

Vigour and juvenile stage in pistachio progenies

Vargas F.J., Romero M.A.

X GREMPA Seminar

Zaragoza : CIHEAM

Cahiers Options Méditerranéennes; n. 33

1998

pages 105-111

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=98606173>

To cite this article / Pour citer cet article

Vargas F.J., Romero M.A. **Vigour and juvenile stage in pistachio progenies**. *X GREMPA Seminar*. Zaragoza : CIHEAM, 1998. p. 105-111 (Cahiers Options Méditerranéennes; n. 33)



<http://www.ciheam.org/>
<http://om.ciheam.org/>

Vigour and juvenile stage in pistachio progenies

F.J. Vargas and M.A. Romero

Institut de Recerca i Tecnologia Agroalimentàries (IRTA),
 Departament d'Arboricultura Mediterrània, Centre de Mas Bové,
 Apartat 415, 43280 Reus, Spain

SUMMARY - Observations on vigour (trunk diameter 2, 3 and 4 years after planting) and on juvenile period (presence of flower buds 4 years after planting) in 1,626 pistachio seedlings from 30 controlled crosses between 9 female and 12 male cultivars were made. Among these 1,626 seedlings, 879 (15 families) were distributed at random in the orchard to statistically compare differences between progenies for some important characteristics. A highly significant correlation was found between vigour data corresponding to different years. The correlation coefficients were: 0.83 (2-3 years), 0.75 (2-4 years) and 0.93 (3-4 years). These results showed the possibility to select for vigour when the trees are only two years old. Significant differences between families have been observed regarding vigour. High vigour was shown by progenies 'Mateur' x 'Túnez' and 'Mateur' x 'C' and reduced vigour by 'Larnaka' x 'M-38' and 'Larnaka' x 'M-502'. Referring to parents, seedlings derived from 'Mateur' (female) and 'C' (male) stood out, while derivatives of 'Larnaka' (female) showed less vigour. Considerable differences between families were observed in relation to the juvenile period. Regarding number of trees showing flower buds 4 years after planting, the following families stood out: 'Larnaka' x 'B', 'Batoury' x 'C', 'Mateur' x 'C', 'Kerman' x 'M-11' and 'Kerman' x 'M-36'. Concerning female parents, specially 'Kerman' but also 'Batoury' and 'Mateur' were outstanding. The males 'B', 'C', 'M-502' and 'Peters' were also interesting parents for this character.

Key words: Pistachio, breeding, cultivars, vigour, juvenile period, production.

RESUME - "Vigueur et stade juvénile chez les descendances de pistachier". Des observations sur la vigueur (diamètre du tronc mesuré 2, 3 et 4 années après la plantation) et sur la précocité de la mise à fleur (présence de bourgeons floraux 4 ans après la plantation) ont été réalisées sur 1 626 pistachiers de semis, issus de 30 croisements contrôlés entre 9 variétés femelles et 12 variétés. 879 de ces 1 626 arbres appartenant à 15 familles ont été distribués de façon aléatoire à la plantation, de façon à pouvoir comparer avec un maximum de précision les descendances pour quelques caractéristiques importantes. Une corrélation très significative a été trouvée entre les données de vigueur correspondant aux différentes années d'observations. Les coefficients de corrélation ont été de 0,83 (années 2-3), de 0,75 (années 2-4) et de 0,93 (années 3-4). Ces résultats montrent qu'il est possible de réaliser une sélection pour la vigueur sur des arbres très jeunes. Des différences significatives pour la vigueur ont été observées entre familles. On peut distinguer la vigueur élevée des descendances de 'Mateur' x 'Túnez' et 'Mateur' x 'C' et la faible vigueur de 'Larnaka' x 'M-38' et 'Larnaka' x 'M-502'. En ce qui concerne les géniteurs, les descendants de 'Mateur' (femelle) et 'C' (mâle) ressortent pour leur vigueur, tandis que ceux de 'Larnaka' (femelle), montrent une vigueur plus faible. Des différences notables entre familles ont pu être mises en évidence pour la durée de la période juvénile. Les familles 'Larnaka' x 'B', 'Batoury' x 'C', 'Mateur' x 'C', 'Kerman' x 'M-11' et 'Kerman' x 'M-36', se distinguent par un nombre élevé d'arbres portant des bourgeons floraux dès la 4ème année après la plantation. En ce qui concerne les géniteurs femelles, 'Kerman' mais aussi 'Batoury' et 'Mateur' induisent une période juvénile courte. Les géniteurs mâles 'B', 'C', 'M-502' et 'Peters', sont aussi intéressants pour ce caractère.

