

PISTACHIO ROOTSTOCK BREEDING BY SELECTION OF WILD *PISTACIA* SPECIES IN TURKEY

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Abstract

This study was carried out in the years 1999-2000 to establish a germplasm collection for future breeding programmes and to produce pistachio rootstocks that were vigorous and compatible with cultivars. Seeds from 63 different types were collected from 10 provinces of Turkey, namely Gaziantep, Sanliurfa, Kahramanmaraş, Malatya, Sivas, Tokat, Gumushane, Amasya, Samsun and Trabzon.

Selection studies were carried out in the eastern Anatolia, Black Sea and south-eastern Anatolia regions in 1999. Twenty five *Pistacia palaestina*, 16 *P. atlantica*, 14 *P. terebinthus* and 8 *P. khinjuk* types were selected in the study.

Seeds of selected types were sown in plastic containers in the greenhouse and grown up to seven months. The seedlings were compared with *P. integerrima* seedlings. According to growth and bud take rate, the best results were obtained from 63 ME 01 and 63 ME 02 types of *P. terebinthus*, 46 FS 06 and 46 FS 07 types of *P. palaestina*, and 60 AT 05 type of *P. atlantica*.

1. Introduction

Pistachio production has been practised under rainfed conditions for centuries in Turkey. Our country is the third world producer after Iran and the USA with approximately 50,000 metric tons. In the future, pistachio production will also come from irrigated fields of the South-eastern Anatolia Project and Turkey's production can be doubled. Pistachio growing has been adjusted to irrigated conditions in Turkey and has been the object of much research. There are some studies on rootstocks, but not enough work has been carried out for irrigated conditions.

Turkey is a germplasm site for the genus *Pistacia* and has approximately 50 million wild *Pistacia* trees. These genetic resources should be used for rootstock and cultivar breeding.

Although Turkey has a wide genetic diversity of the genus *Pistacia*, there are no collection orchards of parents suitable for crossing in rootstock breeding. *P. terebinthus* is the species most widely present in Turkey, followed by *P. vera*, *P. khinjuk* and *P. atlantica*, respectively (Bilgen, 1973).

When pistachio trees are budded on suitable rootstocks, both early bearing and high yield may be obtained (Arpacı *et al.*, 1999).

Rootstocks and cultivars affect each other reciprocally on growth, yield and development in fruit trees (Kaska and Yilmaz, 1974).

Up to now, only Kafkas and Kaska (1997) have studied *Pistacia* spp. for selection of rootstocks in Turkey and further research is required.

P. integerrima is vigorous and resistant to some fungal diseases, but it can be damaged by winter frost in Gaziantep conditions (Atli *et al.*, 2000). This species should be crossed with *P. terebinthus*, *P. palaestina* or *P. khinjuk*, which are more resistant to winter frost.

In this study, superior rootstocks were selected among *Pistacia* spp. and a collection orchard was established with genetic resources for breeding programmes in the

future.

2. Materials and methods

Sixty-three different types of *Pistacia* species were marked in the Gaziantep, Sanliurfa, Kahramanmaras, Malatya, Sivas, Tokat, Gumushane, Amasya, Samsun and Trabzon provinces. Their seeds were collected and used in this study, whereas *P. integerrima* was used as control.

This study was carried out in the years 1999-2000. Different *Pistacia* trees were marked as related to tree vigour and its seeds collected in 1999. Seedling performance was tested in 2000.

Seeds were hulled and soaked in a 250 ppm GA₃ solution for 2 days, stratified in perlite for 45 days at 4 °C, and sown in a 2:1:1 peat, tufa and sand mixture in 19x40 cm plastic containers at 20-28 °C in a greenhouse on 25 February.

Diameter and length of seedlings were measured. Diameter was measured 5 cm above the soil surface with a digital compass on 12 September. Length was measured with a ruler from the soil surface to the top. Twenty-four seedlings of each type were measured.

