

Phenological and pomological characteristics of some plum (*Prunus* spp.) cultivars grown in Mashhad, Iran

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ABSTRACT

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Iran, with a yearly production of 147,000 tons of plums, is one of the most important plum producers in the world. This study was conducted to compare the phenological and pomological characteristics of 18 plum cultivars. An experiment was conducted using a randomized complete block design with three replications at the Khorasan Razavi Agricultural and Natural Resource and Agricultural Research Center during the 2003-2008 growing seasons. Phenological and pomological traits were scored and recorded following IPGRI and UPOV instructions and methods. Flowering extended from 21 March (Ghermez Damavand and Queen Rosa) to 6 April (Regina d' Italia) and fruit ripening from 10 August (Black Amber) to 20 September (Angelono). Fruit weight ranged from 16.9 g (Tee Blue) to 105.8 g (Queen Rosa). Results revealed that harvest date differed among plum cultivars. Plum cultivars were divided into three groups based on days after full bloom: early (<110 days), medium (110 to 150 days), and late (> 150 days) ripening. President, Simka, Zuccella, No.17, No.16, Angelono, Stanley and Queen Rosa were better adapted to Mashhad conditions and are thus recommended for plum growing areas in northeastern Iran.

Key words: adaptation, plum, full bloom, ripening, harvesting date

INTRODUCTION

Plum (*Prunus* spp.) is one of the most commercially important fruit species in Iran. Plums are temperate zone fruits, but they are widely grown throughout the world, from the cold climate of Siberia to the sub-tropical conditions of the Mediterranean region (Son, 2010). Iran, with a yearly production of 147 000 tons, is one of the major plum producers in the world (FAOSTAT, 2007). *Prunus* species such as *P. cerasifera*, *P. domestica*, *P. institia* and *P. salicina* are widely grown throughout the world. The European plum (*P. domestica*) and the Japanese plum (*P. salicina*) are more important in terms of commercial production (Ozbek, 1978).

In the past 15 years, increasing demands for fresh plums for direct consumption have contributed to the establishment and development of new, more intensive orchard systems that are harvested earlier and supply better quality fruits to markets (Blažek and Pistekova, 2009). Therefore, plum breeding programs throughout the world are focusing on improving fruit quality, prolonging the harvest season and developing resistance/ tolerance to plum

pox virus (Hartmann and Petruschke, 2002; Blazek, 2007). Maliga (1980) reported that estimation by observation is the simplest method for determining the blooming windows. In Turkey, an experiment was conducted to determine the phenological and pomological characteristics of 14 Japanese plum (*Prunus salicina*) cultivars (Son, 2010). Fruit ripening was earlier in Black Beauty and Obilnaja cultivars than in the other cultivars. Black Diamond, Queen Rosa, October Sun and Autumn Giant produced bigger and heavier fruit (Son, 2010). Gunes (2003) studied the pomological and phenological characteristics of nine local plum varieties in Tokat, Turkey. Of the nine varieties, Hatun Gobegi was recommended as suitable for fresh consumption and canning, while Hurma Erigi and Yesil Erik were recommended for drying. Askin and Koyuncu (1992) collected different local varieties in the province of Van in Turkey, and determined some of their characteristics. Ertekin *et al.* (2006) found that the phenological and pomological characteristics of plum cultivar Firenze 90 were superior to those of Stanley in Antalya, Turkey.

The objective of this research was to evaluate the phenological and pomological traits of several plum cultivars commercially grown in Mashhad, Iran.

MATERIALS AND METHODS

The experiment was conducted at Golmakan Experiment Station, Khorasan Razavi Agricultural and Natural Resource Research Center, Mashhad, in northeastern Iran, during the 2003-2008 growing seasons. Eighteen plum cultivars (Blu Fre, Angelono, Friar, Early Golden, Black Amber, No.16, Laroda, Simka, Stanley, Queen Rosa, Regina d' Italia, President, No.17, Zuccella, Sugar, Tee Blue and two local cultivars, Ghatreh Tala and Ghermez Damavand) were evaluated using a randomized complete block design. These cultivars were propagated on Myrobalane seedling rootstocks and planted (3 × 4 m) under uniform environmental conditions using similar field management practices. Flowering time and yield were first recorded in the fifth year after planting.