Mots-clés : Pistachier, amélioration génétique, variétés, vigueur, mise à fleur, production.

Introduction

Until recently, Pistachio (*Pistacia vera* L.) has been forgotten by research and development programmes. This is specially true in relation to breeding and selection of cultivars. Available information on cultivar characteristics and their adaptability to different environments is also scanty. In comparison with other fruit and nut trees, only a small number (less than 100) of pistachio cultivars has been described. This can be due to several reasons: need to graft (to reduce the excessive number of unfruitful male trees obtained from germination of seeds and to use as rootstocks trees of several wild *Pistacia* species), long life of the tree, selective environmental pressure, human

selection, scarcity of studies, etc. (Maggs, 1973). Usually, in every pistachio growing area only its native cultivars are used, which have distinct traits from those grown in other areas (Kaska, 1990; Gökçe and Akçay, 1993; Hadj-Hassan and Kardouch, 1995; Vargas *et al.*, 1995c; Barone and Caruso, 1996; Rouskas, 1996; Sheibani, 1996).

Work on pistachio breeding has been very scarce (Parfitt *et al.*, 1994; Vargas *et al.*, 1996). Therefore, little is known on pistachio genetics. Most of its wide genetic variability has not been exploited to solve production drawbacks. There are good prospects for obtaining outstanding cultivars, crossing superior male and female cultivars from different origins. However, pistachio breeding faces some important limitations: it is a dioecious species and therefore the potential of male parents for any nut related character is unknown, and it shows late bearing and thus long generation cycles (Parfitt, 1990).

A reduced crossing programme was started in 1989 at IRTA-Mas Bové (Vargas *et al.*, 1996). This pistachio cultivar improvement project has already produced some information about the interest of some cross-combinations for two important traits: vigour and leafing date (Vargas *et al.*, 1995a,b).

In this paper, observations on vigour (trunk diameter 2, 3 and 4 years after planting) and on juvenile period (presence of flower buds 4 years after planting) are presented. Vigour is an important character for breeding, due to its effect on the time needed for the tree to form a large canopy (related with the yield capacity) and on its adaptation to adverse growing conditions in which usually the crop is placed. Early bearing is a desirable feature in pistachio cultivars.

Materials and methods

Controlled crosses were made in the pistachio collection of IRTA-Mas Bové during 1989 and mainly 1990. Seedlings were planted in the field in April 1992. The progenies analysed in this paper and the number of seedlings by cross are reflected on Table 1. A total number of 1,626 seedlings from 30 controlled crosses were observed. Female and male parents used in the crosses are given on Tables 2 and 3. Nine female and 12 male cultivars, from different countries, were utilized. Seedlings were grown in two nearby orchards: Mas Barber and Mas Bové. Seedling distribution in the field is shown on Table 4. Mas Barber orchard was divided in two plots: seedlings from crosses of 1989 (Plot 1) and 1990 (Plot 2). The large progenies planted at Mas Barber had a randomized distribution to statistically compare families for some important characteristics. At Mas Bové, seedlings were grouped per progenies. Among the 1,626 seedlings observed, 879 (15 crosses) were randomly distributed in the field. The planting spaces were small: 5 m x 2 m at Mas Barber and 5 m x 1.3 m at Mas Bové. Both orchards are irrigated. Light pruning is practised to promote early cropping (Vargas *et al.*, 1996).

