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Identification and evaluation of Plum and Prune landrace genotypes to select suitable cultivars in Isfahan Province

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ABSTRACT

Plums are economically important products in Iran, however there have not been consistent efforts to identify, collect and evaluate native genotypes of these fruit crops yet. The present research was performed in Isfahan province from 2013 to 2014 in order to overcoming the lack of classification of local plum landraces. Tree growing areas was mapped at different fruit growth stages, and geographical location as well as important traits of the fruit trees based on the UPOV descriptor, were recorded. Briefly early and late flowering plum landraces with superior qualitative and quantitative characteristics such as intensive growth, dwarfism, and shape of trees, as well as different fruit traits in terms of size, color were identified and collected. This study is by our knowledge, the first providing an intensive categorization of the plum genotypes in the Isfahan province and it could be useful for plum resource certification in Iran.

Key words: Biodiversity, Native Genotypes, Landraces, Plum, Prunus spp.

INTRODUCTION

Plant genetic resources or genetic reserves are one of the most valuable national wealth and fundamental resources in every country due to its great importance. The countries with such resources spend very much on preservation and sustenance of this national wealth in its natural habitat and or on plant gene banks every year. Due to the increasing growth of cities, uncontrolled increase in the world population and excessive exploitation of natural resources, severe destruction of the resources, not only the governmental institutes but the majority of people is responsible for preserving and sustaining and preventing such genetic resources seen in wild plants and or local diversities from extinction in every country. Iran is one of the world areas of plant species diversity and has an important undiscovered plant patrimony. On the other hand, due to its geographical location, Iran is at confluence of other areas of plant biodiversity, such as India and China in the East, Central Asia, the area surrounding the Black Sea in the North and North West and Central Africa in the Southwest. The Iranian botanists believe that there are about 10-12 thousand plant species in Iran whose diversity is more than the whole diversity in Europe. It is noteworthy that 8000 plant species have been identified in Iran so far (Ayanoglua *et al*., 2007; Liu *et al*., 2006 and Sedaghathoor *et al*., 2009). In the countries such as Iran, due to limited water and soil resources the possibility of extending the under cultivation area is very low. For the optimal exploitation of the limited resources and achievement of sustainable agriculture and food security, there should be adequate investment and a comprehensive plan in this regard to increase production per area. Certainly, today's most important and most economic way to increase production per area is the use of modified plants with quantitative and qualitative characteristics adapted to limited conditions of farming and gardening such as water shortage, heat, coldness, salinity and poor soil and resistant to diseases and pests. Obtaining such figures with special characteristics can only be possible through breeding plans and using resistant plant genetic resources with high yield potentials. Currently, different breeding plans have been performed or are underway in the world to transfer some of the

desirable genes from different wild plant species to the agricultural and horticultural plants. Certainly, the success of the breeding plans requires basic genetic resources and the availability of sufficient and diverse germplasm collected based on scientific principles, evaluated and maintained. Therefore, the implementation of research programs in the field of identification, collection and preservation of plant reserves in every country is very important because in addition to providing a strong and diverse germplasm for performing breeding plans, by collecting and maintaining the genetic resources, they are prevented from extinction. Accordingly, international institutions and many gene banks for plant genetic reserves have been established in different countries to hold tasks of collecting and preserving plant sources.

American plum breeding programs have started since 1930, and the figures such as Laroda were introduced in 1950 and quickly spread (Riger, 2006). In a reform plan in Missouri Fruit Research Station in the William H. Darr College of Agriculture (USA) during 1946-1947, the remarkable cultivars such as ark premier and Blue free were introduced (Riger, 2006). The cultivars such as Golf Ruby, Golf Beauty, Golf Plaz, and Golf Rose, and Japanese plum requires low investment and they are perfect for subtropical areas with mild winters. The cultivars are the results of breeding plans for plum varieties in University of Florida (Sherman and Rouse, 2001). According to the report by the working group acted on Prunus in Europe, 3513 Plum and Prunus X-gene were collected by the research institutions in these countries and the breeding plans are being carried out on the basis of selection and hybridization (Maggioni and Lipman, 2006). The morphological and molecular evaluation is in progress to study genetic variance and distance between species and Plum and Prunus X-genes in many countries.

Liu *et al*. (2006) evaluated genetic diversity and phylogenetic relationship of germplasm of plums and their families with RAPD molecular marker and showed that *P. Cerasifera* and *P. spinosa* are discriminated from European plums and they proved the theory on origin of *P. domestica,* the European plum, from these two species (Liu *et al*., 2006). Ayanoglua *et al*. (2007) evaluated genetic diversity of green plum x-genes (*P. cerasifera*) with AFLP molecular marker in Turkey and reported the similarity domain between 82% and 98%. Paprstein and Karesova (1998) evaluated 207 plum and prunus cultivars for sensitivity to viral diseases of plum pox (Sharka) and the viral disease did not affect on the trees in some cultivars such as RinCloadDifneh, RinCloadJandike, Bilatrenka and K-4.

In our country, there have not been any comprehensive plans for collection and evaluation of genotypes and species of plums and prunus. Only a few isolated studies have been done on domestic genotypes. Some researchers in Iran evaluated 75 domestic genotypes and cultivars such as Barghani, red plum, Shablon, Golden drip, *Prunus cerasifera*, Sugar, green plum based on morphological traits and they reported that the maximum fruit diameter was related to prunus variety and the minimum diameter was related to light prunus (Sedaghathoor *et al.* 2009). Ganji moghaddam and his colleagues evaluated 22 cultivars of plum, foreign prunus with three control cultivars named Sorkh Arak, red prunus, golden drip in two Karaj and Mashhad regions based on adaptability. Their results indicated that the cultivars were classified into three groups based on phenology: blossom: time of blossoming, complete blossom, and end of blossom. The cultivars with early blossom such as Tee Blue, Laroda and Zuceella, average blossom cultivars: red prunus, Sorkh Arak, and late blossom such as Sugar, Black Star, Mirobolane, Stantey, Golden Drip, President and Angelona. Other classifications were based on blossom density and other qualitative and quantitative traits (Ganji Moghaddam *et al*., 2010).

