



E-ISSN: 2278-4136

P-ISSN: 2349-8234

www.phytojournal.com

JPP 2020; 9(5): 1799-1802

Received: 24-06-2020

Accepted: 22-08-2020

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Morphological and pomological evaluation of some plum cultivars grown under temperate conditions of Kashmir

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Abstract

The studies on the morphological and pomological evaluation of some plum cultivars were conducted in Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar, Kashmir during the year 2016-17. The present study consisted of six plum cultivars viz. Burbank, Stanley, Friar, Wickson, Santa Rosa and Satsuma of uniform age replicated thrice in a Randomized Complete Block Design (RCBD). In the experimental year, leaf length, leaf breadth, leaf area, tree height, tree girth, tree volume, fruit weight, fruit length, fruit firmness, yield, stone weight, pulp weight of fruit, TSS and acidity were determined. The data recorded revealed that the plum cultivar Santa Rosa was found to have maximum leaf length (12.00 cm), leaf breadth (5.63 cm) and leaf area (64.73 cm²), whereas cultivar Stanley recorded minimum leaf length (6.80 cm) and leaf area (19.69 cm²). However, cultivar 'Burbank' recorded minimum leaf breadth of 3.90 cm, respectively. Tree height was registered maximum in the cultivar 'Wickson' (2.05 m) and minimum (1.88 m) in 'Burbank'. Tree girth was recorded highest in cultivar 'Santa Rosa' (20.40 cm) while as lowest in the cultivar 'Friar' (8.47 cm). Maximum tree volume was recorded in the cultivar 'Satsuma' (4.24 m³) and minimum tree volume (0.22 m³) was observed in 'Friar'. The fruit weight was maximum in cultivar 'Friar' (50.47 g) and minimum in the cultivar Satsuma (38.81 g). Maximum fruit length (4.85 cm), yield (11.55 kg/tree) fruit firmness (2.59 kg/cm²) and stone weight (2.04 g). The study concluded on the note that cultivar Stanley proved to be promising with respect to pomological traits like better yield, good fruit size and firmness.

Keywords: Plum, cultivars, morphological and pomological evaluation

Introduction

Plums (*Prunus* spp.) are by far the most diverse of all the *Prunus* species and could be the most diverse of all deciduous fruit crop species which belongs to genus *Prunus* of sub family Prunoideae (*Amygdaloideae*) and family Rosaceae (Potter *et al.*, 2007) [14]. It is one of the most important stone fruit crop of temperate region throughout the world. It ranks next to peaches in economic importance. It has large number of species, but the commercially grown cultivars belong to two species i.e. *Prunus domestica* L. (European plum) and *Prunus salicina* L. (Japanese plum), the former is hexaploid (2n = 6x = 48) and the latter is diploid (2n = 2x = 16). The European group of plum is native to areas between Black Sea and Caspian Sea and the adjoining areas of Persia and Asia Minor whereas the Japanese group of plum is native to China but was domesticated in Japan and subsequently was introduced to different parts of world. Although in India, plum was first introduced in 1870 by Alexander Counts at Mashobra (Shimla) in Himachal Pradesh but it was commercialized by Prof. W B Hodgson from Florida at Fruit Farm Kandaghat or erstwhile Patiala state in 1935 (now District Solan Himachal Pradesh), thereafter grown in the hilly regions of Jammu and Kashmir, Uttarakhand, Uttar Pradesh and Tamil Nadu. European plum thrives best at 1300-2000 m above mean sea level and requires about 1000-1200 chilling hours (below 7.2 °C) during winter to break the dormancy whereas Japanese plum thrives well at an elevation of 1000-1600m above mean sea level and requires 700-1000 chilling hours (below 7.2°C). European plums are used for drying, table and partly canning purposes whereas Japanese plums are used for table purpose only (Shimada *et al.*, 1999) [18]. Fresh plums are rich in citric acid, sugars, vitamin A and B and minerals like calcium, phosphorous, potassium and fluoride. It is also low in calories (46 calories/100 g) and contain no saturated fats. Plums have a great range of flavour, aroma, texture, colour, size and other characteristics which makes their fruits desirable than other horticultural crops (Westwood, 1993) [21]. It also contain certain health benefiting compounds such as dietary fiber, sorbitol and isatin which help to regulate the functioning of the body (Prajapati *et al.*, 12). Plums have anti-cancer agents which may prevent cancer in the body.

Consuming plums may reduce the chance of contracting a heart disease in the long run. The total production of plum in the world is 99, 21,953 MT in which China ranks first with production of 53, 72,899 MT (FAO, 2016). Its area and production in India is 24,000 ha and 89,000 MT and in Jammu and Kashmir 4,083 ha and 11,860 MT respectively (Anonymous, 2018-19). Plum of Kashmir has good fruit quality in comparison with other commercially growing states in India. . But in Kashmir unfortunately much attention is given for increasing the area and production of apple and pear but not to plum. So there is a need for varietal evaluation of plum so that these can be put in fruit diversification scheme. Therefore the present investigation was proposed with the objectives to evaluate the morphological and pomological traits of various plum cultivars.