Phenology

Phenological characteristics (onset of flowering, end of flowering, flowering period and harvesting date) were determined as follows (Maliga, 1980).

Onset of flowering was recorded when at least 5% of flower buds had bloomed, and the end of flowering was determined when 90% of flower buds had bloomed and corollas had begun to fall off; harvesting date was determined as the day the fruits were sufficiently colored and soft for eating (Tzoner and Yamaguchi, 1999; Funt, 1998).

Pomology

Pomological studies were performed on physical traits (fruit weight, stone weight and fruit size) using digital calipers and chemical tests (total soluble solids, titratable acidity). Total soluble solids (TSS) in the fruit juice were determined by Refractometer OSK-7887, and titratable acidity (TA) was calculated by titrating fruit juice with 0.1 N NaOH and converted by malic acid content. IPGRI and UPOV instructions were used to describe the cultivars' phenological and pomological characteristics.

RESULTS AND DISCUSSION

Flower morphology and phenology

All cultivars had the same number of stamens (20-35), pistils, sepals (five) and petals (five) in each flower. Based on the position of stigma relative to that of the anthers, cultivars were classified into three groups: the same level as anthers (Blu Fre, Angelono, Friar, No.16, Zuccella, Sugar, Tee Blue); above the anthers (Early Golden, Ghatreh Tala, Simka, Regina d' Italia, President); below the anthers (Black Amber, Laroda, Stanley, Queen Rosa, No.17, Germez Damavand) (Table 1). Flower density also differed among cultivars, which were divided into three groups, low (Blu Fre, Ghermez Damavand, Tee Blue, Sugar); medium (Early Golden, Laroda, Simka, Stanley, Queen Rosa, Regina d' Italia, Zuccella) and high (Angelono, Friar, No.17, Black Amber, No.16, Queen Rosa, President, Zuccella, Ghatreh Tala, Laroda) density.

Table 1. Studied phenological and morphological characteristics of the 18 plum cultivars

Cultivars	Petal No.	Sepal No.	Stamen No.	Position of stigma to anthers	Flower * density	Onset of flowering	End of flowering	Flowering period (days)
Ghatreh Tala	5	5	35	Above	High	25 March	29 March	4
Angelono	5	5	25	Same level	High	25 March	30 March	5
Friar	5	5	25	Same level	High	26 March	30 March	4
Early Golden	5	5	30	Above	Medium	23 March	28 March	5
Black Amber	5	5	25	Below	High	24 March	28 March	4
No. 16	5	5	30	Same level	High	25 March	29 March	4
Laroda	5	5	25	Below	Medium	25 March	29 March	4
Simka	5	5	30	Above	Medium	24 March	29 March	5
Stanley	5	5	30	Below	Medium	30 March	02 April	3
Queen Rosa	5	5	30	Below	Medium	21 March	26 March	5
Regina d' Italia	5	5	25	Above	Medium	02 April	06 April	4
President	5	5	20	Above	High	28 March	01 April	4
No. 17	5	5	20	Below	High	24 March	29 March	5
Zuccella	5	5	25	Same level	Medium	01 April	05 April	4
Tee Blue	5	5	27	Same level	Low	29 March	03 April	4
Sugar	5	5	25	Same level	Low	29 March	02 April	4
Blu Fre	5	5	25	Same level	Low	30 March	02 April	3
Ghermez-Damavand	5	5	25	Below	Low	21 March	26 April	5

*Flower density: High (75%), medium (50%) and low (25%).

Phenological characteristics of the studied plum cultivars are given in Table 1. Results showed that

flowering began on 21 March (Ghermez Damavand, Queen Rosa) and ended on 6 April (Regina d' Italia).

There was a 12-day difference between early and late flowering cultivars. Flowering period ranged from 3 to 6 days and was different among cultivars. These results are in agreement with those of Caliskan *et al.* (2006), who reported similar results for 15 plum cultivars at Erdemli, Turkey. The results are also supported by James (1989), who indicated that Queen Rosa and Early Golden were early blooming cultivars.

