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Interrelationships Among Fruit and Leaf Traits Important In Fig Selection

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ABSTRACT: This study was carried out on 12 local fig cultivars (Ağustos, Beyaz, Beyaz Torosan, Değirmen, İpek, İstanbul, Kara, Kara Torosan, Kara Patlıcan, Kuş, Pamuk and Patlıcan) grown in Middle and Eastern Black Sea Region of Turkey (Ordu, Giresun and Trabzon cities) in 1999-2000. In this study, interrelationships among important fruit quality characteristics in fig selection (fruit weight, fruit width, fruit length, peel thickness, ostiol width, fruit shape index, leaf width, leaf length, total soluble solids, titratable acidity and pH value in fruit juices) were determined by path analysis. There were some significant correlations between fruit and leaf characteristics. It was determined that the positive correlation between fruit weight and fruit width, fruit length, leaf length, pH in juice, and the negative correlation between fruit weight and titratable acidity in juice. The direct effects of fruit width and leaf length on fruit weight were more important than their indirect effects.

Key Words : Fig, Ficus carica, Fruit, Leaf, Correlation, Path analysis

İncir Seleksiyonunda Önemli Olan Bazı Meyve ve Yaprak Özellikleri Arasındaki Karşılıklı İlişkiler

ÖZET: Bu çalışma 1999-2000 yıllarında, Türkiye'nin orta ve doğu Karadeniz bölgesinde (Ordu, Trabzon ve Giresun illerinde) yetiştirilen sofralık 12 mahalli incir çeşidi (Ağustos, Beyaz, Beyaz Torosan, Değirmen, İpek, İstanbul, Kara, Kara Torosan, Kara Patlıcan, Kuş, Pamuk ve Patlıcan) üzerinde yürütülmüştür. Bu çalışmada, incir seleksiyonunda önemli olan bazı meyve kalite faktörleri (meyve ağırlığı, meyve eni, meyve boyu, kabuk kalınlığı, ostiol genişliği, meyve şekil indeksi, yaprak eni, yaprak boyu, toplam suda çözünür kuru madde miktarı, titre edilebilir asitlik, ve pH) arasındaki ilişkiler path analizi ile belirlenmiştir. Meyve ve yaprak özellikleri arasında bazı önemli ilişkiler belirlenmiştir. Çalışma sonucunda, meyve ağırlığı ve meyve eni, meyve boyu, yaprak boyu, pH arasında pozitif; meyve ağırlığı ve titrasyon asitliği arasında negatif ilişki belirlenmiştir. Meyve eni ve yaprak boyunun meyve ağırlığı üzerine olan doğrudan etkileri dolaylı etkilerinden daha fazla olmuştur.

Anahtar Kelimeler : İncir, Ficus carica, meyve, yaprak, korelasyon, path analizi

INTRODUCTION

Turkey has a large number of cultivated and wild figs with a great diversity of color, shape and flavor, especially among the cultivars grown for fresh consumption (Özbek, 1978).

Anatolia is the native land of fig, and wild figs were spread from here to the other Mediterranean countries (Küden and Tanrıver, 1998). Fig is a native crop in all coastal regions of Turkey, and they are generally found as single or border trees (Şahin, 1998).

On the shores of northern Turkey, a lot of different local fig cultivars are present mainly for fresh consumption (Bostan *et al*., 1998; Koyuncu *et al*., 1998; Özeker and İsfendiyaroğlu, 1998). All over the country, table fruits are marketed locally (Nalbant *et al*, 1998).

Commercial production of fresh fig cultivars is new because they are very perishable. The demand for table cultivars have increased due to improvements in post harvest processes. Fig cultivars with high fruit quality are necessary for table fig production and marketing (Özeker and İsfendiyaroğlu, 1998). So, breeding by selection of native fig cultivars is very important (Aksoy *et al*., 1992).

The selection studies are very tiresome. So, determination of interrelationships among important fruit traits may facilitate the difficulties.

Many factors have been considered in selection studies carried out on fig. The desirable quality factors differs according to selected types. In the region where genetic resources are rich, natural selections are more important than the other breeding methods. Therefore, the length of the study period is considered more in these studies. If the interrelationships among fruit and leaf traits are known, only some traits could be considered in selections. Interrelationships among traits can give a good estimation for the ther traits that are not considered. By this way, the study period could be shortened, and selection studies could be more easy.

