Erwerbs-Obstbau (2014) 56:139–146
DOI 10.1007/s10341-014-0222-6

ORIGINAL ARTICLE

Biodiversity of figs (*Ficus carica* l.) in Coruh valley of Turkey

Isik Sezen · Sezai Ercisli · Sadiye Gozlekci

Received: 26 September 2014 / Accepted: 13 October 2014 / Published online: 31 October 2014

Abstract The Coruh valley lies within the Caucasus ecological zone, which is considered by the World Wild Fund for Nature and by Conservation International as a one of the biodiversity hotspot in the world. The valley is also recognized by Turkish conservation organizations as an important plant area, an important bird area, a key biodiversity area and has been nominated as a high priority area for protection. This valley is rich in plants and contains 104 nationally threatened plant species of which 67 are endemic to Turkey. Fig (*Ficus carica* L.) is one of the most important wild edible fruit tree along with pomegranate and olive in the valley. Figs have been used for fresh consumption for centuries and also an important element of natural landscape of the valley. The valley abundantly has black, purple and yellow-green fruited fig trees. In this study we determined some important tree, leaf and fruit morphological characteristics of 50 selected wild grown fig accessions naturally found in the valley. The results showed that the investigated morphological traits of fig accessions displayed significant differences each other. Principal coordinate analysis showed that diversity among the accessions was high and the accessions had black and yellow-green colored fruits were the most diverse groups.

S. Ercisli (✉)
Faculty of Agriculture, Department of Horticulture,
Ataturk University,
25240 Erzurum, Turkey
e-mail: sercisli@gmail.com

I. Sezen
Faculty of Architecture and Design, Department of Landscape Architecture, Ataturk University,
25240 Erzurum, Turkey

S. Gozlekci
Faculty of Agriculture, Department of Horticulture,
Akdeniz University,
07058 Antalya, Turkey

Keywords Fig · *Ficus carica* · Natural landscape · Farmers selection · Morphological diversity

Biodiversität von Feigen (*Ficus carica* l.) im Coruh-Tal, Türkei

Zusammenfassung Das Çoruh-Tal liegt in der ökologischen Zone des Kaukasus, die von mehreren Umweltschutzorganisationen als weltweiter Biodiversitätshotspot bezeichnet wurde. Ferner ist das Tal selbst von türkischen Umweltschutzorganisationen als wichtiges Pflanzen-, Vogelrückzugs- und Biodiversitätsgebiet anerkannt und als primärer Kandidat für den Schutzstatus vorgeschlagen worden. Gekennzeichnet durch seine Artenvielfalt beherbergt das Tal 104 bedrohte Pflanzenarten, darunter 67, die in der Türkei heimisch sind. Der Feigenbaum (*Ficus carica* L.) zählt zusammen mit dem Granatapfel- und Olivenbaum zu den wichtigsten wild wachsenden Bäumen mit essbaren Früchten im Tal. Feigen dienen seit Jahrhunderten nicht nur als Obstquellen für den Frischkonsum, sondern auch als wichtiger Bestandteil der natürlichen Landschaft des Tals, wo Bäume mit schwarzen, lilaschwarzen und gelbgrünen Früchten weitverbreitet sind. In dieser Studie haben wir verschiedene wichtige baum-, blatt- und fruchtbezogene morphologische Merkmale für 50 ausgewählte, im Tal heimische, wild wachsende Feigen-Akzessionen erfasst. Die Ergebnisse zeigen signifikante Unterschiede bezüglich der untersuchten morphologischen Merkmale unter den Akzessionen. Eine Hauptkomponentenanalyse hat ergeben, dass die Diversität unter den Akzessionen hoch ist

und unter denjenigen mit schwarzen bzw. mit gelbgrünen Früchten am meisten ausgeprägt ist.

Schlüsselwörter Feige · *Ficus carica* · Natürliche Landschaft · Obstauswahl für Landwirte · Morphologische Diversität

Introduction

Turkey is located in three biogeographical regions: Anatolian, Mediterranean, the Black Sea region, and their transition zones. Its climatic and geographical features change within short intervals of space due to the country's position-a bridge between two continents (Tan 2010). Thanks to its location, Turkey's biological diversity can be compared to that of a small continent: the country's territory consists of forests, mountains, steppe, wetlands, coastal and marine ecosystems and different forms and combinations of these systems (Ercisli 2004).

Turkey has a wealth of flora species. A comparison with the continent of Europe is sufficient to illustrate such wealth: while there are 12,500 gymnospermous and angiospermous plant species in the entire continent of Europe, it is known that about 11,000 such species are present in Anatolia alone, with some one third of them endemic to Turkey. Eastern Anatolia and Southern Anatolia among the geographical regions, and the Irano-Turanian and Mediterranean regions among the phytogeograhical regions, are rich in endemic plant species (Tan 2010).

