
New Selections Apricot of Breeding Program in Sahand Horticulture Research Station (SHRS)

J. Dejampour

Associate professor of Agricultural and Natural Resources Research Center of East Azerbaijan.

dejampour@yahoo.com

Abstract: Apricot (*Prunus armeniaca* L.) breeding project with aim of new cultivars creating through hybridization was started since 1998-99 at Sahand Horticultural Research Station. In this program, 32 crosses were carried out between local and foreign cultivars and 660 hybrid seeds were obtained. The seeds were planted in pots after stratification and second year the seedling screened in nursery and 450 genotypes were planted on farm. After bearing, vegetative and reproductive characteristics, flowering and fruit traits (more than 50 traits) of genotypes were studied and recorded according UPOV international guideline and IBPGIR descriptor of apricot for 4 years. The results of several years evaluation, 25 promising genotypes were selected based on grading and assigning values with respect to some important and effectiveness of traits. By comparison, AD412, AD732, AD412, AD1042, AD533 and AD841 were high and regular yield and resistance to cold of early spring. "DM 101" was the early ripening with the high fruit quality and suitable for fresh market. Fruit total soluble solids were from 17% in AD741 to 26 % in AD1033 among genotypes. The superior genotypes, as third phase of project, in different climatic areas were planted and they were evaluating since 2008. The characteristics of promise genotypes presented in this article.

Keywords: hybrid, promise genotypes, *prunus armeniaca* L.

1. INTRODUCTION

Iran is the most important apricot producer in the world with an annual average production more than 460000 tons with average yield about 9 tons/h in a normal year, but the apricot production fluctuates by due to climatic changes in Iran.

Iranian cultivars are often self – incompatible, high total soluble solid (TSS), sweet kernel, skin color light yellow and flesh color cream but most of genotypes are sensitive to unfavorable climatic condition in early spring (Layne, *et al.* 1996; Dejampour and Grigorian,2004). Therefore the main problems of our cultivars are low fruit set, bearing and irregular yield.

The ripening time among Iranian cultivars is very extension, for example ; Shastomi-I and Noraseh-M are very early ripening (early of June) and MY-101 is very late ripening(mid of Aug.), but their fruit quality was not very good and commercial.

Propagation of apricot by seed during the past years led to a high genetic diversity in Iran (Layne, *et al.*1996). Therefore most of the local cultivars are need to improvement via hybridization with foreign cultivars, especially fruit bearing and fruit quality aspects (Dejampour and Grigorian. 2004). On the other hand, growers of apricot interested to new cultivars for fresh markets, drying and processing.

Breeding the 'perfect' apricot will result in a satisfied breeder, producer, exporter, and consumer. In order to obtain this, there are universal apricot breeding objectives, based on tree characteristics (rootstocks, tree vigor, growth habit, and productivity), floral biology (flowering date, intensity, and fertility), fruit characteristics (maturity, size, firmness, color, and taste), disease resistance, and climatic adaptation (Gulcan *et al.* 1995; Ham and Smith 2006).

Apricot culture mostly depends on the interaction between the climate, soil conditions, and the scion cultivar. Production, fruit quality, and time of harvest will be affected by these three factors (Ayanoglu and Kaska 1995). The effect of soil conditions can be minimized first by selecting the best suitable rootstock for the soil conditions (salinity, nematodes, etc.) and then by correct orchard management practices. Breeding for climatic adaptation, better fruit quality, and disease resistance is much more complicated.

Some of the problems that need to be solved through breeding programs in the near future (Bassi 1997, 2006):

- the diversity and heterozygosity of the apricot germplasm,
- adaptation to the environment, which is hard to manage through standard crossing and selection due to time constraints and the speed of climate change,
- production (fresh and processed),
- fruit quality (size, firmness, aroma, flavor, skin color, sugar, and shape),
- mapping of the apricot genome,
- resistant or tolerant rootstocks and grafting compatibility with scion cultivars, and satisfying consumer preferences on an ongoing basis.

