



Evaluation of Iranian native apple cultivars and genotypes

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Abstract

To evaluate and collect highly valued genotypes of native apples, the growth and fruit characteristics of 79 native cultivars and germplasm of apples in Tehran, Ardebil, Markazi, Ghom, and Hamadan regions were studied in four years. About 30 characteristics such as leaf and tree morphology, fruit and seed characters and susceptibility to pests and diseases were evaluated in this study. Some of collected genotypes are highly promising for fresh consumption with respect to precocity, storage time, yield per tree and marketing potential. Some of these materials could be used for cultivar and rootstock breeding programs. Classification of genotypes based on several traits showed good segregation on the population. For harvest time there was about 7 months of differences between early and late maturing genotypes. For storage life, 7% of genotypes showed very long storage ability. For fruit attractiveness and flesh color also there was a good segregation among genotypes. About 6% of the evaluated materials had high fruit finish and color. The collected genotypes are propagated and are under further evaluation at the Horticulture Department of Seed and Plant Improvement Institute, Karaj, Iran. Among the local genotypes some like Shaki, Beigi and Habibi were found to be promising as new cultivars.

Key words: Apple, germplasm, Iranian apple, genotype identification, genotype selection, genotype evaluation, germplasm collection, local apple, early ripening, fruit attractiveness, fruit quality.

Introduction

Collection and evaluation of native germplasm is considered as the most important step in cultivar improvement. Due to fundamental differences between annual crops and fruit trees, varietal collections of fruit trees should be kept *in situ* for further utilization in breeding programs, and considerable efforts have been made to establish collections of germplasm and cultivars in different countries ^{4, 5, 7, 9, 12-15, 17, 20, 22, 23, 25}. Using the collected germplasm, important characters of vegetative and productive traits, adaptability to specific climatic conditions, resistance to pests and diseases and abiotic stresses are studied ^{1-3, 6, 8, 10, 11, 16, 18, 19, 21, 24}. Iran, with 190,000 ha of cultivation area (2.8% of the world production area) and more than 2 million tons of annual production, is among the world's top apple producers. There is a great genetic variability in the Iranian commercial orchards as seedling materials are used for either cultivars or rootstocks. Also, considerable number of wild apple genotypes is grown in the Caspian Sea region in the Northern Iran. The objective of this research was to select the high value genotypes that could be promising as new cultivar(s) or a valuable source in future breeding programs. In Iran, the first apple collection was made by A. A. Manii composed of about 50 native genotypes and a few foreign cultivars, just established in 1935-1936. Subsequently the research and description of native apple and pear genotypes and cultivars was continued by E. Fallahi during 1972-1975 and collection of native germplasm continued by M. Mostafavi (personal communication). Later in 1990th, apple collections of the country increased up to 100. The evaluation of native germplasm and their collection was

continued intensively during 2000-2005 in 14 different provinces so that the native genotypes in collection exceeded 500 cultivars and genotypes.

The collected genotypes were vegetatively propagated and planted in two main collections in Karaj and Urumieh for further utilization in breeding programs. In this report, some pomological and morphological characteristics of a main group of selected genotypes and cultivars were evaluated.

Material and Methods

The program of collection and preliminary evaluation of native apple germplasm in the Tehran, Ardebil, Markazi, Ghom and Hamadan regions was started in 2002. Vegetative and productive characters of genotypes were studied during pre bloom period, active plant and fruit growth period and at harvest. The evaluations were made studying several quantitative and qualitative characteristics as described in Tables 1 and 2. Characters such as maturation time, fruit size, fruit weight, fruit shape, skin wax, fruit color, juiciness, flesh firmness, taste, soluble solids concentrations, tree vigor and alternate bearing were evaluated.

Results and Discussion

Damavand, in Tehran Province, is one of the most important areas of apple production in Iran. Other areas like Shahriar, Shemiranat, Taleghan and Mountainous region in the north of Karaj (around Chalus Road) are other important locations in apple production.

Several native local cultivars like Shafi abadi, Shemirani, Aranghe or Sangani and Golab Kohanz are originated from these regions. Several local germplasm materials also existed in the Meshkin shahr (Ardebil province), Mahallat and Arak (Markazi province), Ghom (Ghom province) and Hamedan, Nahavand and Malayer (Hamedan province). The evaluated leaf and fruit characteristics are presented in Tables 1 and 2.

