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*Original scientific article*

# EVALUATION OF NEW TURKISH APRICOT GENETIC RESOURCES FROM THE IRANO-CAUCASIAN ECO-GEOGRAPHICAL GROUP

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This study presents 19 characters of 86 apricot cultivars and genotypes of the Irano-Caucasian eco-geographical group evaluated using principal component analysis. The high variability and differences among the apricot genotypes in terms of morphological, phenological and fruit quality traits were defined. The fruit size of the genotypes was generally very small (9.3 %) or small (43.0 %), the total rate of big and very big fruit genotypes was only 16.3%. The data showed that 90.1 % of the genotypes had yellow ground fruit colour, 88.4% had sweet kernel and 65% had firmness ≥5 kg/cm$^2$. About half of the apricot genotypes have 20% or high total soluble solids content. Most of the genotypes (67.3%) were harvested in mid-season and other genotypes (23.3%) were harvested early, while 4.7% of them were harvested very late, 3.5 % of the genotypes late. Only one genotype (1.2%) was harvested very early. The fruit size was highly correlated with fruit weight, pit weight and fruit flesh/pit rate. The same correlation was also observed between the fruit ground colour and fruit flesh colour. On the other hand, the total soluble solids were moderately correlated with fruit flesh firmness and seed taste. The results of the principal component analysis show that the 55% of the total variation is represented for the first three main components (22.9, 19.8, and 12.3%, respectively). The germplasm presented a large variation in the evaluated characters and most of the genotypes were found having high total soluble solids and low titratable acidity which would be beneficial for future breeding programs held to improve the related characters.

*Keywords:* Apricot, fruit quality, germplasm, principal component analysis, *Prunus armeniaca* L.

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## INTRODUCTION

Turkey has been among the first ranked fresh and dried apricot producers in the world in the last decades. Turkey produced 985 thousand tons of fresh and 145 thousand tons of dried apricot in 2017, which means that Turkey's fresh apricot share is 15-20% and dried apricot share is 65-70% at the world markets (FAO, 2020).

Some sources state that apricot culture has existed in Anatolia, located on the main route of the Silk Road, for nearly 2000 years (ASMA, 2015). Continuous propagation of apricots from seed for hundreds of years in different agro climatic conditions of Turkey resulted in high phenotypic variability. Owing to the long-lasting process of natural selection, wild grown apricots have adapted to ecological conditions of habitats and developed natural resistance mechanisms to biotic and abiotic environmental stress factors (ERCISLI, 2009). In Turkey, The Ministry of Agriculture and universities have carried out some studies to collect and conserve the Irano-Caucasian apricot genetic resources in Turkey (GÜLERYÜZ 1995; ASMA and OZTURK, 2005; ASMA *et al.*, 2007; DUMANOĞLU *et al.*, 2019; YURTKULU *et al.*, 2019). Although conservation of the Irano-Caucasian apricot germplasm in Anatolia should be appreciated, it is not known whether these efforts are sufficient or to what extent the genetic variation has been protected (ASMA *et al.*, 2017).

As it is the case in other fruit species, collection of the apricot genetic resources, definition of their morphological and pomological traits (characterization) and sustainable using this material in apricot breeding studies is of crucial importance for the accomplishment of the apricot breeding programs. Many studies have been undertaken in recent years regarding the identification of germplasm belonging to different apricot eco-geographic groups (BADENES *et al*., 1998; HAGEN *et al*., 2002; KHADARI *et al*., 2006; MALIK *et al*., 2010; MRATINIĆ *et al*., 2011; YILMAZ *et al*., 2012; ZAUROV *et al*., 2013; RALLO *et al*., 2019).

Generally, the Irano-Caucasian eco-geographical group have lower chilling requirements and bloom early in the spring. Most cultivars are self-incompatible, but self-compatible forms are not uncommon. Fruit ripening season is not as long as those from the Central Asian group. The predominant fruit colour is light yellow, white or creamy with sweet kernels. Glabrous-skinned fruits are rare (up to 4% cultivars) (LEDBETTER, 2008; YILMAZ and GURCAN, 2012; KRŚKA, 2018).

In this study, the morphological and pomological characteristics of some apricot genetic resources from Irano-Caucasian eco-geographical group collected from Anatolia were evaluated. We have used principal component analysis to study correlations among variables and establish relationships among apricot genotypes. The multivariate analysis is commonly applied for the characterization of apricot genetic resources in a lot of studies (PEREZ-GONZALES 1992; BADENES *et al*. 1998; ASMA and OZTURK 2005; RUIZ and EGEA 2008; MRATINIĆ *et al*. 2011; LI *et al*. 2013; NAZEMI *et al*. 2016).

## MATERIALS AND METHODS

This study was carried out to evaluate 86 apricot cultivars and genotypes in Malatya Turgut Özal University, Horticulture Department (MTUHD) of Turkey. Four commercial cultivars ('Aprikoz', 'Hasanbey', 'Hacıhaliloğlu', and 'Kabaaşı') were used for comparison. Investigated apricot types were propagated through budding on seedling rootstocks of Zerdali, and had been originally collected from different cultivation sites of Anatolia. All plant materials

were at the same age (6 years) and grown under the standard apricot orchard practices. MTUHD is located at 38º27'41.45"N latitude and 38º21'22.84'E longitude. It has 13.9ºC annual average temperature, and 364 mm annual precipitation. The average temperature and monthly precipitation in March–October are 19.3ºC and 26.6 mm, respectively. The soil type at MTUHD is alluvial with a pH 7.85.

Pomological and morphological characteristics of apricot genotypes were examined for two consecutive years (2017-2018). Samples of 50 fruits per genotype were harvested by hand randomly at the maturity stage determined by GÜNEYLI and ONURSAL (2014). The described fruit, flower, and tree characteristics were categorized according to IBPGR descriptors for apricot (GUERRIERO and WATKINS, 1984). Classification parameters were scored by a panel consisting of three trained experts.

As part of the characters evaluated, Fruit Weight (FW) and Pit Weight (PW) was measured using precision scales (0.01 g) which are the mean weights obtained from 50 fruits in grams. Flesh/Pit Ratio (FPR) was obtained according to the following formula (mean fruit weight–mean pit weight)/(mean pit weight). Total solids soluble (TSS) (°Brix) was detected by Fuji hand held brix refractometer (°Bx). Titratable Acidity (TA) was measured by neutralization of fruit juice to pH 8.1 with 0.1 N NaOH and TA values were given as gram malic acid/100 ml fruit juice (CEMEROGLU, 1992). Yield (Y) represents mean fruit yield per tree (kg/tree).Yield and also the other characteristics were classified according to the following list obtained from the descriptor list of UPOV (TG/70/4) together with a slight modification of colour indicators (UPOV, 2011).

