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Effect of two rootstocks on growth, yield and nut characteristics of 'Mateur' and 'Achouri' pistachio varieties

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Abstract. This experiment aimed to study the effect of rootstock on 25-year-old pistachio trees in the Tunisian northeast rainfed conditions. 'Mateur' and 'Achouri' female varieties were grafted onto *Pistacia vera* and *Pistacia atlantica* rootstocks. The vegetative and flower bud breaks have been followed from April to June. The diameter growth of current year shoot was measured. The architecture of flower clusters was studied. Yield and fruit weight, size and dehiscence rate were determined. Results showed no effect of rootstocks on the date of vegetative bud break for both cultivars. 'Achouri' developed flower clusters earlier on *P. atlantica* rootstock and showed a significantly higher shoot diameter growth on *P. vera* rootstock. The nut size characteristics showed no significant differences between both combinations cultivar/rootstock for 'Mateur'. These parameters were significantly higher on *P. atlantica* rootstock for 'Achouri'. According to these preliminary results, rootstock seemed not to affect growth and nut quality of 'Mateur' cultivar while *P. atlantica* rootstock appeared to have some beneficial effects on 'Achouri'.

Key words. Rootstock – *Pistacia* – Growth – Yield – Nut characteristics.

Caractéristiques morphométriques de variétés et écotypes locaux et étrangers de pistachier femelle dans les conditions du nord-est tunisien

Résumé. L'effet de deux porte-greffes (*Pistacia vera* et *Pistacia atlantica*) sur les cultivars de pistachier 'Mateur' et 'Achouri' a été étudié dans les conditions pluviales du nord-est tunisien. Le débournement végétatif et floral a été suivi d'avril à juin. La croissance du diamètre de la pousse de l'année a été mesurée. L'architecture des grappes fruitières a été étudiée. Le rendement, le poids, la taille et le taux de déhiscence des fruits ont été déterminés. Le porte-greffe n'a pas eu d'effet sur la date de débournement végétatif chez les deux cultivars. Le débournement floral était plus précoce sur *P. atlantica* chez 'Achouri'. Ce cultivar a eu une croissance du diamètre des pousses significativement plus élevée sur *P. vera*. Les paramètres relatifs à la dimension du fruit étaient significativement plus élevés sur *P. atlantica* chez 'Achouri' mais n'était pas affectés par le porte-greffe chez 'Mateur'. Selon ces résultats préliminaires, le porte-greffe ne semble pas avoir un effet sur la croissance et la qualité du fruit de la variété 'Mateur' tandis que le porte-greffe *P. atlantica* aurait quelques effets bénéfiques sur 'Achouri'.

Mots-clés. Porte-greffe – *Pistacia* – Croissance – Production – Caractéristiques du fruit.

I – Introduction

Pistachio was used in to develop and valorise arid and semi arid regions subjected to drought. Currently pistachio plantations covers around (DGPA, 2014) concentrated in the center and the south of the country. is ranked 9th in terms of pistachio world production (FAO, 2015) with 3000 t in 2014 (DGPA, 2014). The low diversity of rootstocks as well as less adaptation of some cultivars seems

to be the main problems affecting the cultivation of such crop in. Rootstock choice plays one of the most important roles in orchard management and has economical importance. Selection of the most suitable rootstock/scion combination may have positive effect on tree productivity, fruit quality and resistance to biotic and abiotic stresses. *Pistacia vera* is the main species used as rootstock in. Despite the well adaption of the native *Pistacia atlantica* species to arid conditions, its use as rootstock by farmers is still poor due to the low availability of seeds. The use of this endangered species as rootstock for pistachio varieties contributes certainly in the diversification of rootstocks and more adaptation of pistachio plantations. This study aimed to evaluate the effects of *P. vera* and *P. atlantica* rootstocks on 'Mateur' and 'Achouri' female varieties in terms of yield, growth and fruit cluster and nuts characteristics.

II – Materials and methods

This research was carried out at the INRAT Unity of Agricultural Experimentation at Mornag (North-east of). Twenty-year-old trees were conducted under rainfed conditions. The Tunisian 'Mateur' and the Syrian 'Achouri' cultivars were grafted on *Pistacia atlantica* and *Pistacia vera* rootstocks. For each treatment (rootstocks/cultivars combination), five trees of comparable size and vigor were selected for the study. The current shoot diameter was measured on Mai 14th and November 19th 2014 to determine the annual diameter growth. From April to June, vegetative and reproductive bud breaks were weekly monitored. Fruit clusters were sampled on July, before full maturity, and the total number of fruits per cluster and per each cluster branch order was counted. Fruits were harvested on August 25th at their maturity. The yield per tree was measured at harvesting on 2013 and 2014 years. The in-hull and in-shell fruit fresh weights, in-shell dry weight and nut dehiscence were measured for three replicates of 100 fruits per treatment. The nut and kernel sizes were measured with a digital caliper for 25 fruits per treatment.

