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Fig (*Ficus carica var.* domestica L.) Genetic Resources Conservation and Characterization

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Abstract

In this study, 292 female fig genotypes, (including foreign origins) in the fig field gene bank, were evaluated for qualitative characteristics in IPGRI (International Plant Genetic Resources Institute) definitions. These features are tree growth (tree growth power, branching, shoot length, etc.), leaf (leaf area, shape, number of lobes, etc.), fruit (fruit weight, color, ostiole opening, flesh thickness, etc.). Generally, non-metric definitions of these features were classified between certain ranges and expressed as percentage. For example; tree growth of genotypes was observed to be strong in 33% , and, apical dominance was determined in 17% of the genotypes. 60% of the genotypes have a medium (10-20cm) shoot length and, leaf area varies between 250-400cm^2 in %53 . The color of the fruits was determined as yellow in 34%, green in 32%, purple in 21% and black in 13% of genotypes. Within the scope of this continuous project, the collection of multiple data continues.

Keywords: Fig (Ficus carica L.), genetic resources, fig field gene bank, characterization, IPGRI.

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Dişi İncir (Ficus carica var. domestica L.) Genetik Kaynakları Muhafaza ve Karakterizasyonu

Özet

Bu çalışmada, incir arazi gen bankasında bulunan yabancı orijinliler de dahil olmak üzere 292 dişi incir genotipi, IPGRI (Uluslararası Bitki Genetik Kaynakları Enstitüsü) tanımlamalarındaki nitel özellikler yönünden değerlendirilmiştir. Bu özellikler ağaç gelişimi (ağaç büyüme gücü, dallanma, sürgün uzunluğu vb.), yaprak (yaprak alanı, şekli, lopların sayısı vb.), meyve (meyve ağırlığı, rengi, ostiol genişliği, tabla kalınlığı vb.) özellikleridir. Genellikle bu özelliklere ait metrik olmayan tanımlamalar belirli aralıklar arasında sınıflandırılarak, %'de olarak ifade edilmiştir. Örneğin; ağaç gelişiminin genotiplerin %33'ünde kuvvetli olduğu saptanmış, %17'sinde apikal dominansi görülmüştür. Genotiplerin %60'ı orta (10-20cm) sürgün uzunluğuna sahip olup, yaprak alanı %53'ünde 250-400cm^2 arasında değişmektedir. Meyvelerin rengi, genotiplerin %34'ünde sarı, %32'sinde yeşil, %21'inde mor ve %13'ünde siyah olarak saptanmıştır. Bu sürekli proje kapsamında, çoklu verilerin alınmasına devam edilmektedir.

Anahtar Kelimeler: *İncir (**Ficus carica L.**), genetik kaynaklar,incir arazi gen bankası, karakterizasyon, IPGRI.*

1. Introduction

Plant genetic resources can be freely used in the development of food, animal feed, fiber and industrial crops. The necessity of sharing genetic resources in order to conserve and preserve them for the future has also gained importance from past to present. The collection and storage of seeds for subsequent planting are at least as old as written history. Sumerians BC. in the 2500s, they have been came to Anatolia to collect rose, fig and grape varieties. The fig, which is considered sacred in the world and brought into culture with the settled life of people, is one of the oldest traditional fruit trees. It includes approximately 850 species globally distributed in tropical and subtropical/warm regions (Anonymous 2017).

Turkey, the the country of origin of the fig, has a very large fig population through natural hybridization and selection. Fig varieties are encountered in different climatic conditions of Anatolia. Southeastern Anatolia and Eastern Mediterranean regions are known as the main genetic sources of figs, especially for fresh fig varieties (Kuden and Tanriver, 1998).

However, it was determined that the first cultivars and their wild relatives were lost rapidly in the surveys made in our country and in different parts of the world. In addition to the cultivation of new varieties with superior characteristics, factors such as various diseases and plant pests, different climatic events, natural disasters and the development of residential areas affect fig cultivation. For this reason, in recent years, organizations such as the International Biological Program (IBP), United Nations Food and Agriculture Organization (FAO), International Plant Genetic Resources Board (IBPGR) have focused on the collection, evaluation, conservation and documentation (Küden and et al., 1995).

In many countries where fig genetic diversity exists, studies on the collection, characterization and conservation of genetic resources have been and are still being carried out. Morphology, pomology and molecular markers, tissue culture techniques and protocols are successful tools in assessing genetic diversity and classifying fig accessions (Aksoy et al., 2003; Stover and Aradhya 2005; Şimşek and Yıldırım 2010; Podgornik et al., 2010; Dalkılıç et al. , 2011; Giraldo et al., 2010a et al.; Şimşek et al., 2017; Khadivi et al., 2018; Zhou et al., 2013; Nader et al., 2019).

Morpho-agronomic characterization consists of germplasm analysis and subsequent morphometric analysis using specific descriptors developed by IPGRI (Bioversity International), The International Union for the Protection of New Varieties of Plants (UPOV) or other international consortia. These descriptors have been recommended by the Bioversity International, International Institute for Plant Genetic Resources (IPGRI) (germplasm diversity), International Association for Seed Testing (for quality control of seeds and propagation material to assess) and the Community Plant Diversity Office. Bioversity International has developed descriptors for more than 100 products in collaboration with national genetic resource agencies. The data obtained are used in the phenotyping of the characterized germplasm, in the evaluation of the diversity and variability of biological resources, and in the identification of regional and/or conservation plant varieties. Morpho-agronomic specific information is used in the preparation of passports and reports.

In India, biochemical characterization performed in germplasm analysis uses processes such as protein fractions (storage proteins) or other biochemical markers (antioxidants). Molecular characterization consists of germplasm analysis using different molecular markers (microsatellites, ITSs or SNPs). These descriptors have been proposed by IPGRI to assess the genetic variability of the germplasm, allowing the detection of specific markers for the identification of regional varieties or representation of material through genetic modification (GMO detection). The data obtained are used in typing regional varieties and checking the integrity of the collection of germplasm entries. Specific molecular information is collected in passports and reports (Tripathi, 2017).

Populations consisting of indigenous fig genotypes in İbradi and Kumluca (Antalya/Türkiye) were classified in terms of pomological and morphological characteristics. The data revealed that some fruit and leaf characteristics of the examined fig species were significantly different in terms of location and fig species.

Local fig germplasm was evaluated in Alanya and Kemer districts in the Mediterranean Region. The results showed that the examined pomological characteristics of the fig genotypes showed significant differences in both districts. Fig samples collected from Alanya are more

suitable for making marmalade and jam as they have relatively small fruits. Figs from Kemer were generally accepted as fresh consumption due to their relatively large fruit size (Gözlekçi, 2010 and 2011).