A total of 79 genotypes from the above mentioned area were observed. For the storage life, 7% of the materials had high and 13% had short storage ability and shelf life (Fig. 1). The vegetative vigor classified in three groups and 14, 27 and 59% showed weak, intermediate and strong vigor, respectively (Fig. 1). For canopy type about 54% showed semi upright to upright and 46% spreading to weeping habit (Fig. 1). Fruit firmness varied greatly and was classified in 6 groups ranging from very soft (4%) to very firm (7%) (Fig. 2). The alternate bearing in genotypes was 39, 46 and 15% in low, intermediate and severe categories, respectively (Fig. 2).

Classification of genotypes using UPGMA methods cluster analysis was conducted in 59 genotypes and results are shown in Fig. 3. The germplasm materials based on this analysis were classified into five groups of 23, 10, 3, 4 and 19 genotypes. Among the studied genotypes in this research 'Moro' had high red color and good storage ability, 'Aranghe' had good shelf life, high yield and good taste and 'Arous' had high storage ability up to 1 year and good fruit finish. 'Sabze', a genotype similar to 'Granny Smith', had good storage life. 'Meshki' was a typical cluster bearer, had good storage and was drought resistant. 'Haji-e Ghermez'

was drought resistant, had large red flower, was a good pollinizer and can be used as an ornamental plant. 'Momen-e Zemestane' had good marketing potential and storage life. 'Khomre' had good storage life and fruit shape. 'Beighi' had good market potential and high firmness. 'Arous Jangali' fruits were red and had very good storage life. 'Ghermez' had red flesh. 'Changar' had very low vigour and was well growing in altitudes higher than 2000 s.l.m.

'Shafi abadi' is mid-early, heavy cropping with good fruit attractiveness. 'Golab Kohanz' and 'Ferdos' had early ripening and good fruit attractiveness. 'Shemirani' had good storage and good fruit attractiveness with two clones of 'Red' and 'stripped'. 'Ismael Beighi' was heavy cropping, and its mother genotype is more than 100 years old and resistant to many pests and diseases. 'Nahavandaki' is early ripening and drought resistant and seems to be suitable as rootstock. 'No 3' is heavy cropping, has pendent growth habit and red to violet color flesh. 'Manouchehri' is heavy cropping and relatively resistant to most pests and diseases. 'Shakki' is heavy cropping with very good fruit attractiveness and its white flesh even remained cut for a few days. 'Habibi' has good aroma and good fruit attractiveness. Some genotypes like 'Torshak-e Chalous', 'Torshe Shahriar' and 'Talkhehe Arak' that are propagateable through root suckers showed to be resistant to chlorosis and are used as rootstocks by local fruit growers.

