Suitability of some selected and fast growing P. atlantica, Desf. types as pistachio nut rootstock

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Suitability of some selected and fast growing *P. atlantica*, Desf. types as pistachio nut rootstock

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SUMMARY - In Turkey there are approximately 40 million pistachio nut trees growing in dry, rainfed soils. Most of these trees are budded on *P. vera,* L. seedlings. Since the irrigation of the Harran Plain (Sanlıurfa in the GAP region) started in 1996 there are projects to grow pistachio nuts in irrigated lands as in California and Iran. In this case the rootstock problem arises. To solve this problem research on suitable rootstock was started. In this paper 6 *P. atlantica,* Desf. types selected from Southern, Central and Western Anatolia will be presented. After testing their viabilities and germination rates the seeds of the selected *P. atlantica,* Desf. were first scarified with H_2SO_4 and then they were sown either directly or after treating with GA_3 or after stratification. Growth and development were studied in the seedlings and budding stages were checked by measuring the stem diameters. According to the results obtained, AT-4502 and AT-7001 were found the most suitable material among the other selected ones from the germination and growth rates view points.

Key words: Scarification, stratification, viability, germination rate, *P. atlantica,* Desf.

RESUME *- "Adéquation de certains types de* P. atlantica *Desf. sélectionnés et à croissance rapide comme porte-greffes de pistachiers". En Turquie il y a environ 40 millions de pistachiers poussant dans des terrains secs et sans irrigation. La plupart de ces arbres sont greffés sur des plantules* de P. vera *L. Depuis la mise en irrigation de la plaine de Harran (Sanliurfa dans la région GAP) en 1996 il y a des projets pour planter des pistachiers dans des terres irriguées comme en Californie et en Iran. Dans ce cas se pose le problème des porte-greffes. Pour résoudre ce problème, des travaux ont été entamés pour la recherche de porte-greffes adéquats. Dans ce travail, on présente 6 types de* P. atlantica *Desf. sélectionnés à partir du Sud, du Centre et de l'Ouest de l'Anatolie. Après avoir testé la viabilité et les taux de germination, les semences de* P. atlantica *Desf. sélectionnées ont d'abord été scarifiées avec* H_2SO_4 *et elles ont été semées ensuite soit directement ou après traitement avec du* GA_3 *ou après stratification. On a étudié la croissance et le développement des plantules et on a mesuré le diamètre des troncs lorsqu'ils ont atteint le stade de greffage. Selon les résultats obtenus, AT-4502 et AT-7001 se sont montrés les plus adéquats parmi le matériel sélectionné du point de vue des taux de germination et de croissance.*

Mots-clés : *Scarification, stratification, viabilité, taux de germination,* P. atlantica *Desf.*

Introduction

Traditional pistachio nut rootstocks in Turkey are *P. vera*, L., *P. khinjuk*, Stocks, and *P. terebinthus*, L., whereas *P. atlantica*, Desf. seedlings are very rarely used. The works on the effects of 3 rootstocks on different pistachio nut cvs which were carried out in Gaziantep (Ulusaraç and Karaca, 1995) have shown that *P. atlantica*, Desf. was quite a good rootstock for pistachio nuts. However, all the seed materials used are sold as mixed seeds from different trees. Therefore, the seedlings do not grow homogeneously and in some cases the bud-takes are in very low rates (Kaşka, 1990). In this case reliable seed materials which will have high viability and germination rates and also ability to produce homogenous and fast growing seedlings are needed. Since Turkey is extremely rich in *P. atlantica*, Desf. trees especially in the Southern and Western parts of Anatolia (Kaşka and Bılgen, 1988; Kaşka *et al.,* 1995) to find such seed materials is not difficult. Now Turkey is planning to grow pistachio nut in the irrigated land of Southeast Anatolia. The irrigation of Harran Plain in Sanlıurfa was started this year. Our preliminary experiments have shown that under irrigated conditions pistachio nuts can start bearing after 4 or 5 years of their planting. In this case rootstocks problem must be solved. We thought that *P. atlantica*, Desf. would be a good solution (Banihashemi,

1995) at least for the beginning. The objective of this work is to find *P. atlantica*, Desf. type or types which will be suitable as rootstock for pistachio nuts which will be grown in irrigated land of Harran Plain.