76 fig varieties were collected from Hatay Province in the Eastern Mediterranean Region between 2008 and 2009. Apical dominance, lateral shoot formation, leaf shape, number of lobes, central lobe length, leaf area and leaf width and fruit length for plant and leaf characteristics, pH, colour formation in the flesh, abscission of the stalk from the twig, fruit width, fruit length, fruit weight and antioxidant capacity were determined as distinguishing features. It has been suggested to use reproducible parameters as much as possible for the naming and classification of genetic resources (Caliskan and Polat, 2012a).

Female fig genotypes in Beyazsu region, located between Nusaybin and Midyat countries (Mardin/Türkiye), were selected between 2014 and 2015 using weighted-rankit method. Each selected genotype has been defined (Simsek et al., 2017).

In order to determine the phenotypic variation of fig genotypes grown in Mersin Province, Tarsus District, 24 female fig genotypes were evaluated according to plant and fruit quality characteristics. Among plant and fruit characteristics, 26 of 45 features were found to be more suitable for identifying and distinguishing fig genotypes in the research area. The results showed that the fig genotypes' measured plant and fruit characteristics had significant phenotypic variations (Şimsek et al., 2003 and 2020).

Some fig genotypes were selected from the Istahban Region of Iran in 2005. Morphological features of genotypes; tree growth, vigor, branching, lateral shoot development, apical bud color, annual shoot length, thickness, color and branching tendency, leaf shape, number of leaves per shoot, leaf length, leaf lobe, petiole length; as pomological characteristics; fruit weight, width and length, fruit skin color, shape, neck, symmetry, stem shape, stem length, total soluble solids, pH and total acidity were determined according to IPGRI (Mahdavian et al., 2007).

In order to protect the fig from genetic erosion and start the protection program, and make the morphological characterization of the local fig varieties; 31 fig cultivars belonging to different regions of Tunisia varying from north to south were analyzed according to both qualitative and quantitative morphological characters (Saddoud et al., 2008). Local fig germplasm was observed to determine morphological variability and to identify homonyms and synonyms within cultivars. Characters with high distinctiveness; fruit size, fruit outer color and leaf size were determined (Aljane and Ferchichi, 2009). In Morocco, in six main geographical regions, pomology, Plant

material was collected through observation and interviews with farmers. Local cultivar names were noted as given by the farmers. Photos and GPS coordinates were recorded as a reference for each fig tree collected. The study; It has been provided to characterize different varieties and to determine their geographical ranges. Synonymous and homonymous SSR profile statuses of the genotype groups were determined, which are closely related to fruit skin color (Khadari et al., 2005; Achtak et al., 2010). Most of the descriptive lists for the characterization of genetic resources in plants are long and expensive to evaluate. Also involves a large number of features that complicate the characterization of large collections of germplasm. Consequently, to facilitate the study and maintenance of the germplasm, It is important to carefully select the most informative variables for each species. Ordinal statistical procedures were applied to select the most distinguishing variables from 134 qualitative variables. As a result, a carefully selected and reduced number of highly discriminating variables were allowed for efficient fig germplasm characterization and differentiation, saving significant time and resources (Giraldo et al., 2010a and b).

The genetic diversity of 11 fig cultivars in 45 traits was evaluated using international morphological descriptors in Algeria. The use of morphological descriptors was found to be more appropriate to assess genetic diversity in Algerian fig genotypes. It was stated that 20 quantitative variables and 7 qualitative variables were useful in distinguishing the varieties; skin thickness, fruit length and fruit width were determined as more distinctive pomological variables (Benettayeb et al., 2017)

In the Dagestan Region, 14 morphological features were analyzed. The research results showed that there are significant differences between fig types in all studied natural habitats. Data from studies of rare species *F. carica* populations in Dagestan, status assessment and recommendations for conservation are presented for inclusion in the latest edition of the Red Book of the Republic of Dagestan (Gabibova et al., 2021).

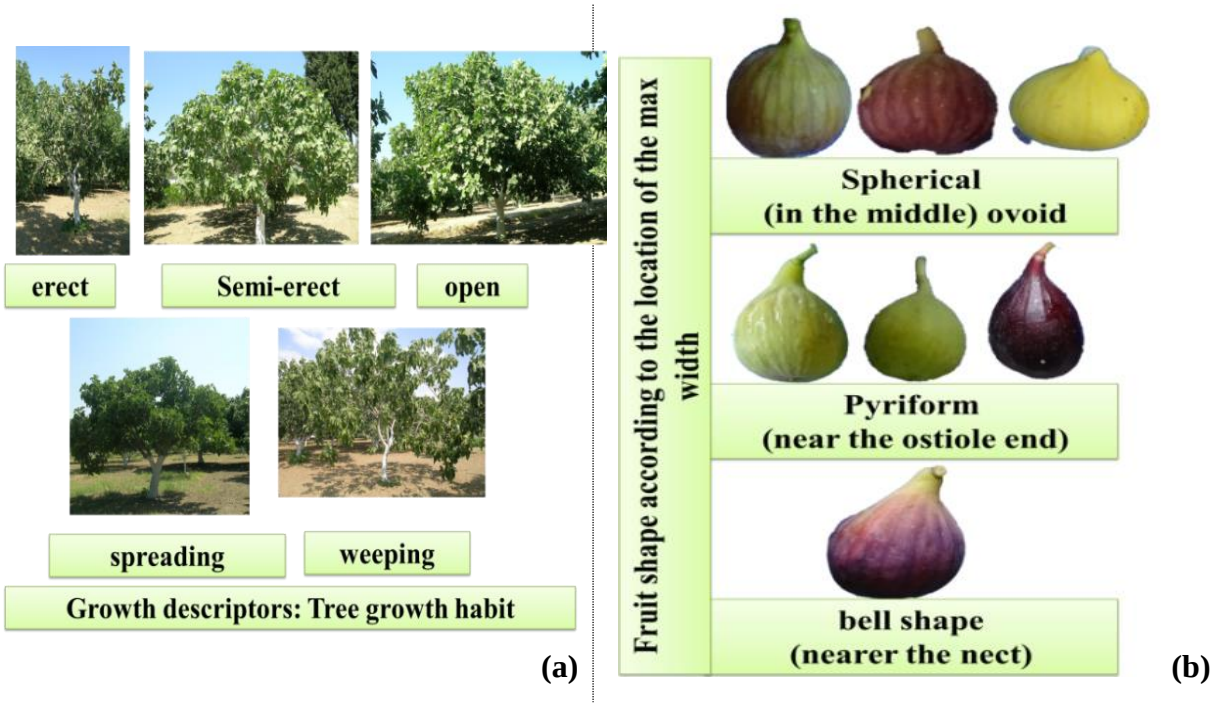
At the Faculty of Horticulture in Bucharest, the collection of important fig genotypes was started in 2015 and has been under evaluation ever since. A selection study of 25 fig genotypes was performed according to IPGRI descriptors. Fruit biochemical analyzes were carried out. Plants that gave good results in terms of all analyzed parameters were found to be resistant to biotic and abiotic stresses (Moisescu and Stănică, 2021). There are 8 germplasm centers in the world. 1. China, 2. India, Malaysia and Thailand, 3. Central Asia, 4. Near East, 5. Mediterranean, 6. Ethopia, 7. Southern Mexico and Central America, 8. South America. Turkey is located very close to both the

