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Research Article

IDENTIFICATION OF DWARF ROOTSTOCK CANDIDATES IN FIG: WILD FIG (*Ficus carica var. rupestris* (HAUSSKN.) BROWICZ) POPULATION AND MORPHOLOGICAL CHARACTERIZATION

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ABSTRACT. This study was carried out to morphologically characterize and evaluate the dwarf rootstock potential of the fig genotypes in the Ficus carica var. rupestris (Hausskn.) Browicz population is distributed in Tunceli, Türkiye. For this purpose, these genotypes' eight qualitative and 16 quantitative traits were investigated. In the study, 42 fig genotypes were selected from the Ficus carica var. rupestris population. Regarding tree growth habit, 40% (17 genotypes) of the genotypes were creeping, and 50% (21 genotypes) were intermediate in tree vigour. Also, shoot internode length of the genotypes was short (24 genotypes), and 76% (32 genotypes) of genotypes showed high characteristics in terms of tendency to form suckers. When all the characteristics were evaluated together using the weighted analysis, FCR-19 was calculated as having the highest rootstock potential (910 points) followed by FCR-6, FCR-7, FCR-14, FCR-15, FCR-20, FCR-24, FCR-27, FCR-31, and FCR-42 genotypes (865 points). At the end of the study, 7 genotypes (FCR-1, FCR-2, FCR-14, FCR-19, FCR-23, FCR-28, FCR-29) with dwarfing rootstock potential were evaluated. We believe that detailed studies on these genotypes will contribute to developing modern fig cultivation techniques and designing new breeding programs.

Keywords: *Ficus carica var. rupestris, genetic source, morphological properties, potential dwarf rootstock.*

INTRODUCTION

Fig cultivation is an important fruit species widely practiced in areas near the Mediterranean Sea. In Türkiye, fig spreads throughout the Black Sea, Marmara, Aegean and Mediterranean coasts, in the microclimate areas on the riversides of Eastern Anatolia, Southeastern Anatolia, and Central Anatolia Regions. The ecological conditions of Anatolia are suitable for fig cultivation, it is possible to grow both dried and table figs [1]. Çalışkan and Dalkılıç [2] showed that Türkiye is one of the original centers of the fig. When the historical traces of the fig in Anatolia are followed, it is a sacred symbol that sheds light on the history of humanity beyond being consumed as a fruit.

So far, morphological and molecular studies have been carried out on *Ficus carica var. caprificus* and *Ficus carica var. domestica* fig species, widely distributed in Türkiye [3, 5, 6, 7]. However, Davis [8] reported that another fig species, *Ficus carica var. rupestris* includes different ecotypes in the Eastern and Southeastern Anatolian regions of Türkiye. No detailed research has been done on this species yet. It can be used as a potential dwarf rootstock for figs since wild forms of this species show particularly poor growth characteristics. In addition, examining their tolerance to different stress conditions and their resistance to diseases and pests may benefit from protecting fig-growing areas against global climate change.

Thanks to its plant gene resources, Türkiye is one of the most important countries in the world. However, biotic and abiotic stress factors are decreasing and disappearing plant genetic resources. Conservation of plant genetic resources is essential for securing future crop production [9, 10]. The study area (Tunceli province) has a biodiversity due to its geographical structure, different climatic features, and water resources. In particular, it attracts attention with the presence of ficus subspecies and botanical varieties.

In Türkiye, there is a need for permanent solutions in modern fruit growing techniques, which will both increase the yield obtained from the unit area and provide earliness, especially in table figs. Dwarf rootstocks can improve the fruit quality of cultivars, reduce labor costs in harvesting and pesticide application, and protect them from soil-borne diseases and pests [11]. In fig cultivation, cuttings easily reproduce cultivars, and an orchard is established without using any rootstock. However, the canopy height of fig trees can grow up to 6 m. This causes an increase in harvesting (50% of the total cost for table figs) and caprification costs. For these reasons, dwarf rootstocks may provide a more sustainable use of fig-growing areas, especially in table fig cultivation. Hosomi et al. [12] indicated that soil sickness inhibits the growth of fig trees and seriously reduces the fruit number and size. Therefore, a suitable rootstock for fig cultivation can be selected for its tolerance to soil thickness. Flaishman et al. [13] stated that there is a tendency toward the transition from traditional planting (wide row spacing and without irrigation) to modern planting (reducing planting distances with compact canopy and using fertilization systems) in fig-growing countries in the world. However, there is not enough information about the species that can be used as dwarf rootstock. In addition, Yakushiji et al. [14] reported that Ceratocystis canker, which is caused by the fungus Ceratocystis fimbriata Ellis et Halsted, is one of the most severe diseases of the fig cultivation areas and interspecies hybridizations with different fig species, it is possible to obtain rootstocks resistant to this disease.

