Plant Genetic Resources: Characterization and Utilization

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'Apatiye' a new cultivar of pistachio with a special growth habit (first report)

Hamid Reza Karimi

Department of Horticultural Science, Faculty of Agriculture, Vali-e-Asr University of Rafsanjan, Rafsanjan, Iran

Abstract

Tree architecture is an important factor in increasing performance and better garden management of pistachios. In a pistachio breeding programme, the genotypes obtained from five open pollinated populations were evaluated in terms of growth characteristics. Among the evaluated genotypes, 'Apatiye' was identified. This genotype has shoots with crouch angle more than 90° and a height of 110 cm. In previous year's shoots, the terminal buds abort and fall in early spring, stimulating more lateral buds to grow (6–7) than other genotypes (3–4). The growth characteristics of 'Apatiye' create a valuable potential resource for breeding pistachio cultivars with low alternate bearing, suitable for manual harvesting and pruning management. In addition, 'Apatiye' can be used as a suitable genetic marker in the study of heritability of growth habit in pistachio trees for future studies.

Short Communication

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Corresponding author:
Hamid Reza Karimi;
Email: hrkarimi2017@gmail.com

Introduction

Pistachios are one of the most important nut fruits in the world with high nutritional value. They have high genetic diversity in seedling trees because of their dioecious nature, pollination mechanism and the possibility of crossing between species. Many studies indicate the existence of high genetic diversity in pistachio genotypes (Kafkas *et al.*, 2002; Karimi *et al.*, 2009, 2012; Karimi, 2012). Most of the studies conducted in the morphological field of pistachio are on the characteristics of leaves and nut and there is no comprehensive report on growth habit. One of the rare growth habits in fruit trees is weeping, which has been reported in peach, apricot trees, cherries, elms and some ornamental trees, but there is no report in this regard in pistachio (Lulu *et al.*, 2021; Cuihua *et al.*, 2022; Luwei *et al.*, 2022). In recent years, the pruning of pistachio trees has been considered in order to reduce the alternate bearing and increase the quality of the fruit. It has been reported that in pistachio, the number of shoots and their length determine tree yield (Nikpeyma, 2020). The weak lateral shoots in pistachio compared to other fruit trees have been attributed to its strong apical dominance. Apical dominance has an effect on the lateral shoot length and the removal of the terminal bud can increase the length of the lateral shoots by removal of auxin sources (Wilson, 2000; Morris *et al.*, 2006). In pistachio, winter pruning has no effect on the production of lateral shoots, but heading back at 4 weeks after bud break produces more lateral shoots in Siirt cultivar. The alternate bearing is a genetic trait in pistachio, and pruning to reduce apical dominance and increase flower buds is costly, therefore, obtaining pistachio genotypes with low apical dominance traits is important in garden management.

Experimental

The 'Apatiye' cultivar is a female tree that was selected from among 150 seedling trees originated from open pollination of 'Akbari', 'Badami', 'Kirmizi', 'Siirt' and 'Uzun' cultivars in Vali Asr University of Rafsanjan. Seedling trees were screened based on the pistachio descriptor (Saghafi *et al.*, 2019). Growth parameters such as leaf area, shoot length of the current season, leaf length, leaf width and shoot angle were measured in the years 2022 and 2023. Data of both years were evaluated as a combined analysis of variance with six replications and comparison of means was done using LSD test. Based on the results, 'Apatiye' cultivar had the lowest height (110 cm) compared to other genotypes. The growth habit in the most genotypes was standard; in some of them it was upright, while it was weeping in 'Apatiye' cultivar (Fig. S1). 'Apatiye' cultivar had odd pinnate leaves with 18.30 cm length and 17.67 cm wide with a thick and leathery texture. It also has more leaf area (57.12 cm^2) and higher chlorophyll index (60.56) than 'Badami' and 'Siirt' genotypes (Table 1). Current season shoot length in 'Apatiye' cultivar (15.3 cm) was more than 'Siirt' genotypes and less than 'Kirmizi' and 'Akbari' genotypes. In 'Apatiye' cultivar, shoots were hanging downwards (weeping), so the angle between shoot and the trunk was more than 90°, while in other genotypes it was between 40 and 70° (Table 1). In the 'Apatiye' cultivar, the most of terminal buds failed in early spring

Table 1. Comparison means of traits measured in some female genotypes with 'Apatiye' cultivar

