

## SELECTION STUDIES ON FIG IN THE MEDITERRANEAN REGION OF TURKEY

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### Abstract

Turkey has great variations in distributions of wild fig forms as well as fig cultivars. Antakya province has a special importance in fig production. This study was carried out in Antakya province, which is located in the eastern Mediterranean coast of Turkey. Forty different fig types were characterized in this selection work. The tree and leaf characteristics of the selected types were investigated. The pomological analyses of the fruits of the selected types were also performed along with fruit bearing dates of the selected types.

According to the results of all observations, analysis and weighted ranked method, the 31-IN-01, 31-IN-08, 31-IN-10, 31-IN-11, 31-IN-12, 31-IM-13 types were classified as table type; 31-IN-13, 31-IN-21, 31-IN-24 as dried type and 31-IN-19, 31-IN-20, 31-IM-04 for canning and jam type. 31-IN-01 type was found to be parthenocarpic in reproduction.

### Introduction

Fig (*Ficus carica* L.), is one of the most important fruit species grown in the Mediterranean countries. Anatolia is the native land of the fig and wild figs distributed from Anatolia to the Mediterranean, Syria, Iran, Iraq, Saudi Arabia, South Caucasia and Crimea (Condit, 1947). Because of the wide adaptability of varieties to the soil and climatic conditions, fig trees are found in many parts of the Anatolia. They are grown in the Aegean (Aydin, Big and small Meander valleys, especially the Sarilop with dry fig cultivar), Mediterranean (Hatay, Adana, Mut, Tarsus with several fresh and dry fig cultivars), Marmara (Bursa, Yalova, with Bursa Siyahi, Sultan Selim- fresh fig cultivars), Black Sea (Giresun, Amasya, Rize-several cultivars), Middle Anatolia and even South parts of East Anatolia regions (Kuden, 1995).

Fig has long been cultivated in Anatolia for consumption in the dried form. Therefore, most of the research has been directed towards dry fig culture. However, recently, the increased possibility for transportation and the developments in packaging for table fruits has led to an increase in the production and export of table figs (İlgin & Kuden, 1997).

The total fig production of Turkey is 280,000 tons (Anon., 2004), and recently there has been a big demand for fresh figs in the European markets. So, fresh figs from Turkey should have a big market in the very near future. Bursa siyahi is one of the best quality fresh fig cultivar grown in the country and there is an increase in its export. There are many other good quality fresh fig cultivars which do not need any pollination and are mostly parthenocarpic.

The selection studies on figs began in the 1990's, with the experiments of Kaska *et al.*, (1990); Aksoy *et al.*, (1992); Küden & Tanriver (1995) and Ilgin & Küden, (1997) in the South East and South Anatolia regions. In the present study, the selection work has been continued in the Antakya province to find out the best table figs, with emphasis on the quality characteristics.

### Material and Methods

This study was carried out in the Antakya province, which is located in the east of the Mediterranean region of Turkey. The female trees were surveyed during 1996-1997 and the selected types were evaluated according to Aksoy (1991).

The characteristics of the fruits used to evaluate the types were carefully selected for the requirements of the table fig industry. These characteristics were fruit weight, fruit shape, neck length, skin cracking, peeling of the fruit skin, ostiolum width, total soluble solid content and titrable acidity. Thirty fruit, with three replications for each type were used for analysis. The quality evaluation of types was performed according to a weighted ranked method (Table 1).

### Results and Discussion

During the study, 40 types of fig were selected with special emphasis on the fruit quality characteristics. Table 2 show the most important characteristics of these types recorded in the two years.

The initiation of the ripening of the types studied ranged between 10<sup>th</sup> of June and the 30<sup>th</sup> of August. In the selected types, most of the ripening period was at the beginning of August and at the end of September. Selection number 31-IN-01, 31-IN-02 and 31-IM-01 ripened at the earliest and selection 31-IM-13, 31-IM-10, 31-IN-10 began to ripen on or after 30<sup>th</sup> of September and were the latest one to ripen. The harvesting period was continued for at least 25-40 days and the longest period was about 60 days for 31-IM-08, 31-IN-15, 31-IM-12 and 31-IN-19 fig types.