MATERIALS AND METHODS

The study was carried out in Tunceli province in 2021 and 2022. In the study, 42 genotypes belonging to *Ficus carica var. rupestris* (Hausskn.) Browicz was selected (Figure 1). The genotypes were compared according to different morphological and growth characteristics. Morphological descriptions of the genotypes selected as rootstock candidates were evaluated by making some modifications according to the "Fig Descriptor" [15] (Table 1). The following characteristics were examined in 10 shoots, 30 leaves, and 20 fruits in each genotype (Table 1).

While determining the individuals selected for breeding, the modified weighted ranked method specified in Table 2 was used. In the evaluation, 7 genotypes were selected according to scoring and molecular analysis. Selected 7 genotypes were propagated to determine their rootstock potential. A total of 30 cuttings (prepared in 15-20 cm length) from the selected genotypes were taken during the resting period. The cuttings taken from genotypes were rooted in the heated greenhouse of the Faculty of Agriculture at Erciyes University. The rooting process was done in a 1:1 perlite: peat mixture in the misting unit. Although it is known that figs are easily rooted with cuttings, to increase the rooting rate in the species *Ficus carica var. rupestris* (Hausskn.) Browicz, the cuttings were kept for

5 seconds in a solution of 1000 ppm IBA. Rooted cuttings were transplanted into pots in spring. Afterwards, it was protected in the Research and Application Center of Hatay Mustafa Kemal University, Faculty of Agriculture, Department of Horticulture, Türkiye.

Fig. 1. *Pictures of plants belong to the Ficus carica var. rupestris (Hausskn.)Browicz species*

Table 1. *Morphological characteristics evaluated in Ficus carica var. rupestris genotypes*

Code	Variable	Classification				
7.2.1	Tree growth habit	Erect	Spreading	Weeping	Creeping	
7.2.2	Tree vigour	Low	Intermediate	High		
7.2.3.1	Apical dominancy	Absent	Present			
7.2.3.2	Lateral shoot formation	Absent	Present			
7.2.9	Terminal bud color	Light green	Green	Pinkish brown	Brown	
7.2.10.1	Shoot length (cm)	Short	Medium	Long	Extremely long	
7.2.10.2	Shoot width (mm)	Thin	Medium	Thick		
7.2.10.3	Shoot internode length (cm)	Short	Medium	Long		
7.2.11	Shoot color	Green	Grey	Brown	Other	
7.2.12	Tendency to form suckers	Low	Medium	High		
7.3.1	Number of leaves per shoot	Low	Medium	High		
7.3.2	Leaf shape	A-B-C-D-E-F-G-H				
7.3.3	Number of lobes	Absent	3 Lopes	5 Lopes	7 Lopes	>7 Lopes
7.3.8	Leaf length (cm)	Small	Medium	Large	Very large	
7.3.9	Leaf width (cm)	Small	Medium	Large	Very large	
7.3.10	Leaf area (cm^2)	Small	Medium	Large	Very large	
7.3.12	Leaf margin dentation	No dentation	Only upper margins dented		Lobes sides completely dented	
7.3.14	Leaf hairiness	None	Sparse	Intermediate	Dense	
7.3.16	Leaf venation	Unapparent	Slightly apparent	Apparent		
7.3.18	Petiole length (cm)	Short	Medium	Long	Extremely long	
7.4.6	Fruit size (diameter)	Small	Medium	Large		
7.4.15	Shape of the fruit stalk	A-B-C-D-E-F-G-H-I-J				
7.5	Productivity	Low: < 3 number/shoot, Medium 3-6 number/shoot, High: > 6 number/shoot				