III – Results and discussion

During 2014 growth season, vegetative bud break started by the 1st of April for all cultivar/rootstock combinations. Flowering of 'Achouri' cultivar started 5 to 7 days earlier (8th April) on *P. atlantica* rootstock than on *P. vera* one. No rootstock effect on phenology was observed on 'Mateur' cultivar. The rootstock had no effect on shoot diameter growth of 'Mateur' cultivar (Fig. 1). However, shoot diameter growth of 'Achouri' was significantly higher on *P. vera* than on *P. atlantica* rootstock. These results were not consistent with those of Kaska *et al.* (2002) on different cultivars that reported high or invariable shoot diameter on *P. atlantica* rootstock. In the Tunisian south-east conditions, Chelli Chaabouni *et al.* (2009) described enhancing or no effects of *P. atlantica* rootstock on shoot diameter growth of four year-old irrigated 'Mateur' trees depending on the season of growth.

Statistical data analysis related to fruit cluster showed no significant effect of rootstock on cluster ramification and on the number of fruits per cluster (Table 1). These results corroborate those of Tajabadipour *et al.* (2006). However, some differences were noted on cluster organization. Great variability was noted on the number of tertiary ramifications and the number of fruits per secondary and tertiary ramifications. This is particularly true for 'Mateur' grafted on *P. atlantica* with a standard deviation higher than mean values. 'Achouri' recorded the greatest number of fruits per infructescence independently of the rootstock. The number of fruits per primary branching was significantly higher on 'Achouri' grafted on *P. vera* than on 'Mateur' having *P. atlantica* as rootstock.

At harvest time, the yield per tree was no significantly different neither between cultivars nor between rootstocks (Table 2). Rootstocks had no effect on endocarp dehiscence rate of nuts that was significantly higher on 'Achouri' than on 'Mateur'. These results were clearly below the dehiscence rate (76%) of 'Mateur' cultivar but were comparable to the rate obtained for 'Achouri' (86%) recorded

in the same orchard in 2013. The year to year variation of nut splitting noted on 'Mateur' cultivar in this study was reported by Loudyi (2001) as a common characteristic of *P. vera* cultivars. The dehiscence rate was reported to be of 70-90% for 'Mateur' (Anonymous, 1972) and 55-99% for 'Achouri' (Oukabli, 1995; Hadj-Hassan, 2001).

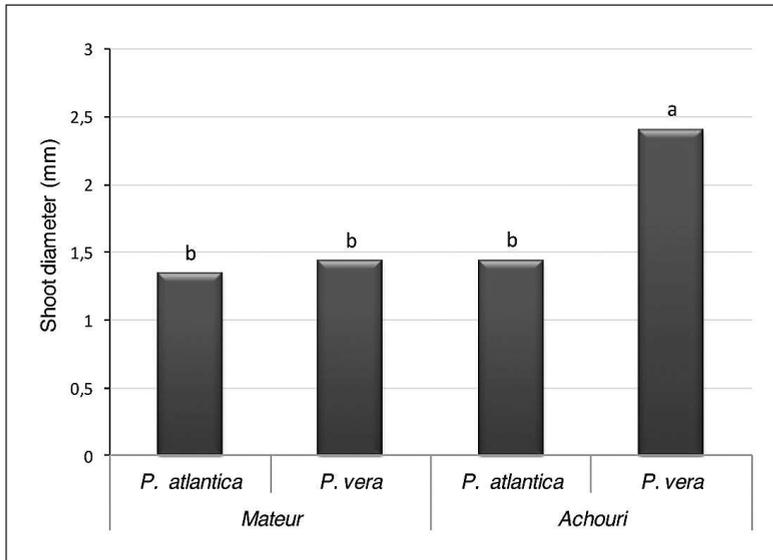


Fig. 1. Effect of Rootstock on diameter growth of current year shoot.