Material and method

Material

Seed samples of *P. atlantica*, Desf. were collected from 6 selected naturally grown trees in Manisa (Aegean region), Karaman (Central Anatolia) and Mut (Mediterranean region). Ohadi cv. seeds were used as control.

Method

Viability tests of the seeds were performed with 1% TTC solution. The embryos were soaked in the TTC solution and kept in a drying cabinet for 24 hours.

Evaluation of the test is as follow:

Staining (%)	Evaluation
100	Viable
75	Viable
50	Semi-viable
25 or less	Non-viable

In order to facilitate the germination, the seeds were scarified with H_2SO_4. for each type of seed scarification period was separately determined. Scarifications were performed at room temperature (22-25°C). Scarified seeds were washed 2 days under tap water in order to wash-out the H_2SO_4 residue. In Ohadi, scarification was not performed instead split seeds were selected for germination. Scarified seeds stratified 60 days at 4°C in moist sterile sand (Nikpeyma and Kaşka, 1995a). Stratification of the seeds started on 9th November. Unstratified seeds were kept in bags at 4°C until 7th of January. At this date one part of the unstratified seeds were soaked in 125 ppm GA_3 solution for 48 hours and other half were kept 2 days in distilled water. All the seeds were sown on 9th of January into small pots and leaved for germination in a slightly heated glasshouse. In each treatment 75 seeds were used. At the end, the germination rates and speeds were calculated.

In all the treatments root tips of the small plantlets grown in small pots were pinched (Nikpeyma and Kaşka, 1995b) and then they were transferred to 5 litter plastic bags. In July from 5 cm above the soil surface stem diameters and plant heights were measured.

As the germination media sand: turf (1:2 ratio) was used. After the germination of the seeds the emerged seedlings with at least two leaves were transplanted to the plastic bags of 32x14x7 cm dimensions. The transplanting media was in 1:1:1:1 ratio of sand + soil + FYM + turf.

In the measurements of seedling diameter and seedling heights 25 replicates were used. Number of seedlings which were reached to 6 mm (or more) diameter in July were counted by supposing them to be ready for budding.

Results and discussion

Viability of the seeds

The TTC tests have shown that the highest rates of the fully stained seeds were in AT-4502 (91.7%) and the lowest in AT-70E1 (51.7%), (Table 1). In the Ohadi seeds the viability was 88.3%.

When the semi-viable seeds were added to the completely stained seeds the rates of the viable seeds were 100% in AT-33M1, AT-4502 and AT-7001 and 83.3% in Ohadi (Table 1).

Table 1. Rates of seed viabilities in different *P. atlantica,* Desf. types

P. atlantica types and Ohadi variety	Full-stained cotyledones		Full-stained cotyledones		Total	
	Number	Rates (%)	Number	Rates (%)	Number	Rates (%) $D_{\%5}$:11.73
AT-33M1	48	80.0	12	20.0	60	100^{a} *(90.00)*†
AT-4501	43	71.7	11	18.3	54	90.0^{bc} *(73.66)*
AT-4502	55	91.7	5	8.3	60	100^{a} *(90.00)*
AT-7001	38	63.3	22	36.7	60	100^{a} *(90.00)*
AT-70E1	31	51.7	15	25.0	46	76.7^{d} *(61.30)*
AT-70E2	44	73.3	8	13.3	52	86.6^{cd} *(69.13)*
Ohadi	53	88.3	5	8.3	58	96.7^{ab} *(83.30)*

†Numbers in the parenthesis are the angle degrees corresponding the percent values
a,b,c,d: Means within the same column with same letter are not significantly different