Tree vigour (TV): 1 (very weak), 3 (weak), 5 (medium), 7 (strong), and 9 (very strong).

Tree habitus (TH): 1 (fastigiate), 2 (upright), 3 (upright to spreading), 4 (spreading), 5 (drooping), and 6 (weeping).

Distribution of flower buds (DFB): 1 (predominantly on spurs), 2 (equally on spurs and on one-year-old shoots), and 3 (predominantly on one-year-old shoots)

Time of beginning of flowering (TBF): 1 (very early), 3 (early), 5 (medium), 7 (late), and 9 (very late)

Time of beginning of fruit ripening (TBFR): 1 (very early, ≤75 days fruit development period), 3 (early, 75-90 days), 5 (medium, 90-110 days), 7 (late, 110-140 days), and 9 (very late, ≥140 days)

Fruit size (FSZ): 1 (very small, ≤30 g), 3 (small, 30-40 g), 5 (medium 40-60 g), 7 (large 60-85 g), and 9 (very large, ≥85 g)

Fruit ground colour (FGC): 1 (cream), 2 (yellow), 3 (light orange), 4 (medium orange), and 5 (dark orange)

Flesh colour (FC): 1 (cream), 2 (yellow), 3 (light orange), 4 (medium orange), and 5 (dark orange)

Relative of over colour (ROC): 1 (absent or very small), 3 (small), 5 (medium), and 7 (large).

Flesh firmness (FF): 1 (very soft, ≤1 kg/cm$^2$), 3 (soft, 1-3 kg/cm$^2$), 5 (medium, 3-5 kg/cm$^2$), 7 (firm, 5-7 kg/cm$^2$), and 9 (very firm, ≥7 kg/cm$^2$)

Fruit shape (FS): 1 (triangular), 2 (ovate), 3 (oblong), 4 (elliptic), 5 (circular), 6 (oblate), and 7 (obovate)

Adherence of pit to the flesh (APF): 1 (absent or very weak), 3 (weak), 5 (medium), and 7 (strong)

Kernel bitterness (KB): 1 (absent or very weak), 2 (weak), and 3 (strong)

*Statistical Analysis*

The result obtained from germplasm evaluations were statistically analysed as the average value of two consecutive years using JMP software (JMP 15.0; SAS Inc., Cary, NC). To assess correlations among variables, Pearson's Correlation Test was performed at $P<0.05$ significance level. Besides, the data were subjected to Principal Component Analysis (PCA) to assess correlations and genetic relations among variables and the genotypes.

## RESULTS AND DISCUSSION

*Evaluation of Morphological and Pomological Traits*

Quite a high variation was defined in the apricot genotypes in terms of fruit and pit size (Table 1). The FW was changed between 21.9 g ('Adilcevaz-18') and 87.5 g ('İpekpare'). The FSZ of the genotypes was generally found to be very small (9.3%) or small (43.0%). The total rate of big and very big genotypes was only 16.3%. The PW changed between 1.4 g and 4.5 g ('Adilcevaz-18' and 'Çitil', respectively) while the FPR was between 21.9 and 9.1% ('Hasanbey-118' and 'Özal', respectively). 'Hasanbey-151', 'Alişar', 'Dilbay' and 'İpekpare' drew attention as the genotypes with high FPR rate. For the control group of apricot cultivars, this rate was defined as 22.8% for 'Aprikoz' and 18.9% for 'Hasanbey'. For the table apricot cultivars, the big FSZ and high FPR are preferable. The results obtained for the fruit size show similarities partially with those identified by the previously carried out studies for the Turkish apricot types and cultivars. ASMA and OZTURK (2005) reported that the FW of 1/3 of the Turkish apricot germplasm is below 30 g. Likewise, YILMAZ *et al*. (2012) reported that 2/3 of the apricot population they analysed was medium size.

About half of the genotypes in the population had a20% or high water-soluble solids content. Several studies state that the Turkish apricots usually possess high TSS and low TA (LEDBETTER, 2008; YILMAZ and GURCAN, 2012; ZHEBENTYAYEVA *et al*., 2012).

An extensive variation was observed among the apricot genotypes in terms of yield. The 38% of the apricot genotypes had a yield of 40 kg/tree which is higher than the average. 'Burakbey' (89.3 kg/tree) and 'Çağataybey' cultivars (65.8 kg/tree) had the highest yield, while 'Sarılök' and '44-2009-396' genotypes had the lowest yield (8.5 and 16.9 kg/tree, respectively). A previous study reported that there were substantial yield differences among the Turkish apricot genotypes (ASMA and OZTURK, 2005). This might be resulted from fact that the apricot genotypes with low yield have sterility or self-incompatibility.

The tree habitus was defined as 'upright' (3.5%), 'upright to spreading' (62.8%), 'spreading' (22.1%) and 'dropping' (11.6%). These results differed from the results obtained by YILMAZ *et al*. (2012) that reported 'upright to spreading' (25.5 %), 'spreading' (41.5%), and 'drooping' (13.8%) in some other Turkish apricot genotypes evaluated by the authors. The difference between the two results may be related to the apricot population. The distribution of flower bud is 'equally on spurs and on one-year-old shoots' (59.3%), 'predominantly on one-year-old shoots' (32.6%). Only seven genotypes have flower buds 'predominantly on spurs'.

*Table 1. Phenotypic evaluation results of apricot genotypes and reference cultivars*