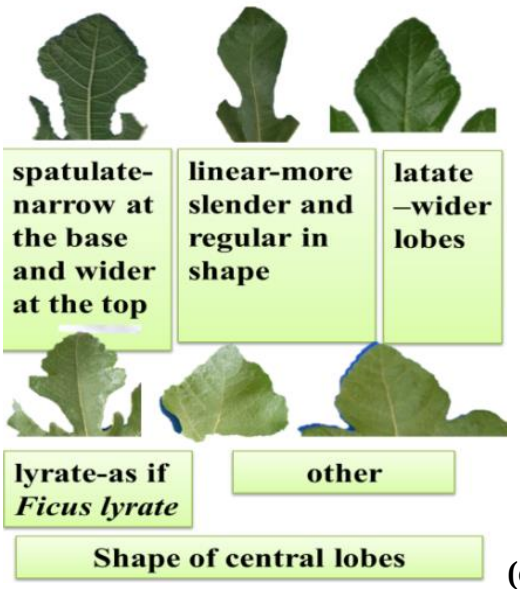
Near East and the Mediterranean genetic diversity. And this situation highlights Turkey's germplasm diversity and importance (Tanriver, 2019).

In this study, fig genotypes collected from the fig growing regions of Turkey by scientific survey and selection studies were taken under protection in the field gene bank in order to provide material for breeding studies and to transfer the data and material flow to future generations. With the new collection studies, the enrichment and identification of the collection continues with morphological measurements, pomological analyzes and phenological observations. A detailed archive has been created by describing the genotypes and recording the data. The data obtained and registered in this research were used in the evaluation of the diversity and variability of fig genetic resources.

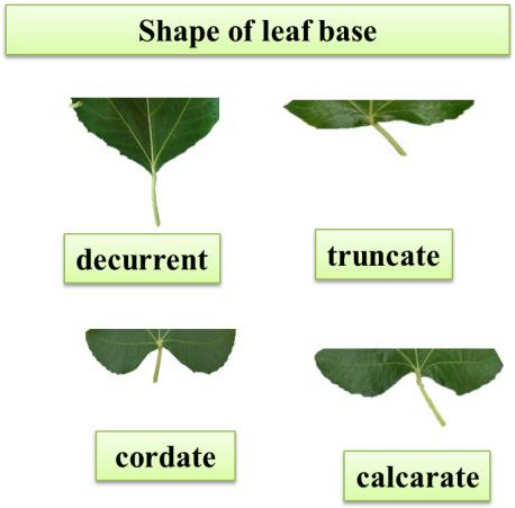
2. Material and Methods

All female fig genotypes in the Fig Research Institute Umurlu fig field gene bank constituted the study material. As criteria in the definitaon of IPGRI; 19 tree growth, 21 leaves, 47 were fruit (Table1) and 12 phenological characteristics (breba formation status, onset of breba and main product fruit maturity, harvest period time, caprification period) were used. The onset of defoliation the date was taken when 50% of the leaves on the tree were shed (Figure 1) (Anonymous, 2003 and 2007).

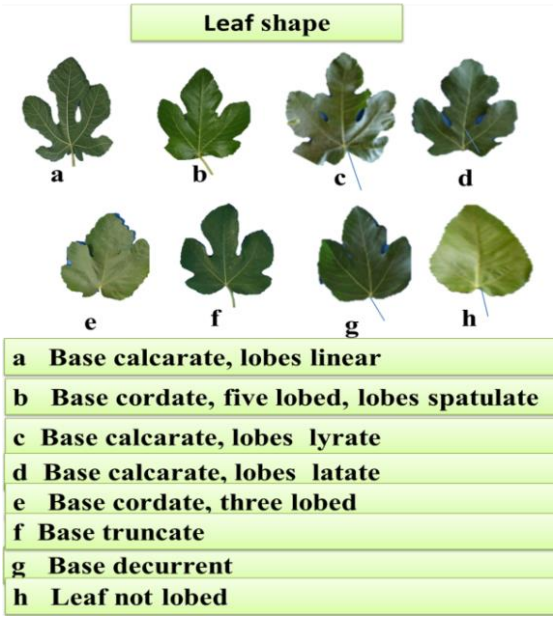



spatulate-narrow at the base and wider at the top
linear-more slender and regular in shape
latate –wider lobes
lyrate-as if *Ficus lyrate*
other
Shape of central lobes

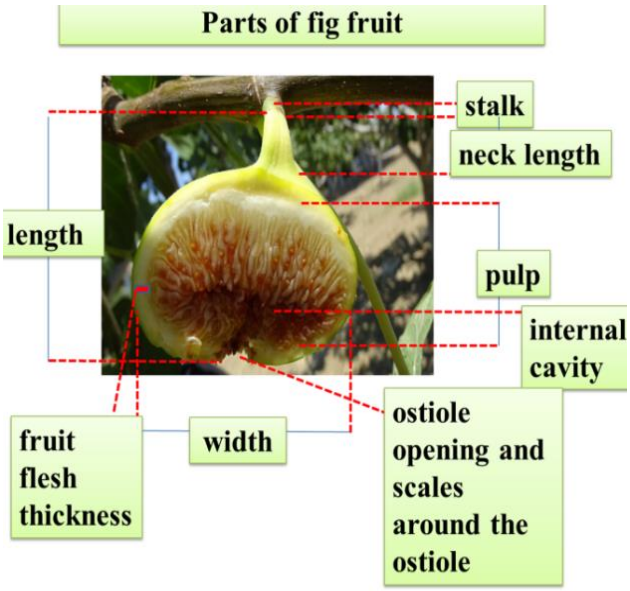
(c)