There are the several study as related to selection of apricot with fruit quality and resistance to late spring (Acka, and Sen. 1999), study on tolerance of apricot to winter temperature fluctuation and spring frost (Bassi, et al. 1995), investigation of effective pollination period and year - to - year variation of bearing of apricot (Egea and Burgos, 1992, Egea and Burgos, 1994) and breeding projects via crossing between different cultivars (Pennone, 1997; Audergon, et al.1997)

In 1998, this research was started via hybridization and collection of native genotypes as first apricot breeding program in Iran. Therefore crossing aimed at using some of the Iranian and European cultivars as parents in order to introduce the new cultivars with regular productivity and high fruit quality. Evaluation of their offspring and the characteristics of promising genotypes presented in this paper.

2. MATERIALS AND METHODS

This breeding program as first hybridization and improving of apricot (*prunus armeniaca* L.) cultivars in Iran has been carried out in Sahand Horticultural Research Station since 1994. This station is situated in North West of Iran in East – Azerbaijan province (46°, 45' E and 38°, 15' N., elevation 1359 m) and maximum temperature is 42°C and minimum temperature is -22°C. The main research projects of this station are on cultivation and improvement of apricot and almond. There are collection gardens of local and foreign elite genotypes in this station. In last year's ((Dejampour *et al.* 2012 , Rahnemuon *et al.* 2012) 4 new apricot cultivars namely; "Maragehi-90", "Nasiri-90", "Ordebad-90" and "Aybatan" released among local superior genotypes in Sahand station, Iran.

The choice of the parents was based on some important traits; high and regular productivity, fruit size, TSS fruit, time of ripening and suitable for fresh market and possessing.

The cultivars utilized as parents in the breeding program were;

- Nasiri-90 : high TSS, large fruit size, high drying ability.
- Ordebad 90 : high drying ability, good flesh firmness
- Germezeh- Sh : large fruit size, high fruit flavor and suitable for fresh market.
- Aibatan : intermediate early ripening, large fruit size and good eating quality
- Maragehi 90 : high productivity, high TSS, good flesh firmness
- Shastomi-I : very early ripening
- My- 101 : late ripening
- Canino : self – compatible, regular productivity

32 crossed were made between local and foreign cultivars via isolation of flowers and trees, crossing which were performed at last twice for each parents and repeated for 3 years. At ripening, fruits from each hybrid combination were separately gathered, the stone dried, stratified at 4°C for 3 months.

After germination the hybrid seedlings were planted in plastic pots and second year the seedlings were transplanted in the selection field and spaced 1 x 4 m.

Seedlings screening and evaluation included several phases:

1. In nursery, the selection carried out based on health and vigor of the seedling (1998- 2001).
2. In the field, first selection conducted on the basis of fruit quality, resistance to disease (Bacterial canker, *Pseudomonas syringea* and shot hole, *stigmia carpophila*), chlorosis and spring cold hardness (2001 – 2007).
3. Second selection was on the basis of tree yield, regular productivity and fruit quality according to selection indices in breeding programs (2007– 2009).
4. Forth selection as third phase of project was carried out on the basis of ecological adaptation in different climatic regions (since 2009).

The evaluation of genotypes were carried out according to IBPGIR descriptor and UPOV international guideline of apricot, based on grading and assigning values with respect to some important and effectiveness of pomological, morphological and reproductively characters. The promising selections grafted on the seedling rootstocks and were planted in evaluation field of three provinces (Tabriz, Karaj and Mashahd) with statistical RB design.

3. RESULTS AND DISCUSSION

In this breeding program, 660 hybrid seeds from all crosses and 200 seeds of open pollination of Maragehi 90 cultivar were obtained (Table-1, 2). The seeds sterification and planted in nursery but 10-30 percent of seeds did not germination in different crosses. In first phase after nursery screening, 450 genotypes trees were planted in selection field. In second phase after first evaluation in field, 122 genotypes were selected based on fruit quality, resistance to disease, chlorosis and spring cold hardness. In third phase after second evaluation in field in order to study of traits stability for 3 years, 25 promising genotypes were selected as the best selections for testing in different ecological condition(Table 1,2).