Vigour was recorded by measuring trunk diameter at 20 cm above ground level in the winter seasons (January-March) of 1994, 1995 and 1996 (2, 3 and 4 years after planting). In this paper, the correlation between data of the 3 years in 1,626 seedlings (from 30 crosses) and the vigour of the offsprings from 18 larger families (a total number of 1381 seedlings) is analysed.

Regarding juvenile period, in summer 1996 (4 years after planting), the presence or absence of flower buds in the 1,626 seedlings was recorded.

Results and discussion

A highly significant correlation was found between vigour data of 1,626 seedlings corresponding to different years after planting (Table 5). The correlation coefficients were: 0.83 (2-3 years), 0.75 (2-4 years) and 0.93 (3-4 years). These results showed the possibility to select for this important character when the trees are very young (only two years old in this case).

Mean trunk diameters of 18 pistachio progenies, in the 3 years of observations, are given on Table 6. In the randomized Plot 1, the differences between the 3 families studied were significant but not important. The offsprings of 'Mateur' x 'Túnez' were more vigorous than seedlings from 'Sfax' x 'M-502' and 'Larnaka' x 'B'. In the also randomized Plot 2, with 12 families, very important and significant

differences between families were observed. The offsprings of 'Mateur' x 'C' and 'Batoury' x 'C' showed high vigour, while progenies from 'Larnaka' x 'Nazar', 'Larnaka' x 'M-38' and 'Larnaka' x 'M-502', were less vigorous. In the unrandomized Plot 3, with 10 families studied, the offsprings of 'Kerman' x 'M-11' and 'Mateur' x 'C' showed high vigour whereas 'Larnaka' x 'Nazar' and 'Larnaka' x 'M-38' showed low vigour. Seven progenies are included in both Plot 2 and Plot 3. The results obtained in the two plots are in agreement. The comparison of some progenies with common female or male parents is also very interesting. Regarding female parents, seedlings derived from 'Mateur' are more vigorous than seedlings obtained from 'Aegina', 'Ouleimy' and mainly 'Larnaka'. Male 'C' stood out as parent.

Table 1. Crosses and seedlings number

Cross	No. of seedlings
'Mateur' x 'M-502'	199
'Mateur' x 'M-38'	171
'Larnaka' x 'Nazar'	151
'Mateur' x 'Nazar'	122
'Larnaka' x 'M-38'	115
'Mateur' x 'C'	115
'Aegina' x 'M-502'	109
'Sfax' x 'M-502'	84
'Larnaka' x 'M-502'	76
'Aegina' x 'Enk'	71
'Mateur' x 'M-36'	68
'Batoury' x 'C'	60
'Larnaka' x 'B'	40
'Ouleimy' x 'M-502'	40
'Mateur' x 'Túnez'	39
'Batoury' x 'Nazar'	27
'Mateur' x 'Peters'	25
'Kerman' x 'M-11'	23
'Kerman' x 'M-37'	15
'Mateur' x 'B'	15
'Batoury' x 'M-502'	9
'Kerman' x 'M-36'	9
'Kerman' x 'M-38'	9
'Kerman' x 'M-P3'	7
'Larnaka' x 'Túnez'	7
'Larnaka' x 'Peters'	6
'Iraq' x 'Peters'	5
'White Ouleimy' x 'C'	5
'Aegina' x 'B'	3
'White Ouleimy' x 'B'	1
Total	1626

Records regarding nonbearing period in progenies are presented on Table 7. Considerable differences in the percentage of offsprings showing flower buds 4 years after planting were observed. The following families are promising: 'Larnaka' x 'B', 'Batoury' x 'C', 'Mateur' x 'C', 'Kerman' x 'M-11' and 'Kerman' x 'M-36'. In relation to female parents, specially 'Kerman' but also 'Batoury' and 'Mateur' were outstanding. Males 'B', 'C', 'M-502' and 'Peters' were also interesting genitors for this character.