Material and Method

The present investigation was carried out in the orchard of Division of Fruit Science, Sher-e-Kashmir University of Agricultural Science and Technology, Shalimar, Srinagar, Kashmir in the year 2017. Bearing plum trees of different cultivars of uniform age (4 years old), rootstock (seedling rootstock), vigor, health, bearing and agronomical practices were selected for the trial. The trees were planted in square system of planting and maintained under uniform cultural practices as per package and practices followed during the period of study. Six cultivars of plum viz, Burbank, Stanley, Friar, Wickson, Santa Rosa and Satsuma were investigated. The experimental design was randomized complete block design (RCBD). Each treatment comprised of a single plant and was replicated three times. The study focused on (i) Leaf length, (ii) Leaf breadth, (iii) Leaf area, (iv) Tree height, (v) Tree girth, (vi) Tree volume, (vii) Fruit weight, (viii) Fruit length, (ix) Fruit firmness, (x) yield, (xi) stone weight, (xii) Pulp weight of fruit, (xiii) TSS and (xiv) Acidity. Leaf length and breadth of the mature leaf was measured with the digital Vernier Calliper and expressed in centimeters. The leaf area of each sample comprising of 30 leaves which was collected at random from different directions of each experimental tree and measured with the help of a leaf area meter and expressed in square centimeters. The height of the selected trees were measured from ground level to the top of the main branch or leader with the help of measuring tape and expressed in meters. Tree girth was measured 15cm above the graft union with the measuring tape and expressed in centimeter. The total above ground tree volume of each tree was calculated from the data on height and spread measurements according to the formula suggested by Westwood (1978) ^[20] and was expressed in cubic meters.

- i. For a tree that was taller than wide (Prolate Spheroid)
Volume = $4/3\pi ab^2$
- ii. For a tree that was wider than tall (Oblate Spheroid)
Volume = $4/3\pi a^2b$

Where,

$$\pi = 3.14$$

a = ½ the major axis (height)

b = ½ the minor axis (spread)

Ten fruits from each treatment in each replications were weighed individually on a sensitive monopan balance and average weight was recorded in grams and it gives the fruit weight. The fruit length of ten randomly selected fruits from each treatment in each replication was measured with the help of digital Vernier Calliper, averaged and expressed in centimeters. Fruit firmness of ten randomly selected fruits

were determined with the help of pressure tester (Penetrometer) at shoulder of the fruit and average firmness of the ten fruits was calculated and expressed as fruit firmness in kilogram per square centimeter. The crop harvested from each experimental unit was recorded and expressed in kilogram per tree and it gives fruit yield. The stones were separated from ten randomly selected fruits in each treatment and weighed separately. The average weight of stones was expressed as stone weight in grams. Pulp weight of ten randomly selected fruits were calculated by estimating the difference between the total weight of the fruit and the weight of the stone and was expressed in grams.

Weight of sample x volume of aliquot taken x 1000

The data generated were subjected to statistical analysis as per the procedures described by Gomez and Gomez.

Results and Discussion

The data pertaining to different characteristics are presented in Table-1 and 2. Among the cultivars, the maximum leaf length (12.00 cm), leaf breadth (5.63 cm) and leaf area (64.73 cm²) was recorded in cultivar Santa Rosa whereas cultivar 'Stanley' recorded minimum leaf length (6.80 cm) and leaf area (19.69 cm²). However, cultivar 'Burbank' recorded minimum leaf breadth of 3.90 cm. Maximum tree height was recorded in cultivar Wickson (2.17 m) which was statistically at par with cultivars Santa Rosa (2.16 m) and Friar (2.14 m). The smallest tree height was recorded in cultivar Satsuma (1.89 m) which was statistically at par with cultivars Stanley (1.90 m) and Burbank (1.91 m). Maximum tree girth was recorded in cultivar Santa Rosa (20.40 cm) whereas minimum tree girth was attained by cultivar Friar (8.47 cm). The highest tree volume was recorded for the cultivar Satsuma (4.24 m³) and lowest was observed in cultivar Friar (0.22 m³).