Table 1. Different stage of the breeding program, crosses combination, selection and evaluation for self compatibility and drying ability

Parents	Nasiri 90 x Canino	Nasiri 90 x Germezeh Sh	Ordobad 90 x MY101	Maragehi 90 x Canino
Flowers	400	550	510	646
Seeds	73	83	90	120
Germinated seeds	60	68	71	90
Seedlings	57	68	69	85
Nursery screen	55	62	64	81
First selection in field	20	18	12	26
Second selection in field	4	4	1	5
Evaluation in different areas (promising selections)	AD533,AD503, AD1033, AD507	HS501, HS731, AD811, HS643	AD546	AD1042, AD403,AD412,, AD732, DA626
Ability of drying	AD503, AD1033 AD507	AD501,AD811	-	AD626,

Table 2. Different stage of the breeding program, crosses combination, selection and evaluation for self compatibility and drying ability

Parents	Germezeh Sh x Canino	Ordobad 90 x Aibatan	Nasiri 90 x Shastomi- I	Gorbaneh 90 (open pollination)
Flowers	620	490	410	880
Seeds	101	120	86	180
Germination seeds	67	56	58	165
Seedlings	60	46	53	160
Nursery screening	57	42	50	145
First selection in field	15	13	10	21
Second selection in field	3	5	1	2
Evaluation in different areas (promising selections)	AD841, AD405, AD743,	HS201, HS203, HS210,AD416,AD650	DM 101	AD1035, AD741
Drying ability	-	HS201, HS203		AD1035

J. Dejampour

Among this population several genotypes were resistance to unfavorable weather condition in early spring and pollination time. By comparison, AD412, AD732, AD412, AD1042, AD533 and AD841 were high and regular yield and resistance to cold of early spring. This may be related to effective pollination period (EPP), self – compatibility rate and cold hardness of flower (Egea and Burgos, 1994; Bassi, *et al.* 1995).

“DM 101” was the early ripening promising selection with the high fruit quality and suitable for fresh market. Ripening time of this genotype was 7 days after Shastoni –I and 38 days before Canino Cultivar.

Fruit total soluble solids were from 17% in AD741 to 26 % in AD1033 among genotypes, so these cultivars are suitable for fresh market and industrial applications. Fruit weights were from 34 in AD403 hybrid to 65 in AD643. Bearing habit among trees ranged from spurs to one year old branches and the blooming time among cultivars ranges from early to late was maximum 6 days and usually changes year to year.

Some of the important pomological and phonological characteristics of superior promising selections from apricot breeding program are described in below;

AD412 (Maragehi 90 × Canino)

Yield: high and regular

Use: drying and fresh market



Tree vigor	Intermediate	Fruit W./Stone W.	16
Tree habit	Upright	Stone	free
Type of bearing	Spurs and one year old shoots	Kernel taste	Sweet
Fruit size	Medium	Time of flowering	Medium
Over color	Red	Total Soluble Solids	19%
Skin color	Yellow	Fruit shape	Elliptic
Flesh color	Light orange	Fruit weight	51(g)
Firmness of flesh	Medium	Time of ripening	Medium

AD841 (Germezeh Sh × Canino)

Yield : high

Use : drying and fresh market



Tree vigor:	Strong	Fruit W./Stone W	20.43
Tree habit	Upright	Stone :	Free
Type of bearing	Spurs and one year old shoots	Kernel taste :	Sweet
Fruit size	Medium	Time of flowering :	Medium
Over color	Red	Total Soluble Solids	18%
Skin color	Yellow	Fruit shape	Round
Flesh color	Light orange	Fruit weight	53(g)
Firmness of flesh	Medium	Time of ripening	Medium

AD741 (Maragehi 90 × Canino)

Yield: high and regular

Use : drying and processing



Tree vigor	Intermediate	F W/S W	15.80
Tree habit	Spreading	Stone	Semi-clinging
Type of bearing	Mostly one year old shoots	Kernel taste	Weak bitterness
Fruit size	Large	Time of flowering	Medium
Over color	Red	Total Soluble Solids	17%
Skin color	Yellow	Fruit shape	Round
Flesh color	Orange	Fruit weight	60 (g)
Firmness of flesh	Firm	Time of ripening	Medium

AD643 (Ordobad 90 × Germezeh Sh)

Yield : high

Use : drying



Tree vigor	Strong	Fruit W./Stone W.	19.86
Tree habit	Spreading	Stone	Free
Type of bearing	Spurs and on one year old shoots	Kernel taste	Sweet
Fruit size	Large	Time of flowering	Medium
Over color	Slight	Total Soluble Solids	20%
Skin color	Yellowish	Fruit shape	Ovate
Flesh color	Cream	Fruit weight	65 (g)
Firmness of flesh	Firm	Time of ripening	Medium