Table 2. *Weighted ranked score table used in the selection of fig genotypes*

Criteria	Relative Scores	Class Interval-Scores
Tree vigour	50	Low:10, Intermediate:7, High:3
Tree growth habit	20	Creeping:10, Weeping:7, Spreading:3, Erect:1
Shoot internode length	15	Short:10, Medium:7, Long:1
Tendency to form suckers	15	Low:10, Medium:7, High:1
TOTAL	100	

RESULTS AND DISCUSSION

The minimum-maximum and average values of the morphological characteristics of wild fig (*Ficus carica var. rupestris* (Hausskn.) Browicz) genotypes selected in the study were shown in Table 3.

While shoot length, shoot width, and shoot internode length of genotypes were determined between 5.33-46.33 cm, 3.54-8.68 mm, and 0.67-4.50 cm, respectively. The average values of genotypes were evaluated as 17.45 cm, 5.67 mm, and 2.66 cm, respectively. The number of leaves on the shoots of the genotypes ranged between 4.00 and 14.33, and the average number of leaves on the shoot was 7.62 mm. The mean leaf length, leaf width, leaf area, and petiole length values of the genotypes were 12.89 mm (from 7.75 to 20.25 mm), 10.41 mm (from 6.75 to 15.75 mm), 91.17 cm2 (from 32.75 to 204.25 cm2), and 4.11 cm (from 2.38 to 6.25 cm), respectively.

Many studies have been carried out on female and caprifig figs of the *Ficus carica* species. In previous studies, the number of leaves on the shoot varied between 2.00 and 11.80, shoot lengths varied between 4.11 and 114.04 cm, shoot width varied between 3.30 and 21.43 cm, leaf length varied between 6.70 and 28.39 cm, leaf width varied between 5.60 and 25.37 cm, leaf area varied between 50.70 and 720.37 cm2 [16, 17, 18] and petiole length varied between 1.60 and 22.13 cm [16, 18, 19, 20, 21, 22]. Our study results are similar to the results of previous studies.

Table 3. *Values of shoot and leaf characteristics in wild fig genotypes*

	Shoot lenght (cm)	Shoot width (mm)	Shoot internode length (cm)	Number of leaves per shoot	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Petiole length (cm)
Minimum	5.33	3.54	0.67	4.00	7.75	6.75	32.75	2.38
Maximum	46.33	8.68	4.50	14.33	20.25	15.75	204.25	6.25
Average	17.45	5.67	2.66	7.62	12.89	10.41	91.17	4.11

Plant characteristics of genotypes are presented in Table 4. The most common tree growth habit in genotypes was creeping (17 genotypes) and the tree vigour was intermediate (21 genotypes). While apical dominancy was not found in 23 genotypes, lateral shoot formation was observed in 23 genotypes. The terminal bud color of the fig genotypes was mainly green (20 genotypes). Shoot color was mostly grey (23 genotypes). Generally, the tendency to from suckers of the wild fig genotypes was high (32 genotypes).

Tree vigor, apical dominance, lateral shoot formation, terminal bud color, shoot color, tendency to form suckers characteristics of the genotypes in the study are similar to the results of many studies conducted on the *Ficus carica* species [16, 18, 19, 20, 21, 22]. Although the genotypes are similar to previous studies regarding tree growth habit characteristics, it has been determined that some genotypes have completely creeping characteristics.