Table 2. Female parents

Females	Origin	No. of seedlings
'Mateur'	Tunisia	754
'Larnaka'	Cyprus	395
'Aegina'	Greece	183
'Batoury'	Syria	96
'Sfax'	USA	84
'Kerman'	USA	63
'Ouleimy'	Syria	40
'White Ouleimy'	Syria	6
'Iraq'	Iraq	5
Total		1626

Table 3. Male parents

Males	Origin	No. of seedlings
'M-502'	Italy	517
'Nazar'	Israel	300
'M-38'	Syria	295
'C'	Greece	180
'M-36'	Syria	77
'Enk'	Israel	71
'B'	Greece	59
'Túnez'	Tunisia	46
'Peters'	USA	36
'M-11'	Syria	23
'M-37'	Syria	15
'M-P3'	Spain	7
Total		1626

Table 4. Seedling distribution in the field

Plot	Field	Crossing year	Randomized		Unrandomized	
			Number of crosses	Number of seedlings	Number of crosses	Number of seedlings
1	Mas Barber	1989	3	151	5	51
2	Mas Barber	1990	12	728	6	166
3	Mas Bové	1990			18	530

Table 5. Correlation coefficients between trunk diameter records of different years

Years	1995 (3 years old)	1996 (4 years old)
1994 (2 years old)	0.83	0.75
1995 (3 years old)		0.93

S.L.: 0.0001

Table 6. Vigour of pistachio progenies. Mean trunk diameter (mm) at 20 cm above ground level in 1994, 1995 and 1996 (2, 3 and 4 years after planting)

Cross	No. of seedlings	Mean trunk diameter		
		1994	1995	1996
Plot 1. Randomized seedlings				
'Mateur' x 'Túnez'	39	18.06 ^a	30.93 ^a	43.91 ^a
'Larnaka' x 'B'	40	17.58 ^{ab}	28.16 ^b	39.95 ^b
'Sfax' x 'M-502'	72	16.01 ^b	26.58 ^b	39.22 ^b
Plot 2. Randomized seedlings				
'Mateur' x 'C'	56	16.03 ^a	30.08 ^a	44.45 ^a
'Batoury' x 'C'	60	14.82 ^{ab}	28.32 ^{ab}	42.52 ^{ab}
'Mateur' x 'Nazar'	64	14.62 ^b	26.29 ^{bc}	39.86 ^{bc}
'Mateur' x 'M-502'	63	14.89 ^{ab}	27.31 ^{bc}	39.84 ^{bc}
'Mateur' x 'M-36'	64	13.52 ^{bc}	25.57 ^{cd}	38.18 ^{cd}
'Mateur' x 'M-38'	57	14.55 ^b	25.50 ^{cd}	37.61 ^{cd}
'Aegina' x 'M-502'	63	14.03 ^b	25.56 ^{cd}	36.82 ^{cde}
'Aegina' x 'Enk'	55	12.15 ^d	23.67 ^{de}	36.34 ^{de}
'Ouleimy' x 'M-502'	39	14.09 ^b	25.50 ^{cd}	36.08 ^{de}
'Larnaka' x 'Nazar'	64	12.47 ^{cd}	22.24 ^{ef}	33.80 ^{ef}
'Larnaka' x 'M-38'	73	11.79 ^d	21.17 ^f	32.25 ^f
'Larnaka' x 'M-502'	70	12.12 ^d	21.71 ^{ef}	32.20 ^f
Plot 3. Unrandomized seedlings				
'Kerman' x 'M-11'	23	14.40	29.39	42.14
'Mateur' x 'C'	48	12.53	26.05	39.94
'Mateur' x 'M-502'	120	12.34	25.77	38.35
'Kerman' x 'M-37'	15	11.70	24.39	38.07
'Mateur' x 'Nazar'	47	11.44	23.88	37.07
'Mateur' x 'M-38'	104	11.81	23.97	37.04
'Mateur' x 'B'	15	13.69	24.53	36.83
'Aegina' x 'M-502'	35	12.37	22.36	35.17
'Larnaka' x 'Nazar'	71	9.98	21.51	34.04
'Larnaka' x 'M-38'	24	10.22	21.41	33.93