Correlations between fruit traits and vegetative traits in some crops make it possible to select indirectly for fruiting characteristics in juvenile trees (Sherman and Lyrene, 1983).

The use of path analysis provides a plausible explanation of observed correlations by modeling the cause-and effect relations between the variables. Thus, it is possible to analyze the correlation coefficient of variables in the form of variance and covariance using path analysis (Bostan and İslam, 1999).

The aim of this study is to determine interrelationships among important fruit and leaf traits in fig, and to ease the difficulties encountered in breeding studies. After the determination of interrelationships among the some important quality characteristics that are the bases in fig selection studies, selection principles could be determined again.

MATERIALS AND METHODS

This study was carried out on 12 local table fig cultivars named as Ağustos, Beyaz, Kara and Kuş in Ordu province; Pamuk, İstanbul, İpek and Değirmen in Giresun province and Beyaz Torosan, Kara Torosan, Kara Patlıcan and Patlıcan in Trabzon province in Middle and Eastern Black Sea Region of Turkey in 1999 and 2000 years.

The experimental design was randomized complete design with three replicates. Three trees were used in each replicate for each cultivar. 30 fruit and leaf samples were collected randomly from different sides of the trees that were at the age of 25-30.

Interrelationships among the traits were determined by path analysis with a computer program.

The main crop of these cultivars were harvested, and fruit weight (FW, g), fruit width (FWI, cm), fruit length (FL, cm), peel thickness (PT, mm), ostiol width (OW, mm), fruit shape index (FSI= FWI/FL), leaf width (LWI, cm), leaf length (LL, cm), total soluble solids (TSS, %), titration acidity as citric acid (TA, %) and pH value in fruit juices were determined, and then, interrelationships among these traits were calculated by the path analysis.

RESULTS AND DISCUSSION

As a result of the analysis, some significant correlations were determined among the traits (Table 1). The correlations between fruit weight-fruit width, fruit weight-fruit length, fruit weight-leaf length, fruit weight-pH, fruit length-leaf length, fruit length-pH, leaf width-leaf length, leaf length-pH, fruit width-leaf width and fruit width-pH were found as positive and significant whereas the correlations between fruit weight-titratable acidity, fruit length-fruit shape index, fruit length-titratable acidity, titration acidity-pH and fruit width-titratable acidity were negative. The correlations between the other traits were not significant.

The highest correlations were determined between fruit shape index and fruit length (-0.938**), fruit width and fruit weight (0.868**), titratable acidity and pH (-0.831**), fruit width and pH (0.829**) (Table 1).

While fruit weight, soluble solids and total sugar were increasing, firmness, total acids and starch level were decreased in kiwifruit (Beever and Hopkirk, 1990). In our study, fruit weight-titratable acidity (-0.667**) and pH-titratable acidity (-0.831**) correlations were significant and negative, as well.

In a study, it was showed that the most weighted fruits cultivars have the largest leaves (Mısırlı *et al*., 1998). In our study, positive and significant correlations were determined between leaf length and fruit weight (0.615*), leaf length and fruit length (0.613*), as well.

In similar studies, the correlations among fruit and leaf traits differed according to the cultivars in apricot and plum (Bostan, 1994 and 1995). In apricots, fruit weight-leaf petiole length and fruit stalk length-leaf petiole length were significant and negative (Bostan, 1994). In plums, fruit weight-leaf width correlation was significant but the direction whether negative or positive varied according to the cultivars (Bostan, 1995). In an other study, it was found that the leaf width and leaf length differed in cultivars (Mısırlı *et al*., 1998).

The path coefficient analysis of direct and indirect effects of important traits on fruit weight are presented in Table 2.

The direct effects of fruit width (0.835) and leaf length (0.497) on fruit weight were higher than their indirect effects. Thus, fruit width and leaf length affected the fruit weight as direct.

The indirect effects of fruit length (0.411), titratable acidity (-0.581) and pH (0.692) on fruit weight were higher than their direct effects (-0.108, 0.398 and 0.427, respectively). Thus, fruit length, titratable acidty and pH according to fruit width were affected on fruit weight.