Shape of leaf base
decurrent
truncate
cordate
calcarate

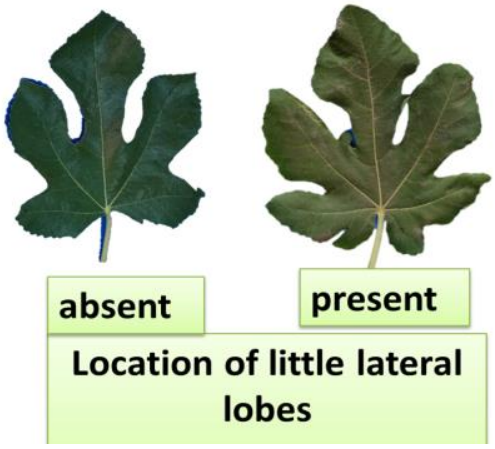
(d)


Leaf shape
a
b
c
d
e
f
g
h
a Base calcarate, lobes linear
b Base cordate, five lobed, lobes spatulate
c Base calcarate, lobes lyrate
d Base calcarate, lobes latate
e Base cordate, three lobed
f Base truncate
g Base decurrent
h Leaf not lobed

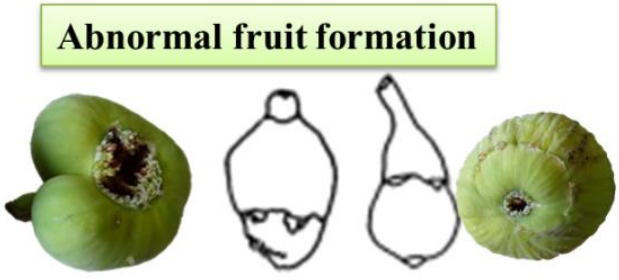
(e)


Parts of fig fruit
stalk
neck length
length
pulp
internal cavity
fruit flesh thickness
width
ostiole opening and scales around the ostiole

(f)


absent
present
Location of little lateral lobes

(g)


Abnormal fruit formation

(h)

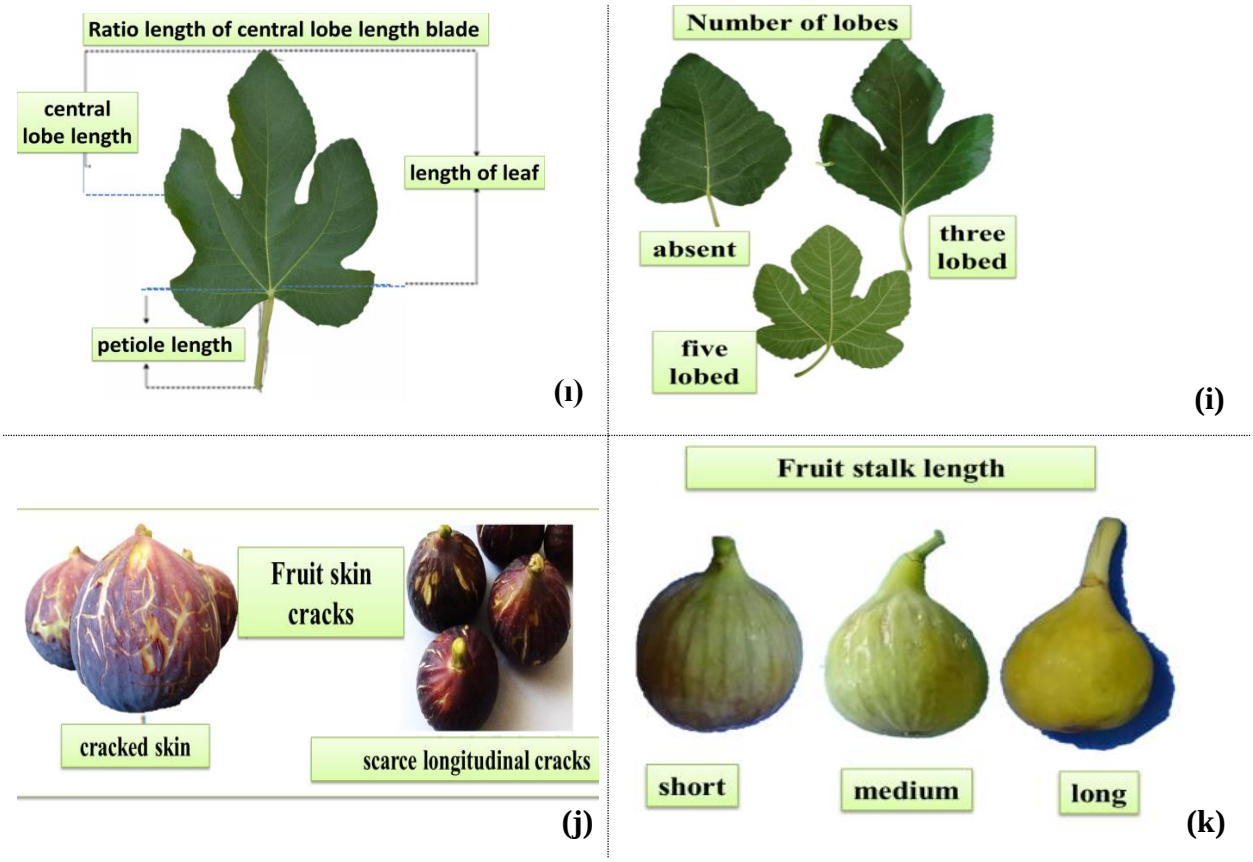


Figure 1. Some criteria used in definitions; tree growth habit (a), fruit shape (b), leaf shape (c-d-e-g-ı-i), shape of leaf base (d), ratio length of central lobe/length blade and petiole length (ı), little lateral lobes on petiole sinus (g), abnormal fruit formation (h), parts of fruit (f), expression of skin cracks (j), stalk length and shape (k) *((Definition photos were taken from the fig field gene bank, and modifided accordance with IPGRI).*