| | Genotypes | FW | PW | FPR | TSS | TA | Y | TV | TH | DFB | TBF | TBFR | FSZ | FGC | FC | ROC | FF | FS | APF | KB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Adilcevaz-18 | 21.9 | 1.4 | 14.3 | 15.7 | 1.40 | 18.2 | 5 | 2 | 3 | 5 | 9 | 1 | 2 | 2 | 3 | 5 | 2 | 5 | 3 |
| 2 | Adilcevaz-22 | 43.5 | 2.6 | 15.7 | 16.1 | 1.23 | 30.4 | 7 | 3 | 3 | 5 | 5 | 5 | 2 | 2 | 3 | 5 | 3 | 5 | 1 |
| 3 | Adilcevaz-36 | 59.5 | 2.9 | 19.5 | 19.5 | 0.96 | 18.5 | 7 | 3 | 3 | 5 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 5 | 1 |
| 4 | Adilcevaz-51 | 54.7 | 2.9 | 17.9 | 18.4 | 0.96 | 33.0 | 7 | 3 | 3 | 5 | 5 | 5 | 2 | 2 | 1 | 5 | 2 | 5 | 3 |
| 5 | Alatayıldızı | 62.1 | 3.8 | 15.3 | 13.5 | 1.85 | 59.0 | 5 | 4 | 2 | 5 | 3 | 7 | 3 | 3 | 5 | 5 | 4 | 3 | 2 |
| 6 | Alişar | 65.4 | 3.1 | 20.1 | 19.8 | 0.57 | 46.8 | 9 | 4 | 3 | 5 | 5 | 7 | 2 | 2 | 3 | 7 | 3 | 3 | 1 |
| 7 | Alkaya | 40.6 | 2.5 | 15.2 | 22.9 | 0.57 | 42.5 | 5 | 4 | 3 | 5 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 3 | 1 |
| 8 | Burakbey | 69.1 | 3.8 | 17.2 | 19.5 | 0.96 | 89.3 | 9 | 3 | 1 | 5 | 5 | 7 | 4 | 4 | 3 | 5 | 3 | 3 | 1 |
| 9 | Çağataybey | 46.6 | 2.9 | 15.1 | 14.6 | 1.20 | 65.8 | 7 | 5 | 2 | 5 | 3 | 5 | 4 | 4 | 7 | 7 | 4 | 3 | 2 |
| 10 | Çağribey | 48.0 | 3.2 | 14.0 | 13.9 | 1.33 | 52.7 | 7 | 5 | 2 | 5 | 3 | 5 | 4 | 4 | 7 | 7 | 2 | 3 | 1 |
| 11 | Çatalhasan | 31.7 | 1.9 | 15.7 | 23.0 | 0.57 | 45.0 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 9 | 2 | 1 | 1 |
| 12 | Çataloğlu-03 | 32.7 | 2.1 | 14.6 | 23.5 | 0.43 | 52.7 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 13 | Çataloğlu-09 | 35.4 | 2.2 | 15.1 | 22.8 | 0.43 | 50.0 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 14 | Çataloğlu-80 | 35.0 | 2.0 | 16.5 | 22.9 | 0.50 | 54.5 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 15 | Çataloğlu-95 | 39.7 | 2.2 | 17.0 | 22.5 | 0.57 | 40.5 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 16 | Çitil | 85.9 | 4.5 | 18.1 | 21.6 | 0.75 | 18.5 | 9 | 3 | 2 | 7 | 5 | 9 | 2 | 2 | 3 | 9 | 3 | 3 | 1 |
| 17 | Darende-35 | 33.5 | 2.5 | 12.4 | 20.0 | 0.67 | 45.0 | 7 | 4 | 3 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 3 | 1 |
| 18 | Darende-89 | 39.7 | 2.7 | 13.7 | 19.5 | 0.77 | 50.0 | 7 | 4 | 3 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 3 | 1 |
| 19 | Dilbay | 61.3 | 2.9 | 20.1 | 15.5 | 0.64 | 38.9 | 7 | 4 | 2 | 7 | 3 | 7 | 3 | 3 | 5 | 5 | 4 | 5 | 1 |
| 20 | Dr.Kaşka | 42.7 | 2.7 | 14.8 | 12.5 | 1.85 | 42.0 | 5 | 5 | 2 | 5 | 3 | 5 | 4 | 4 | 3 | 5 | 3 | 3 | 1 |
| 21 | Eylül | 38.6 | 2.2 | 16.5 | 18.9 | 0.57 | 59.7 | 5 | 3 | 2 | 3 | 9 | 3 | 2 | 2 | 5 | 7 | 2 | 3 | 1 |
| 22 | Gemici | 37.5 | 2.1 | 16.9 | 23.5 | 0.43 | 55.5 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 5 | 7 | 2 | 3 | 1 |
| 23 | Gürün-12 | 31.5 | 2.1 | 14.0 | 15.5 | 1.20 | 37.5 | 7 | 3 | 3 | 3 | 5 | 3 | 2 | 2 | 3 | 5 | 1 | 5 | 1 |
| 24 | Gürün-15 | 39.0 | 3.0 | 12.0 | 19.4 | 0.96 | 25.6 | 7 | 3 | 2 | 5 | 3 | 3 | 2 | 2 | 1 | 5 | 1 | 5 | 2 |
| 25 | Hacihaliloğlu-04 | 35.7 | 2.1 | 16.0 | 23.7 | 0.36 | 38.0 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 26 | Hacihaliloğlu-17 | 42.4 | 2.3 | 17.4 | 22.8 | 0.50 | 40.5 | 5 | 3 | 2 | 5 | 5 | 4 | 2 | 2 | 5 | 7 | 2 | 1 | 1 |
| 27 | Hacihaliloğlu-89 | 40.9 | 2.2 | 17.6 | 21.9 | 0.50 | 28.5 | 7 | 3 | 2 | 5 | 5 | 4 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 28 | Hacihaliloğlu-347 | 41.5 | 2.2 | 17.9 | 23.6 | 0.57 | 21.5 | 7 | 3 | 2 | 5 | 5 | 4 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 29 | Hacihaliloğlu-Baskil | 33.7 | 1.9 | 16.7 | 24.7 | 0.36 | 38.4 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 4 | 1 | 1 |