Turkey is well known main origin and diversity centres of Fig (*Ficus carica* L.) and in most parts of the country, fig trees differs each other both tree and fruit characteristics. In particular in Mediterranean coastal line, Southern Anatolia and Northeastern Anatolia (particularly Coruh valley) this diversity is more visible (Caliskan and Polat 2008; Simsek and Yildirim 2010; Gozlekci 2011; Gozlekci et al. 2011; Ercisli et al. 2012).

Coruh River basin is one of the most picturesque yet significantly underdeveloped regions of Turkey. The River Coruh cuts through the mountainous region of Artvin and reaches the Black Sea. Beginning at the Mescit Mountains (3225 m), it flows for 466 km before reaching the Black Sea in Georgia, and is one of the fastest flowing rivers in the world. The small towns and villages located along the river are historically interesting, and the whole area represents the combination of Eastern Anatolian and Black Sea cultures. The Çoruh Basin is an absolute paradise for wild edible forms of fruits including fig, pomegranate, cornelian cherry, grape, mulberry, olive, quince etc. (Agar et al. 2012; Ercisli et al. 2012; Orhan et al. 2014; Sengul et al. 2014). With its rich biological diversity, the Çoruh Valley is one of the 34 world hotspots of biodiversity pointed out by Conservation International as the western section of "Caucasus Ecosystem". It is a place of immense biological diversity. There are estimated to be around 67 plant species endemic to this region (IUCN 2013).

The biggest diversity exists for the wild edible fruits, particularly for fig in the valley and thousands wild edible fig trees display great morphological diversity on leaves, fruits and trees (Ercisli et al. 2012). Local communities in the Coruh valley historically linked to fig trees and they used fig trees both aesthetic purposes and also consume fresh fig fruits for centuries. Therefore, the wild fig fruits have a great socioeconomic significance because of their food and medicinal values. Fig fruits constitute a major part of daily food intakes and play an important role in well-balanced diet and maintain healthy living of local people in the valley. Wild fig trees had different colored of fruits make a great addition to valley's natural landscape. Among the fruits, figs continue to be one of the most popular fruit grown in Coruh valley and they are very well adapted to Coruh valley's growing conditions, produce a good fruit crop and are low-maintenance.

The valley likes an 'open-air museum' including morphologically diverse seed propagated fig trees. Fresh fig fruits obtained from diverse fig trees have unique taste and texture. They are lusciously sweet with a texture that combines the chewiness of their flesh, the smoothness of their skin, and the crunchiness of their seeds.

Currently morphological markers still keep importance and widely used in different fruit species, cultivars and genotypes and might be appropriate for classification (Poledica et al. 2012; Yilmaz et al. 2012; Koc and Bilgener 2013).

The aims of this study were to determine the morphological diversity among fig genetic resources from Coruh valley and to evaluate them in terms of morphological properties.

Materials and Methods

In 2011year, a survey and selection studies were carried out in Coruh valley (Fig. 1) aimed to more diverse fig genotypes which had high fruit yields, free of pest and disease and attractive fruit characteristics.

Finally 50 more diverse fig trees (accessions) selected for further analysis. Out of 50 genotypes 18 had purple fruit color, 17 had yellow-green fruit color and 15 had black fruit color. The morphological measurements i.e. fruit weight, width, length, fruit shape index, fruit neck length and ostiole width were done on a total 20 random fruits per genotypes.

Average leaf area (cm^2) and the number of leaves per shoot were determined on 20 leaves and shoots. Some additional tree (tree growth habit, tree vigour, relative degree of branching) and fruit (fruit skin color) characteristics were also determined. Fruit weight was determined by using a

Fig. 1 Coruh valley in Turkey

digital balance with a sensitivity of 0.001 g. Linear fruit dimensions, i.e. width, length of fruit, width of ostiole and length of fruit neck were measured by using a digital caliper with a sensitivity of 0.01 mm (Fig. 2). Fruit shape index was determined as fruit width/fruit length. Leaf area was determined by area meter. Skin color of the fruit samples was evaluated as black, purple and yellow-green (Fig. 3).

Statistical Analysis

All data were analyzed using SPSS software and procedures. Analysis of variance tables were constructed using the Least Significant Difference (LSD) method at $p<0.01$ and 0.05. The morphological characteristics were subjected to principle component analysis (PCA) using the PRINCOMP procedure as well.

