Cultivar–Rootstock Combinations for Unirrigated Pistachio in Turkey

H.S. Atli, S. Arpaci, A. Akgun and I. Acar
Pistachio Research Institute
27060 Gaziantep, Turkey

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Abstract

Trials were carried out between 1975–2001 to determine the best cultivar–rootstock combination of pistachio for arid conditions at The Pistachio Research Institute's experiment areas in Gaziantep. Five standard pistachio cultivars ('Siirt', 'Kirmizi', 'Halebi', 'Uzun', and 'Ohadi') were budded on three different rootstock species (*Pistacia khinjuk* Stocks, *P. atlantica* Desf. and *P. vera* L.). Experimental orchard was established at 2 × 2 m in spacing in 1976 but spacing was changed to 2 × 4 m in 1995. Based on tree growth, bearing, yield and some quality characteristics of rootstock and cultivar combinations 'Siirt' *P. khinjuk* was determined as the best rootstock and cultivar combination for arid areas.

INTRODUCTION

Pistachio production has been carried out under unirrigated conditions in Turkey with annual production is about 50,000 tonnes. With this production value, Turkey is third after Iran and the USA (Table 1). However, in Iran and the USA, pistachio production is carried out under irrigation.

Eleven species of *Pistacia* can be used as rootstock in pistachio production in Turkey (Ozbek and Ayfer, 1959). *Pistacia terebinthus* is the most widespread species among the naturally growing pistachio rootstocks in Turkey, followed by *P. vera, P. khinjuk* and *P. atlantica* (Bilgen, 1968).

Five *Pistacia* species are used as rootstock for pistachio in Turkey: *P. vera*, *P. khinjuk*, *P. atlantica* (subspecies *P. mutica*), *P. terebithus*, and *P. palaestina* (Atli et al., 1999). In this project, suitable cultivar–rootstock combinations were determined for unirrigated conditions.

MATERIAL AND METHODS

Three 3 *Pistacia* species (*P. vera*, *P. khinjuk*, and *P. atlantica*) were used as rootstock in combination with five pistachio cultivars ('Siirt', 'Kirmizi', 'Halebi', 'Uzun' and 'Ohadi'). Experimental orchard was established in 1976. Yield and quality were determined between 1997–2001. Average annual precipitation was 572 mm during the 5 year trial. The experiment was established as a factorial randomized block design with 6 trees evaluated in each block for each cultivars. Rootstock diameters were measured 5 cm below the budding point and cultivar diameters were measured 5 cm above the budding point. Yield per tree was taken measured for 6 trees from each block based on dry fruit weight. Quality was based on number of fruit/100 g, splitting rate, and kernel percentage. Kernel percentage was calculated as kernel dry weight/fruit dry weight × 100.

RESULTS AND DISCUSSION

Seedling Growth

Seeds of *Pistacia* species were sown in autumn, 1974. Seedling diameters were measured 15 cm above the soil surface between 1976–1978 (Table 2).
Although growth of seedlings were similar at the first years (1976–1978), growth of *P. vera* seedlings was superior to *P. khinjuk* and *P. atlantica* (Uygur, 1982).

Precocity

'Siirt' and 'Ohadi' started to bear the fifth year after budding (in 1983) indepen-

dent of rootstocks. 'Kirmizi', 'Uzun' and 'Halebi' started to bear the eighth year after budding (in 1986) (Uygur, 1986). Akkok and Karaca (1994) reported 'Uzun' started bearing 3 years after 'Siirt' and 'Ohadi' under irrigated conditions.

Rootstock Diameter, 2001

Diameter of rootstocks over all cultivars is shown in Fig. 1. *P. atlantica* had highest rootstock (15.83 cm) followed by *P. khinjuk* (15.39 cm) and *P. vera* (12.79 cm).

Cultivars influenced rootstock diameter (Fig. 2). The highest rootstock diameters were on rootstocks budded with 'Uzun' (16.26 cm), followed by 'Halebi' (14.84 cm), 'Kirmiz'i (14.66 cm), 'Siirt' (14.12 cm), and 'Ohadi' (13.49 cm) cultivars.

Cultivar Trunk Diameter, 2001

Rootstocks also influenced cultivar trunk diameter (Fig. 3). Cultivar diameter was highest on *P. khinjuk* (14.73 cm) and *P. atlantica* (14.51 cm) and the lowest on *P. vera* (11.85 cm). Rootstock and cultivar diameters increased about 80–90% in 2001 as compared with Ulusarac's measurements in 1992.

