ozeker and Isfandiyaroglu, 1998) and 8.01 mm (Polat and Ozkaya, 2005). In this study, however, the neck lengths of the selected types were lower than those of other researches.

The ostiolum width values ranked from 3.90 to 2.44 mm. The ostiole width was reported as 0.6–9.1 mm (Aksoy et al., 1992), 1.5–4.0 mm (Koyuncu et al., 1998), and 1.0–9.4 mm (Polat and Ozkaya, 2005). In this study, the ostiole width was partly different from the results of the other researchers. A large ostiole on the fig is an undesirable characteristic as pests and pathogens enter the fruit (Can, 1993).

In this study, the total soluble solid contents were ranged from 23.40 to 18.25. These results were lower than those of Calışkan and Polat (2008). But, the results in the study were better than those of them because high quality table figs in term of the TSS contents are better if they are between 13.0 and 25.1% (Aksoy et al., 1992). The titrable acidity ranged from 0.29 to 0.14%. These results were different from those (0.480-0.177%) of Küden et al. (2008). The pH of the fruit juice ranged from 6.04 to 4.67. The TSS/titrable acidity ratio is one of the most important factors in fruit taste (Karaçalı, 2002). Preferred ratio will vary with the use of fig fruits, but ratios will provide guidance in selecting types and cultivars for specific uses (Can, 1993). TSS/titrable acidity ranged from 137.03 to 63.11. These results were good for table figs.

In this study, the fruit stalk shapes of the selected fig types were determined as in Ilgın (1995) and Simsek (2008). In this contex, the fruit stalk shape can change

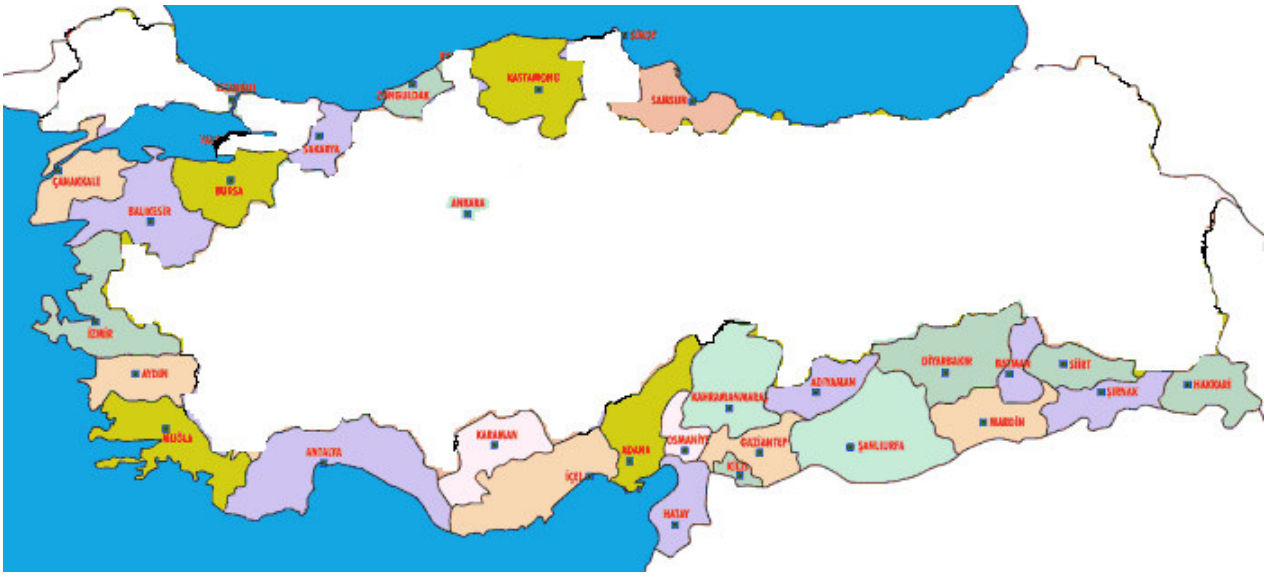

Figure 4. Map of Turkey and its areas of some fig types or the cultivars.

according to the types and cultivars. 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. Observations in this study were partly different from the those of Ilgın (1995) and Alper (2006).

In general, all the fig types was harvested in August. The yield values of the fig types were determined as in Ilgın (1995). The ease of peeling of all the fig types was difficult except 47-00-3 (easy). The ease of peeling is critical for local and global customer preferences (Can, 1993; Ilgın, 1995).

In this study, the fruit skin color ranged between yellow and light green. Calışkan and Polat (2008) observed fruit skin cracks changed from yellow to black. Arendt (1970) reported that fig types winned their unique skin colors in 5-10 days before the full maturation. In addition, the reason of color differences in fig types and cultivars can be connected according to the type and cultivar properties, the maturation time, light, seasonal changes.

The reason of differences in the selected fig types and cultivars in term of the scores could due to genetic properties and enviromental conditions of the types.

The plant growth habit, the number of lobes, the tendency to form suckers, the number of lobes per leaf, the leaf shape, the leaf magrin dentation, the leaf venation, the apical dormancy, the density of hairs on leaf upper surface, the density of hairs on leaf lower surface, the shape of the fruit stalk, the pulp internal colour, the colour of scales around the ostiolum, the adhension of scales around the ostiolum, the scale size around the ostiolum, the drop at the eye and colour of liquid drop at the ostiole can change according to the types and the cultivars. The fruit cavity can change according to the fig types and the cultivars. The fig types and cultivars of the fruit cavity and the abnormal fruit formation is undesirable. The tree vigor, the shoot color, the terminal bud color, the number of leaf per shoot, the petiole color, the fruit skin color of the fig types and cultivars can change according to the genetics and the enviromental conditions. 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.

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