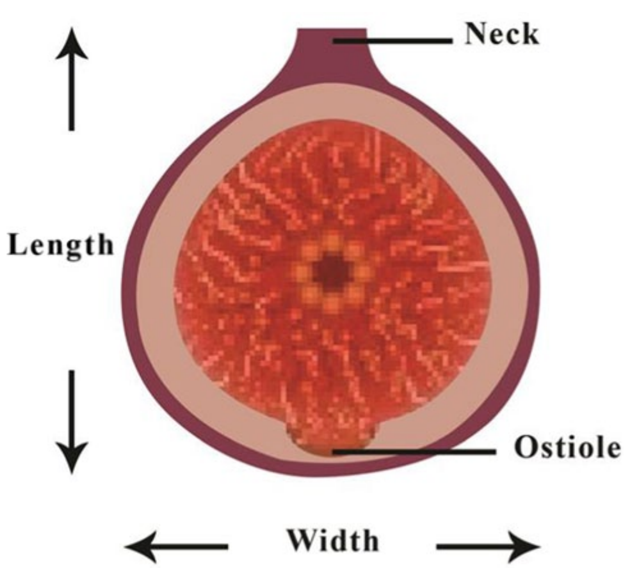

Fig. 2 The sections of fig fruit

Fig. 3 *Black*, *yellow-green* and *purple* fig fruits in the valley

Results and Discussion

The variance analysis revealed that there were statistically significant differences among accessions for all fruit traits ($P<0.01$) (Table 1). There were statistically important differences between leaf area and the number of leaves per shoot as well ($P<0.01$) (Table 2).

A big variation on fruit weight among 50 fig accessions are evident (Fig. 4) and the fruit weight of fig accessions from Coruh valley ranged from 14.9 g (Coruh 29) to 44.1 g (Coruh 45). Caliskan and Polat (2008) reported fruit weight from 22.2 to 52.5 g on a large number of fig accessions sampled in East Mediterranean region. Gozlekci (2011) carried out a selection study on figs in Kemer and Alanya districts belongs to Antalya provinces located west Mediterranean Region in Turkey and found that fruit weight was between 14.7 and 60.5 g in Kemer district, while the fruit weight of fig accessions from Alanya district varied from 13.8 to 48.5 g. Previously fruit weights of fig accessions from Turkey and different countries showed great variability that varied from 9 to 134 g (Chessa and Nieddu 1990; Ilgin 1995; Kuden et al. 1995; Bostan et al. 1998; Aksoy et al. 2003; Karadeniz 2003; Ferrara and Papa 2003; Simsek,

Table 1 Some important fruit characteristics of fig accessions sampled from Coruh valley