Germination rates of the seeds

There are quite significant effects of the stratification on the germination percentages and durations of the seeds (Fig. 1). The stratified experimental seeds reached the highest germination percentages in much shorter times than the GA_3 treated or direct sown seeds (Fig. 1, 2 and 3). In all the treatments Ohadi seeds resulted with the highest germination rates than the *P. atlantica* seeds. The highest germination percentage was 93.33% in the stratified, 81.33% in GA_3 treated and 62.67% in direct sown seeds of Ohadi. Among the experimental *P. atlantica* seeds AT-4502 have shown the highest germination rates (78.67%) in the stratified and the lowest (46.67%) in the direct sown seeds. AT-7001 has also shown quite high germination rates in the stratified (73.33%) and GA_3-treated (57.67%) seeds. Direct sown seeds resulted with the lowest germination rates (42.67%). The seeds of AT-4501 germinated with low percentages in all the three treatments.

As it is seen in Fig. 1, 2 and 3 stratified seeds always germinated in much shorter times with higher rates than the GA_3 treated and direct sown seeds.

Effects of the treatments on the growth of stem diameter

The stem diameters of the selected *P. atlantica* seedlings were compared with each other and Control after 6 months of their sowing (in July). It was seen that the seeds stratified before sowing produced bigger stem diameter than the other treatments (Table 2). The biggest stem diameter was obtained from Control as 6.68 mm and it is followed by AT-4502 seedlings with 6.40 mm. AT-33M1 (6.11 mm) and AT-7001 (5.80 mm) were also appeared to be as the fast growing types. In GA_3 treated materials the order of growth rates were similar. The diameter of the Control seedlings were the biggest (6.31 mm) and it is followed by AT-4502 (6.03 mm). The thinnest stem diameters (4.49 mm) were produced by AT-70E1. Some small differences occurred in the stem diameters of the

seedlings after direct sowing of the seeds to the nursery. Here the biggest stem diameters were measured in Control seedlings as 6.14 mm but it is followed by AT-7001 seedlings with 6.07 mm instead of AT-4502 seedlings with 5.77 mm.

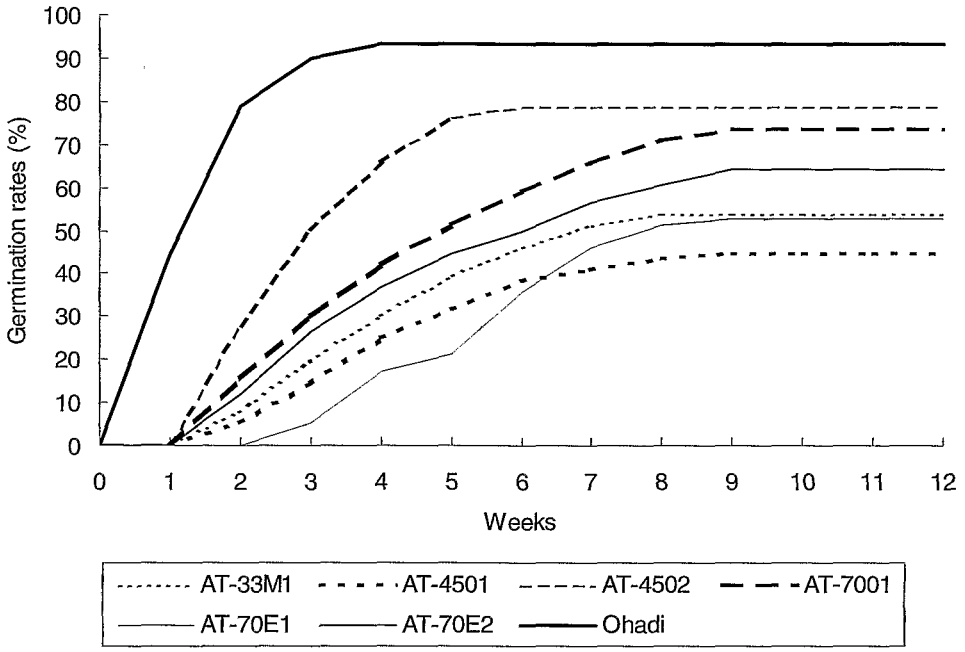

Fig. 1. Effects of stratification on the germination rates of *P. atlantica* seeds.