Table 4. *Plant characteristics of wild fig genotypes*

Genotype	Tree growth habit	Tree vigour	Apical dominancy	Lateral shoot formation	Terminal bud color	Shoot color	Tendency to form suckers
FCR-1	Weeping	High	Absent	Present	Pinkish brown	Grey	Low
FCR-2	Creeping	Low	Present	Absent	Green	Green	High
FCR-3	Creeping	Low	Present	Absent	Green	Green	High
FCR-4	Creeping	Low	Present	Absent	Green	Green	High
FCR-5	Spreading	High	Present	Absent	Pinkish brown	Green	High
FCR-6	Creeping	Low	Present	Absent	Green	Green	High
FCR-7	Creeping	Low	Present	Absent	Green	Grey	High
FCR-8	Erect	Intermediate	Absent	Present	Green	Grey	Medium
FCR-9	Erect	Intermediate	Present	Absent	Green	Green	High
FCR-10	Erect	Intermediate	Present	Absent	Green	Green	High
FCR-11	Spreading	Intermediate	Absent	Present	Pinkish brown	Grey	High
FCR-12	Erect	Intermediate	Present	Absent	Green	Grey	Medium
FCR-13	Spreading	Intermediate	Absent	Present	Green	Green	Medium
FCR-14	Creeping	Low	Present	Absent	Green	Green	High
FCR-15	Creeping	Low	Present	Absent	Green	Grey	High
FCR-16	Creeping	Intermediate	Absent	Present	Pinkish brown	Green	High
FCR-17	Creeping	Intermediate	Present	Absent	Green	Green	High
FCR-18	Erect	Intermediate	Absent	Present	Green	Grey	Medium
FCR-19	Creeping	Low	Absent	Present	Light green	Grey	Medium
FCR-20	Creeping	Low	Present	Absent	Light green	Green	High
FCR-21	Weeping	Intermediate	Absent	Present	Light green	Grey	High
FCR-22	Erect	Intermediate	Absent	Present	Light green	Grey	High
FCR-23	Creeping	Intermediate	Absent	Present	Pinkish brown	Green	High
FCR-24	Creeping	Low	Absent	Present	Light green	Grey	High
FCR-25	Erect	Intermediate	Absent	Present	Light green	Green	High
FCR-26	Erect	Intermediate	Absent	Present	Green	Grey	Low
FCR-27	Creeping	Low	Absent	Present	Green	Grey	High
FCR-28	Erect	Intermediate	Present	Absent	Light green	Green	High
FCR-29	Erect	Intermediate	Absent	Present	Light green	Green	Medium
FCR-30	Creeping	Low	Absent	Present	Light green	Grey	High
FCR-31	Creeping	Low	Absent	Present	Green	Grey	High
FCR-32	Spreading	Low	Present	Absent	Light green	Grey	Low
FCR-33	Weeping	High	Absent	Present	Pinkish brown	Grey	High
FCR-34	Erect	Intermediate	Present	Absent	Brown	Grey	High
FCR-35	Erect	Low	Absent	Present	Light green	Grey	High
FCR-36	Erect	Intermediate	Absent	Present	Light green	Grey	High
FCR-37	Erect	High	Absent	Present	Green	Grey	High
FCR-38	Spreading	Intermediate	Absent	Present	Green	Green	High
FCR-39	Spreading	Intermediate	Present	Absent	Pinkish brown	Grey	High
FCR-40	Erect	Intermediate	Absent	Present	Light green	Green	Medium
FCR-41	Erect	High	Present	Absent	Green	Grey	High
FCR-42	Creeping	Low	Present	Absent	Light green	Green	High

The leaf and fruit characteristics of the genotypes are given in Table 5. The leaf shape of the genotypes in the study was mainly H group (25 genotypes). The number of leaf lobes in the 25 genotypes were observed in the absent (entire) class. The genotypes were the most dense (29 genotypes) in leaf hairiness and the mainly open (34 genotypes) class in leaf venation. Most genotypes were grouped as small (<15 mm) for the fruit size (33 genotypes). The shape of the fruit stalk of the genotypes in the study was mainly C group (33 genotypes). In addition, the number of individuals in the edible fig form (31 genotypes) of the selected wild figs was higher than those in the caprifig form (11 genotypes).

Similar results regarding the leaf shape, number of lobes, leaf hairiness, leaf venation, leaf margin dentation, fruit size, shape of the fruit stalk, and productivity characteristics of the genotypes have been reported in different studies [16, 18, 19, 20, 21, 22].