Fruit weight is one of the most important components for determining the size of fruits. The fruit weights ranged from 29.2g to 109.7g among the types selected in the first year, and from 103.8 g to 26.2 g in the second year. Averaged over the two years, the fruit weight was found to be highest at 106.80 g in 31-IN-08 and lowest at 27.68g in 31-IN-20. The best size were obtained from 31- IN- 08 fig type (Table 2). These results are better than the results of Küden (1995) and Ilgin & Küden (1997). Ilgin & Kuden (1997) determined the fruit weight of 52 fig types over 2 years and found that fruit weight ranged between 71.50 g and 17.05 g in Kahramanmaraş province which is located in the northeast of the Mediterranean region of Turkey; while Kuden (1995) reported the fruit weight of 28 fig types as between 96.0 g to 21.5 g.

Averaged over the two years, the neck lengths of the figs ranged from 0.00 mm to 8.01 mm. Fruits with neck that are too long one not desired by the table fig industry. Twenty of the selected types were found as without neck (Table 2).

The ostiolum width of the selected types ranged between 1.04 mm - 9.43 mm. Since high ostiolum width is an undesirable characteristic, 31-IN-24, 31-IM-03 and 31-IM-07 types were rejected for the table fig industry.

**Table 1. Evaluation of the selected fig types according to the weighted ranking method.**

| Characteristics                      | Weighting factor<br>(coefficient) | Classification and<br>points |    |
|--------------------------------------|-----------------------------------|------------------------------|----|
| Fruit weight                         | 20                                | <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  |
| Ripening time                        | 20                                | > 60.0 g                     | 10 |
|                                      |                                   | < 20 July                    | 8  |
|                                      |                                   | 20-30 July                   | 6  |
|                                      |                                   | 1-15 August                  | 2  |
|                                      |                                   | 15-30 August                 | 6  |
| Fruit shape[index (width/ length)=I] | 9                                 | >30 August                   | 8  |
|                                      |                                   | I<0.9                        | 8  |
|                                      |                                   | I=0.9-1.1                    | 10 |
| Neck length                          | 6                                 | I>1.1                        | 6  |
|                                      |                                   | <5.0 mm                      | 0  |
|                                      |                                   | 5.1-10.0 mm                  | 10 |
|                                      |                                   | 10.1-15.0 mm                 | 6  |
| Skin cracking                        | 10                                | >15.0 mm                     | 2  |
|                                      |                                   | none-little                  | 10 |
|                                      |                                   | medium                       | 6  |
| Peeling of skin                      | 10                                | high                         | 0  |
|                                      |                                   | easy                         | 10 |
|                                      |                                   | medium                       | 6  |
| Ostiolum width                       | 5                                 | difficult                    | 0  |
|                                      |                                   | 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  |
| <b>Total</b>                         | <b>100</b>                        |                              |    |

Averaged of the data for over two years, the titrable acidity was found to be highest 0.240% in 31-IM-02 and lowest 0.098% in 31- IN -06. The total soluble solid contents of the types ranged from 16.07% to 27.47 % in the first year and from 16.20 % to 26.87 % in the second year. Averaged over the two years, the highest total soluble solid content was found in 31-IN-21 (27.17%), followed by 31.IM.08 (25.33%). For high quality table figs, soluble solid contents should be between 13.0% and 25.1% (Aksoy *et al.*, 1992). Therefore, all of the selected types had sufficient levels of soluble solids.