a,b,c,d,e,f: Values marked with different letters are significantly different following Duncan's Multiple Range Test (95%)

Conclusions

A highly significant correlation was found between vigour data corresponding to the 2, 3 and 4 years after planting. These results showed the possibility to select for this trait when the trees are very young.

Significant and very important differences between families have been observed regarding vigour. High vigour was shown by progenies 'Mateur' x 'Túnez' and 'Mateur' x 'C' and reduced vigour by 'Larnaka' x 'M-38' and 'Larnaka' x 'M-502'. Referring to parents, seedlings derived from 'Mateur' (female) and 'C' (male) stood out, while derivatives of 'Larnaka' (female) showed less vigour.

In relation to early bearing, the following families stood out: 'Larnaka' x 'B', 'Batoury' x 'C', 'Mateur' x 'C', 'Kerman' x 'M-11' and 'Kerman' x 'M-36'. Concerning female parents, specially 'Kerman' but also 'Batoury' and 'Mateur' were outstanding. Males 'B', 'C', 'M-502' and 'Peters' were also interesting genitors.

Table 7. Juvenile period of pistachio progenies. Seedlings with flower bud in summer 1996 (4 years old)

Progenies	No. of seedlings	Seedlings with flower buds	
		Number	%
Plot 1. Randomized seedlings			
'Larnaka' x 'B'	40	12	30
'Sfax' x 'M-502'	72	3	4
'Mateur' x 'Túnez'	39	0	0
Plot 2 (a). Randomized seedlings			
'Batoury' x 'C'	60	5	8
'Mateur' x 'C'	56	4	7
'Mateur' x 'Nazar'	64	3	5
'Mateur' x 'M-502'	63	2	3
'Ouleimy' x 'M-502'	39	1	3
'Aegina' x 'M-502'	63	1	2
'Mateur' x 'M-38'	57	1	2
'Aegina' x 'Enk'	55	0	0
'Larnaka' x 'Nazar'	64	0	0
'Larnaka' x 'M-38'	73	0	0
'Larnaka' x 'M-502'	70	0	0
'Mateur' x 'M-36'	64	0	0
Plot 2 (b). Unrandomized seedlings			
'Kerman' x 'M-36'	9	5	56
'Kerman' x 'M-38'	9	3	33
'Kerman' x 'M-P3'	7	2	29
Plot 3. Unrandomized seedlings			
'Kerman' x 'M-11'	23	9	39
'Kerman' x 'M-37'	15	2	13
'Mateur' x 'B'	15	2	13
'Larnaka' x 'Nazar'	71	2	3
'Mateur' x 'M-502'	120	4	3
'Mateur' x 'C'	48	1	2
'Mateur' x 'Nazar'	47	1	2
'Mateur' x 'M-38'	104	2	2
'Aegina' x 'M-502'	35	0	0
'Larnaka' x 'M-38'	24	0	0

Acknowledgements

This research was conducted under the Spanish funded project INIA (SC93-120) 'Selección de material vegetal en frutos secos o desecados alternativos: nogal, pistachero, algarrobo y pecanero'.