Accessions	Fruit weight (g)	Fruit width (mm)	Fruit length (mm)	Fruit shape index	Neck length (mm)	Ostiole width (mm)
Coruh 1	27.0 ± 1.5	33.5 ± 0.6	42.0 ± 1.3	0.80 ± 0.0	10.30 ± 0.8	3.70 ± 0.3
Coruh 2	33.3 ± 2.0	38.1 ± 0.7	49.2 ± 1.4	0.77 ± 0.0	13.32 ± 0.9	4.87 ± 0.3
Coruh 3	21.4 ± 1.2	33.1 ± 0.7	36.5 ± 0.6	0.91 ± 0.0	6.89 ± 0.6	3.78 ± 0.4
Coruh 4	19.5 ± 0.9	31.5 ± 0.6	40.6 ± 1.1	0.78 ± 0.0	10.62 ± 0.8	3.45 ± 0.2
Coruh 5	22.1 ± 0.7	34.7 ± 0.7	41.5 ± 1.0	0.84 ± 0.0	9.18 ± 0.8	3.11 ± 0.2
Coruh 6	25.3 ± 1.6	36.2 ± 0.8	34.1 ± 1.0	1.06 ± 0.0	7.05 ± 0.6	2.75 ± 0.3
Coruh 7	27.7 ± 1.6	37.3 ± 0.9	37.6 ± 1.1	0.99 ± 0.0	9.88 ± 0.7	3.30 ± 0.3
Coruh 8	23.5 ± 0.9	35.7 ± 0.8	36.8 ± 1.2	0.97 ± 0.0	6.98 ± 0.6	5.11 ± 0.4
Coruh 9	21.7 ± 0.6	33.7 ± 0.6	35.9 ± 1.0	0.94 ± 0.0	7.13 ± 0.5	2.56 ± 0.1
Coruh 10	29.4 ± 0.5	36.6 ± 0.6	42.7 ± 1.1	0.86 ± 0.0	7.86 ± 0.4	3.21 ± 0.3
Coruh 11	17.4 ± 0.4	31.1 ± 0.7	35.6 ± 1.0	0.87 ± 0.0	10.41 ± 0.9	3.17 ± 0.2
Coruh 12	25.9 ± 0.6	35.1 ± 0.6	35.9 ± 1.0	0.98 ± 0.0	6.15 ± 0.5	4.41 ± 0.3
Coruh 13	23.6 ± 0.3	36.5 ± 0.4	36.7 ± 0.6	0.99 ± 0.0	5.46 ± 0.5	3.11 ± 0.3
Coruh 14	31.7 ± 1.9	38.4 ± 0.7	42.7 ± 1.4	0.90 ± 0.0	6.89 ± 0.7	4.34 ± 0.4
Coruh 15	22.7 ± 1.1	35.9 ± 0.8	38.6 ± 1.2	0.93 ± 0.0	7.44 ± 0.7	5.11 ± 0.5
Coruh 16	26.8 ± 1.4	33.4 ± 0.7	34.9 ± 1.0	0.96 ± 0.0	8.03 ± 0.8	3.76 ± 0.2
Coruh 17	28.5 ± 1.3	34.5 ± 0.6	37.6 ± 1.1	0.92 ± 0.0	4.78 ± 0.8	2.98 ± 0.2
Coruh 18	23.4 ± 1.2	34.7 ± 0.5	30.5 ± 1.0	1.14 ± 0.0	2.88 ± 0.6	3.78 ± 0.3
Coruh 19	19.4 ± 0.9	30.1 ± 0.6	38.7 ± 1.0	0.78 ± 0.0	11.43 ± 0.9	3.11 ± 0.3
Coruh 20	41.1 ± 1.7	43.1 ± 1.1	40.4 ± 1.6	1.15 ± 0.0	7.18 ± 0.8	4.19 ± 0.4
Coruh 21	23.5 ± 1.0	35.3 ± 1.0	30.8 ± 0.9	1.15 ± 0.0	2.77 ± 0.4	3.33 ± 0.3
Coruh 22	36.7 ± 1.1	38.4 ± 1.2	41.3 ± 0.8	0.93 ± 0.0	5.11 ± 0.6	4.02 ± 0.3
Coruh 23	28.4 ± 1.0	32.5 ± 1.3	39.5 ± 0.8	0.83 ± 0.0	4.41 ± 0.5	3.05 ± 0.2
Coruh 24	23.4 ± 0.5	33.0 ± 0.6	32.9 ± 1.0	1.00 ± 0.0	6.43 ± 0.5	3.06 ± 0.1
Coruh 25	28.5 ± 0.5	34.6 ± 0.6	40.7 ± 1.1	0.85 ± 0.0	8.76 ± 0.4	3.00 ± 0.3
Coruh 26	19.3 ± 0.4	34.0 ± 0.7	35.1 ± 1.2	0.97 ± 0.0	7.48 ± 0.5	4.44 ± 0.2
Coruh 27	20.2 ± 1.0	33.3 ± 0.6	28.6 ± 1.0	1.16 ± 0.0	4.11 ± 0.6	3.48 ± 0.3
Coruh 28	23.6 ± 0.9	32.1 ± 0.6	39.9 ± 1.3	0.81 ± 0.0	12.66 ± 0.8	2.88 ± 0.3
Coruh 29	14.9 ± 0.5	29.3 ± 0.5	32.9 ± 1.0	0.89 ± 0.0	11.40 ± 0.8	4.10 ± 0.3
Coruh 30	26.7 ± 0.5	34.1 ± 0.4	34.9 ± 0.8	0.98 ± 0.0	7.77 ± 0.6	2.93 ± 0.3
Coruh 31	42.9 ± 1.5	45.0 ± 1.2	42.8 ± 1.6	1.05 ± 0.0	8.65 ± 0.8	5.11 ± 0.4
Coruh 32	23.5 ± 1.0	35.3 ± 1.0	30.8 ± 0.9	1.15 ± 0.0	2.77 ± 0.4	3.33 ± 0.3
Coruh 33	38.4 ± 1.2	39.7 ± 1.2	42.5 ± 0.8	0.94 ± 0.0	6.38 ± 0.6	5.35 ± 0.3
Coruh 34	30.3 ± 1.5	35.1 ± 0.8	45.2 ± 1.5	0.78 ± 0.0	12.30 ± 0.9	4.44 ± 0.3
Coruh 35	20.6 ± 1.0	31.1 ± 0.7	34.4 ± 0.6	0.91 ± 0.0	5.13 ± 0.4	2.56 ± 0.2
Coruh 36	38.9 ± 1.0	41.3 ± 1.0	41.0 ± 0.8	1.01 ± 0.0	5.11 ± 0.6	2.90 ± 0.2
Coruh 37	29.3 ± 0.8	34.5 ± 1.1	37.6 ± 0.7	0.92 ± 0.0	5.78 ± 0.4	3.45 ± 0.2
Coruh 38	27.7 ± 0.5	36.0 ± 0.7	35.5 ± 1.0	1.02 ± 0.0	7.40 ± 0.5	3.26 ± 0.1
Coruh 39	19.3 ± 0.2	31.3 ± 0.4	35.8 ± 1.1	0.88 ± 0.0	12.43 ± 0.9	5.10 ± 0.4
Coruh 40	23.3 ± 0.5	30.1 ± 0.4	32.4 ± 0.6	0.93 ± 0.0	5.70 ± 0.5	2.90 ± 0.2
Coruh 41	34.1 ± 1.1	35.7 ± 1.0	38.5 ± 0.8	0.92 ± 0.0	7.30 ± 0.7	4.02 ± 0.2
Coruh 42	27.3 ± 1.0	32.8 ± 0.7	42.0 ± 1.6	0.78 ± 0.0	11.49 ± 0.8	3.94 ± 0.3
Coruh 43	28.3 ± 06	34.6 ± 0.7	40.7 ± 1.0	0.85 ± 0.0	8.11 ± 0.6	3.56 ± 0.3
Coruh 44	19.2 ± 0.4	30.8 ± 0.6	36.6 ± 1.1	0.84 ± 0.0	6.35 ± 0.8	4.10 ± 0.2
Coruh 45	44.1 ± 1.8	45.4 ± 0.8	44.7 ± 1.5	1.02 ± 0.0	8.81 ± 0.7	6.10 ± 0.7
Coruh 46	39.3 ± 1.5	44.8 ± 0.9	38.6 ± 0.8	1.16 ± 0.0	5.38 ± 0.3	4.06 ± 0.4
Coruh 47	19.0 ± 0.2	30.1 ± 0.6	35.0 ± 1.0	0.86 ± 0.0	11.11 ± 0.6	3.56 ± 0.4
Coruh 48	22.2 ± 0.2	33.7 ± 0.7	36.9 ± 1.1	0.91 ± 0.0	10.40 ± 0.9	4.28 ± 0.4
Coruh 49	41.2 ± 1.7	45.9 ± 0.9	46.7 ± 1.6	0.98 ± 0.0	7.90 ± 0.6	6.70 ± 0.7
Coruh 50	37.2 ± 1.3	42.8 ± 0.7	39.1 ± 0.8	1.09 ± 0.0	4.87 ± 0.3	4.91 ± 0.3
LSD values	8.33**	7.34**	6.57**	0.11**	4.10**	1.44**