| 30 | Hacihaliloğlu-Gürün | 38.2 | 2.0 | 18.1 | 23.0 | 0.43 | 26.0 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 4 | 3 | 1 |
| 31 | Hacihaliloğlu-Kale | 31.8 | 1.8 | 16.7 | 24.8 | 0.36 | 40.5 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 32 | Hacihaliloğlu-Puturge | 36.7 | 2.0 | 17.4 | 22.0 | 0.57 | 43.8 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 1 | 7 | 2 | 1 | 1 |
| 33 | Hasanbey-118 | 61.9 | 2.7 | 21.9 | 18.6 | 0.57 | 44.5 | 7 | 3 | 3 | 7 | 3 | 7 | 2 | 2 | 1 | 9 | 3 | 3 | 1 |
| 34 | Hasanbey-151 | 63.8 | 2.9 | 21.0 | 20.1 | 0.57 | 35.0 | 5 | 3 | 3 | 7 | 3 | 7 | 2 | 2 | 1 | 9 | 3 | 3 | 1 |
| 35 | Hasanbey-156 | 74.6 | 3.5 | 20.3 | 17.6 | 0.50 | 22.5 | 7 | 3 | 3 | 7 | 3 | 7 | 2 | 2 | 1 | 7 | 3 | 3 | 1 |
| 36 | Hasanbey-196 | 57.4 | 2.8 | 19.5 | 21.1 | 0.57 | 55.5 | 5 | 3 | 3 | 7 | 3 | 5 | 2 | 2 | 1 | 9 | 3 | 3 | 1 |
| 37 | Hasanbey-200 | 60.9 | 2.9 | 20.0 | 20.8 | 0.57 | 36.8 | 5 | 4 | 3 | 7 | 3 | 7 | 3 | 2 | 1 | 9 | 3 | 3 | 1 |
| 38 | Hırmanlı | 26.5 | 1.5 | 16.6 | 11.4 | 1.45 | 54.5 | 7 | 2 | 2 | 5 | 1 | 1 | 3 | 3 | 5 | 3 | 2 | 3 | 3 |
| 39 | İmamlı | 39.5 | 2.3 | 16.2 | 15.8 | 0.96 | 45.0 | 5 | 5 | 1 | 5 | 3 | 3 | 2 | 2 | 5 | 5 | 4 | 3 | 1 |
| 40 | Imamlı 114 | 36.8 | 2.2 | 15.7 | 16.5 | 0.96 | 52.0 | 5 | 5 | 1 | 5 | 3 | 3 | 2 | 2 | 5 | 5 | 4 | 3 | 1 |
| 41 | Inciaz Eriği | 24.5 | 1.5 | 15.3 | 12.2 | 1.95 | 39.5 | 5 | 5 | 1 | 3 | 3 | 1 | 2 | 2 | 1 | 3 | 5 | 5 | 2 |
| 42 | Ipekpare | 85.9 | 4.1 | 20.0 | 14.7 | 1.16 | 45.6 | 9 | 2 | 1 | 5 | 3 | 9 | 4 | 4 | 7 | 7 | 5 | 3 | 3 |
| 43 | K 08 | 33.7 | 2.2 | 14.3 | .17.8 | 1.07 | 55.5 | 7 | 3 | 3 | 5 | 5 | 3 | 3 | 3 | 3 | 7 | 2 | 3 | 1 |
| 44 | K 126 | 27.9 | 2.0 | 13.0 | 15.6 | 1.30 | 40.5 | 7 | 3 | 3 | 5 | 7 | 1 | 2 | 2 | 3 | 7 | 2 | 3 | 1 |
| 45 | K 210 | 45.7 | 2.5 | 17.3 | 14.8 | 1.23 | 32.5 | 5 | 3 | 3 | 5 | 5 | 5 | 2 | 2 | 3 | 5 | 2 | 3 | 1 |
| 46 | K 423 | 32.9 | 2.2 | 14.0 | 18.4 | 0.96 | 38.0 | 5 | 3 | 3 | 5 | 5 | 3 | 2 | 2 | 5 | 5 | 3 | 3 | 3 |
| 47 | Kabaaşı-14 | 38.6 | 2.2 | 16.5 | 22.7 | 0.57 | 44.5 | 7 | 4 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 48 | Kabaaşı-57 | 41.5 | 2.5 | 15.6 | 23.1 | 0.50 | 39.7 | 7 | 4 | 2 | 5 | 5 | 5 | 2 | 2 | 5 | 7 | 2 | 1 | 1 |
| 49 | Kabaaşı-119 | 46.8 | 2.9 | 14.9 | 22.8 | 0.57 | 28.6 | 7 | 4 | 2 | 5 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 50 | Kabaaşı-140 | 45.4 | 2.6 | 16.4 | 23.0 | 0.43 | 25.0 | 7 | 4 | 2 | 5 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | Kabaaşı-Darende | 36.9 | 2.2 | 15.8 | 23.4 | 0.36 | 33.7 | 7 | 4 | 2 | 5 | 5 | 3 | 2 | 2 | 5 | 7 | 2 | 1 | 1 |
| 52 | Kabaaşı-Kale | 40.5 | 2.3 | 16.6 | 23.5 | 0.36 | 33.0 | 7 | 3 | 2 | 5 | 5 | 5 | 2 | 2 | 3 | 5 | 2 | 1 | 1 |
| 53 | Kabaaşı-Kinay | 57.5 | 2.8 | 19.5 | 24.0 | 0.43 | 26.5 | 9 | 3 | 2 | 5 | 5 | 5 | 2 | 2 | 3 | 9 | 3 | 3 | 1 |
| 54 | Kabaaşı-Önal | 54.1 | 2.9 | 17.7 | 24.3 | 0.36 | 22.0 | 7 | 3 | 2 | 5 | 5 | 5 | 2 | 2 | 1 | 9 | 3 | 3 | 1 |
| 55 | Kadıoğlu-Sarılık | 38.7 | 2.3 | 15.8 | 24.5 | 0.29 | 48.0 | 7 | 4 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 3 | 1 |
| 56 | Kadıoğlu-Turancı | 34.2 | 2.2 | 15.5 | 24.2 | 0.29 | 45.0 | 5 | 4 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 3 | 1 |
| 57 | Kağızman-03 | 45.7 | 2.7 | 15.9 | 15.4 | 0.96 | 29.5 | 5 | 2 | 3 | 5 | 5 | 5 | 2 | 2 | 1 | 5 | 3 | 3 | 2 |
| 58 | Kağızman-09 | 39.1 | 2.5 | 14.4 | 18.5 | 0.88 | 33.0 | 5 | 3 | 3 | 5 | 5 | 3 | 2 | 2 | 1 | 5 | 3 | 3 | 2 |
| 59 | Kale-31 | 44.8 | 2.5 | 16.9 | 22.1 | 0.36 | 36.0 | 5 | 3 | 2 | 5 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 60 | Kale-48 | 35.3 | 2.1 | 15.8 | 23.0 | 0.57 | 35.0 | 5 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 5 | 7 | 2 | 1 | 1 |