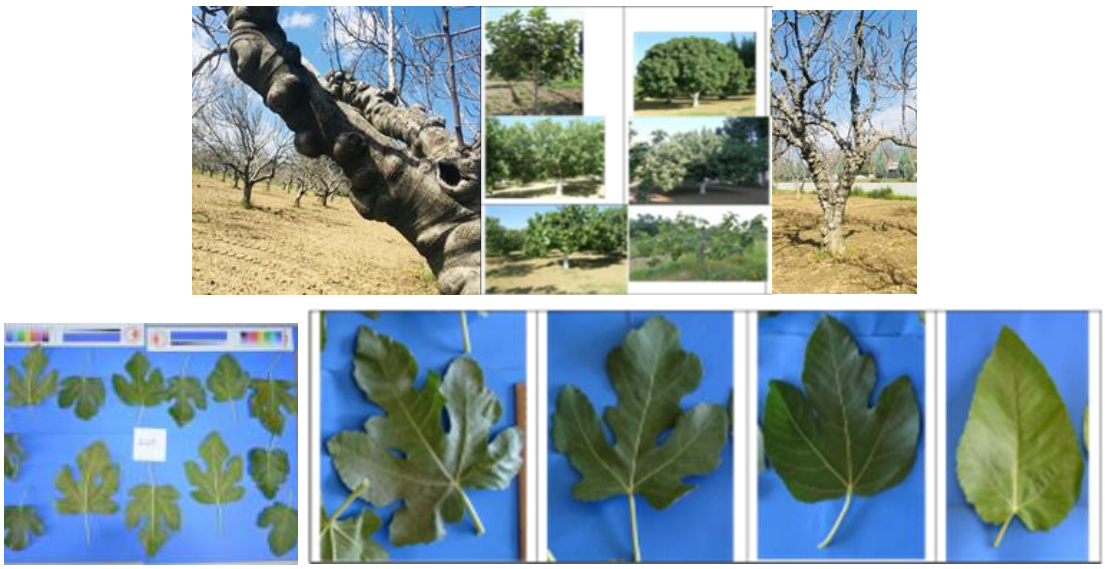


Figure 2. Some tree growth and leaf characteristics in the fig field gen

Table 1. Some descriptions used in female fig genotypes

Easy of peeling; Determined by manually removing the peel from the fruit neck towards the ostiole. If the peel of the fruit is peeled without breaking from the neck to the ostiole, it is easily peeled, while the skin of the fruit is peeled from the neck to the ostiole by hand, if the peel is broken off in the abdomen or before reaching the ostiole, such types are described as hard to peel. *Amount of fruitlets;* Fruitlets were compared with fruitlets of Sarılop. If less fruitlets than Sarılop, low. If more fruitlets than Sarılop,so high. The types with no fruitlets were considered to have no fruitlets. The other fruitlets were described as medium. *Fruitlets size;* The fruitlets found in Sarılop fig fruits were accepted as medium sized and by comparison with the fruitlets of the types, those with the size of Sarılop fig fruitlets were accepted as medium, those smaller than Sarılop fig fruitlets were considered small. The fruitlets of fig types with large fruitlets from Sarılop fig fruitlets were accepted as large. *Fruit skin cracks;* It was determined according to the condition of the cracks formed from around the ostiole *Fruit inner-cavity*; The fruit was checked by dividing it in half with a knife from the fruit neck towards the ostiole (axis) and from the fruit ventral region (diameter). If there is no gap in the fruit center, if the inside is completely full, there is no gap; the gaps up to the lentil volume are very small, the gaps between the lentil-chickpea volume are small; The voids up to the chickpea volume were considered medium, and the voids larger than the chickpea volume were considered large. *Leaf shape and lobes:* It is generally possible to come across about 3-4 different leaf characteristics. Studies were carried out according to the dominant leaf shape in the leaf samples taken.	*Tree growth characteristics*; Tree grown development, tree vigor, branching (apical dominancy and branching frequency), side branch formation, top bud shape- color-shoot color, bottom shoot formation tendency, nodal swellings location (Figure 4). *Leaf features;* Leaf shape, shape of lobes, location of little lateral lobes, degree of leaf lobation/incision (length of central lobe/length of leaf ratio (%)), shape of leaf base, petiole color, profile cross-section, leaf margin dentation, upper and lower leaf surface hairiness, leaf venation, leaf colour (Figure 1 and 2). *Fruit characteristics;* Uniformity of fruit size, fruit symmetry, liquid drop at the ostiole, scale size-color-adhesion, fruit stalk shape-length, abnormal fruit formations, abcission of the stalk from the twig, easy of peeling, fruit ribes, skin cracks, resistance to ostiole-end cracks, firmness of the fruit, skin colour, fruit skin ground over colour, fruit skin ground over colour(irregular patches), lenticels quantity-size and color, colour formation in the flesh, pulp internal colour, pulp flavour, pulp texture, pulp juicness, fruit inner cavity, amount of fruitlets, fruitlets size, colour of dried fruit and firmness of dried fruit (Figure 1 and 3).
It was determined by measuring with a digital caliper.	Terminal bud length-width(mm), shoot length(cm)-dia(cm), Leaf length-width(cm)- leaf area(LxW), length of leaf stalk(mm) Fruit width-length, breba and main crop neck length, fruit flesh thickness,ostiole opening
-	Number of leaves per shoot, number of lobes, number of dried fruits per kilogram
*Fruitlets weight;*100 fruitlets of the fruits were counted and weighed with precision scale.	Weight of 100 fruitlets (g),
Total soluble solids; Detected with a refractometer. Titratable acidity (TA) (in citric acid) (%); 10 ml sample taken from the crushed juice filtrate in the blender was titrated with 0.1 N NaOH solution until the pH reached 8.10. Using the amount of spent NaOH, the free acidity was calculated in terms of citric acid. Mettler Toledo-DG-115-SC automatic titrator instrument was used for titration (Ayar and Seferoğlu, 2021).	Total soluble solids (TSS) (%) and titratable acidity (TA)(%)