** is statistically significant at 0.01

Table 2 Some important leaf, tree and fruit characteristics of fig accessions from Coruh valley

Accessions	Leaf area (cm^2)	The number of leaves per shoot	Tree growth habit	Tree vigour	Relative degree of branching	Fruit peel color
Coruh 1	141 ± 8	4.48 ± 0.3	Spreading	Strong	Dense	Purple
Coruh 2	154 ± 11	7.54 ± 0.5	Weeping	Strong	Dense	Purple
Coruh 3	210 ± 12	10.21 ± 0.7	Spreading	Strong	Dense	Purple
Coruh 4	185 ± 9	8.50 ± 0.3	Spreading	Strong	Dense	Purple
Coruh 5	313 ± 13	4.62 ± 0.4	Spreading	Strong	Dense	Purple
Coruh 6	246 ± 9	6.62 ± 0.8	Open	Intermediate	Intermediate	Purple
Coruh 7	157 ± 7	9.11 ± 0.7	Spreading	Strong	Dense	Purple
Coruh 8	225 ± 11	4.75 ± 0.3	Weeping	Strong	Dense	Purple
Coruh 9	218 ± 8	5.11 ± 0.5	Spreading	Strong	Dense	Purple
Coruh 10	311 ± 11	6.75 ± 0.4	Spreading	Strong	Dense	Purple
Coruh 11	162 ± 10	5.45 ± 0.7	Spreading	Strong	Dense	Purple
Coruh 12	126 ± 6	7.65 ± 0.4	Weeping	Intermediate	Dense	Purple
Coruh 13	305 ± 13	8.11 ± 0.4	Open	Strong	Intermediate	Purple
Coruh 14	227 ± 10	5.49 ± 0.5	Spreading	Strong	Dense	Purple
Coruh 15	155 ± 11	7.22 ± 0.6	Spreading	Strong	Dense	Purple
Coruh 16	302 ± 14	4.68 ± 0.3	Spreading	Strong	Dense	Purple
Coruh 17	222 ± 8	10.43 ± 0.6	Spreading	Strong	Dense	Purple
Coruh 18	163 ± 7	7.77 ± 0.5	Spreading	Strong	Dense	Purple
Coruh 19	181 ± 9	11.45 ± 0.6	Spreading	Strong	Dense	Yellow-Green
Coruh 20	241 ± 11	5.19 ± 0.4	Open	Intermediate	Intermediate	Yellow-Green
Coruh 21	230 ± 8	4.67 ± 0.5	Spreading	Strong	Dense	Yellow-Green
Coruh 22	261 ± 12	6.66 ± 0.4	Spreading	Strong	Dense	Yellow-Green
Coruh 23	173 ± 10	8.23 ± 0.3	Open	Strong	Intermediate	Yellow-Green
Coruh 24	287 ± 12	9.23 ± 0.4	Spreading	Strong	Dense	Yellow-Green
Coruh 25	301 ± 13	4.18 ± 0.2	Spreading	Strong	Dense	Yellow-Green
Coruh 26	197 ± 9	3.98 ± 0.3	Spreading	Intermediate	Dense	Yellow-Green
Coruh 27	320 ± 12	4.33 ± 0.6	Spreading	Strong	Dense	Yellow-Green
Coruh 28	251 ± 9	5.10 ± 0.5	Spreading	Strong	Dense	Yellow-Green
Coruh 29	150 ± 8	9.31 ± 0.5	Weeping	Strong	Dense	Yellow-Green
Coruh 30	187 ± 9	3.10 ± 0.4	Spreading	Strong	Dense	Yellow-Green
Coruh 31	259 ± 11	4.73 ± 0.4	Spreading	Intermediate	Dense	Yellow-Green
Coruh 32	169 ± 10	7.10 ± 0.4	Spreading	Strong	Dense	Yellow-Green
Coruh 33	140 ± 12	9.31 ± 0.6	Spreading	Strong	Dense	Yellow-Green
Coruh 34	323 ± 15	5.18 ± 0.4	Spreading	Strong	Dense	Yellow-Green
Coruh 35	240 ± 10	3.89 ± 0.3	Spreading	Strong	Dense	Yellow-Green
Coruh 36	322 ± 13	4.71 ± 0.5	Spreading	Strong	Dense	Black
Coruh 37	198 ± 8	3.81 ± 0.4	Open	Strong	Intermediate	Black
Coruh 38	250 ± 13	3.67 ± 0.3	Spreading	Intermediate	Dense	Black
Coruh 39	183 ± 10	6.18 ± 0.4	Spreading	Strong	Dense	Black
Coruh 40	205 ± 10	7.48 ± 0.4	Weeping	Strong	Dense	Black
Coruh 41	310 ± 12	5.10 ± 0.3	Spreading	Strong	Dense	Black
Coruh 42	213 ± 10	3.80 ± 0.3	Spreading	Strong	Dense	Black
Coruh 43	383 ± 16	3.89 ± 0.4	Spreading	Strong	Dense	Black
Coruh 44	180 ± 9	4.60 ± 0.3	Open	Intermediate	Intermediate	Black
Coruh 45	143 ± 8	5.10 ± 0.3	Spreading	Strong	Dense	Black
Coruh 46	313 ± 16	7.84 ± 0.5	Spreading	Strong	Dense	Black
Coruh 47	197 ± 9	8.19 ± 0.6	Weeping	Strong	Dense	Black
Coruh 48	200 ± 8	6.28 ± 0.3	Spreading	Strong	Dense	Black
Coruh 49	283 ± 10	4.10 ± 0.4	Spreading	Strong	Dense	Black
Coruh 50	312 ± 14	4.95 ± 0.6	Spreading	Strong	Dense	Black
LSD	16.32**	2.11**				