Seedlings were budded on 13 September by T budding with the 'Ohadi' cultivar. The budding point was chosen 5-10 cm above the soil surface. Seedlings with a diameter of 5.5 mm and above were budded. During the budding, the average temperature was about 27°C and relative humidity 75% in the greenhouse.

3. Results and discussion

3.1. Seed germination

The highest seed germination rates were obtained in 58 FS 02, 27 BT 01 and 63 ME 08 with 92%, 75% and 70%, respectively. The lowest rates were obtained in 46 FS 04 and 63 ME 10 with 31% (Table 1).

3.2. Seedling diameter

The highest seedling diameters were observed in the 63 ME 01 and 63 ME 02 types of *P. terebinthus* with 7.12 and 7.21 mm; 46 FS 06 and 46 FS 07 types of *P. palaestina* with 7.99 and 7.13 mm; and 60 AT 05 type of *P. atlantica* with 6.88 mm. Seedling diameters of *P. khinjuk* types were low (Table 2). Seedlings were measured at 7 months of age. In this study, some promising types were found. Seedling diameter of some *P. khinjuk* types could reach up to 6.09 - 6.22 mm under Çukurova conditions (Kafkas and Kaska, 1997) and of *P. vera* cv. 'Siirt' up to 6.11 mm in Adana conditions (Ak et al., 1988). Normally, seedlings of *P. vera* grow more than the other *Pistacia* species in the first year (Bilgen, 1973). Our results are higher than those of Kafkas and Kaska (1997) and Ak et al. (1988).

3.3. Seedling length

The highest seedling lengths were observed in the 60 AT 03, 60 AT 01, and 60 AT 02 types of *P. atlantica* with 51.2, 49.6, and 48.6 cm; and 46 FS 08 type of *P. palaestina* with 47.5 cm, respectively. Seedling lengths of *P. khinjuk* and *P. terebinthus* types was generally low (Table 3).

3.4. Bud take

Seedlings of 44 types reached a suitable diameter for budding in September and were budded by T budding with 'Ohadi' cv. The highest bud take rates were obtained with

the types 55 FS 01 and 60 AT 05 with 100%. These types were followed by 27 FS 02, 46 FS 06, 46 FS 07, and 55 FS 02 with 87.5% (Table 4).

4. Conclusion

In this study, superior rootstocks were selected among *Pistacia* spp. and a collection orchard was established as a genetic resource for breeding programmes in the future.

According to growth and bud take rate, the best results were obtained with 63 ME 01 and 63 ME 02 types of *P. terebinthus*, 46 FS 06 and 46 FS 07 types of *P. palaestina*, and 60 AT 05 type of *P. atlantica*.

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Table 1. Seed germination rates (%) of different *Pistacia* types.

Type	Germination rate (%)	Type	Germination rate (%)	Type	Germination rate (%)
60 AT 01	50.0	55 FS 02	53.0	29 AT 05	65.6
63 ME 01	63.0	46 FS 04	31.0	60 FS 01	57.0
60 AT 02	50.3	63 ME 02	57.0	46 FS 01	55.0
46 FS 08	67.6	63 ME 12	61.3	29 AT 02	47.3
60 AT 05	56.0	46 FS 05	43.3	63 ME 08	70.0
46 FS 03	54.3	27 BT 01	75.0	46 BT 02	55.6
46 ME 01	63.0	60 AT 03	66.0	55 FS 01	33.6
05 AT 01	45.3	44 BT 01	43.3	46 BT 01	57.3
27 FS 01	55.6	29 BT 01	45.0	63 ME 05	44.6
60 AT 06	63.0	63 ME 10	31.0	61 FS 02	34.6
46 FS 06	68.6	46 FS 09	54.3	29 FS 03	60.0
29 AT 03	46.0	63 ME 13	44.0	29 AT 04	34.0
58 BT 01	56.0	58 FS 02	92.0	05 FS 01	44.0
60 AT 04	66.0	29 FS 02	35.6	63 ME 04	57.3
27 FS 02	65.0	58 AT 01	56.0	44 BT 02	65.0
05 AT 02	45.3	58 AT 02	63.0	61 FS 01	47.3
46 FS 02	40.0	63 ME 09	61.3	29 AT 01	36.0
46 FS 07	53.0	49 FS 01	42.6	60 ME 01	65.6
63 ME 06	66.6	46 FS 10	46.6	05 FS 02	45.0
58 BT 02	46.6	60 ME 02	52.3	05 FS 03	47.0
63 ME 07	59.0	60 FS 02	41.0	<i>P.integer.</i>	59.0
29 AT 06	59.0				