Table 2. The fruit characteristics of the selected types (average two years).

| Type code no. | Fruit weight (g)       | Fruit width (mm) | Fruit length (mm) | Neck length (mm) | Ostium width (mm) | Titrable acidity (%) | Total soluble solid (%) |
|---------------|------------------------|------------------|-------------------|------------------|-------------------|----------------------|-------------------------|
| 31-İN-01      | 66.66 c <sup>(2)</sup> | 54.98 abc        | 53.44 abc         | 0.00 i           | 1.84 fg           | 0.171 ab             | 23.83 bcd               |
| 31-İN-02      | 39.63 h-l              | 44.42 e-k        | 37.85 lmn         | 0.00 i           | 1.64 fg           | 0.214 ab             | 16.53 lm                |
| 31-İN-03      | 54.07 c-h              | 51.71 b-g        | 43.88 d-m         | 0.00 i           | 3.83 c-g          | 0.166 ab             | 22.56 b-g               |
| 31-İN-04      | 45.67 e-j              | 50.92 b-h        | 48.44 b-i         | 0.00 i           | 4.42 b-f          | 0.201 ab             | 22.90 b-g               |
| 31-İN-05      | 58.79 cde              | 49.97 b-i        | 51.50 a-e         | 4.56 b-g         | 2.63 d-g          | 0.168 ab             | 22.26 b-h               |
| 31-İN-06      | 59.99 cde              | 43.00 h-k        | 42.99 e-n         | 0.00 i           | 1.66 fg           | 0.098 b              | 21.03 d-j               |
| 31-İN-07      | 58.69 c-f              | 46.24 d-k        | 50.53 a-f         | 3.81 c-g         | 3.34 c-g          | 0.172 ab             | 20.30 f-k               |
| 31-İN-08      | 106.80 a               | 61.65 a          | 59.11 a           | 5.40 b-e         | 2.27 d-g          | 0.144 ab             | 23.90 a-d               |
| 31-İN-09      | 68.33 bc               | 57.99 ab         | 47.38 c-k         | 0.00 i           | 3.69 c-g          | 0.131 ab             | 22.80 b-g               |
| 31-İN-10      | 65.27 c                | 50.09 b-i        | 40.65 h-n         | 0.00 i           | 1.41 g            | 0.166 ab             | 23.63 b-e               |
| 31-İN-11      | 65.58 c                | 43.36 g-k        | 36.98 mn          | 0.00 i           | 2.54 d-g          | 0.169 ab             | 19.83 g-l               |
| 31-İN-12      | 68.31 bc               | 51.18 b-h        | 47.85 b-j         | 5.24 b-e         | 1.26 g            | 0.162 ab             | 22.74 b-g               |
| 31-İN-13      | 57.94 c-g              | 50.22 b-i        | 42.83 e-n         | 2.24 ghı         | 2.42 d-g          | 0.141 ab             | 23.27 b-f               |
| 31-İN-14      | 82.34 b                | 57.01 ab         | 41.07 g-n         | 1.33 hı          | 2.91 d-g          | 0.194 ab             | 21.24 d-j               |
| 31-İN-15      | 59.37 cde              | 53.71 a-d        | 56.46 ab          | 3.30 e-h         | 2.53 d-g          | 0.141 ab             | 19.13 h-l               |
| 31-İN-16      | 49.60 d-i              | 52.30 b-f        | 43.62 e-m         | 4.41 b-g         | 2.65 d-g          | 0.218 ab             | 17.60 klm               |
| 31-İN-17      | 67.10 bc               | 52.07 b-f        | 41.97 f-n         | 0.00 i           | 2.72 d-g          | 0.167 ab             | 23.70 b-e               |
| 31-İN-18      | 49.40 d-i              | 51.10 b-h        | 49.15 b-i         | 2.25 ghı         | 2.76 d-g          | 0.177 ab             | 23.10 b-g               |
| 31-İN-19      | 38.29 i-l              | 47.62 c-j        | 47.48 c-k         | 4.48 b-g         | 2.05 efg          | 0.184 ab             | 20.45 e-k               |
| 31-İN-20      | 27.68 l                | 38.88 k          | 50.61 a-f         | 4.65 b-f         | 1.58 fg           | 0.137 ab             | 22.44 b-h               |
| 31-İN-21      | 32.07 jkl              | 39.00 k          | 49.61 b-g         | 5.87 a-d         | 2.69 d-g          | 0.161 ab             | 27.17 a                 |