** is statistically significant at 0.01

Fig. 4 Diversity among figs in Coruh valley in Turkey

2009). The results related to fruit weight of the study are in general in agreement with these findings.

The fruit width and length was between 29.3 mm (Coruh 29) and 45.9 mm (Coruh 49) and 28.6 mm (Coruh 27) and 46.7 mm (Coruh 49), respectively (Table 1). Gozlekci (2011) reported fruit width between 28.6 and 51.1 mm and fruit length between 28.3 and 54.7 mm among fig accessions from Turkey. Our fruit width and length results were between above literature and also our results are parallel to the findings of previous reports (Kuden et al. 1995; Ilgin 1995; Kuden and Tanriver 1998; Ozkaya 1997; Ferrara and Papa 2003; Caliskan and Polat 2008). Aksoy et al. (1992) reported that the fruit size (width and length) and fruit weight were considered as an important trait in the fresh consumed figs. In Turkey small fruits are used for canning, whereas big ones are consumed as fresh in general particularly Mediterranean region in Turkey (Gozlekci 2011).

The fruit shape indexes of accessions in Coruh valley were between 0.77 and 1.16 (Table 1). Gozlekci (2011) reported fruit shape index between fig accessions between 0.72 and 1.14. According to our fruit shape index result, it is clear that most of the accessions had oblate and oblong fruit shape.

The fruit neck length of fig accessions were between 2.77 mm (Coruh 21, Coruh 32) and 13.32 mm (Coruh 2) (Table 1). Caliskan and Polat (2008) found fruit neck length in fig accessions between 1.0 and 8.9 mm. Gozlekci (2011) also reported fruit neck length between 1.97 and 17.4 mm. Short neck length in fig fruits is not preferred by growers because damages may occur due to difficulties in harvest (Ozeker and Isfendiyaroglu 1998).

The ostiole widths of the fruits were determined between 2.56 (Coruh 9 and Coruh 35) and 6.70 mm (Coruh 49), respectively (Table 1). Gozlekci (2011) reported ostiole width between 2.25 and 8.93 mm. A large ostiole width on the fig fruit is an undesirable characteristic as pests and pathogens enter the fruit easily (Can 1993). Ostiole width was reported as 0.6−9.1 mm (Aksoy et al. 1992), 1.1–4.9 mm (Caliskan and Polat 2008) and 1.0–9.4 mm (Polat and Ozkaya 2005) in different fig growing areas in Turkey. Our results are also in accordance with above studies

Leaf area of fig accessions was found between 126 cm^2 (Coruh 12) and 383 cm^2 (Coruh 43) indicating great variability on this character (Table 2). The number of leaves per shoot was highest in Coruh 19 as 11.45 while the lowest was in Coruh 30 as 3.10 (Table 2). Results on leaf area and the number of leaves per shoot were in similar with Simsek (2009).