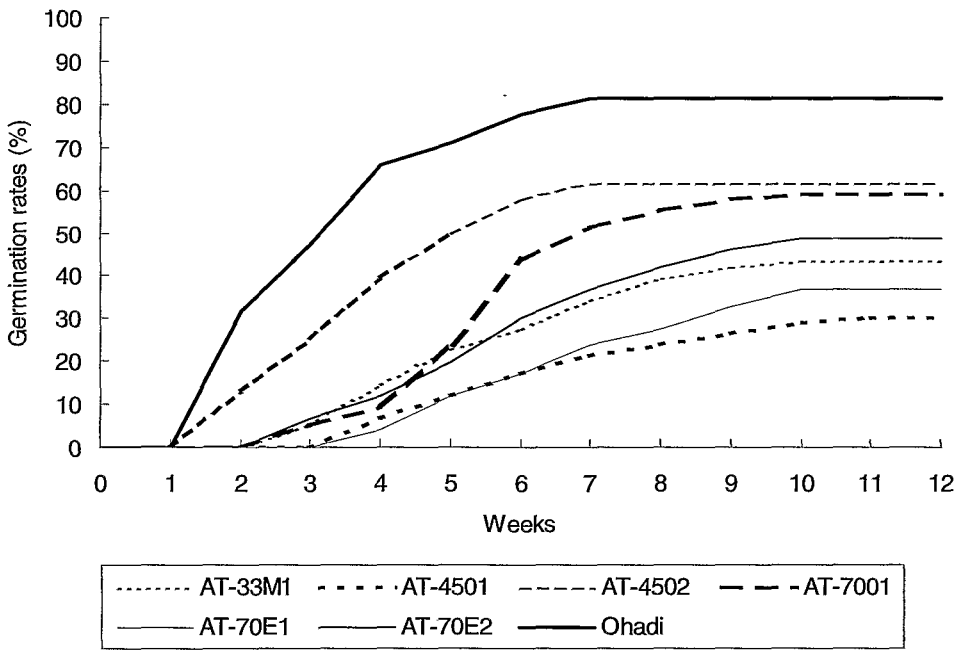

Fig. 2. Effects of GA_3 treated on the germination rates of *P. atlantica* seeds.