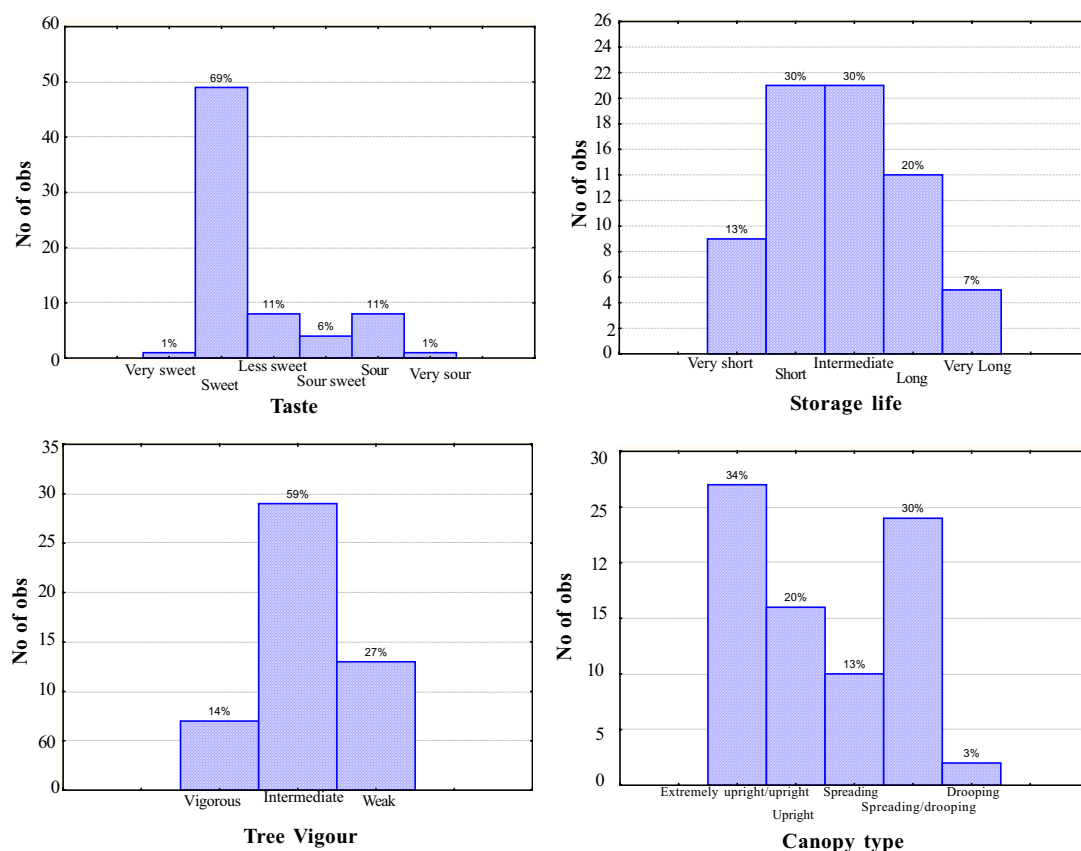


Figure 1. Segregation of genotypes on fruit taste, storage life, tree vigor and canopy type.

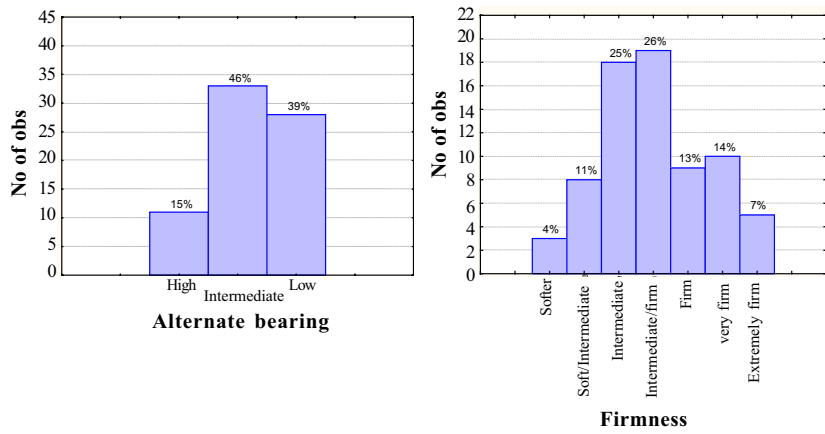


Figure 2. Alternate bearing and fruit firmness distributions in apple genotypes.