Table 2 (Cont'd).

| Type code no.  | Fruit weight (g) | Fruit width (mm) | Fruit length (mm) | Neck length (mm) | Ostium width (mm) | Titrable acidity (%) | Total soluble solid (%) |
|----------------|------------------|------------------|-------------------|------------------|-------------------|----------------------|-------------------------|
| 31-IN-22       | 45.38 e-k        | 40.86 jk         | 48.40 b-1         | 0.00 1           | 1.54 g            | 0.134 ab             | 22.50 b-g               |
| 31-IN-23       | 32.40 jkl        | 43.17 h-k        | 36.76 mn          | 7.91 a           | 2.20 d-g          | 0.135 ab             | 17.97 j-m               |
| 31-IN-24       | 35.30 i-l        | 40.72 jk         | 48.75 b-1         | 0.00 1           | 9.43 a            | 0.182 ab             | 24.97 abc               |
| 31-IM-01       | 49.54 d-1        | 50.69 b-1        | 45.96 c-1         | 0.00 1           | 1.22 g            | 0.180 ab             | 19.80 g-l               |
| 31-IM-02       | 41.27 h-1        | 44.31 e-k        | 39.28 j-n         | 6.37 ab          | 6.04 bc           | 0.240 a              | 15.67 m                 |
| 31-IM-03       | 30.03 kl         | 42.35 ijk        | 35.81 mn          | 0.00 1           | 7.20 ab           | 0.138 ab             | 18.93 i-m               |
| 31-IM-04       | 32.72 jkl        | 41.08 jk         | 34.25 n           | 0.00 1           | 2.38 d-g          | 0.144 ab             | 23.93 a-d               |
| 31-IM-05       | 45.26 e-k        | 45.42 d-k        | 43.85 d-m         | 0.00 1           | 3.45 c-g          | 0.106 ab             | 22.40 b-h               |
| 31-IM-06       | 41.90 h-1        | 44.57 e-k        | 46.92 c-k         | 2.38 f-1         | 4.75 b-e          | 0.104 ab             | 22.83 b-g               |
| 31-IM-07       | 57.61 c-g        | 53.29 a-d        | 39.40 j-n         | 0.00 1           | 3.74 c-g          | 0.184 ab             | 21.86 c-1               |
| 31-IM-08       | 38.36 i-l        | 43.94 f-k        | 49.50 b-h         | 8.01 a           | 5.02 bcd          | 0.186 ab             | 25.33 ab                |
| 31-IM-09       | 47.38 e-j        | 55.15 abc        | 42.21 f-n         | 3.77 c-g         | 2.70 d-g          | 0.189 ab             | 20.29 f-k               |
| 31-IM-10       | 47.47 e-j        | 52.55 b-e        | 49.74 b-g         | 0.00 1           | 2.73 d-g          | 0.142 ab             | 22.36 b-h               |
| 31-IM-11       | 32.99 jkl        | 43.08 h-k        | 43.03 e-n         | 3.12 e-h         | 1.04 g            | 0.157 ab             | 17.62 klm               |
| 31-IM-12       | 43.13 f-1        | 41.15 jk         | 38.91 k-n         | 3.51 d-h         | 1.21 g            | 0.157 ab             | 25.10 abc               |
| 31-IM-13       | 63.42 cd         | 50.67 b-1        | 52.67 a-d         | 0.00 1           | 2.11 efg          | 0.174 ab             | 23.30 b-f               |
| 31-IM-14       | 33.62 jkl        | 40.16 jk         | 48.79 b-1         | 5.99 abc         | 1.07 g            | 0.176 ab             | 22.47 b-g               |
| 31-IM-15       | 42.47 g-1        | 43.90 f-k        | 40.32 i-n         | 0.00 1           | 2.77 d-g          | 0.126 ab             | 21.80 c-1               |
| 31-IM-16       | 39.01 h-1        | 45.81 d-k        | 37.22 lmn         | 0.00 1           | 2.78 d-g          | 0.166 ab             | 18.70 i-m               |
| D(%)**, D(%5)* | 15.58**          | 8.50**           | 8.83**            | 2.40**           | 2.84**            | 0.134*               | 3.40**                  |