Yield of Rootstock–Cultivar Combinations, 1998–2001

Cultivar yields (1998–2001) of scions budded on *P. khinjuk* and *P. atlantica* were higher than on *P. vera*. The highest yield per tree was obtained from 'Siirt'/*P. khinjuk* (3.47 kg), 'Siirt'/*P. atlantica* (3.11 kg), and 'Siirt'/*P. vera* (2.74 kg) (Table 3).

Effect of Rootstock–Cultivar Combinations on Fruit Quality

Fruit quality was based on number of fruit/100 g, splitting rate, and kernel percentage. The largest fruits were obtained from 'Ohadi'/*P. atlantica* (69 fruit/100 g), 'Ohadi'/*P. khinjuk*(70 fruit/100 g), 'Ohadi'/*P. vera* (73 fruit/100 g), 'Siirt'/*P. atlantica* (73 fruit/100 g) and 'Siirt'/*P. khinjuk* (75 fruit/100 g) (Table 4).

The highest splitting values were obtained from 'Halebi'/*P. khinjuk* (94.2%), 'Uzun'/*P. vera* 86.8%), and 'Siirt'/*P. atlantica* (86.2%) (Table 4).

The highest kernel/fruit percentage values were observed in 'Ohadi'/*P. khinjuk* (45.9%), 'Ohadi'/*P. vera* (45.8%), and 'Ohadi'/*P. atlantica* (45.2%). Generally, kernel percentage of 'Ohadi' was higher than the other cultivars for each rootstocks, followed by 'Siirt' (Table 4).

Fruit quality results were consistent with the results of Koroglu et al. (1997) and higher than results of Akkok and Karaca (1994).

CONCLUSION

'Siirt' and 'Ohadi' started bearing 3 years before other cultivars. The combination 'Siirt' on *P. khinjuk* rootstock was the most suitable rootstock and cultivar for unirrigated conditions.

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Tables

Table 1. World pistachio production. Source: FAO.

	Annual production (tonnes)						
Country	1995	1996	1997	1998	1999	2000	2001
Iran	239,000	260,080	111,910	313,950	131,160	120,000	115,000
USA	67,130	47,630	81,900	85,280	55,790	110,220	95,000
Turkey	36,000	60,000	70,000	40,000	40,000	70,000	35,000
Syria	14,530	24,320	29,420	35,680	30,130	39,920	39,920
China	25,000	28,000	30,000	32,000	32,000	32,000	32,000
Greece	5,590	4,500	3,600	4,700	6,000	6,500	6,500
World	393,100	428,700	336,250	512,970	292,310	383,230	328,010

Table 2. Seedling diameter of 3 *Pistacia* species.

Years	Rootstocks	Seedling diameter (mm)
1976	*P. atlantica*	2.29
	P. khinjuk	3.29
	P. vera	3.11
1977	*P. atlantica*	3.80
	P. khinjuk	4.48
	P. vera	4.51
1978	*P. atlantica*	8.96
	P. khinjuk	9.85
	P. vera	9.86

Table 3. Yield of cultivar–rootstock combinations (1998–2001).

		Yield (kg/tree)				
Rootstock	Cultivar	1998	1999	2000[1]	2001	Average
P. atlantica	Halebi	4,230	----	3,210 bc	----	1,860
	Kirmizi	4,570	----	3,350 bc	----	1,980
	Ohadi	3,260	0,830	1,210 bc	3,150	2,110
	Siirt	4,910	1,500	3,440 bc	2,460	3,110
	Uzun	5,060	----	3,440 bc	----	2,130
P. khinjuk	Halebi	4,720	----	1,470 bc	----	1,550
	Kirmizi	3,860	----	6,980 a	----	2,710
	Ohadi	2,540	1,560	0,660 c	1,580	1,590
	Siirt	4,610	0,690	7,350 a	1,240	3,470
	Uzun	5,880	----	3,070 bc	----	2,240
P. vera	Halebi	5,600	----	2,450 bc	----	2,010
	Kirmizi	5,790	----	1,590 bc	----	1,850
	Ohadi	4,510	1,340	1,940 bc	2,730	1,950
	Siirt	4,510	1,090	3,450 bc	1,920	2,740
	Uzun	3,300	----	4,610 ab	----	1,980
LSD 5%		NS		3,479		

[1]Mean separation by LSD 5%.; NS: No Significance

Table 4. Fruit quality of cultivar–rootstock combinations (4 year average).