| 61 | Kale-53 | 35.3 | 2.0 | 16.7 | 22.1 | 0.96 | 26.0 | 5 | 3 | 3 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 5 | 1 |
| 62 | Konak | 28.5 | 2.3 | 11.4 | 16.6 | 1.23 | 16.5 | 5 | 5 | 2 | 5 | 9 | 1 | 2 | 1 | 1 | 5 | 2 | 7 | 3 |
| 63 | Malatya Yildizi | 25.6 | 1.8 | 13.2 | 25.7 | 0.74 | 16.9 | 5 | 5 | 1 | 3 | 3 | 1 | 2 | 1 | 5 | 3 | 5 | 5 | 1 |
| 64 | Ozal | 28.5 | 2.8 | 9.1 | 15.6 | 1.50 | 39.5 | 5 | 4 | 1 | 5 | 3 | 1 | 2 | 1 | 1 | 5 | 4 | 5 | 3 |
| 65 | Şahinbey | 46.7 | 2.9 | 15.7 | 12.5 | 1.37 | 38.5 | 5 | 4 | 2 | 5 | 5 | 5 | 3 | 3 | 3 | 5 | 2 | 3 | 1 |
| 66 | Serintepe | 77.1 | 3.9 | 18.8 | 16.6 | 0.82 | 62.8 | 9 | 3 | 2 | 5 | 5 | 7 | 2 | 2 | 3 | 7 | 3 | 3 | 2 |
| 67 | Sarılök | 33.8 | 2.1 | 15.1 | 20.8 | 0.67 | 8.5 | 7 | 3 | 2 | 5 | 3 | 3 | 2 | 2 | 3 | 5 | 2 | 1 | 1 |
| 68 | Torunoğlu | 24.6 | 1.7 | 13.4 | 19.9 | 0.96 | 17.5 | 5 | 5 | 3 | 5 | 9 | 1 | 2 | 1 | 1 | 5 | 5 | 3 | 1 |
| 69 | Uzümlü | 63.7 | 3.8 | 15.8 | 16.4 | 1.03 | 67.0 | 9 | 5 | 2 | 5 | 7 | 7 | 2 | 2 | 1 | 7 | 3 | 3 | 1 |
| 70 | Zerdali-17 | 73.5 | 4.1 | 16.9 | 13.3 | 1.20 | 36.0 | 9 | 2 | 3 | 3 | 3 | 7 | 3 | 3 | 5 | 3 | 2 | 3 | 2 |
| 71 | Zerdali-18 | 61.5 | 3.8 | 15.2 | 17.0 | 1.13 | 28.5 | 9 | 3 | 3 | 5 | 5 | 7 | 2 | 2 | 3 | 5 | 1 | 5 | 3 |
| 72 | Zerdali-41 | 55.7 | 3.0 | 17.6 | 19.4 | 0.67 | 45.6 | 9 | 3 | 2 | 3 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 5 | 2 |
| 73 | Zerdali-85 | 46.8 | 2.7 | 16.3 | 15.8 | 1.03 | 16.5 | 9 | 3 | 3 | 3 | 7 | 5 | 2 | 1 | 5 | 5 | 2 | 5 | 3 |
| 74 | 23-2011-62 | 35.7 | 2.3 | 14.5 | 22.2 | 0.60 | 33.0 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 75 | 23-2011-187 | 46.9 | 3.5 | 12.4 | 18.6 | 0.80 | 39.0 | 7 | 3 | 3 | 5 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 3 | 1 |
| 76 | 23-2011-203 | 38.3 | 3.3 | 10.6 | 21.5 | 0.67 | 21.0 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 1 | 7 | 2 | 1 | 1 |
| 77 | 24-2004-03 | 37.2 | 2.9 | 11.8 | 18.0 | 1.20 | 25.5 | 7 | 3 | 3 | 5 | 5 | 3 | 2 | 2 | 1 | 5 | 3 | 1 | 1 |
| 78 | 24-2004-11 | 30.7 | 2.0 | 14.4 | 17.3 | 1.20 | 18.0 | 7 | 3 | 3 | 5 | 5 | 3 | 3 | 3 | 3 | 5 | 2 | 3 | 3 |
| 79 | 24-2004-19 | 35.5 | 2.8 | 11.7 | 15.7 | 1.50 | 30.0 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 1 | 5 | 2 | 5 | 3 |
| 80 | 24-2004-22 | 57.6 | 3.5 | 15.4 | 15.4 | 1.64 | 38.5 | 9 | 3 | 2 | 5 | 5 | 5 | 2 | 2 | 1 | 7 | 2 | 1 | 3 |
| 81 | 44-2009-18 | 38.1 | 2.7 | 13.1 | 22.7 | 0.56 | 25.0 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 3 | 1 | 1 |
| 82 | 44-2009-43 | 35.0 | 2.4 | 13.6 | 18.0 | 0.80 | 22.5 | 9 | 3 | 2 | 5 | 3 | 3 | 2 | 2 | 3 | 7 | 4 | 1 | 1 |
| 83 | 44-2009-315 | 44.5 | 3.6 | 11.4 | 19.6 | 0.74 | 27.5 | 5 | 3 | 2 | 5 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 84 | 44-2009-396 | 40.8 | 3.0 | 12.6 | 23.5 | 0.43 | 16.0 | 7 | 4 | 3 | 5 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 85 | 44-2009-399 | 33.2 | 2.4 | 12.8 | 24.0 | 0.36 | 39.0 | 7 | 4 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 5 | 2 | 1 | 1 |
| 86 | 44-2009-456 | 37.7 | 2.5 | 13.0 | 16.5 | 0.80 | 35.7 | 7 | 4 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| Reference Cultivars | | | | | | | | | | | | | | | | | | | | |
| 87 | Aprikoz | 61.9 | 2.6 | 22.8 | 19.1 | 0.88 | 59.5 | 7 | 5 | 2 | 5 | 3 | 7 | 2 | 2 | 1 | 5 | 3 | 1 | 1 |
| 88 | Hacıhaliloğlu | 35.2 | 2.3 | 14.3 | 23.5 | 0.36 | 40.5 | 7 | 3 | 2 | 5 | 5 | 3 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |
| 89 | Hasanbey | 63.6 | 3.2 | 18.9 | 20.5 | 0.74 | 36.8 | 7 | 3 | 3 | 5 | 3 | 7 | 2 | 2 | 1 | 9 | 3 | 1 | 1 |
| 90 | Kabaaşı | 45.8 | 2.7 | 16.0 | 23.8 | 0.36 | 51.0 | 7 | 3 | 2 | 5 | 5 | 5 | 2 | 2 | 3 | 7 | 2 | 1 | 1 |