<sup>z</sup> Means within a column followed by different letter are significantly at the 1% or 5% by Tukey test

Table 3. The evaluation of the fig types according to the weighted ranking method.

| Type code no. | Characteristics studied |               |             |             |               |                 |              |     |                   |              | Total points |
|---------------|-------------------------|---------------|-------------|-------------|---------------|-----------------|--------------|-----|-------------------|--------------|--------------|
|               | Fruit weight            | Ripening time | Fruit shape | Neck length | Skin cracking | Peeling of skin | Ostium width | TSS | Titration acidity | Total points |              |
| 31-IN-01      | 200                     | 160           | 54          | 0           | 100           | 100             | 50           | 80  | 80                | 80           | 824          |
| 31-IN-02      | 80                      | 160           | 90          | 0           | 60            | 100             | 50           | 100 | 100               | 740          |              |
| 31-IN-03      | 160                     | 40            | 54          | 0           | 100           | 60              | 30           | 80  | 80                | 604          |              |
| 31-IN-04      | 120                     | 120           | 54          | 0           | 100           | 60              | 40           | 80  | 80                | 654          |              |
| 31-IN-05      | 160                     | 40            | 72          | 0           | 100           | 100             | 40           | 80  | 80                | 672          |              |
| 31-IN-06      | 160                     | 120           | 72          | 0           | 100           | 60              | 50           | 80  | 60                | 742          |              |
| 31-IN-07      | 160                     | 40            | 72          | 0           | 100           | 100             | 40           | 80  | 80                | 672          |              |
| 31-IN-08      | 200                     | 120           | 90          | 60          | 100           | 100             | 50           | 80  | 80                | 880          |              |
| 31-IN-09      | 200                     | 40            | 54          | 0           | 100           | 100             | 40           | 80  | 80                | 694          |              |
| 31-IN-10      | 200                     | 160           | 54          | 0           | 100           | 100             | 50           | 80  | 80                | 824          |              |
| 31-IN-11      | 200                     | 120           | 54          | 0           | 100           | 100             | 40           | 80  | 80                | 774          |              |
| 31-IN-12      | 200                     | 120           | 90          | 60          | 100           | 100             | 50           | 80  | 80                | 880          |              |
| 31-IN-13      | 160                     | 120           | 54          | 0           | 100           | 100             | 40           | 80  | 80                | 734          |              |
| 31-IN-14      | 200                     | 120           | 54          | 0           | 60            | 0               | 40           | 80  | 80                | 634          |              |
| 31-IN-15      | 160                     | 120           | 72          | 0           | 100           | 60              | 40           | 100 | 80                | 732          |              |
| 31-IN-16      | 120                     | 120           | 90          | 0           | 100           | 100             | 40           | 100 | 100               | 770          |              |
| 31-IN-17      | 200                     | 120           | 54          | 0           | 100           | 100             | 40           | 80  | 80                | 774          |              |
| 31-IN-18      | 120                     | 120           | 54          | 0           | 100           | 60              | 40           | 80  | 80                | 734          |              |
| 31-IN-19      | 120                     | 40            | 72          | 0           | 100           | 60              | 40           | 80  | 80                | 592          |              |

Table 3 (Cont'd.)