The maximum fruit weight (50.47 g) was recorded in plum cultivar Friar which was statistically at par with Santa Rosa (50.23 g) but superior to Wickson (48.27 g). The lightest fruit weight was recorded in cultivar Satsuma (38.81 g) which was statistically at par with Burbank (39.49 g). The longest average fruit length (4.85 cm) was found in cultivar Stanley which was statistically at par with Santa Rosa (4.78 cm), both being superior to cultivar Wickson (4.21 cm) which in turn was statistically at par with cultivar Burbank (4.18 cm). Minimum fruit length (3.65 cm) was noticed in Satsuma (3.65 cm) which was statistically at par with Friar (3.73 cm). Maximum fruit firmness (2.59 g/cm²) was recorded in the cultivar Stanley which was statistically superior to the all the cultivars. The minimum fruit firmness (1.78 kg/cm²) was recorded in the cultivar Burbank which was found statistically at par with Satsuma (1.87 kg/cm²). Highest yield was observed in cultivar Stanley (11.55 kg/tree) followed by Friar (10.54 kg/tree). The yield of Burbank was statistically less than Friar but was at par with Wickson (8.90 kg/tree). The yield of Santa Rosa (6.43 kg/tree) was at par with the yield observed in Satsuma (7.65 kg/tree), both being least yielders. Highest stone weight was recorded in Stanley (2.04 g) whereas lowest stone weight was recorded in cultivar Friar (0.72 g) which was statistically at par with Satsuma (0.74 g). Maximum pulp weight of fruit was recorded in cultivar Friar (49.74g) which was statistically at par with Santa Rosa (48.78 g). Minimum pulp weight of fruit was recorded in Burbank (37.73 g). Highest TSS (16.10 °Brix) was recorded in cultivar Stanley. Total soluble solid content of cultivar Santa Rosa (15.26 °Brix) was statistically at par with Friar (14.93 °Brix) but was statistically superior to Satsuma (12.73 °Brix). Minimum TSS was recorded in cultivar Wickson (12.33 °Brix) which was

found statistically at par with cultivar Burbank (12.40 °Brix). Maximum acidity was recorded in cultivar Burbank (1.94%) followed by Santa Rosa (1.78%), Satsuma (1.55%), Wickson (1.10%) and Friar (0.77%) which differed statistically. Lowest acidity was recorded in Stanley (0.56%).

The variation for leaf characteristics are in accordance with the findings of Sundouri *et al.* (2017) [19] who reported similar type of variation in different leaf characters of plum (leaf length, leaf breadth and leaf area). The results obtained in present studies are in accordance with the findings of Gonzales (1992) [7], Okie and Hancock (2008) [13] and Rozpara *et al.* (2008) [17] who reported that the traits viz, leaf length, leaf breadth and leaf area are genetically inherited characters which varied with variety, age of tree, location and soil fertility status of an orchard. The observations of present study regarding tree height and tree volume are in accordance with the results of Kumar *et al.* (2018) [10]. In the present study

tree girth varied from 8.47 to 20.40 cm which was observed to be in accordance with the work of Kuden *et al.* (1994) [9]. In the present study, fruit weight varied from 38.81g (Satsuma) to 50.47 (Friar) which was found to be in accordance with the results of Kumar *et al.* (2018) [10]. The fruit length in the studied cultivars ranged from 3.65cm (Satsuma) to 4.85cm (Stanley) and these values are in agreement with the findings of Kishor *et al.* (2017) [8]. The fruit firmness recorded was maximum in Stanley (2.59 kg/cm²) and minimum in cultivar Burbank (1.78 kg/cm²). Our results are supported by the findings of Molnar *et al.* (2016) [12] and Kumar *et al.* (2018) [10] who reported that cultivar Stanley had highest firmness (2.99 ± 0.77 kg/cm²) followed by Friar (2.36 kg/cm²). Stone weight varied from 0.72 g to 2.04 g among the cultivars under study, which was observed to be in accordance with the work of Sundouri *et al.* (2017) [19].

Table 1: Morphological characteristics of different plum cultivars

Cultivars	Parameters					
	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm ²)	Tree height (m)	Tree girth (cm)	Tree volume (m ³)
Burbank	10.07	3.90	30.63	1.91	15.63	1.67
Stanley	6.80	4.07	19.69	1.90	15.33	1.21
Friar	10.30	4.37	33.20	2.14	8.47	0.22
Wickson	8.13	4.10	28.10	2.17	16.22	3.42
Santa Rosa	12.00	5.63	64.73	2.16	20.40	2.91
Satsuma	10.23	4.73	52.80	1.89	17.60	4.24
CD (P<0.05)	0.261	0.151	1.45	0.176	0.702	0.442
C.V.	1.50	1.91	2.18	4.02	2.48	10.33

Table 2: Pomological characteristics of different plum cultivars

Cultivars	Parameters					
	Fruit weight (g)	Fruit length (cm)	Fruit firmness (kg/cm ²)	Yield (kg/tree)	Stone weight (g)	Pulp weight of fruit (g)
Burbank	39.49	4.18	1.78	9.50	1.75	37.73
Stanley	40.96	4.85	2.59	11.55	2.04	38.91
Friar	50.47	3.73	2.41	10.54	0.72	49.74
Wickson	48.27	4.21	1.93	8.90	1.13	47.14
Santa Rosa	50.23	4.78	2.12	6.43	1.85	40.47
Satsuma	38.81	3.65	1.87	7.65	1.46	48.78
CD (P<0.05)	0.980	0.077	0.108	0.842	0.74	38.07
C.V.	1.24	1.57	2.89	1.61	0.101	0.985

Conclusion

From the present study, it can be concluded that cultivars 'Stanley' and 'Friar' proved to be promising with respect to pomological traits like better yield, good fruit size and firmness.

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