References

- Barone, E. and Caruso, T. (1996). Genetic diversity within *Pistacia vera* in Italy. In: *Workshop on Taxonomy, distribution, conservation and uses of Pistacia genetic resources*, Palermo, Italy, 1995, Padulosi, S., Caruso, T. and Barone, E. (eds). IPGRI, Rome, pp. 20-28.
- Gökçe, MH. and Akçay, M. (eds). (1993). *Antepfistigiçesit katalogu* (en turc avec les descripteurs en anglais). T.C. Tarım ve Köyisleri Bakanlığı, Ankara, Turkey, 361(20): 64.

- Hadj-Hassan, A. and Kardouch, M. (1995). Status of pistachio nut cultivation in Syria. In: First International Symposium on Pistachio Nut, Adana, Turkey, 1994, Kaska, N., Küden, A.B., Ferguson, L. and Michailides, T. (eds). ISHS, *Acta Horticulturae*, 419: 221-227.
- Kaska, N. (1990). Pistachio research and development in the Near East, North Africa and Southern Europe. In: *Nut Production and Industry in Europe, Near East and North Africa*, Yalova, Turkey, 1990, Menini, U.G., Ölez, H., Büyükyılmaz, M. and Özelkök, S. (eds). FAO REUR and MAFRA, REUR Technical Series, 13: 133-160.
- Maggs, D.H. (1973). Genetic resources in pistachio. *Plant Genetics Resources Newsletter*, 29: 7-15.
- Parfitt, D.E., (1990). Pistachio cultivars and prospects for improvement. In: *81st Annual Report of the Northern Nut Growers Association*, University of Nebraska, Lincoln, USA, pp. 132-134.
- Parfitt, D.E., Badenes, M.L. and Ferguson, L. (1994). Pistachio breeding and genetics program at the University of California. In: First International Symposium on Pistachio Nut, Adana, Turkey, 1994, Kaska, N., Küden, A.B., Ferguson, L. and Michailides, T. (eds). ISHS, *Acta Horticulturae*, 419: 279.
- Rouskas, D. (1996). Conservation strategies of *Pistacia* genetic resources in Greece. In: *Workshop on Taxonomy, distribution, conservation and uses of Pistacia genetic resources*, Palermo, Italy, 1995, Padulosi, S., Caruso, T. and Barone, E. (eds). IPGRI, Rome, pp. 37-41.
- Sheibani, A. (1996). Distribution, use and conservation of pistachio in Iran. In: *Workshop on Taxonomy, distribution, conservation and uses of Pistacia genetic resources*, Palermo, Italy, 1995, Padulosi, S., Caruso, T. and Barone, E. (eds). IPGRI, Rome, pp. 51-56.
- Vargas, F.J., Romero, M.A., Batlle, I. and Clavé, J. (1995a). Estudio del vigor en familias de pistachero. In: *VI Congreso de la Sociedad Española de Ciencias Hortícolas (SECH), Resúmenes*, Barcelona, Spain, SECH, p. 198.
- Vargas, F.J., Romero, M.A., Clavé, J. and Batlle, I. (1995b). First results of vigour and leafing in pistachio progenies. In: First International Symposium on Pistachio Nut, Adana, Turkey, 1994, Kaska, N., Küden, A.B., Ferguson, L. and Michailides, T. (eds). ISHS, *Acta Horticulturae*, 419: 273-277.
- Vargas, F.J., Romero, M.A., Plana, J., Rovira, M. and Batlle, I. (1995c). Characterization and behaviour of pistachio cultivars in Catalonia (Spain). In: First International Symposium on Pistachio Nut, Adana, Turkey, 1994, Kaska, N., Küden, A.B., Ferguson, L. and Michailides, T. (eds). ISHS, *Acta Horticulturae*, 419: 181-188.
- Vargas, F.J., Romero M.A., Rovira M. and Batlle I. (1996). Pistachio cultivar improvement at IRTA-Mas Bové. In: *Proceedings of the IX GREMPA Meeting-Pistachio*, Sciacca (Agrigento), Italy, 1993, Caruso, T., Barone, E. and Sottile, F. (eds). RENIER, Publisher, Palermo, pp. 15-19.