Table 2. Seedling diameter (mm) of different *Pistacia* types.

Type	Diameter (mm)	Type	Diameter (mm)	Type	Diameter (mm)
44 BT 02	4.4333 j-k	61 FS 01	5.1833 c-k	60 AT 05	6.8867 a-d
58 FS 02	5.6333 b-k	44 BT 01	5.6300 b-k	27 FS 02	6.6733 a-f
63 ME 08	5.3500 b-k	60 ME 02	5.4033 b-k	60 AT 06	6.1400 a-j
63 ME 04	4.4833 ijk	46 FS 05	6.2533 a-j	60 AT 04	5.8200 b-k
05 AT 02	6.3167 a-j	29 AT 01	4.0867 k	46 FS 06	7.9900 a
63 ME 10	6.4333 a-j	58 BT 02	5.4200 b-k	46 ME 01	6.7333 a-f
60 ME 01	5.4533 b-k	46 FS 03	6.4867 a-i	29 FS 03	5.8900 b-k
05 FS 02	5.0333 d-k	05 FS 03	4.5700 h-k	58 AT 02	4.9567 d-k
63 ME 07	6.1300 a-j	29 AT 02	5.4533 b-k	29 AT 05	5.1733 c-k
46 FS 04	5.9733 b-k	29 BT 01	5.0033 d-k	63 ME 12	6.6700 a-f
63 ME 06	6.5100 a-h	60 FS 01	5.7733 b-k	46 FS 08	6.2400 a-j
63 ME 05	6.6067 a-g	58 BT 01	5.6700 b-k	46 BT 01	5.1533 c-k
63 ME 09	6.0867 a-k	46 FS 09	6.4100 a-j	46 FS 10	6.1167 a-j
27 BT 01	5.8867 b-k	55 FS 01	6.3400 a-j	60 AT 02	6.4900 a-h
61 FS 02	5.1533 c-k	29 AT 04	4.8167 f-k	05 AT 01	6.4600 a-i
58 AT 01	4.8500 e-k	46 FS 07	7.1300 abc	27 FS 01	6.7933 a-f
55 FS 02	6.1967 a-j	60 AT 03	5.8400 b-k	63 ME 01	7.1233 abc
46 FS 02	6.1633 a-j	63 ME 02	7.2167 ab	29 AT 06	4.9533 d-k
05 FS 01	5.3733 b-k	63 ME 13	6.6200 a-f	46 FS 01	5.6767 b-k
49 FS 01	6.3300 a-j	29 FS 02	6.8533 a-e	44 BT 02	4.6167 g-k
60 FS 02	5.7200 b-k	29 AT 03	6.3300 a-j	<i>P.integer.</i>	5.8733 b-k
60 AT 01	6.6067 a-g				

Tukey's 5% 0.3186

Table 3. Seedling length (cm) of different *Pistacia* types.