AD 732 (Maragehi 90 × Canino)

Yield : very high and regular

Use : processing



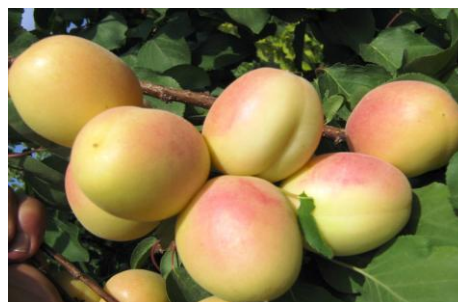
J. Dejampour

Tree vigor	Intermediate	Fruit W./Stone W.	16.83
Tree habit	Spreading	Stone	Free
Type of bearing	Mostly on one year old shoots	Kernel taste	Sweet
Fruit size	Medium	Time of flowering	Medium
Over color	Red	Total Soluble Solids	18%
Skin color	Green- Yellowish	Fruit shape	Round
Flesh color	Light orange	Fruit weight	45 (g)
Firmness of flesh	Medium	Time of ripening	Intermediate late

DM101 (Nasiri × Shashtomi -I)

Yield : medium

Use : fresh market



Tree vigor:	Intermediate	Fruit W./Stone W.	21.57
Tree habit	Upright	Stone	Free
Type of bearing	Mostly on spurs	Kernel taste	Sweet
Fruit size	Medium	Time of flowering	Medium
Over color	Red	Total Soluble Solids	17%
Skin color	Yellowish	Fruit shape	Heart shaped
Flesh color	Light orange	Fruit weight	58 (g)
Firmness of flesh	Medium	Time of ripening	Early

HS731 (Germezeh Sh × Nasiri 90)

Yield : high

Use : fresh market



Tree vigor	Intermediate	Fruit W. /Stone W.	15.18
Tree habit	Up right	Stone	Free
Type of bearing	Mostly on One year old shoots	Kernel taste	Sweet
Fruit size	Large	Time of flowering	Medium
Over color	Red	Total Soluble Solids	19%
Skin color	Yellow	Fruit shape	Ovate
Flesh color	Light orange	Fruit weight	59 (g)
Firmness of flesh	Medium	Time of ripening	Medium

HS203 (Nasiri 90 × Maragehi 90)

Yield : high

Use : drying and fresh market



New selections apricot of breeding program in Sahand Horticulture Research Station (SHRS)

Tree vigor	Intermediate	Fruit W. /Stone W.	15
Tree habit	Spreading	Stone	Free
Type of bearing	Mostly on One year old shoots	Kernel taste	Sweet
Fruit size	Large	Time of flowering	Medium
Over color	Red	Total Soluble Solids	22%
Skin color	Yellowish	Fruit shape	Ovate
Flesh color	Orange	Fruit weight	55 (g)
Firmness of flesh	Firm	Time of ripening	Medium

AD 405 (Germezeh Sh × Canino)

Yield : High

Use : fresh market



Tree vigor	Intermediate	Fruit W. /Stone W.	18.91
Tree habit	Up right	Stone	Free
Type of bearing	Mostly on One year old shoots	Kernel taste	Sweet
Fruit size	Medium	Time of flowering	Medium
Over color	Red	Total Soluble Solids	19%
Skin color	Yellow	Fruit shape	Ovate
Flesh color	Cream	Fruit weight	42(g)
Firmness of flesh	Medium	Time of ripening	Medium

HS201 (Ordobad × Maragehi 90)

Yield : High

Use : Drying and fresh



Tree vigor	Intermediate	Fruit W. /Stone W.	15.18
Tree habit	Up right	Stone	Free
Type of bearing	Mostly on spurs	Kernel taste	Sweet
Fruit size	Medium	Time of flowering	Medium
Over color	Red	Total Soluble Solids	23%
Skin color	Yellowish	Fruit shape	Heart shaped
Flesh color	Light orange	Fruit weight	49(g)
Firmness of flesh	Medium	Time of ripening	Medium