No	Genotype code	Season shoot length (cm)	Shoot diameter (mm)	Chlorophyll index	*Fv/Fm*	RWC (%)	Leaf length (cm)	Leaf wide (cm)	Leaf area (cm^2)	Shoot angle
1	A1	12.03	6.97	58.28	0.70	58.59	15.67	12.00	40.20	50–70
2	A3	11.68	5.47	56.85	0.67	45.84	12.17	9.67	20.17	40–70
3	A5	15.47	5.81	52.98	0.69	50.47	13.33	10.23	40.06	60–70
4	A6	18.82	6.65	58.56	0.64	48.94	15.40	12.43	44.28	56–75
5	A8	17.90	6.17	58.23	0.68	55.07	12.17	10.07	36.94	40–55
6	A9	18.60	6.12	56.30	0.68	62.82	15.43	9.57	38.97	50–75
7	A10	7.72	5.73	52.58	0.73	39.43	10.43	7.33	33.17	60–70
8	A11	10.37	7.23	56.85	0.74	31.61	13.33	9.07	37.55	40–65
9	A12	19.40	8.30	56.93	0.71	61.76	14.50	11.67	41.42	55–75
10	A13	8.25	6.12	57.63	0.67	51.14	13.67	11.4	32.09	50–75
11	U1	8.23	5.65	55.85	0.69	71.18	10.33	12.1	31.23	40–60
12	U2	11.33	7.48	48.57	0.71	61.93	12.50	9.73	35.98	50–75
13	K3	13.13	7.27	58.90	0.73	76.82	11.73	10.23	36.93	60–70
14	K4	14.17	7.71	56.39	0.74	70.63	15.83	8.40	41.29	50–70
15	K5	10.69	7.29	57.01	0.68	70.24	13.50	8.67	30.11	60–70
16	K6	16.40	7.30	52.29	0.73	70.46	12.33	9.27	31.94	60–70
17	K7	13.09	6.72	56.26	0.67	40.86	11.50	11.4	39.30	60–70
18	K8	15.40	8.55	54.65	0.71	75.37	14.00	11.15	40.65	60–70
20	S2	14.74	8.71	52.35	0.76	76.05	16.15	10.83	46.74	60–70
21	S3	14.36	7.59	52.11	0.72	76.76	15.67	17.67	48.93	60–70
22	S4	11.90	7.07	54.61	0.73	72.88	13.50	10.82	41.90	60–70
23	S6	13.56	8.49	51.76	0.75	74.16	16.27	12.43	58.00	60–70
24	S7	8.89	5.85	52.38	0.70	70.98	11.33	10.36	36.92	60–70
25	S8	11.30	6.86	48.16	0.67	63.90	13.50	9.67	36.78	60–70
26	B2	13.20	7.84	52.34	0.68	50.58	16.67	14.50	58.61	50–70
27	B3	18.39	7.91	56.02	0.72	55.77	18.00	14.77	56.14	50–70
28	B5	10.79	7.24	53.71	0.69	54.56	15.45	12.83	54.84	50–70
29	Apatiye	15.30	7.97	60.56	0.75	73.91	18.30	17.67	50.86	>90
LSD		2.16	0.35	2.79	0.019	0.65	–	–	2.68	–

'Akbari' (A), 'Badami'(B), 'Kirmizi'(K), 'Siirt'(S) and 'Uzun'(U). RWC, relative water content; *Fv/Fm*, ratio variable fluorescence to maximum fluorescence.

and stimulated the lateral buds to grow (Fig. 1), so the number of lateral shoots produced in it was 6–7 which was more than other genotypes.

Discussion

Tree architecture affects various aspects of fruit trees such as planting density, fruit quality and yield, pruning, fruit harvesting time and weeds control. The architecture of the trees is determined by the height of the tree, direction and angle of the branches, which are influenced by the initial growth of the tree, branching pattern, position of flowers and death of the buds and branches (Lauri and Laurens, 2005). In the present study, 'Apatiye' cultivar had a weeping growth habit. Several physiological reasons have been stated for this growth habit in different trees. In apricot and peach, it has been reported that the reduction of cellulose synthesis reduces the cellulose content of the secondary cell wall, followed by an increase in lignin and non-cellulosic compounds, which causes cell wall weakness and lack of branch strength (Lulu *et al.*, 2021; Luwei *et al.*, 2022). Xiang *et al.* (2008) measured the amount of gibberellic acid (GA) and lignin in different growth types of peach and reported that the amount of lignin in the lower and upper parts of shoots was different so the trees with an upright growth habit had a higher lignin than weeping growth habit. They also reported that the concentration of GA was not the same in the upper and lower parts of the shoots in weeping peach trees and imbalance of GA concentration in shoots causes the unbalanced growth of secondary xylems and hang of shoots. Pruning of pistachio trees is done in order to reduce alternate bearing and increase the yield and quality of fruits (Nikpeyma, 2020). In pistachios, the

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Figure 1. Comparison of control (left) with terminal bud growing (black line) and 'Apatiye' cultivar (right) with abort terminal bud; dead terminal bud (red line) and shoots grown from lateral buds (blue line).

number of shoots and their length determine the yield of the trees. Pistachio trees have few lateral shoots because of the low number of vegetative lateral buds and strong apical dominance. Removal of terminal buds can reduce apical dominance and stimulate lateral bud formation. In this study, 'Apatiye' cultivar produced had more lateral shoot through the death of the terminal buds. This trait has already been reported in some fruit and forest trees (Costes *et al.*, 2015). In conclusion, it can be said that 'Apatiye' cultivar has a valuable potential for breeding pistachio cultivars with low alternate bearing and suitable for manual harvesting.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S1479262124000406.

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