Rootstocks	Cultivars	No. fruit/100 g	Splitting rate (%)	Kernel/fruit DW (%)
P. vera	Halebi	87 ab	75.1 de	40.6 cde
	Kirmizi	85 b	64.9 g	38.9 de
	Ohadi	73 de	66.2 fg	45.8 a
	Siirt	77 d	85.3 bc	43.0 abc
	Uzun	92 a	86.8 b	41.7 cd
P. atlantica	Halebi	89 ab	80.0 cd	38.4 e
	Kirmizi	89 ab	66.4 fg	42.2 bc
	Ohadi	69 e	54.1 h	45.2 ab
	Siirt	73 de	86.2 b	42.0 bcd
	Uzun	84 bc	71.4 ef	40.0 cde
P. khinjuk	Halebi	78 cd	94.2 a	40.6 cde
	Kirmizi	85 b	64.8 g	40.0 cde
	Ohadi	70 e	71.4 ef	45.9 a
	Siirt	75 de	85.7 b	43.0 abc
	Uzun	85 b	71.0 ef	38.9 de
LSD 5%		6.95	5.65	3.22

Figures

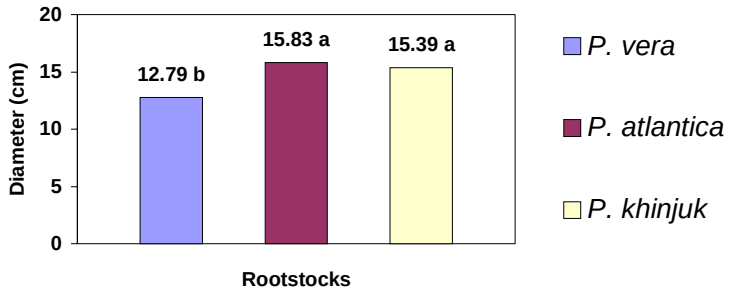

Fig. 1. Trunk diameter (cm) of pistachio rootstocks in 2001.

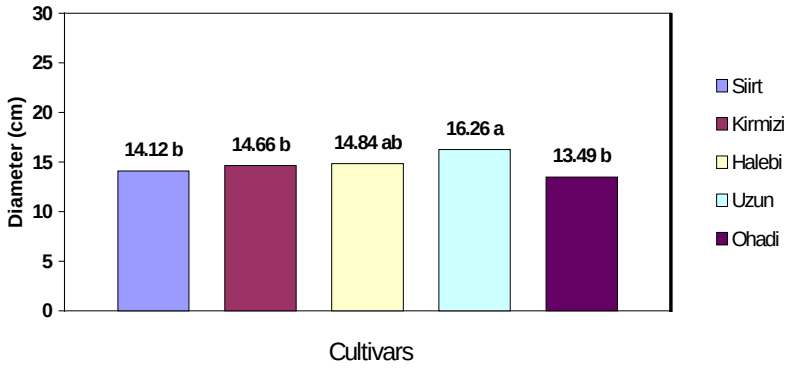

Fig. 2. Effect of pistachio cultivars on rootstock diameters, 2001.

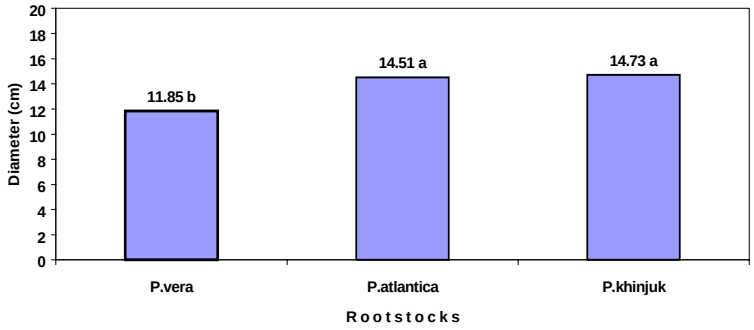

Fig. 3. Effect of rootstocks on cultivar diameters, 2001.