Anonymos, (2003); 24.03.201; fig descriptor TG/265/1

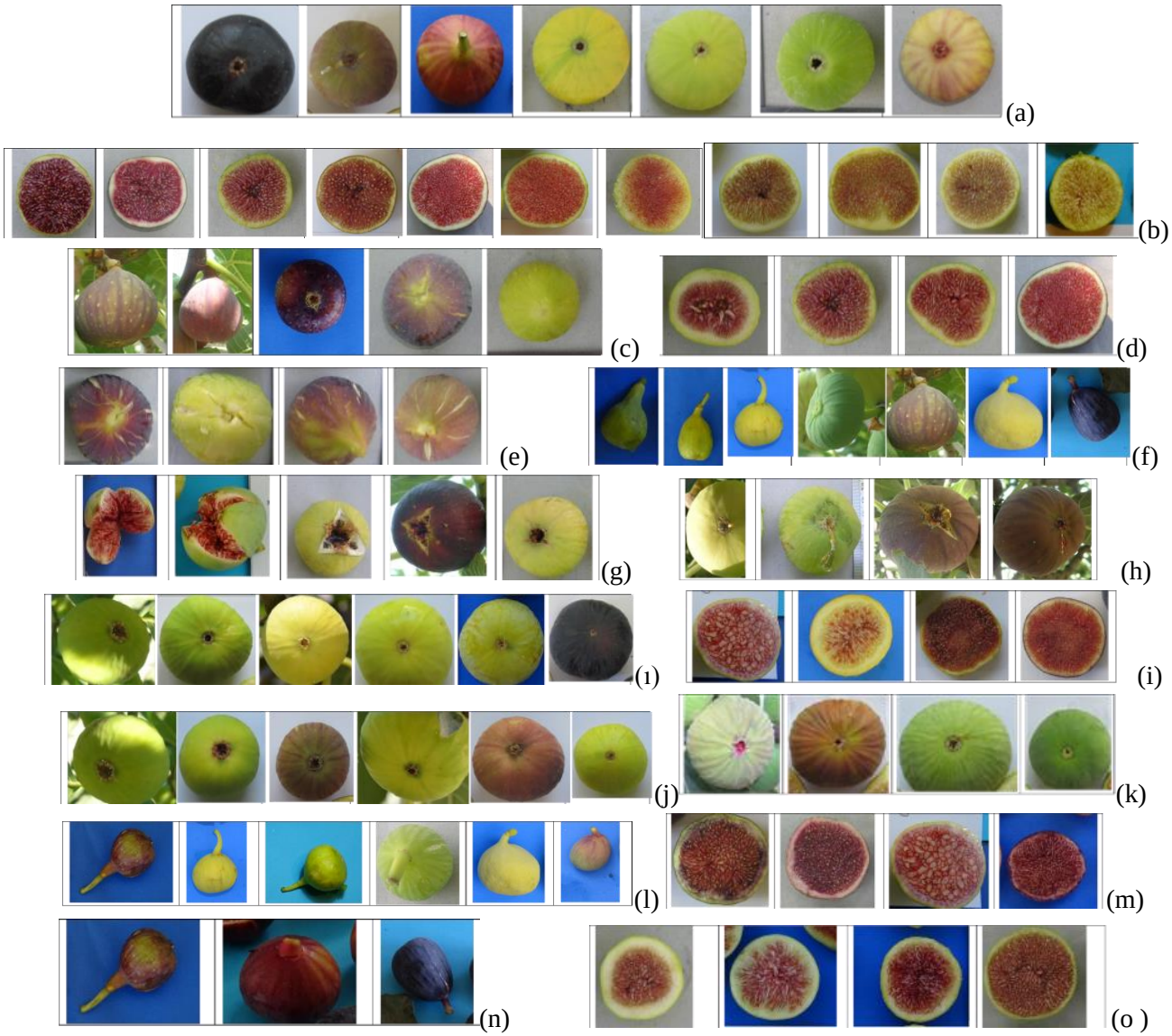


Figure 3. Fruit skin and ground colour (a), pulp internal colour (b), lenticel colour and quantity (c), fruit inner cavity (d), fruit skin cracks (e), fruit shape (f), resistance to ostiole and cracks (g), color of liquid drop at the ostiole (h), ostiole opening (ı), amount of fruitlets (i), size, colour and adhesion of the scales around the ostiolum (j), ribes (longitudinal on the fruit surface) (k), stalk lenght and shape (l), colour formationin the flesh (m), neck length (n), flesh thickness (o)

3. Results and Discussion

Tree growth habits of female genotypes showed 38% semi-erect, 24.65% spreading, 15.75% open, 11.99% erect and 7.88% weeping development. As an example; 1002 Bardakçı, 1053 Aydın İnciri, 1064 Mor erect; 205-Sarı Dizlik, 1010 Kara Yaprak, 1034 Sakız semi erect; 1013 Beyaz Orak, 1031 Alaca, 1036 Lop open; 1004 Kuşadası Bardakçı, 1012 Siyah Orak, 1051 Langav spreading and, 256 Yediveren, 309 Mor, 319 Osmaniyeli were showed weeping tree growth.

In terms of tree vigor, 50.68% showed medium growth, 32.53% showed high growth performance and the rest showed low growth performance.

It was determined that 16.48% were without apical dominacy and no lateral branch, 41.10% with apical dominancy and lateral branching, 25.34% with only apical dominance and 17.47% with only lateral branching. 23% of the genotypes are sparse, 49% are medium branched, and 28% are dense branched. The apical bud is usually in the form of a cone. The terminal bud length varies between 4.84- 19.72 mm, and the terminal bud width varies between 3.19-16.74 mm.

Terminal bud colour is generally in the yellow-green (light green) group.

Seasonal shoot growth on trees was 10-20 cm (medium) in half of the collection, <10 cm (short) in 34%, 21-35 cm (long) in 5.82%; shoot diameter was <10 mm (thin) in 47.60% and 10-

15 mm (medium) in 48.28%. The genotypes in the collection were mostly (70.20%) in the group with red-brown shoot color. The tendency to form tuber is low in more than half of the collection (<3). Nodal swellings location is 31% in the elderly and 26.71% in young branches (Table 2).

Table 2. Qualitative characteristics of genotypes measured in terms of tree growth

Tree growth habit	11.99% erect	38.00% Semi-erect	15.75% open	24.65% spreading	7.88% weeping
Tree vigor	16.79% low	50.68% medium	32.53% high		
Branching:apical dominancy (BAD) lateral shoot formation on seasonal growth (LSF)	16.48% BAD (-); LSF (-)	41.10% BAD (+); LSF (+)	25.34% BAD (+); LSF (-)	17.47% BAD (-); LSF (+)	
Relative degree of branching	23.00% sparse	49.00% medium	28.00% dense		
Shoot length (cm)	34.00% <10cm (short-poor)	60.18% 10-20 cm (medium)	5.82% 21-35cm (long)		
Shoot width (mm)	47.60% <10mm (thin)	48.28% 10-15mm (medium)	4.12% >15mm (thick)		
Shoot colour	7.53% grey-green group	5.48% green group	70.20% red-brown group	16.78% other	
Nodal swellings location	26.71% young branches	31.00% older branches	42.29% none		

The number of leaves in the shoot generally varies in the range of 4-8 pieces. leaf shape; divided into two groups spur and others.