***Table 5.** Leaf and fruit characteristics of wild fig genotypes*

Genotype	Leaf shape	Number of lobes	Leaf hairiness	Leaf venation	Leaf margin dentation	Fruit size	Shape of the fruit stalk	Productivity	Gender
FCR-1	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	High	Female
FCR-2	C	5	None	Slightly apparent	Completely dented	Medium	A	Low	Female
FCR-3	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	Low	Female
FCR-4	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	Low	Female
FCR-5	G	3	Dense	Slightly apparent	Completely dented	Small	C	Medium	Caprifig
FCR-6	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	Low	Female
FCR-7	H	Absent	Sparse	Apparent	Completely dented	Medium	E	Low	Female
FCR-8	H	Absent	Dense	Apparent	Completely dented	Small	C	High	Female
FCR-9	A	5	Dense	Slightly apparent	Completely dented	Small	C	High	Female
FCR-10	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	Medium	Female
FCR-11	H	Absent	None	Slightly apparent	Completely dented	Small	C	Low	Female
FCR-12	G	3	Dense	Slightly apparent	Completely dented	Small	C	Medium	Caprifig
FCR-13	G	3	Dense	Slightly apparent	Completely dented	Small	C	Low	Caprifig
FCR-14	G	3	Sparse	Slightly apparent	Completely dented	Small	C	High	Caprifig
FCR-15	G	3	Dense	Slightly apparent	Completely dented	Small	C	Low	Caprifig
FCR-16	G	3	None	Apparent	Completely dented	Medium	E	High	Female
FCR-17	G	3	Dense	Slightly apparent	Completely dented	Small	C	Medium	Caprifig
FCR-18	H	Absent	Intermediate	Slightly apparent	Completely dented	Medium	E	Medium	Female
FCR-19	C	5	Dense	Apparent	Completely dented	Small	C	Low	Female
FCR-20	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	Low	Female
FCR-21	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	Low	Caprifig
FCR-22	C	5	Dense	Slightly apparent	Completely dented	Small	C	Medium	Caprifig
FCR-23	C	5	Dense	Slightly apparent	Completely dented	Small	C	Medium	Female
FCR-24	H	Absent	None	Slightly apparent	Completely dented	Medium	F	Low	Female
FCR-25	G	3	Dense	Slightly apparent	Completely dented	Small	C	Medium	Female
FCR-26	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	High	Female
FCR-27	H	Absent	None	Slightly apparent	Completely dented	Medium	A	Medium	Female
FCR-28	G	3	Dense	Slightly apparent	Completely dented	Small	C	Low	Caprifig
FCR-29	H	Absent	None	Slightly apparent	Completely dented	Medium	E	Medium	Female
FCR-30	G	3	Dense	Slightly apparent	Completely dented	Small	C	Low	Female
FCR-31	H	Absent	Dense	Apparent	Completely dented	Small	C	Medium	Female
FCR-32	H	Absent	None	Slightly apparent	Completely dented	Medium	F	High	Female
FCR-33	H	Absent	Sparse	Slightly apparent	Completely dented	Small	C	Low	Caprifig
FCR-34	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	Low	Female

FCR-35	A	5	Dense	Apparent	Completely dented	Small	C	Low	Female
FCR-36	H	Absent	Sparse	Apparent	Completely dented	Medium	E	High	Female
FCR-37	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	High	Female
FCR-38	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	Low	Female
FCR-39	H	Absent	Sparse	Slightly apparent	Completely dented	Small	C	Medium	Female
FCR-40	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	Low	Female
FCR-41	H	Absent	Dense	Slightly apparent	Completely dented	Small	C	High	Caprifig
FCR-42	G	3	Dense	Apparent	Completely dented	Small	C	Low	Female

In previous studies on figs, morphological features were generally used in determining the differences in plant species and cultivars. Until now, morphological characteristics have been used in the description of fig genotypes in studies conducted both in Türkiye and in different geographies of the world, and individuals suitable for breeding purposes have been selected based on these properties [3, 23, 24, 25, 26, 27, 28, 29]. In these studies, fruit ripening times, and fruit and leaf characteristics were successful criteria for distinguishing male and female fig species [30]. However, we determined that the genotypes of *Ficus carica var. rupestris* were characterized by small fruit and leaf size, mostly entire leaves, the presence of lobes sides completely dented in the leaves, short shoot internode length, and weak growth of the plants. The weighted ranked scores of the fig genotypes in the study were shown in Table 6. The weighted ranked scores of the genotypes ranged from 290 to 910. In terms of these selection criteria, the FCR-19 genotype received the highest score with 910, followed by the FCR-6, FCR-7, FCR-14, FCR-15, FCR-20, FCR-24, FCR-27, FCR-31 and FCR-42 genotypes with 865 points.