FW: Fruit Weight; PW: Pit Weight; FPR: Fruit/Pit Ratio; TSS: Total Soluble Solids; TA: Titratable Acidity; Y: Yield; TV: Tree Vigour; TH: Tree Habitus; DFB: Distribution of Flower Buds; TBF: Time of Beginning of Flowering; TBFR: Time of Beginning of Fruit Ripening; FSZ: Fruit Size; FGC: Fruit Ground Colour; FC: Flesh Colour; ROC: Relative Over Colour; FF: Flesh Firmness; FS: Fruit Shape; APF: Adherence of Pit to Flesh; KB: Kernel Bitterness

There is no any data published regarding the DFB and other traits of the Turkish apricot cultivars.

Most of the apricot genotypes (84.9%) blossomed in mid-term while six genotypes blossomed earlier, and seven genotypes did later. Only eight to 10 days of difference were identified among the early and late blossomed genotypes in terms of the beginning of blossoming. Crop losses caused by late spring frosts occur frequently in this region, and apricot producers suffer from serious problems. The most efficient and practical expediency for the

protection against the late spring frost is to breed the late-blossoming genotypes with high fruit yield. According to a study carried out in the Cappadocia Region of Anatolia, many apricot genotypes bloom 14-15 days later when compared with the control (DUMANOĞLU *et al*., 2019). Unfortunately, there is no genotype having an extreme late blossoming trait at the MTUHD apricot genetic resources.

There is a wide variation among the apricot genotypes for the harvesting season. Most of the apricot genotypes (67%) were harvested in mid-season (20 June-15 July). Other genotypes (23.3%) were harvested in the early season while 4.7% in the very late season, 3.5% late. Only one genotype was harvested in the early season. The harvesting season lasts about 2.5 months at the Apricot Genetic Resources Plot of MTUHD. In recent years, several studies have been carried out to select the extreme early or late apricots among the wild apricot population in Anatolia (BOLAT and GÜLERYÜZ, 1995; ASMA, 2012a; ASMA *et al*., 2017; BAKIR *et al*., 2019; YURTKULU *et al*., 2019). Furthermore, successful results were obtained from the studies carried out for the breeding of new apricots with high fruit quality, early and late maturing. The early ripening cultivar 'Dilbay' and the late ripening cultivar 'Eylül' were bred (ASMA, 2012b; ASMA *et al*., 2018). The tests are still underway for several promising early and late ripening hybrids (CROSS *et al*., 2018).

As it is seen in the Table 1, the FGC of the genotypes (90.1%) is yellow. A very small amount is orange. Concerning FC, we had results similar to FGC. Only five genotypes had yellow skin and cream flesh colour. In this study, 10 genotypes had bitter seeds while the rest had sweet ones. In Turkey, the apricot seeds have a remarkable commercial value. The sweet seeds are eaten as snack. The bitter ones are used by cosmetic and pharmaceutical industry (ARI, 1999).

For the freshly-consumed table apricots, the FSZ and firmness of fruit flesh is considered to be important quality characters. The rate of genotypes that had $\geq 5$ kg/cm$^2$ was 65%. Among the genotypes, only one cultivar named 'Konak' had adherence to the fruit flesh (clingstone). The adherence of others was absent or very weak (freestone). In this study, 'İnciaz Eriği' which is a natural hybrid between *Prunus cerasifera* × *P. armeniaca*, and 'Malatya Yıldızı' (whose fruit is similar to nectarine), which is smooth skinned and has a distinct aroma, are the most attractive genotypes. These two genotypes have similar fruit and tree characteristics with those of *P. persica* var. *nectarine* and *P. cerasifera*.

*Correlations among Variables*

Pearson's correlation analysis was performed to examine the relations among variables and the results were presented in Table 2. Results indicated some significant correlations especially for pomological traits, but also for morphological and phenological properties.

TV presented moderate significant correlations with FW and PW (*r=0.46* and *r=0.45*, respectively). Another moderate significant correlation was found between TBF and FF (*r=0.48*). 'Fruit Size' was found as very highly correlated with FW and PW (*r=0.94* and *r=0.81*, respectively), but also highly with FPR (*r=0.61*). Previous studies regarding the Turkish apricots also showed a high correlation between fruit and pit weight (ASMA and OZTURK, 2005; CALISKAN *et al*., 2012). Similar results were reported for the European eco-geographical apricot group (BADENES *et al*., 1998; RUIZ and EGEA, 2008).

*Table 2. Correlation matrix among the assessed characteristics*

| | TH | DFB | TBF | TBFR | FSZ | FGC | FC | ROC | FF | FS | APF | KB | FW | PW | FPR | TSS | TA | Y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TV | -0.26* | -0.02 | -0.09 | -0.02 | 0.39** | 0.09 | 0.17 | 0.07 | 0.17 | -0.14 | -0.11 | 0.09 | **0.46**** | **0.45**** | 0.19 | 0.02 | -0.11 | 0.10 |
| TH | | -0.30** | -0.04 | -0.06 | -0.09 | 0.13 | -0.02 | 0.07 | -0.15 | 0.34** | 0.12 | -0.21* | -0.14 | -0.07 | -0.16 | -0.09 | 0.15 | 0.16 |
| DFB | | | 0.19 | 0.23* | 0.15 | -0.17 | -0.13 | -0.28** | 0.13 | -0.33** | 0.17 | 0.04 | 0.09 | 0.06 | 0.09 | -0.10 | 0.02 | -0.26* |
| TBF | | | | -0.24* | 0.37** | 0.05 | 0.10 | -0.27* | **0.48**** | 0.10 | -0.15 | -0.20 | 0.35** | 0.22* | 0.34** | 0.11 | -0.23* | 0.00 |
| TBFR | | | | | -0.28** | -0.35** | -0.39** | -0.13 | 0.07 | -0.29** | 0.07 | 0.04 | -0.28** | -0.20 | -0.26* | 0.19 | -0.12 | -0.17 |
| FSZ | | | | | | 0.31** | 0.37** | 0.03 | 0.30** | 0.09 | -0.02 | -0.06 | **0.94**** | **0.81**** | **0.61**** | -0.14 | -0.05 | 0.19 |
| FGC | | | | | | | **0.90**** | **0.44**** | -0.17 | 0.23* | 0.13 | 0.16 | 0.28** | 0.29** | 0.09 | **-0.47**** | **0.43**** | 0.38** |
| FC | | | | | | | | **0.44**** | -0.06 | 0.08 | -0.04 | 0.04 | 0.32** | 0.31** | 0.16 | **-0.41**** | 0.32** | **0.46**** |
| ROC | | | | | | | | | -0.13 | 0.06 | -0.04 | 0.01 | -0.01 | -0.03 | 0.01 | -0.09 | 0.01 | 0.23* |
| FF | | | | | | | | | | -0.14 | -0.39** | **-0.45**** | 0.29** | 0.16 | 0.34** | **0.51**** | **-0.57**** | 0.08 |
| FS | | | | | | | | | | | 0.16 | 0.02 | 0.17 | 0.06 | 0.17 | -0.20 | 0.22* | 0.07 |
| APF | | | | | | | | | | | | **0.50**** | 0.08 | 0.10 | -0.04 | **-0.50**** | **0.52**** | -0.10 |
| KB | | | | | | | | | | | | | 0.03 | 0.13 | -0.18 | **-0.52**** | **0.57**** | -0.11 |
| FW | | | | | | | | | | | | | | **0.85**** | **0.64**** | -0.18 | 0.00 | 0.20 |
| PW | | | | | | | | | | | | | | | 0.15 | -0.27** | 0.17 | 0.13 |
| FPR | | | | | | | | | | | | | | | | 0.09 | -0.27** | 0.21* |
| TSS | | | | | | | | | | | | | | | | | **-0.88**** | -0.15 |
| TA | | | | | | | | | | | | | | | | | | 0.05 |