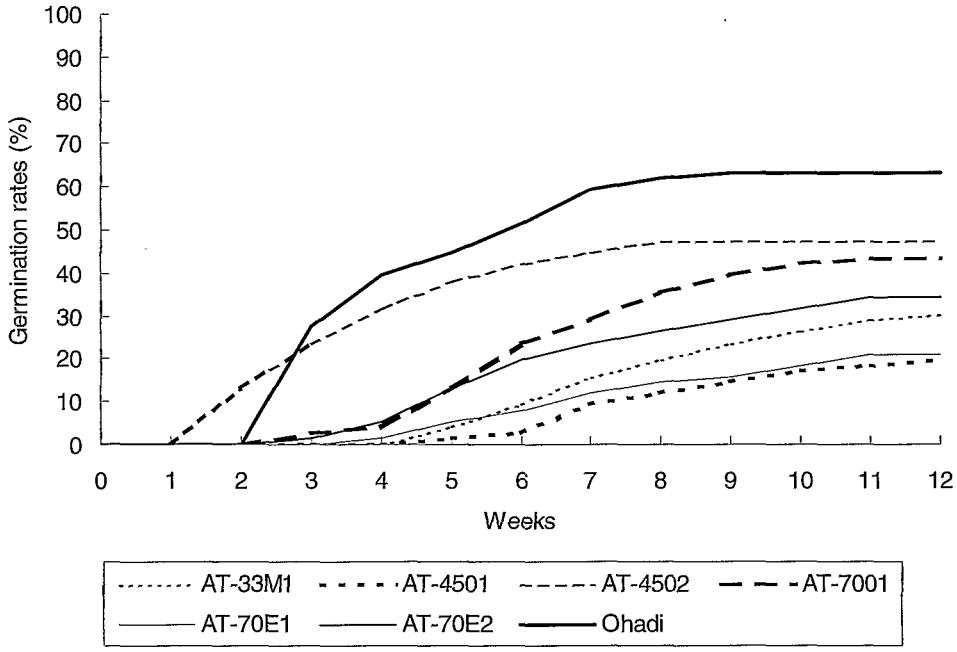

Fig. 3. Effects of direct sowing on the germination rates of *P. atlantica* seeds.

Table 2. Stem diameter (cm) GA_3 treated, stratified and direct sown seeds of *P. atlantica* types after 6 months from sowing

P. atlantica types	Treatments						$D_{\%5}$	Averages of types and variety
	Stratification		GA_3-treated		Direct sown			
AT-33M1	6.11^{bc}	a	5.37^{b}	b	5.22^{bc}	b	0.61	5.56^{c}
AT-4501	5.17^{d}	a	5.01^{bc}	a	4.96^{c}	a	0.59	5.04^{d}
AT-4502	6.40^{ab}	a	6.03^{a}	ab	5.77^{ab}	b	0.42	6.06^{ab}
AT-7001	5.80^{c}	a	5.34^{b}	b	6.07^{a}	a	0.44	5.74^{bc}
AT-70E1	4.87^{d}	ab	4.49^{c}	a	5.15^{bc}	b	0.56	4.84^{d}
AT-70E2	4.82^{d}	a	4.75^{c}	a	4.85^{c}	a	0.31	4.81^{d}
Ohadi	6.68^{a}	a	6.31^{a}	ab	6.14^{a}	b	0.45	6.38^{a}
$D_{\%5}$	0.50		0.56		0.79			0.34
Average	5.53^{a}		5.33^{ab}		5.16^{b}		0.20	

a,b,c,d: Means within the same column with same letter are not significantly different

Readiness of the seedling for budding

For early production of *Pistacia* nut nursery plants early budding in June or July is necessary. For this purpose the stem diameters of the seedlings should be at least 6 mm at the 5 cm height from the soil surface. As it was mentioned above, especially the seedlings of AT-4502 and AT-33M1 and to some extend AT-7001 emerged from the stratified seeds reached the budding stage after 6 months of their sowing. When the rates of these seedlings suitable for budding were calculated it was seen that AT-4502 was in the first order with 84% and it is followed by AT-33M1 (40%) and AT-7001 (36%), (Table 3). The seedlings of Ohadi obtained from similarly treated seeds have shown higher rates (92%). In other words 92% of the seedlings emerged from the stratified seeds of Ohadi were ready to budding after 6 months of their sowing. Neither GA_3 treatments nor the direct sowing increased these

rates (Table 3). However, 32% of the seedlings emerged from GA_3 treated AT-4502 seeds and 40% of the seedlings emerged from the direct sown seeds of AT-7001 reached to budding stage after 6 months of their sowing. These results showed that from the reaching to budding stage point of view AT-4502 seedlings were superior than the other seedlings.

Table 3. Readiness for budding of the seedlings after 6 months from seed sowing in selected *P. atlantica* types (%)

P. atlantica types	Treatments		
	Stratification	GA_3-treated	Direct sown
AT-33M1	40	4	0
AT-4501	0	0	0
AT-4502	84	32	20
AT-7001	36	8	40
AT-70E1	0	0	0
AT-70E2	0	0	0
Ohadi	92	72	52

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