In the cultivars fruit weight ranked from 11.35 g to 65.00 g and the mean was 44.04 g. Peel thickness varied between 0.12-1.50 mm, the mean being 0.48 mm. Total soluble solids were determined to range between 15.10 % and 21.00 %. The highest coefficients of variation were obtained for peel thickness (111 %), fruit weight (34 %), titratable acidity (30 %), fruit length (27 %), fruit shape index (25 %) and ostiole width (23 %) (Table 3).

CONCLUSION

In figs, there were some significant correlations were determined among the fruit and leaf traits. The correlations of fruit dimensions, leaf length and pH with fruit weight were positive, and the correlation between fruit weight and titratable acidity was negative.

Total sugars such as in soluble solids in fruits at maturing period increase as percentage and per fruit. On the other hand, titratable acid content decreases at maturing period, generally (Karaçalı, 1990).

The direct effects of fruit width and leaf length on fruit weight were higher than their indirect effects. The negative correlation between fruit weight and titratable acidity, and the positive correlations between fruit weight and fruit width, fruit length, leaf length, pH in juice could be taken into consideration in the future natural selection studies. Therefore, about the titration acidity could be informed by the determination the fruit weight, or about the fruit weight could be informed by the determination the fruit width and fruit length or leaf length.

Table 1. Correlation coefficients between traits in Fig

	FW	**FWI**	**FL**	**FSI**	**PT**	**OW**	**LWI**	**LL**	**TSS**	**TA**	**pH**
FW	1,000	0,868**	0,705**	-0,469	-0,029	0,135	0,300	0,615*	0,188	-0,667**	0,797**
FWI	0,868**	1,000	0,492	-0,203	-0,096	0,298	0,546*	0,496	0,202	-0,696**	0,829**
FL	0,705**	0,492	1,000	-0,938**	0,159	-0,014	0,222	0,613*	0,120	-0,652**	0,654**
FSI	-0,469	-0,203	-0,938**	1,000	-0,208	0,098	-0,055	-0,472	-0,033	0,492	-0,450
PT	-0,029	-0,096	0,159	-0,208	1,000	0,320	-0,155	-0,349	-0,163	-0,071	-0,310
OW	0,135	0,298	-0,014	0,098	0,320	1,000	0,351	-0,104	0,213	-0,256	0,040
LWI	0,300	0,546*	0,222	-0,055	-0,155	0,351	1,000	0,613*	0,304	-0,306	0,450
LL	0,615*	0,496	0,613*	-0,472	-0,349	-0,104	0,613*	1,000	0,215	-0,357	0,605*
TSS	0,188	0,202	0,120	-0,033	-0,163	0,213	0,304	0,215	1,000	-0,438	0,276
TA	-0,667**	-0,696**	-0,652**	-0,492	-0,071	-0,256	-0,306	-0,357	-0,438	1,000	-0,831**
pH	0,797**	0,829**	0,654**	-0,450	-0,310	0,040	0,450	0,605*	0,276	-0,831**	1,000

*,**: Significant at 0.05 and 0.01 probability level, respectively

Table 2. The path coefficient analysis of direct effects (DE) and indirect effects of important traits on fruit weight

	DE	Indirect Effects									
		FWI	**FL**	**FSI**	**PT**	**OW**	**LWI**	**LL**	**TSS**	**TA**	**pH**
FWI	0,835	--	-0,053	0,030	-0,027	0,032	-0,306	0,247	0,034	-0,277	0,354
FL	-0,108	0,411	--	0,139	0,045	-0,002	-0,124	0,305	0,020	-0,260	0,279
FSI	-0,149	-0,169	0,102	--	-0,058	0,010	0,031	-0,235	-0,006	0,196	-0,192
PT	0,280	-0,081	-0,017	0,031	--	0,034	0,087	-0,174	-0,028	-0,028	-0,132
OW	0,106	0,249	0,001	-0,015	0,090	--	-0,197	-0,052	0,036	-0,102	0,017
LWI	-0,561	0,456	-0,024	0,008	-0,043	0,037	--	0,305	0,052	-0,122	0,192
LL	0,497	0,414	-0,066	0,070	-0,098	-0,011	-0,344	--	0,037	-0,142	0,258
TSS	0,170	0,169	-0,013	0,005	-0,045	0,023	-0,170	0,107	--	-0,175	0,118
TA	0,398	-0,581	0,071	-0,073	-0,020	-0,027	0,172	-0,178	-0,074	--	-0,355
pH	0,427	0,692	-0,071	0,067	-0,087	0,004	-0,253	0,301	0,047	-0,331	--

Table 3. Minimum, maximum and mean values, and coefficients of variation for 11 traits in twelve cultivars.