AD503 (Nasiri 90 × Canino)

Yield : high

Use : drying and fresh market



Tree vigor	Strong	Fruit W. /Stone W.	21.64
Tree habit	Spreading	Stone	Free
Type of bearing	Mostly on one year old shoots	Kernel taste	Sweet
Fruit size	Large	Time of flowering	Medium
Over color	None	Total Soluble Solids	19%
Skin color	Green-yellowish	Fruit shape	Ovate
Flesh color	Orange	Fruit weight	60(g)
Firmness of flesh	Firm	Time of ripening	Medium

AD1033 (Nasiri 90 × Canino)

Yield : high

Use : drying and fresh market



Tree vigor	Intermediate	Fruit W. /Stone W.	15.68
Tree habit	Spreading	Stone	Free
Type of bearing	Mixed	Kernel taste	Sweet
Fruit size	Large	Time of flowering	Medium
Over color	Red	Total Soluble Solids	26%
Skin color	Yellow	Fruit shape	Ovate
Flesh color	Light orange	Fruit weight	54(g)
Firmness of flesh	Medium	Time of ripening	Medium

AD1042 (Maragehi 90 × Canino)

Yield : High and regular

Use : drying and fresh market



Tree vigor	Intermediate	Fruit W. /Stone W.	15.33
Tree habit	Up right	Stone	Free
Type of bearing	Mixed	Kernel taste	Sweet
Fruit size	Medium	Time of flowering	Medium
Over color	Red	Total Soluble Solids	19%
Skin color	Light orange	Fruit shape	Round
Flesh color	orange	Fruit weight	45(g)
Firmness of flesh	Medium	Time of ripening	Medium

AD811 (Germezeh Sh × Maragehi 90)

Yield : High

Use : drying and fresh market



New selections apricot of breeding program in Sahand Horticulture Research Station (SHRS)

Tree vigor	Strong	Fruit W. /Stone W.	20.22
Tree habit	Up right	Stone	Free
Type of bearing	Mostly on One year old shoots	Kernel taste	Sweet
Fruit size	Large	Time of flowering	Medium
Over color	Red	Total Soluble Solids	20%
Skin color	Yellow	Fruit shape	Oblong
Flesh color	Orange	Fruit weight	55 (g)
Firmness of flesh	Medium	Time of ripening	Medium

AD 403 (Maragehi90 × Canino)
Yield : medium
Use : drying and fresh market



Tree vigor	Intermediate	Fruit W. /Stone W.	15.5
Tree habit	Spreading	Stone	Free
Type of bearing	Mostly on one year shoots	Kernel taste	Sweet
Fruit size	Medium	Time of flowering	Medium
Over color	Red	Total Soluble Solids	18%
Skin color	Yellow	Fruit shape	Elliptic
Flesh color	Light orange	Fruit weight	34 (g)
Firmness of flesh	Medium	Time of ripening	Medium

HS210 (Ordobad 90 × Germezeh Sh.)
Yield : medium
Use : drying and fresh market



Tree vigor	Intermediate	Fruit W. /Stone W.	23.73
Tree habit	Up right	Stone	Free
Type of bearing	Mostly on spurs	Kernel taste	Sweet
Fruit size	Very Large	Time of flowering	Medium
Over color	Red	Total Soluble Solids	27%
Skin color	Green-yellowish	Fruit shape	Heart shaped
Flesh color	Light orange	Fruit weight	73(g)
Firmness of flesh	Medium	Time of ripening	Medium

In this research, heritability of some traits were clear, for example; the round shape of fruit was dominant over elongated, light cream flesh of fruit was dominant over the yellow and orange color and sweet kernel (seed) was dominant over bitter kernel in progeny(Singh, *et al.*, 2001; Vachun, 2003). The weight fruit with sugar content and round shape of fruit were negative correlation. However apricot has a great deal of genetic variability (Bailey and Hough 1975), but information on apricot traits' heritability is very scarce. There is still uncertainty about some characteristics, such as

fruit size, color (skin and background), flavor, red blush, seed (sweet and bitter), and time of ripening that can be influenced by climatic conditions or polygenic control. Therefore, the average performance of the progeny could be predicted on the basis of the phenotype of the parents in most traits (Layne *et al.* 1996; Bassi 2006).