Fruit skin color of fig accessions were mainly purple (18 genotypes) followed by yellow-green (17 genotypes) and black (15 genotypes), respectively (Table 2). Gozlekci (2011) indicated fruit skin color in fig accessions ranged from green-yellow to black. Ercisli (2004) reported that there is great variability for skin colour in fig accessions and cultivars. Similarly, a great variation for skin colour among 50 fig accessions was found in this study.

The majority of accessions had spreading tree growth habit, strong tree vigour and dense relative degree of branching characteristics (Table 2). Fruit skin colors vary from yellow, green to brown, purplish black. The harvest dates were between 20 August and 10 September for yellow-green color group, 30 August and 20 September for purple group and between 10 September and 30 September for black group (data not shown).

The means of all traits were subjected to PCA (Principal Component Analysis) (Fig. 5). The accessions had purple colored fruits had lower diversity than black and yellow-green accessions (Fig. 5). The results indicated that the first three components showed 47, 23 and 13 % of the morphological variations, for a total of 83 %. The most important traits positively correlated were fruit weight, shape index, neck length, leaf areas and the number of leaves per shoot with PC1. The accessions were plotted on three dimensions based on their PCA results (Fig. 5). The genotypes were easily separated from each other with enough diversity. Continuous seed propagation in the region for centuries had resulted in a number of local genotypes differing in most of fruit characteristics in the valley. These genotypes are unknown origin and represent rich diversity.

Conclusions

The study revealed that there is a great biodiversity on most of fruit, leaf and tree characteristics figs that may have hid-

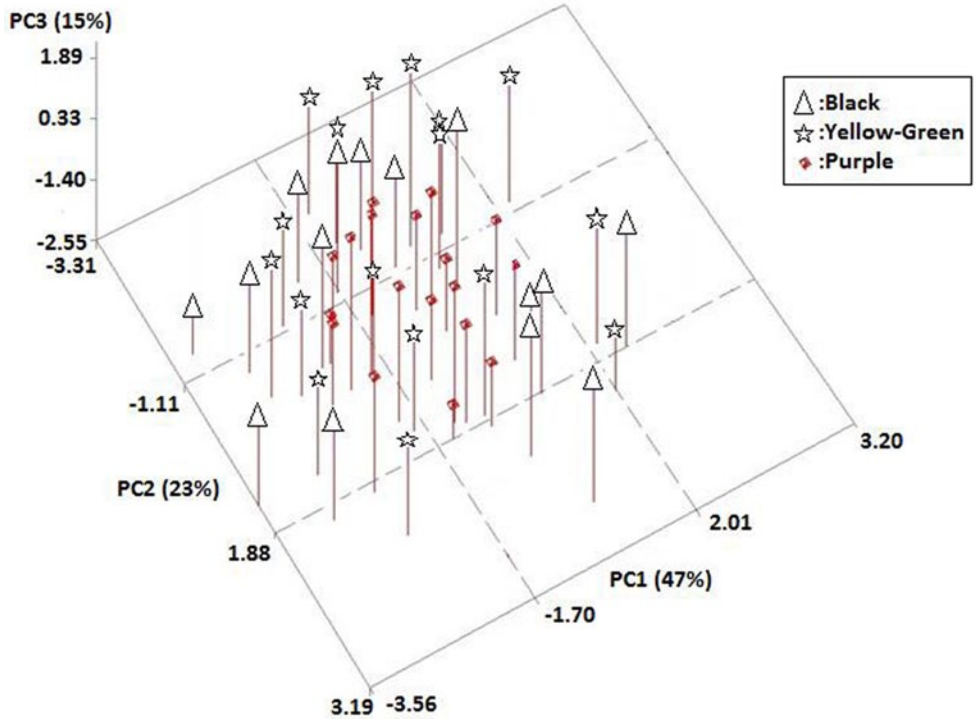

Fig. 5 PCA plot of the first three PCs depicting relationships among fig genotypes sampled from Coruh valley

den important genes inside and they could be important for breeding better fig cultivars by using them as parental material in future. This study also showed that fig trees are an important element of the natural landscape of valley and have a link cultural heritage of local people. Diverse fig trees value added on plant biodiversity in the valley.