MATERIALS AND METHODOLOGY

In this research, identification, primary evaluation of genotypes and domestic species of plum and prunus in Esfahan province was done based on evaluation and discrimination descriptors of International Union for the Protection of New Varieties of Plants (UPOV). In the way that the right places were identified and visited during the different phases of development for example: before outgrowth of shoots and buds, during complete blossom, and during ripening, and the desired traits were recorded based on descriptors and each identified tree was marked and coded.

RESULTS AND DISCUSSION

Table 1: The morphological and biochemical characteristics of native (local, primitive) plum and prune cultivars

Serial No.	Measured Properties	Ghohrood	Dobahreh	Khansar	Plum No.1 of Mobarakeh
1	% Of genotype frequencies than other genotypes	70%	25%	100%	20%
2	Propagation method	Sucker & graft	Sucker & graft	Sucker	Graft
3	Fruit type of rootstock	Self	Tomato Plum	Self	Tomato Plum
4	Compatibility between rootstock and scion	Good	Good	Good	Good
5	Produce suckers	Less	Less	More	Less
6	Tree height (in meters)	3.5	3	3	2.5
7	Branching growth habit	Semi long	Long	Wide	Semi long
8	Branch color	Brown	Brown	Brown	Brown
9	Length of branch (Current season branch) (cm)	67	59	46	46
10	Lengths of 2-year-old shoot (cm)	22	26	14	17
11	Diameter of one year old shoot	5.7	5.5	3.2	3.2
12	Length of internode shoot (cm)	4.9	4.7	2.2	2.2
13	Size of vegetative bud (mm)	1.6	1.8	1.3	1.4
14	Number of fruit per cluster (density)	2	3	2-3	3
15	Leaf length (cm)	8.5	11	7.7	7.6
16	Leaf width (cm)	4.4	6.5	3.3	3.6
17	Length of leaf-to-width of leaf ratio	1.93	1.69	2.33	2.1
18	Length of petiole (cm)	13	16	14	15
19	Fruit length (mm)	39	31	46	56
20	Fruit width (mm)	45	33	44	40
21	Fruit diameter (mm)	49	34	42	41
22	Fruit tail length (mm)	13	16	13	14
23	Length to width ratio of fruit	0.86	0.93	1.04	1.4
24	Fruit cavity depth (mm)	3.3	1.6	1.2	1.2
25	Fruit cavity width (mm)	4.2	2.1	5.2	4.3
26	Stone length (mm)	16	17	20	26
27	Stone width (mm)	13	13	15	15
28	Stone diameter (mm)	4	4	3	4
29	Flesh fruit diameter (mm)	1.4	1.3	12	13
30	Fruit weight (g)	50	23	27.12	25.3
31	Stone weight (g)	1.4	0.9	1.1	1.3
32	TSS	22	19	21	18
33	Stone adhesion	Complete	Complete	Completely separate	Complete
34	Time of fruit ripening	July 28	July 28	Sept. 21	Oct. 12
35	pH fruit juice	3.7	3.6	3.54	3.61

Plate 1: Plum No.1 of Mobarakeh, Isfahan,Iran

Plate 2: Dobahreh Ghohrood, Kashan, Iran

Plate 3: Plum No.1 of Mobarakeh, Isfahan, Iran

Significant traits such as late shoot and blossom, short distant between knots, type of intensive growth, short trees, wide canopy, time of fruit ripening, early ripening of prunus and late ripening of plum, fruits in violet or any other different colors and fruits with free stone, were of the outstanding traits which were considered.

The morphological and biochemical characteristics of native (local, primitive) plum and prune cultivars are given in Table 1. Most total soluble solids related to Ghohrood-e- Kashan. While Plum No.1 of Mobarakeh-e- Isfahan had the lowest total soluble solids. Varieties and genotypes with high total soluble solids suitable for using as dried (Milosevic et al., 2010). Ganji Moghadam et al. (2010) reported the soluble solid contents of the European plums had the highest amount of total soluble solids also in this research, the genotypes of the European species were highly total soluble solids. The fact that substantial climate- and soil-dependent variations could occur in the above traits should be taken into account. The native (primitive, local) plum and prune cultivars or accessions apperceive in this study could serve as a prominent genetic basis and a source of germplasm for plum and prune breeding aimed at expanding new cultivars and rootstocks. In terms of fruit ripening, the results of this study were identical to the ones obtained by Ganji Moghadam et al., 2010. Fruit weight ranged from 23 to 50 g respectively belonged to Dobahreh and Ghohrood. The results received in this study authenticated those provided

by the above authors in terms of the high degree of genotypic variability in fruit weight of native (local) plum cultivars. Stone weight ranged from 0.9 g (Dobahreh) to 1.4 g (Ghorood), which was in agreement with the results obtained by Ganji Moghadam et al., 2010.

CONCLUSIONS

Rounded shape, yellow-green ground color and yellow-green flesh color prevailed. All the fruits could be processed, and some could be dried or used fresh. The native (primitive, local) plum and prune cultivars or accessions observed in this study could serve as an outstanding genetic basis and a source of germplasm for plum breeding aimed at developing new cultivars and rootstocks.

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