Table 6. *Results of weighted ranked classification for some wild fig*

Genotype	TV	TGH	SIL	TFS	TOTAL	Genotype	TV	TGH	SIL	TFS	TOTAL
FCR-1	3	7	10	10	590	**FCR-22**	7	1	7	1	490
FCR-2	10	10	7	1	820	**FCR-23**	7	10	10	1	715
FCR-3	10	10	7	1	820	**FCR-24**	10	10	10	1	865
FCR-4	10	10	7	1	820	**FCR-25**	7	1	10	1	535
FCR-5	3	3	7	1	330	**FCR-26**	7	1	10	10	670
FCR-6	10	10	10	1	865	**FCR-27**	10	10	10	1	865
FCR-7	10	10	10	1	865	**FCR-28**	7	1	10	1	535
FCR-8	7	1	7	7	580	**FCR-29**	7	1	7	7	580
FCR-9	7	1	7	1	490	**FCR-30**	10	10	7	1	820
FCR-10	7	1	7	1	490	**FCR-31**	10	10	10	1	865
FCR-11	7	3	10	1	575	**FCR-32**	10	3	10	10	860
FCR-12	7	1	10	7	625	**FCR-33**	3	7	10	1	455
FCR-13	7	3	10	7	665	**FCR-34**	7	1	7	1	490
FCR-14	10	10	10	1	865	**FCR-35**	10	1	10	1	685
FCR-15	10	10	10	1	865	**FCR-36**	7	1	10	1	535
FCR-16	7	10	7	1	670	**FCR-37**	3	1	10	1	335
FCR-17	7	10	7	1	670	**FCR-38**	7	3	7	1	530
FCR-18	7	1	7	7	580	**FCR-39**	7	3	7	1	530
FCR-19	10	10	7	7	910	**FCR-40**	7	1	10	7	625
FCR-20	10	10	10	1	865	**FCR-41**	3	1	7	1	290
FCR-21	7	7	10	1	655	**FCR-42**	10	10	10	1	865

TV: Tree vigour, TGH: Tree growth habit, SIL: Shoot internode length, TFS: Tendency to form suckers

In the experiment, 42 genotypes were selected from the Ficus carica var. rupestris (Hausskn.) Browicz population, which grows naturally in the flora of Tunceli province. These selected genotypes were morphologically characterized and evaluated using the weighted ranked method. In addition, the weak growing genotypes of Ficus carica var. rupestris (Hausskn.) Browicz, which is included in the genetic resources of Türkiye, were selected as a rootstock candidate, and taken under protection. At the end of the study, 7 genotypes (FCR-1, FCR-2, FCR-14, FCR-19, FCR-23, FCR-28, FCR-29) with dwarfing rootstock potential were determined and reproduced. The reproduced genotypes were determined from analyses with SRAP and ISSR marker techniques. Considering the genetic similarity between genotypes genotypes with low genetic similarity were determined and reproduced [24].

CONCLUSION

In this study, the first detailed morphological characterization of genotypes of Ficus carica var. rupestris was performed. The data displayed an important variation in plant, fruit, and leaf characteristics of wild fig genotypes in Türkiye. Fruit and leaf size, the number of lobes in the leaf, the presence of lobes sides completely dented in the leaves, shoot internode length, and plant growth were successful traits in revealing the differences among genotypes. These results revealed that genotypes with dwarf rootstock potential for edible fig cultivation can be found in this species. In recent years, there have been studies on the cultivation of figs suitable for dense planting with applications such as cordon pruning system in figs, but the difficulties in controlling the growth power of the cultivar in such pruning systems require studies on potential dwarf rootstocks in figs. Thus, the applicability of this and similar pruning systems in figs using dwarf rootstocks can increase the yield and fruit quality obtained from the unit area and increase the fig growing areas. We can say that these plants have the potential for different breeding studies and their use as rootstocks. As a result, it was very important to grow these plants in another area to determine their true growth status due to their growth in ecology with cold winters, and promising genotypes were planted in the research area at Hatay Mustafa Kemal University, Hatay, Türkiye.

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