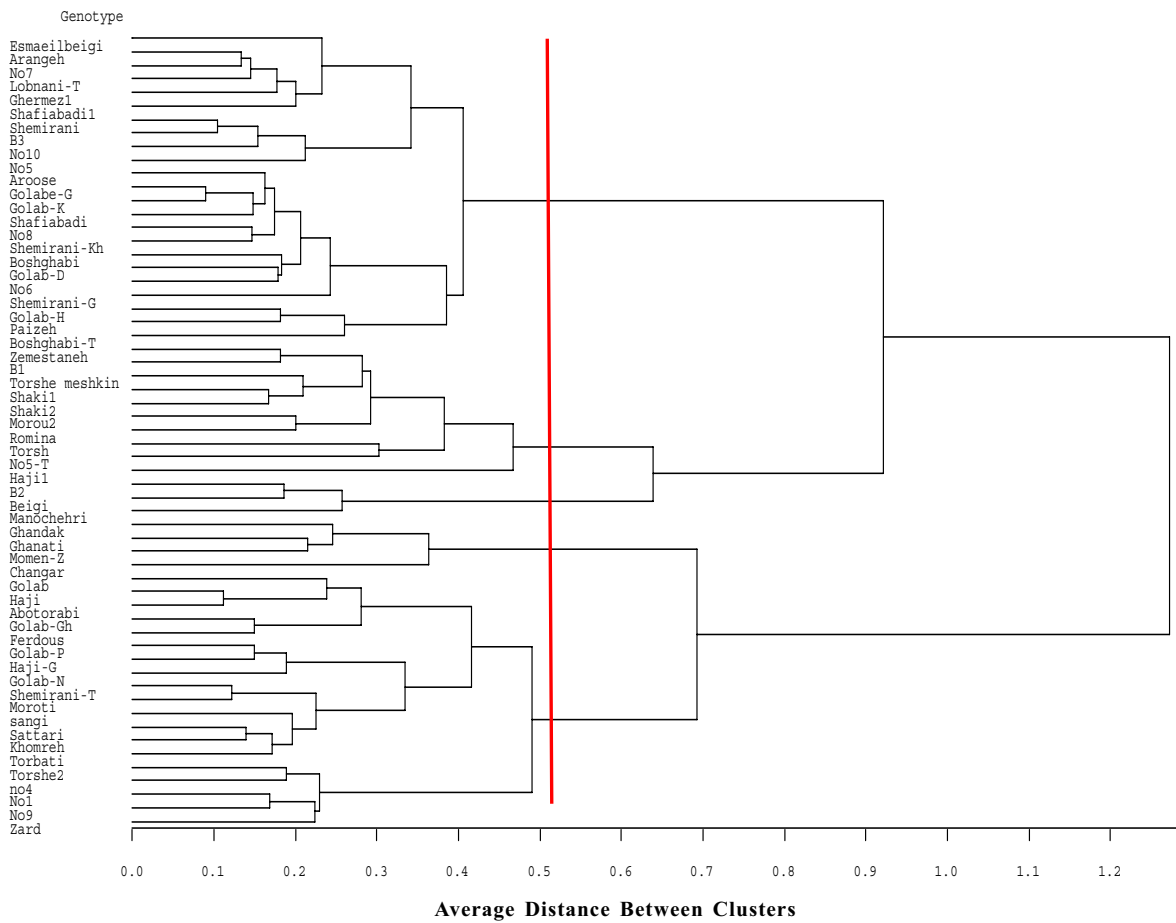


Figure 3. Classification of apple genotypes using cluster analysis UPGMA methods.

Table 1. The evaluated qualitative characters and observed data in apple genotypes.

Character	Evaluation classes				Number of classes	Observed data					
	Min		Max			N	Min	Max	Mean	Range	Std. Error
	Index	Class	Index	Class							
Yield	very low	1	very high	9	5	78	3	9	6.64	6	0.170
Fruit size	extremely small	1	extremely large	9	9	77	1	6	3.95	5	0.115
Fruit shape	globose	1	oblong-waisted	13	13	72	1	12	3.56	11	0.342
Wax	with wax	1	without wax	5	2	72	1	2	1.18	1	0.046
Calyx depth	low	1	deep	5	3	72	1	5	3.14	4	0.144
Russetting	0%	1	100%	9	9	71	1	4	1.35	3	0.078
Fruit attractiveness	extremely poor	1	extremely good	9	5	72	1	9	5.17	8	0.219
Ground colour	red	1	green	11	6	72	1	11	7.58	10	0.245
Over color	orange	1	brown	11	6	60	1	9	1.53	8	0.201
Pattern of over color	striped	1	very dark *	13	7	60	1	13	6.83	12	0.661
Flesh quality	very coarse	1	extremely fine	9	5	72	1	7	4.47	6	0.181
Panel	very poor	1	extremely good	9	9	73	2	8	5.22	6	0.171
Juicy	low	1	high	3	3	72	1	3	2.13	2	0.068
Firmness	extremely soft	1	extremely firm	9	9	72	3	9	6.01	6	0.183
Storage life	very short	1	very long	9	5	70	1	9	4.57	8	0.270
Canopy type	extremely upright	1	weeping	9	7	79	2	7	3.92	5	0.200
Tree vigour	very weak	1	very strong	9	5	49	3	7	4.73	4	0.177
Alternate bearing	low	1	high	5	3	72	1	6	2.53	5	0.170
Leaf hair density	without	1	high	7	4	69	1	7	3.32	6	0.196
Leaf density	low	1	high	5	3	69	1	5	3.38	4	0.161
Stipule	with	1	without	3	2	69	1	2	1.01	1	0.014

Table 2. The evaluated quantitative characters together with mean and maximum of each character in apple genotypes.

Character	N	Minimum	Maximum	Mean	Range	Std. Error
Fruit length (mm)	47	25.0	69.8	52.64	44.8	1.33
Fruit width (mm)	47	26.0	76.0	59.28	50.0	1.48
Fruit weight (gr)	71	9.0	165.0	84.79	156.0	4.66
Tree height (m)	79	1.5	69.0	5.48	67.5	0.83
Vegetative growth (cm)	79	12.0	48.0	26.25	36.0	0.98
Canopy spreading (cm)	79	0.3	3.4	58.19	111.0	2.58
Trunk circumference (cm)	77	9.0	120.0	8.79	7.0	0.19
Leaf length (cm)	70	5.0	12.0	4.66	5.0	0.12
Leaf width (cm)	70	2.0	8.0	2.63	4.0	0.09
Petiole length (cm)	70	1.0	5.0			

Conclusions

Some of the collected genotypes showed to be promising as cultivars like 'Shaki', 'Beighi' and 'Habibi'. These cultivars were propagated and are under further evaluation in Horticulture Department of Seed and Plant Improvement Institute, Karaj, Iran. The promising genotypes will be released as new cultivars in the near future and other genotypes in this group together with other material collected from other stations in the country will be used as breeding source in the breeding programs for the improvement of new apple cultivars.

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