As for harvest time, there were differences among cultivars (Table 2). Fruit ripening extended from early July to September under Mashhad climatic conditions. Early Golden and Ghatreh Tala were the earliest ripening cultivars (1-11 July), and Angelono, Zuccella, President, Stanley, Regina d' Italia and Friar were the latest (11-21 September) (Table 2). These findings can be attributed to the characteristics of different plum cultivars (Son, 2010). Ripening occurred between 102 and 178 days after full bloom. The 18 cultivars could be divided into three groups, based on the number of days after full bloom:

Table 2. Comparing harvest time of the 18 plum cultivars

Cultivar	DAFB*	Harvest time (date)
Ghatreh Tala	107	First decade of July
Angelono	178	Second decade of September
Friar	125	Second decade of September
Early Golden	107	First decade of July
Black Amber	102	First decade of August
No. 16	168	Second decade of August
Laroda	168	First decade of September
Simka	126	First decade of August
Stanley	172	Second decade of September
Queen Rosa	144	Second decade of August
Regina d' Italia	172	Second decade of September
President	164	Second decade of September
No. 17	134	First decade of September
Zuccella	173	Second decade of September
Tee Blue	143	Second decade of August
Sugar	140	Second decade of August
Blu Fre	138	Third decade of September
Ghermez Damavand	140	Third decade of September

*Days after full bloom.

Early (< 110 days): Ghatreh Tala, Early Golden, Black Amber.

Medium (110 to 150 days): Friar, Simka, Queen Rosa, No. 17, Tee Blue, Sugar, Blu Fre, Ghermez Damavand.

Late (> 150 days): Angelono, No. 16, Laroda, Stanley, Regina d' Italia, President, Zuccella.

Increasing the duration of harvest time is important to be able to send an adequate supply of fresh fruit to market, due to its high demand and

high price. To reduce risks and prevent spring frost damages, expand harvest time and increase the supply of fresh fruit to market, early, medium and late plum cultivars can be grown considering climatic conditions in target areas (Kemp *et al.*, 1986).

Yield and pomology

Results showed that average fruit yield differed among plum cultivars. President and No. 16 produced higher fruit yields (30-35 kg tree⁻¹), while Blu Fre, Ghermez Damavand, Tee Blue, Black Amber and Sugar produced lower ones (5-10 kg tree⁻¹) (Fig. 1).

Pomological characteristics of fruit and stones are given in Table 3. Fruit weight ranged from 105.8 g (Queen Rosa) to 16.9 g (Tee Blue). Son (2010) reported that fruit weight of President was 63.79 g, but in the present study the fruit weight of this cultivar was 74 g. Different soil and climatic conditions and management practices are among the likely reasons for the observed differences.

Stone weight showed also considerable variation among cultivars, from 0.7 to 3.1 g. Adherence of stone to flesh ranged from strong (Ghatreh Tala), medium (Ghermez Damavand), and weak (No.16), to free (Angelono) (Table 3).

Fruit biochemical characteristics are presented in Table 3. Total soluble solids (TSS) ranged between 12.1% (Angelono) to 23.55% (Blu Fre). The sugar : acid ratio differed among cultivars, from 5.97 (Black Amber) to 19.14 (Blu Fre).

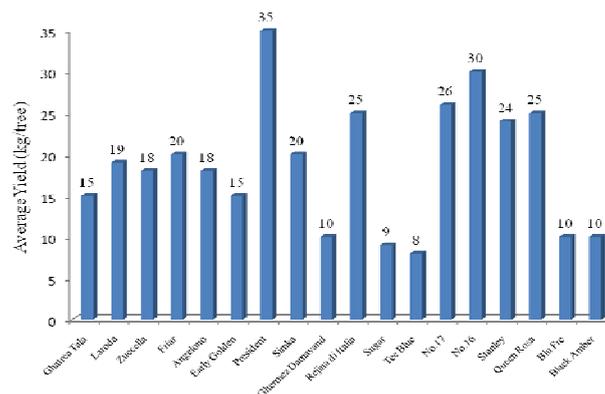


Fig. 1. Average fruit yield of the 18 plum cultivars

Wide variation in physico-chemical characteristics of plums cultivars has been reported (Bilgu and Seferoglu, 2005).