Traits	Min.	Max.	Mean	CV (%)
FW (g)	11,350	65,000	44,036	34
FWI (cm)	3,100	5,500	4,587	12
FL (cm)	2,200	6,700	4,863	27
FSI	0,730	1,430	1,004	25
PT (mm)	0,120	1,500	0,480	111
OW (mm)	1,500	4,000	2,920	23
LWI (cm)	18,500	25,600	22,687	8
LL (cm)	19,000	28,900	23,120	10
TSS (%)	15,100	21,000	18,093	8
TA (%)	0,110	0,300	0,183	30
pH	4,200	5,300	4,933	6

REFERENCES

Aksoy, U., Seferoğlu, G., Mısırlı, A., Kara, S., Şahin, N., Bülbül, S., Düzbastılar, M., 1992. Selection of table fig cultivars adapted to Eagan conditions. (in Turkish). First National Horticultural Congress of Turkey. İzmir. pp: 545-548.

Beever, D.J., Hopkirk, G., 1990. Fruit Development and Fruit Physiology (Kiwifruit: Science and Management. Edited by Warrington, I.J. and Weston, G.C.). pp. 97-126.

Bostan, S.Z., 1994. A research on correlations between fruit and leaf characteristics in some apricot cultivars. (in Turkish). Journal of Agricultural Faculty. Yüzüncü Yıl University. 4:55-66.

Bostan, S.Z., 1995. Determination of correlations between fruit and leaf characteristics in plum cultivars. (in Turkish). Journal of Agricultural Faculty. Yüzüncü Yıl University. 5:123-131.

Bostan, S.Z.., İslam, A., Aygün, A., 1998. A study on pomological characteristics of local fig cultivars in Norrthern Turkey. . Acta Horticulturae. 480:71-73.

Bostan, S.Z., İslam, A., 1999. Determination of interrelationships among important nut quality characteristics on Palaz and Sivri hazelnut cultivars by path analysis. Turkish Journal of Agriculture and Forestry. 23: 371-375.

Karaçalı, İ., 1990. Bahçe Ürünlerinin Muhafazası ve Pazarlanması. EÜZF Yayınları, No: 494, 413 s. Bornova/İZMİR.

Koyuncu, M.A., Bostan, S.Z., İslam, A., Koyuncu, F., 1998. Investigation on some physical and chemical characteristics in fig cultivars grown in Ordu. . Acta Horticulturae. 480:87-89.

Küden, A.B., Tanrıver, E., 1998. Plant genetic resources and selection studies on figs ın the East Mediterranean and South East Anatolia regions. Acta Horticulturae. 480:49-54.

Mısırlı, A., Topuz, F., Zeybekoğlu, N., 1998. Research on variation of female and male figs in terms of leaf properties and stomatal distribution. . Acta Horticulturae. 480:129-132.

Nalbant, M., Şahin, N., Aydın, Ş., 1998. Fig genetic resources at the fig research institute (Aydın/Turkey). . Acta Horticulturae. 480:43-48.

Özbek, S., 1978. Special Fruit Growing (Deciduous Fruits). Çukurova University Agricultural Faculty press. Nr:128, 482 p.

Özeker, E., İsfendiyaroğlu, M., 1998. . Evaluation of table fig cultivars in Çeşme peninsula. Acta Horticulturae. 480:55-60.

Şahin, N., 1998. Fig adaptation studies in Western Turkey. Acta Horticulturae. 480:61-70.

Sherman, W.B., Lyrene, P.M., 1983. Handling Seedling Populations (Methods in Fruit Breeding. Eds.: Moore, J.N.; Janick, J.). pp: 66-73. Purdue Univ. Press. West Lafayette, Indiana.