| Type code no. | Characteristics studied |               |             |             |               |                 |              |     |                   |     | Total points |
|---------------|-------------------------|---------------|-------------|-------------|---------------|-----------------|--------------|-----|-------------------|-----|--------------|
|               | Fruit weight            | Ripening time | Fruit shape | Neck length | Skin cracking | Peeling of skin | Ostium width | TSS | Titration acidity |     |              |
| 31-IN-20      | 40                      | 160           | 72          | 60          | 100           | 60              | 50           | 80  | 80                | 702 |              |
| 31-IN-21      | 80                      | 160           | 72          | 0           | 100           | 60              | 40           | 60  | 80                | 652 |              |
| 31-IN-22      | 120                     | 40            | 72          | 60          | 100           | 100             | 50           | 80  | 80                | 702 |              |
| 31-IN-23      | 80                      | 40            | 72          | 0           | 100           | 60              | 40           | 100 | 80                | 572 |              |
| 31-IN-24      | 80                      | 40            | 54          | 0           | 100           | 60              | 10           | 60  | 80                | 484 |              |
| 31-IM-01      | 120                     | 160           | 54          | 60          | 60            | 100             | 50           | 80  | 80                | 764 |              |
| 31-IM-02      | 120                     | 120           | 54          | 0           | 100           | 100             | 10           | 100 | 100               | 704 |              |
| 31-IM-03      | 40                      | 40            | 54          | 0           | 100           | 60              | 10           | 80  | 80                | 464 |              |
| 31-IM-04      | 80                      | 40            | 54          | 0           | 100           | 60              | 40           | 80  | 80                | 534 |              |
| 31-IM-05      | 120                     | 120           | 54          | 0           | 100           | 60              | 40           | 80  | 60                | 634 |              |
| 31-IM-06      | 120                     | 40            | 72          | 0           | 100           | 60              | 30           | 80  | 60                | 562 |              |
| 31-IM-07      | 160                     | 40            | 54          | 60          | 100           | 60              | 40           | 80  | 80                | 674 |              |
| 31-IM-08      | 80                      | 40            | 72          | 0           | 100           | 60              | 30           | 80  | 60                | 522 |              |
| 31-IM-09      | 120                     | 120           | 54          | 0           | 100           | 100             | 40           | 80  | 80                | 694 |              |
| 31-IM-10      | 120                     | 160           | 72          | 0           | 100           | 60              | 40           | 80  | 60                | 692 |              |
| 31-IM-11      | 80                      | 120           | 54          | 0           | 100           | 60              | 50           | 100 | 80                | 644 |              |
| 31-IM-12      | 120                     | 120           | 54          | 0           | 100           | 60              | 50           | 80  | 80                | 664 |              |
| 31-IM-13      | 200                     | 160           | 72          | 0           | 100           | 60              | 50           | 80  | 80                | 802 |              |
| 31-IM-14      | 80                      | 40            | 72          | 60          | 100           | 100             | 50           | 80  | 80                | 510 |              |
| 31-IM-15      | 120                     | 120           | 54          | 0           | 100           | 60              | 40           | 80  | 80                | 654 |              |
| 31-IM-16      | 80                      | 120           | 54          | 0           | 100           | 60              | 40           | 100 | 80                | 634 |              |

These results are similar to the reports of Kaska *et al.*, (1990) but showed some differences compared with the results of Küden (1995) and Ilgin & Küden, (1997). For example, Kuden (1995) reported that the total soluble solid contents of the 28 fig types ranged from 14.1% and 25.0%. Also, in a research conducted by Ilgin & Kuden (1997), averaged over the two years, the neck lengths of the fig types ranged from 0.00 mm to 10.9 mm; the ostium widths of the types ranged from 0.15 mm to 13.9 mm. Similarly, the total soluble solid contents of the types ranged from 18.4% to 38.7%, while the titratable acidity ranged between 0.045% and 0.49%.

The fruit shape of the selected types ranged between oblate neck and spherical neck. From the view point of cracking, very little cracking was seen. There were differences among the types in their fruit rind colour and this varied from green to yellow to dark blue.

When the fruit bearing dates in the region were examined it was found that the earliest spring crop was borne on the type 31-IN-01 in February, while the spring crops of other types occurred in March and April. The main crop bearing occurred on the type 31-IN-01 in April and the main crop bearing of other types occurred in May and June.

According to these evaluations and the weighted ranking method, 31-IN-01, 31-IN-08, 31-IN-10, 31-IN-12, 31-IM-13 fig types were found as the promising types (Table 3). However, these types need further trials under the same climatic and soil conditions before they can be recommended to growers.

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