In order to introduce or release of the “elite” genotypes, they grafted on seedling rootstocks and were planted in three provinces (Tabriz, Karaj and Mashhad) of Iran with different climatic condition for field evaluation and climatic adaptation.

REFERENCES

- [1] Akca, Y., S. Sen, M. 1993. Selecting apricots with good quality and resistance to late spring frosts in Gurun. progress in temprature fruit breeding: 117 – 178.
- [2] Bassi, D. (2006) Apricot breeding: update and perspectives. *Acta Horticulturae* 701,279–294.
- [3] Bellini, E., G. Giannelli, , E. Picardi, and E. Giordani 1989. New selection of very early ripening apricot obtained in florence. *Acta. Hort. I. S. H. S.* (293): 183 – 190.
- [4] Cociu, V. 1991. Forty years of apricot breeding in Romania. *Acta Horticulturae.* 293: 197 – 201.
- [5] Della Strada, G., C. Fideghelli, , F. Monastra, , F. Pennone, , and R. Quarta 1991. Apricot breeding at the Istituto sperimentale per la Frutticoltura of Rome. *Acta Horticulturae.* 293 (1): 121 – 132.
- [6] Dejampour,J. , H. Rahnemoun and D. Hassani 2005. Breeding almond interspecific hybrid rootstocks in Iran, IV International Symposium on Pistachios and almond (ISHS).
- [7] Dejampour, J., and V. Grigorian. 2004. Effect of pollen type on some quantities and qualitative characteristics of apricot fruit .Iranian journal of horticultural science and technology. Vol. 5,No. 1.
- [8]Dejampour, D., E. Majidi, , S. Khosravi, , S. Farhadi, , and A. Shadmehr, 2011. In vitro propagation of HS314 rootstock (*Prunus amygdulus* × *P. persica*). *HortScience* 46(6):928-931.
- [9]Dejampour, J., H. Rahnemuon, E. Gangi Mogadam, N. Bozari and M. Zaribal. 2012. Maragheh 90, A New High Yielding Apricot Cultivar Suitable for Table and Processing Purposes. Iranian journal of Seed and plant Improvement. Vo28. 2,No. 4.
- [10] Fathi, H. J. Dejampour, U. Jahani, and M. Zarrinbal.2012. Tree and fruit characterization of peach genotypes grown under Ardabil and East Azarbaijan environmental conditions in Iran
- [11] Gulcan, Y., H. Dumanoglu, and B. Kunter, (1995) Fruit cracking in some Turkish apricot cultivars. *Acta Horticulturae* 384, 277–282.
- [12] Guleryuz, M. 1993. Selection of the quality – fruited wild apricot (*Prunus armeniaca* L.) forms resistant to late spring frosts on Erzincan Plain. *Act Hort.* No: 384. 1995. p: 189 – 194.
- [13] Ham, H. and Smith, C. (2006) Apricot breeding in South Africa – changing of climates. *Acta Horticulturae* 701, 389–393.
- [14] Layne, R.E.C., C.H. Bailey. L.F. Hough.1996. Apricots. In: Janick, J., Moore, J.N. (Eds.) *Fruit Breeding: Tree and Tropical Fruits*, vol. II. John Wiley and Sons, New York. pp. 79–111.
- [15] Okie, W.R., and J.F. Hancock,. 2008. Plums, pp. 337-358 *Temperate Fruit Crop Breeding*. Springer, New York.
- [16] Rahnemuon H, J. Dejampour, E. Gangi Mogadam, N. Bozari and M. Zaribal. 2012. Ordubad 90, A New High Yielding Apricot Cultivar Suitable for Processing
- [17] Purposes.Iranian journal of of Seed and plant Improvement. Vo28. 2,No. 4.
- [18] Singh, M. P., D. C. Dimri and M. C. Nautiral 2001. Determination of fruit maturity indices in Apricot (*Prunus armeniaca* L.) cv.New Castle. *Journal of Applied Horticulture Lucknow.*3:2. 108-110.
- [19] Vachun, Z. 2003. Phenophases of blossoming and picking maturity and their relationships in twenty apricot genotypes for a period of six years. *Zahradnictvi Horticultural Science.* 30:2. 43-50.