Type	Length (cm)	Type	Length (cm)	Type	Length (cm)
44 BT 02	17.567 ef	61 FS 01	33.000 a-f	60 AT 05	43.100 a-e
58 FS 02	27.500 a-f	44 BT 01	30.133 a-f	27 FS 02	29.800 a-f
63 ME 08	26.333 a-f	60 ME 02	25.400 a-f	60 AT 06	38.733 a-f
63 ME 04	18.833 def	46 FS 05	23.267 a-f	60 AT 04	22.933 a-f
05 AT 02	31.867 a-f	29 AT 01	18.733 def	46 FS 06	40.467 a-f
63 ME 10	28.867 a-f	58 BT 02	22.767 a-f	46 ME 01	34.300 a-f
60 ME 01	25.500 a-f	46 FS 03	39.200 a-f	29 FS 03	33.567 a-f
05 FS 02	30.067 a-f	05 FS 03	12.400 f	58 AT 02	22.200 a-f
63 ME 07	29.733 a-f	29 AT 02	30.567 a-f	29 AT 05	24.300 a-f
46 FS 04	35.733 a-f	29 BT 01	21.633 b-f	63 ME 12	26.000 a-f
63 ME 06	26.400 a-f	60 FS 01	28.833 a-f	46 FS 08	47.500 a-d
63 ME 05	34.300 a-f	58 BT 01	19.867 c-f	46 BT 01	31.033 a-f
63 ME 09	29.867 a-f	46 FS 09	21.800 a-f	46 FS 10	30.567 a-f
27 BT 01	29.633 a-f	55 FS 01	34.500 a-f	60 AT 02	48.633 abc
61 FS 02	26.667 a-f	29 AT 04	22.533 a-f	05 AT 01	42.600 a-e
58 AT 01	16.433 ef	46 FS 07	32.567 a-f	27 FS 01	23.567 a-f
55 FS 02	26.967 a-f	60 AT 03	51.233 a	63 ME 01	36.300 a-f
46 FS 02	27.433 a-f	63 ME 02	31.067 a-f	29 AT 06	33.400 a-f
05 FS 01	26.100 a-f	63 ME 13	27.800 a-f	46 FS 01	24.367 a-f
49 FS 01	24.833 a-f	29 FS 02	34.100 a-f	44 BT 02	17.333 ef
60 FS 02	26.933 a-f	29 AT 03	45.533 a-e	<i>P.integer.</i>	40.767 a-f
60 AT 01	49.667 ab				

Tukey's 5% 0.4695

Table 4. Bud take rates (%) of different *Pistacia* types.

Type	Bud take rate (%)	Type	Bud take rate (%)	Type	Bud take rate (%)
44 BT 02	***	61 FS 01	***	60 AT 05	100
58 FS 02	50.0	44 BT 01	50.0	27 FS 02	87.5
63 ME 08	***	60 ME 02	80.0	60 AT 06	50.0
63 ME 04	***	46 FS 05	83.3	60 AT 04	16.6
05 AT 02	50.0	29 AT 01	***	46 FS 06	87.5
63 ME 10	80.0	58 BT 02	***	46 ME 01	70.0
60 ME 01	***	46 FS 03	66.6	29 FS 03	77.7
05 FS 02	***	05 FS 03	***	58 AT 02	***
63 ME 07	80.0	29 AT 02	***	29 AT 05	***
46 FS 04	60.0	29 BT 01	***	63 ME 12	50.0
63 ME 06	83.4	60 FS 01	57.1	46 FS 08	50.0
63 ME 05	77.7	58 BT 01	20.0	46 BT 01	***
63 ME 09	80.0	46 FS 09	75.0	46 FS 10	60.0
27 BT 01	60.0	55 FS 01	100	60 AT 02	75.0
61 FS 02	***	29 AT 04	***	05 AT 01	42.8
58 AT 01	***	46 FS 07	87.5	27 FS 01	75.0
55 FS 02	87.5	60 AT 03	60.0	63 ME 01	75.0
46 FS 02	75.0	63 ME 02	66.6	29 AT 06	***
05 FS 01	***	63 ME 13	50.0	46 FS 01	75.0
49 FS 01	80.0	29 FS 02	62.5	44 BT 02	***
60 FS 02	75.0	29 AT 03	16.6	<i>P.integer.</i>	66.6
60 AT 01	75.0				

*** Un-budded (seedling diameter below 5.50 mm)