Table 1. Number of fruit cluster ramification and number of flowers per cluster and on each branching order

Cultivar	Rootstock	PR	SR	TR	FR	FPB	FSB	FTB	TF
'Mateur'	<i>P. vera</i>	11.1 ^a	8 ^a	0.8 ^a	8 ^a	44.4 ^{ab}	14.8 ^a	1.8 ^a	68.9 ^a
	<i>P. atlantica</i>	8.9 ^a	5.8 ^a	1.4 ^a	6.1 ^a	32.7 ^b	12.7 ^a	1.9 ^a	53.3 ^a
'Achouri'	<i>P. vera</i>	11.5 ^a	9.6 ^a	1.9 ^a	7.5 ^a	54.6 ^a	19.1 ^a	3.8 ^a	85 ^a
	<i>P. atlantica</i>	12.3 ^a	11.7 ^a	2.8 ^a	6.3 ^a	47.3 ^{ab}	21.3 ^a	3.7 ^a	78.7 ^a
SD		3.4	6.5	2.1	2.9	21.1	14.3	3.2	36

In the same column, values followed by same letters are not significantly different (Duncan; $p < 0.5$).

PR: Number of primary ramification; SR: Number of secondary ramification; TR: Number of tertiary ramification; FR: Number of fruits on rachis; FPB: Number of fruits on primary branching; FSB: Number of fruits on secondary branching; FTB: Number of fruits on tertiary branching; TF: Total number of fruits per infructescence; SD: standard deviation.

Table 2. Average yield per tree and nut dehiscence rate

Cultivar	Rootstock	Yield (kg)	Nut dehiscence rate (%)
'Mateur'	<i>P. vera</i>	8.4 ± 4 ^a	32.5 ± 23.2 ^b
	<i>P. atlantica</i>	9.1 ± 7.6 ^a	31.0 ± 17.9 ^b
'Achouri'	<i>P. vera</i>	7.5 ± 2.8 ^a	83.8 ± 10 ^a
	<i>P. atlantica</i>	7.2 ± 3.6 ^a	76.5 ± 23.4 ^a

The rootstock had no significant effect on in-hull and de-hulled fresh fruit weight of 'Mateur' cultivar. In contrary, 'Achouri' showed significantly lower values on *P. vera* rootstock. On another hand, the rootstock/cultivar combination had no effect on in-shell nut dry weight. 'Mateur' and 'Achouri' grafted on *P. vera* and *P. atlantica* rootstocks produced nuts having a dry weight ranged between 82 and 89 g (Table 3). In these experimental conditions, rootstocks seem to more affect hull than the endocarp and kernel of the fruit.

Results related to fruit size are presented in table 4. For 'Mateur' cultivar, all fruit size parameters were not affected by the type of rootstock. For 'Achouri', the lengths of in-hull and de-hulled fruit as well as the length and width of kernel were significantly higher for trees grafted on *P. atlantica* rootstock. This effect was particularly notable on kernel length whose value passed, according to rootstock, from being significantly lower to significantly higher than 'Mateur' value.

Overall, 'Mateur' and 'Achouri' cultivars showed similar fruit characteristics independently of rootstock.

Table 3. In-hull and de-hulled fruit fresh weight and in-shell nut dry weight (average of 100 unities)

Cultivar	Rootstock	Ih FW (g)	Dh FW (g)	Is DW (g)
'Mateur'	<i>P. vera</i>	219.9 ± 31.5 ^{ab}	127 ± 10.5 ^a	88.8 ± 7.7 ^a
	<i>P. atlantica</i>	229.1 ± 23.6 ^a	124.6 ± 11.7 ^a	86.2 ± 9.2 ^a
'Achouri'	<i>P. vera</i>	203.7 ± 12.3 ^b	110.6 ± 6.3 ^b	81.9 ± 4.8 ^a
	<i>P. atlantica</i>	217.3 ± 42.6 ^{ab}	123.6 ± 29.8 ^a	87.7 ± 18.7 ^a

Ih FW: In-hull fresh weight; Dh FW: De-hulled fresh weight; Is DW: In-shell dry weight.

Table 4. In-hull fruit, de-hulled nut and kernel sizes (mm)

Cultivar	Rootstock	In-hull fruit			De-hulled nut			Kernel		
		Length	Width	Thickness	Length	Width	Thickness	Length	Width	Thickness
'Mateur'	<i>P. vera</i>	24 ^a	11.8 ^a	10.7 ^a	20.5 ^a	11.1 ^b	9.8 ^{ab}	16 ^b	7.8 ^{ab}	7.6 ^b
	<i>P. atlantica</i>	24.3 ^a	12.1 ^a	11 ^a	20.6 ^a	11.1 ^b	9.8 ^{ab}	16 ^b	7.8 ^{ab}	7.4 ^b
'Achouri'	<i>P. vera</i>	22.3 ^c	10.9 ^b	10 ^b	19.5 ^b	10.6 ^b	9.5 ^b	15.4 ^c	7.6 ^b	7.5 ^b
	<i>P. atlantica</i>	23.2 ^b	10.7 ^b	10 ^b	20.6 ^a	10.9 ^{ab}	9.9 ^b	16.5 ^a	8 ^a	7.9 ^b

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