*: Correlation is significant at the 0.05 level, **: Correlation is significant at the 0.01 level

FW: Fruit Weight; PW: Pit Weight; FPR: Fruit/Pit Ratio; TSS: Total Soluble Solids; TA: Titratable Acidity; Y: Yield; TV: Tree Vigor; TH: Tree Habitus; DFB: Distribution of Flower Buds; TBF: Time of Beginning of Flowering; TBFR: Time of Beginning of Fruit Ripening; FSZ: Fruit Size; FGC: Fruit Ground Colour; FC: Flesh Colour; ROC: Relative Over Colour; FF: Flesh Firmness; FS: Fruit Shape; APF: Adherence of Pit to Flesh; KB: Kernel Bitterness

Another significant correlation was found between FGC and FC (*r=0.90*). Similarly, RUIZ and EGEA (2008) reported in their study that a high correlation had existed between FGC and FC. This means that the flesh colour of fruit can be estimated without damaging the fruit. Furthermore, we determined a moderate significant correlation of FGC with ROC (*r=0.44*) and TA (*r= 0.43*), and also with TSS (*r = –0.47*) but in a negative way.

We determined a negative high correlation coefficient between TSS content and TA (*r= –0.88*). This indicates that the Turkish apricots, which have high TSS content, have low TA. Likewise, RUIZ and EGEA (2008) determined a negative correlation (*r=–0.47*) between TSS and TA, while BADENES *et al.* (1998) who studied the European eco-geographical apricot group, reported that there was no significant relationship between TSS and TA.

In addition TA, we determined moderate significant correlations of TSS with FF (*r=0.51*), APF (*r=–0.50*) and KB (*r =–0.52*). The previous studies carried out before by BADENES *et al.* (1998) and RUIZ and EGEA (2008) reported that there had not been any correlations for these characters. On the other hand, BYRNE *et al.* (1991) reported significant correlations among TSS, TA and FC in their study conducted on peach genotypes.

The correlation results of this study were generally found parallel to the results reported by ASMA and OZTURK (2005) and YILMAZ *et al*. (2012) but not to the results of BADENES *et al*. (1998) and RUIZ and EGEA (2008), although similar traits were studied. These results may be due to the eco-geographical groups and the genotypic effect (ASMA and OZTURK, 2005; CALISKAN *et al*., 2012).

*Principal Component Analysis*

Principal component analysis (PCA) is a multivariate statistical procedure being used to study correlations among traits and genetic relations between genotypes (RUIZ and EGEA 2008; YILMAZ *et al*. 2012; KARAAT and SERÇE, 2019). Correlations among the characters determined via PCA may also be related to genetic linkage of the loci controlling the characters or a pleiotropic effect (IEZZONI and PRITTS, 1991). PCA results of the evaluated traits were presented in Table 3 including Eigen values, variances and correlation results of the first three principal components, which represented most of the total variance. Additionally, a bidimensional plane was plotted for PC1 and PC2 including component scores in Figure 1.

According to the results, 22.9% of the total variation was explained by PC1, 19.8 % by PC2, and 12.3 % by PC3, totally 55.0%. Based on the component scores, the important traits composed PC1 were TV, TBFR, FSZ, FGC, FC, FS, FW, PW, and except for TBFR, positive values for PC1 indicated genotypes having higher values for those traits,. As can be observed on Figure 1, genotypes such as 'İpekpare' and 'Serintepe' belonged to this group.

*Table 3. Eigen values, variances and correlation results of the first three PC of the assessed characteristics*

| Variable/Factor | PC1 | PC2 | PC3 |
|---|---|---|---|
| Tree Vigour | 0.38 | 0.27 | 0.20 |
| Tree Habitus | -0.02 | -0.25 | -0.43 |
| Distribution of Flower Buds | -0.05 | 0.16 | 0.65 |
| Time of Beginning of Flowering | 0.26 | 0.50 | 0.06 |
| Time of Beginning of Fruit Ripening | -0.49 | 0.01 | 0.32 |
| Fruit Size | 0.81 | 0.43 | 0.21 |
| Fruit Ground Colour | 0.71 | -0.35 | -0.35 |
| Flesh Colour | 0.73 | -0.12 | -0.37 |
| Relative Over Colour | 0.25 | -0.21 | -0.52 |
| Flesh Firmness | 0.04 | 0.81 | -0.04 |
| Fruit Shape | 0.28 | -0.20 | -0.27 |
| Adherence of Pit to Flesh | 0.16 | -0.55 | 0.44 |
| Kernel Bitterness | 0.18 | -0.59 | 0.48 |
| Fruit Weight | 0.83 | 0.40 | 0.27 |
| Pit Weight | 0.74 | 0.19 | 0.33 |
| Fruit/Pit Ratio | 0.47 | 0.51 | 0.01 |
| Total Soluble Solids | -0.51 | 0.70 | -0.25 |
| Titratable Acidity | 0.34 | -0.82 | 0.23 |
| Yield | 0.41 | 0.01 | -0.47 |
| *Eigen value* | 4.35 | 3.72 | 2.33 |
| *Variance (%)* | 22.9 | 19.8 | 12.3 |
| *Cumulative variance (%)* | 22.9 | 42.7 | 55.0 |