Leaf shape in most of the genotypes (37.33%), was determined by base cordate, five lobes and spatulate. The leaves of 63.36% of the collection have five lobes, 28.43% have three lobes, and 3% have no lobes. The shape of the pieces is grouped as spatulate (45%), latate (31%), linear (17%), and as in *Ficus lyrata* (4%). Small lateral slices are usually located in the lateral lobe (62%) and the middle lobe (36%). Leaf

fragments/ the degree of indentation (89%) were found in the range of 0.51-0.75% (pronounced sliced) in general.

The shape of the petiole sinus is grouped as calcarate (35.27%), truncate (30%), cordatei (26.03%), decurrent (7.88%) and open calcarate (1.61%). Leaf area (length*width), 250-400 (medium) (52.74%), 400-550 (large) (20.89%), <250 (small) (20.55%), and >550cm^2 (very large) (5.82%) detected in the range. The petiole is generally light green, and its length is between 50-80mm (medium). Leaf margin dentation were completely no dentation (44.52%), only the upper margins dented (51.72%), and the lobes sides were completely dented (3.42%). Leaf margin dentation is generally located in the crenate group. The density of spicules/hairs on leaf's upper surface was generally medium (48.97%), the density of spicules/hairs on the lower surface was determined as sparse (43.83%), medium (38.70%), dense (11.64%) and hairless.

The leaf venation of more than half (51%) of the collection is apparent and 54.79% of them have green leaf color. Petiole length is grouped in the range of <50mm (14.04%) short, 50-80mm (65.41%) medium and >80mm (20.55%) long (Table 3).

Table 3. Qualitative characteristics of genotypes measured in terms of leaf growth

Leaf shape	8.22% lobes linear	37.33% base cordate, five lobed, lobes spatulate	9.25% lobes lyrate	11.30% lobes latate		10.96% base cordate, three-lobed	7.53% base truncate	14.04% base decurrent	1.36% leaf not lobed
	base calcarate					other			
Number of lobes	3.00% absent	28.43% three	63.36% five						
Shape of lobes	45.00% spatulate)-(narrow at the base and wider at the top)]	31.00% [(latate)-(wider lobes)]	17.00% [(linear)-(more slender and regular in shape)]	4.00% *[(lyrate)-(as in F. lyrate)*					
Location of little lateral lobes	36.00% İn central lobe	62.00% in lateral lobes							
Shape of leaf base (petiole sinus)	35.27% calcarate	1.61% open calcarate	30.00% truncate	26.03% cordatei	7.88% decurrent				
Leaf margin dentation	44.52% no dentation	51.72% only upper margins dented	3.42% lobes sides completely dented						
Leaf margin	52.74% crenate	14.38% dentate	10.96% serrate	17.81% undulate					
Petiole length	14.04% <50mm (short)	65.81% 50-80 (medium)	20.55% >80mm (long)						
Leaf area (LxW) (cm^2)	20.55% <250 (small)	52.74% 250-400 (medium)	20.89% 400-550 (large)	5.82% >550 (very large)					

In most genotypes, breba fruit is born. However, the fruits that remain on the tree for a certain period of time are shed because they are not fertilized.

Genotypes 224, 1012, 1013, Banana, Nazareth, N.D Caromb, Black Flower, White Flower, Masui Dauphine, Fethiye PRT, 1071, 1019 have parthenocarpic characteristics. It was determined that genotypes 235, 250, 345, 501, 535, 536, 1011, 1042, 1073, 1094 ripened breba fruits on the tree, albeit partially. Breba fruit ripening takes place between June 1-15 (mid) and June 16-30 (late). The maturity status of the Main crop is generally 11-31 August (medium). The harvest period is in the range of 41-60 days (long), the beginning of harvesting is in the range of >10 June to 10-30 June, the harvesting period is 7-15 days, if there is precipitation, 16-21 days, the beginning of leaf fall occurs in late November-early December.

Fruit width was defined as 28-38mm (small) (16%), 39-49mm (medium) (51.40%), 50-60mm (large) (30%) and >60mm (very large) (1.40%). Fruit size; It was found in the range of 29-46mm (short) (75%), 47-54mm (20%), and 55-75mm (long) (25%). The neck length of the main crop is generally 5-15mm (medium) (51.40%).

Fruit sizes (76.71%) were uniform, and fruits were defined as symmetrical in 87%. Ostiole opening was determined as >5mm (very large) (36%), 4-5 mm (large) (45%), 1-3mm (medium) (16%), and <1mm (small) (2%). There was a liquid drop at the ostiole in 25% of the collection, and the color of the liquid drop at the ostiole was determined as transparent (94.52%), pinkish (4.45%) and red (1%). Genotypes 331, 332, 225, 1104, 1029, 1048, 1049, 1066, 1080, 338, 519, 532, 701 were included in the group with pinkish liquid drop at the ostiole.

44% of the genotypes are covered with small scales, 35% medium and 19% large scales, and the scale color of 52% is different from the color of the fruit skin. In terms of scales around the ostiole; frequency, genotypes were grouped as detached, adhered and semi- adhered. Shape of the fruit stalk was determined in variously (23.63%), long and slender(23.29%), and short-thick (53%). The length of the fruit stalk varies between 1.09-17.86 mm. Abnormal fruit formations were generally not observed. Fruit stalk remained on the branch during harvest (41.78%) and easily separated from the branch (57.88%); easy peeling (69.86%) and hard peeling (6.5%) genotypes were determined. Genotypes with prominent ribes on the fruit surface (25.68%), intermediate (52%) and no ribes fruit surfaces were divided into three different groups.

The skin cracks on the fruit are generally in the form of longitudinal and minute cracks (94%). Genotypes were grouped as susceptible to ostiole cracking (18.83%), intermediate (33.56%) and resistant (47.60%). Fruit flesh thickness was determined in the range of 0.55-7.46 mm. The firmness of the fruit skin is grouped as those with soft, medium, firm and rubbery structure, and 48.30% of the genotypes have a medium-soft fruit firmness of skin structures. The genotypes of fruit skin ground colour were grouped as purple (18%), brown (2%), green (27%), light green (13%), yellow-green (30%) and yellow (9%). Fruit skin color is divided into yellow (34 %), green (32 %), purple (21 %) and black (13 %) color groups. Genotypes 304, 308, 339, 347, 1109, 1113 have a very light yellow fruit skin color. 209, 210, 231, 302, 305, 306, 309,

311, 517, 523, 537, 705, 1009, 1020, 1021, 1024, 1033, 1037, 1039, 1086, 1095, 1096, 1108, 1111 genotypes were found to have purple fruit skin. Some genotypes in the black fruit skin group; 208, 216, 237, 1071, 1101, and Fethiye PRT genotypes can be given as examples. Lenticels on fruit; It is usually small, scarce in quantity and usually white in color. Genotypes with intense colour formation (2.74%) and light coloration (15.75%) on fruit flesh were found. The pulp inner colour is mostly red, with little flavour, a little juicy and the pulp texture is good in genotypes. Fruit inner cavity is almost non-existent in genotypes. The amount and size of fruitlets were generally included in the medium group, and the weight of 100 fruitlets was determined in the range of 41-304 mg. The total soluble solids (%) was found to be very high (>20) in general, and the titratable acidity value was found to be in the range of 0.126-0.225 (Table 4).