President, Simka, Zuccella, No.17, No.16, Angelano, Stanley and Queen Rosa were better adapted to Mashhad conditions and are therefore recommended for plum growing areas in northeastern Iran.

Table 3. Pomological characteristics of the 18 plum cultivars

Cultivars	TSS*%	TSS/TA	Fruit weight (g)	Stone weight	Adherence of stone to flesh
Ghatreh Tala	14.84	10.09	29.8	0.9	Strong
Angelono	12.01	18.76	67.7	1.5	Free
Friar	12.33	16.22	74.4	1.4	Free
Early Golden	13	7.26	23.1	1.1	Free
Black Amber	12.54	5.97	53.6	1	Free
No. 16	17.44	10.9	51.2	1.23	Weak
Laroda	17.54	10.19	61.36	1.2	Free
Simka	15.74	18.30	68.68	1.34	Free
Stanley	15.94	15.56	48.9	2.3	Free
Queen Rosa	12.44	7.49	105.8	1.4	Free
Regina d' Italia	15.24	11.90	71.3	1.8	Free
President	18.85	9.92	74	3.1	Free
No. 17	14.24	6.78	52.33	1.1	Free
Zuccella	14.87	11.99	60.8	1.1	Free
Tee Blue	21.25	13.28	16.9	0.7	Weak
Sugar	15.47	4.48	25.01	2.24	Free
Blu Fre	23.55	19.14	21.5	0.9	Free
Ghermez	20.35	15.18	69.88	1.8	Medium
Damavand					

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REFERENCES

- Askin, M. A., and M. A. Koyuncu. 1992. Biological studies on some local plum cultivars, grown in Van ecological conditions. Pp. 17-21. *In* Proceedings of 1st Turkish National Horticultural Congress.
- Blazek, J. 2007. A survey of the genetic resources used in plum breeding. *Acta Hort.* 734: 31-45.
- Blazek, J., and I. Pistekova. 2009. Preliminary evaluation results of new plum cultivars in a dense planting. *Hort. Sci. (Prague)* 36: 45-54.
- Caliskan, T., M. Eken, and M. Bircan. 2006. Studies on the adaptation of new Japanese plum cultivars to the different regions of Turkey. Horticulture Research Institute of Alata. Mersin, Turkey. 18 pp.
- Ertekin, C., S. Gozlekci, O. Kabas, S. Sonmez, and I. Akinci. 2006. Some physical, pomological and nutritional properties of two plum cultivars. *J. Food Eng.* 75(4): 508-514.
- FAOSTAT. 2007. Food and Agriculture Organization of the United Nations. FAO Statistics Division. <http://www.faostat.fao.org>.
- Funt, R. C. 1998. Plums: A Guide to Selection and Use. Ohio State University Extension Fact Sheet.
- Gunes, M. 2003. Some local varieties grown in Tokat province. *Pak. J. of Appl. Sci.* 3(5): 291-295.
- Hartmann, W., and M. Petruschke. 2002. Sharka resistant plum and prunes by utilisation of hypersensitivity. *Acta Hort.* 538: 391-395.
- James, H. L. 1989. Peaches, Plums, and Nectarines: Growing and Handling for Fresh Market. ANR press. 268 pp.
- Kemp, W. P., B. Dennis, and R. C. Beckwith. 1986. Stochastic phenology model for the western spruce budworm (Lepidoptera: Tortricidae). *Environ. Entomol.* 15: 547-554.
- Maliga, P. 1980. Fertility of sour cherry hybrids. *Mezogazdasagi Kiado Budapest* 223-228.
- Ozbek, S. 1978. Fruit growing. University of Cukurova, Agriculture Faculty Press, No. 128. Adana, Turkey. 486 pp.
- Son, L. 2010. Determination of quality characteristics of some important Japanese plum (*Prunus salicina* Lindl.) cultivars grown in Mersin-Turkey. *Afric. J. of Agric. Res.* 5(10): 1144-1146.
- Tzoner, R., and M. Yamaguchi. 1999. Investigation on some far-east prunus species, phenology. *Acta Hort.* 488: 239-242.