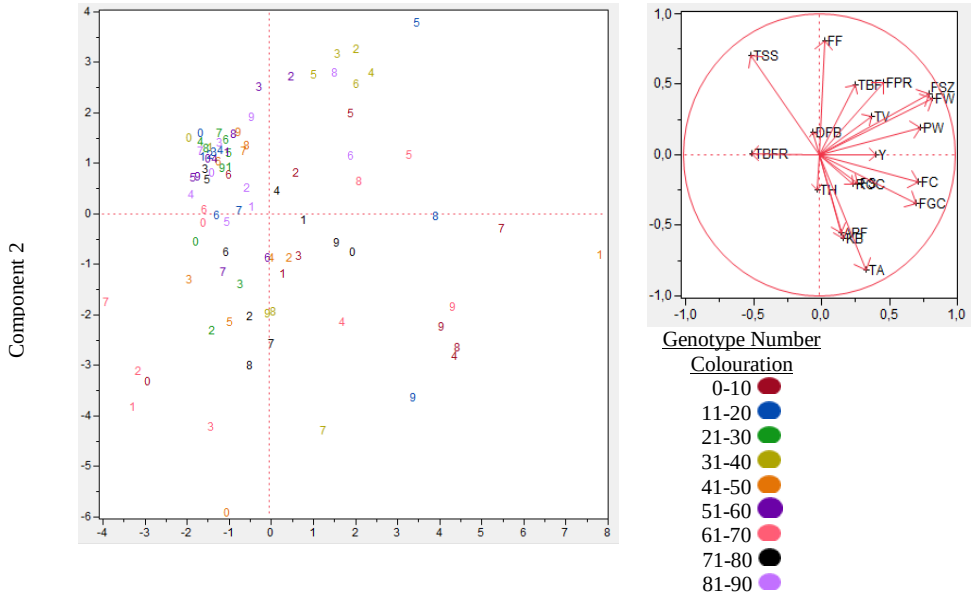


Figure 1. Segregation of apricot cultivars, genotypes, and reference cultivars according to their assessed traits determined by PCA

PC2 represented mainly the traits of TBF, FF, KB, FPR, TSS and TA. Positive values for PC2 indicated later TBFT, FF, FPR, and TSS. 'Kabaaşı-Kınay' and 'Kabaaşı-Önal' set an example for this group, having high FPR, FF and TSS. On the other hand, negative values of PC2 indicated genotypes with higher contents of KB and TA. For example, the genotype 'Dr. Kaşka' belonged to this group.

The most important characteristics contributed to PC3 were TH, DFB, ROC, APF, and Y. Positive PC3 values associated with higher DFB and APF, and negative values with TH, ROC and Y. Due to the huge size of the tables and figures, component scores of PC3 are not presented here. 'Burakbey' constituted an example for this group.

Results indicated a high variation among the genotypes in terms of the evaluated characteristics. Totally eight of the 19 characters were represented by PC1 including phenological, morphological and pomological traits. In their study, YILMAZ *et al.* (2012) evaluated apricot genotypes from the Irano-Caucasian eco-geographical group, some fruit traits also evaluated in this current study and similarly found that FSZ and FW to be represented by PC1. The authors reported that PC1, PC2, and PC3 in their study presented 40%, 22%, and 11% (totally 73%) of the total variation, respectively. Similarly, ASMA and OZTURK (2005) also reported FW represented by PC1 in their study conducted on Turkish apricot genetic resources, and totally 69.7% of the total variation were reported to be represented by first three principal components (49.3, 12.2, and 8.2%, respectively). On the other hand, in a study conducted by RUIZ and EGEA (2008) on Spanish apricot cultivars, FW was represented by PC2, and FF by PC3. The authors found the first three principal components (28.3, 22.1, and 16.1%, respectively)

representing 66.5% of the total variation. BADENES *et al*. (1998) evaluated 55 apricot cultivars belong to the European eco-geographical group and reported that PC1 accounted for 28.6% of the total variance and represented fruit weight, pit weight, and flesh firmness. The authors also reported that PC2 represented acidity and PC3 vigour and productivity.

## CONCLUSION

Collection and characterization of apricot genetic resources may provide considerable advantages for the success of apricot breeding programs. The studies regarding the characterization of the Anatolian apricots, which are well known for having high TSS, low TA and sweet seed and firm flesh, are limited. In this study, high variation was found in the Turkish apricot germplasm in terms of TSS, FSZ, TBFR and FF. About half of the apricots population have 20% and high TSS. In addition, numerous genotypes, which have large fruit size, firmly flesh, red over-colour and are in good taste for fresh consumption and early or late ripening, have been identified, though Anatolia is famous for its dried apricot cultivars. The previous studies reported that most of the apricot germplasm in Anatolia had had small-sized fruit. However, we identified 21 genotypes whose FW is 50 g or above (24.4%).Among the Turkish apricot cultivars and genotypes, the increase in the number of early and late ripening plant material with large FSZ and red over-colour is remarkable. This situation may indicate that more attention has been given to table apricot production in Turkey due to the problems at the dried apricot sector. The data demonstrated that new genotypes with extreme traits may be found in concerning fruit quality and harvest season if the apricot population of Anatolia is carefully selected. New apricot cultivars which would have large-sized and attractive fruits with low acidity and high sugar content as consumers demanding are required to be bred to increase the freshly consumed apricot. Cross-breeding will be needed to combine the desired quality traits. Most of the apricot genotypes included in this study presented high TSS and low TA values. It is foreseen that these genotypes may be useful to be parents for future apricot breeding programs.

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# OCENA NOVIH TURSKIH GENETIČKIH RESURSA KAJSIJE IZ IRANO-KAVKAZSKE EKO-GEOGRAFSKE GRUPE

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Izvod

Ova studija prikazuje 19 osobina 86 sorti kajsije i genotipove iransko-kavkaske eko-geografske grupe, ocenjene analizom glavnih komponenti. Definisane su velike varijabilnosti i razlike među genotipovima kajsije u pogledu morfoloških, fenoloških i osobina kvaliteta ploda. Veličina plodova genotipova je generalno bila vrlo mala (9,3 %) ili mala (43,0 %), ukupna stopa genotipova velikih i vrlo velikih plodova bila je samo 16,3 %. Podaci su pokazali da je 90,1% genotipova imalo žutu boju mlevenih plodova, 88,4% slatko jezgro i 65% čvrstoću ≥5 kg/cm$^2$. Oko polovine genotipova kajsije ima 20% ili viši sadržaj ukupnih rastvorljivih čvrstih materija. Većina genotipova (67,3%) obrana je u sredini sezone, a drugi genotipovi (23,3%) obrani su rano, dok je 4,7% njih sakupljeno vrlo kasno, 3,5% genotipova kasno. Samo jedan genotip (1,2%) ubran je vrlo rano. Veličina ploda bila je u velikoj korelaciji sa težinom ploda, težinom koštica i odnosom voćne mase i koštice. Ista korelacija je primećena i između boje usitnjenog voća i boje mesa ploda. S druge strane, ukupne rastvorljive čvrste supstance su bile u umerenoj korelaciji sa čvrstinom mesa ploda i ukusom semena. Rezultati analize glavne komponente pokazuju da je 55% ukupne varijacije zastupljeno za prve tri glavne komponente (22,9, 19,8 i 12,3%, respektivno). Germplazma je pokazala velike varijacije u ocenjenim osobinama, a za većinu genotipova je nađeno da imaju visoku ukupnu rastvorljivost čvrste supstance i nisku titrabilnu kiselost, što bi bilo korisno za buduće programe oplemenjivanja radi poboljšanja povezanih osobina.

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