Table 4. Qualitative characteristics of genotypes measured in terms of fruit growth

Fruit with (mm)	16.00% 28-38mm (small)	51.40% 39-49mm (medium)	30.00% 50-60mm (large)	1.40% >60mm (very large)			
Fruit length (mm)	75.00% 29-46 mm (short)	19.52% 47-54mm (medium)	5.14% 55-75mm (long)				
Ostiole width (mm)	2.00% <1mm (small)	16.00% 1-3mm (medium)	45.00% 4-5mm (large)	36.00% >5mm (very large)			
Shape of the fruit stalk	53.00% short and thick	23.29% long and slender	23.63% variously				
Abcission of the stalk from the twig	%41.78 fruit stalk remains attached to the shoot at harvest	%57.88 easy					
Fruit ribes (logitudinal ridges on the fruit suface)	25.68% prominent	52.00% intermediate	22.32% none				
Resistance to ostiole-end cracks	18.83% susceptible	33.56% intermediate	47.60% resistant				
Fruit skin ground colour	17.81% purple	2.06% brown	26.71% green	12.67% light green	30.14% yellow-green	8.90% yelow	1.71% black
Fruit skin colour	34 % yellow	32 % green	21 % purple	13 % black			
Colour formation in the flesh	81.51% absent	15.75% light coloration	2.74% intense colour formation				

The average values of the genotypes that stand out in terms of some criteria in this study are summarized below. In shoot length measurements, which is one of the parameters that reveal tree development; 1019 Karabakunya (6.93 cm), 1034 Sakız (8.11 cm) and 1035 Sarı Çiçek (8.95 cm)

showed less than 10 cm growth. 1001 Göklop, 1004 Kuşadası Bardakçı, 1005 Şeker İnciri, 1008 Yeşilgüz and 1029 Sarılop shoot growth were detected in the medium group (10-20 cm). The genotypes in the group between 21-35 cm (long) shoot development was determined as 1002 Bardakçı, 1012 Siyah Orak and 1013 Beyaz Orak. 1019 Mor 1, 216 Siyah and 708 Darpak can be given as examples for those with a shoot diameter of >15mm. 237 Bursa Siyahı (102.80g), 708 Darpak (95.50g), 1029 Sarılop (89.30g) and 1006 Morgüz (65.00g) were given as a example of large-fruited genotypes. An example of genotypes that have a too liquid drop of the ostiole, was given 253 Sultan Selim and 1003 Kara Hünü. An example of the most genotypes width fruit flesh thickness was given 1006 Morgüz (6.28mm), 1001 Göklop (4.71mm), 237 Bursa Siyahı (4.31mm).

The threat of genetic erosion has become a significant risk, especially for fig varieties of the "Smyrna type", and a large number of field gene banks-collection gardens are being established for the solution in different countries. It is very important to develop new approaches to fig growing and to summarize them with international approaches. Alternative methods for genetic resource management should be considered. It is emphasized that the creation of reference collections, the adoption of a universal list of identifiers and guidelines for the safe movement of germplasm, and the definition of diversity standards will be very useful. In fig cultivation, there is a need for the development of high-quality fruiting varieties and new breeding studies (Mars, 2003; Mars et al., 2008; Gozlekci, 2010 and 2011; Gaaliche et al., 2012; Presti and Wasko, 2014; Nader et al., 2019; Padmavati et al., 2021).

Another important detail is the determination of the reasons for the abandonment of local species, their collection and preservation in order to pass them on to the next generation. Forestry reserves, national parks and protected areas are encouraged to facilitate the in situ conservation of plant species. In situ on-farm conservation of useful plant genetic resources is another important concept that promotes the in situ conservation of valuable plant varieties that have been developed and preserved by breeders for centuries in certain areas.

In order to create a healthy database, mislabeling and redundancy, which is frequently encountered in the management of genetic resources, should be eliminated before planting/planting, passport information should be obtained completely, and all accesses that define the genotype should be characterized multiple long years. However, most of the lists of defination contain a large number of descriptors that make it difficult to perform a long and time-consuming characterization. The use of descriptors that best describe the genotype is important in obtaining more reliable data.

In order to ensure the sustainability of the genotypes taken under protection in-situ and ex-situ in the fig field gene banks, and against the risk of loss in fig growing regions, the necessary importance and support should be given by new selection studies.

4. Conclusion

Fig (*Ficus carica* L.) Genetic Resources Conservation and Characterization Project is a continuous Project (2005-2022-…) (Kocataş et al, (2005-2014); (Ayar et al., 2015-2022…). In this project the collection of multiple data for the characterization of female fig genotypes in field conditions and in the laboratory environment continues with similar approaches and international complements to the genetic resources studies conducted in other countries.

In this study, significant variability was observed among the figs collected from different fig regions of Türkiye. Genotypes with different tree growth, fruit and leaf characteristics were determined.

As a result of the molecular study with 310 fig genotypes in the fig field gene bank, differences were determined between the genotypes. Genotypes collected from 6 geographic regions were analyzed with 14 SSR loci. 7 identical (identical), 54 clone-level similarities, 36 synonyms (different name but (SSR) genetically same) and 22 homonyms (same name but (SSR) genetically different) differences were found (Ergul et al., 2021).

Characterization designs of morphological variability in collections and selection of the most important genotypes should be done carefully to better conserve and exploit genetic resources (Giraldo et al. 2010a and b).

Characterization of fruit species is recognized as a primary and important step to preserve, conserve, maintain and carry out any future breeding program (Gözlekçi, 2010 and 2011; Basheer et al., 2013). The characterization, conservation and sustainability of fig genetic resources and natural plant ponds is considered very important work for future breeding programs and has become one of the principles that are encouraged to be passed down through generations.

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