References

Agar G, Yildirim N, Ercisli S, Ergul A, Yuksel C (2012) Determination of genetic diversity of *Vitis vinifera* cv. Kabarcik populations from the Coruh Valley using SSR markers. Biochem Genet 50 (5–6):476–483

Aksoy U, Seferoglu G, Misirli A, Kara S, Duzbastilar M, Bulbul S, Can HZ, Sahin N (1992) Clonal selection in cv. Sarilop fig. Processing 1st National Horticultural Congress. Izmir (in Turkish) 1:545–548

Aksoy U, Can HZ, Misirli A, Kara S (2003) Fig (*Ficus carica* L.) selection study for fresh market in western Turkey. Acta Hortic 605:197–203

Bostan SZ, Islam A, Aygun A (1998) A study on pomological caracteristics of local fig cultivars in Northern Turkey. Acta Hortic 480:71–73

Caliskan O, Polat AA (2008) Fruit characteristics of fig cultivars and genotypes grown in Turkey. Sci Hortic 115:360–367

Can HZ (1993) A study on the determination of some characteristics of selected table figs in Aegean region. Ege University Graduate School of Applied and Natural Science, (MSc Thesis), (in Turkish, with English summary). Izmir, Turkey.

Chessa I, Nieddu G (1990) Caratteristiche del Patrimonio Genetico del Fico in Sardegna. Agricoltura Ricerca XII (112–113). 9–48

Ercisli S (2004) A short review of the fruit germplasm resources of Turkey. Genet Res Crop Evol 51:419–435

Ercisli S, Tosun M, Karlidag H, Dzubur A, Hadziabulic S, Aliman Y (2012) Color and antioxidant characteristics of some fresh fig (*Ficus carica* L.) genotypes from Northeastern Turkey. Plant Foods Hum Nutr 67:271–276

Ferrara E, Papa G (2003) Evaluation of fig cultivars for breba crop. Acta Hortic 605:91–93

Gozlekci S (2011) Pomological traits of fig (*Ficus carica* L) genotypes collected in the west Mediterranean region in Turkey. J Anim Plant Sci 21(4):646–652

Gozlekci S, Kafkas E, Ercisli S (2011) Volatile compounds determined by HS/GC-MS technique in peel and pulp of fig (*Ficus carica* L.) cultivars grown in Mediterranean region of Turkey. Not Bot Horti Agrobo 39(2):105–108

Ilgin M (1995) Fig selection in Kahramanmaras region and floral biology of selected types. Cukurova University, Graduate School of Applied and Natural Science, (PhD Thesis), Adana-Turkey (in Turkish, with English summary)

IUCN (2013) International Union for Conservation of Nature. www.iucn.org

Karadeniz T (2003) A study on some fruit characteristics and propagations of these by hardwood cuttings of local cultivars grown in Ordu (Turkey). Acta Hortic 605:107–112

Koc A, Bilgener S (2013) Morphological characterization of cherry rootstock candidates selected from Samsun Province in Turkey. Turk J Agric For 37:575–584

Kuden AB, Tanriver E, Kaska N (1995) Determination of some fig cultivars and clones for Cukurova region. Proceedings of 2nd National Horticultural Congress 1:663–667

Kuden AB, Tanriver E (1998) Plant genetic resources and selection studies on figs in the east Mediterranean and south east Anatolia regions. Acta Hortic 480:49–54

Orhan E, Ercisli S, Esitken A, Sengul M (2014) Molecular and morphological characterization of pomegranate (*Punica granatum* L.) genotypes sampled from Coruh valley in Turkey. Genet Mol Res 13(3):6375–6382

Ozeker E, Isfendiyaroglu M (1998) Evaluation of table fig cultivars in Cesme peninsula. Acta Hortic 480:55–60

Ozkaya M (1997) Selection studies on figs in Antakya region. M.K.U. Graduate School of Applied and Natural Science, (MSc Thesis) (in Turkish, with English summary) p. 150

Polat A, Ozkaya M (2005) Selection studies on fig in the Mediterranean region of Turkey. Pak J Bot 37(3):567–574

Poledica MM, Milivojevic JM, Radivojevic DD, Dragisic-Maksimovic JJ (2012) Prohexadione-Ca and young cane removal treatments control growth, productivity, and fruit quality of the Willamette raspberry. Turk J Agric For 36:680–687

Sengul M, Eser Z, Ercisli S (2014) Chemical properties and antioxidant capacity of cornelian cherry genotypes grown in coruh valley of Turkey. Acta Sci Pol Hortorum Cultus 13(4):73–82

Simsek M (2009) Evaluation of selected fig genotypes from south east Turkey. Afr J Biotechnol 8(19):4969–4976

Simsek M, Yildirim H (2010) Fruit characteristics of the selected fig genotypes. Afr J Biotechnol 9(37):6056–6060

Tan A (2010) Second National Report of Turkey on conservation and sustainable utilization of plant genetic resources for food and agriculture. Aegean Agricultural Research Institute Menemen, Izmir, TURKEY

Yilmaz KU, Paydas Kargi S, Kafkas S (2012) Morphological diversity of the Turkish apricot (*Prunus armeniaca* L.) germplasm in the Irano-Caucasian ecogeographical group. Turk J Agric For 36:688–694