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Comparative Response of Some Peach [*Prunus persica* (L.) Batsch.] Accessions for Tree, Foliage and Floral Traits

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Abstract

The present investigation entitled "Comparative Response of Some Peach [*Prunus persica* (L.) Batsch.] Accessions for Tree, Foliage and Floral Traits" was carried out for the evaluation of sixteen peach accessions namely Shan-i-Punjab, Kanto-5, Fertilia, Yum Yong, Flordasun, Summerglo, Suncoast, FlordaBelle, Ambri, Early Redhaven, Okubo, Early Amber, Fire Prince, Belle of Georgia, Hale Haven, Nishiki for their tree, foliage and floral characters. Flordasun recorded maximum plant height (6.13 m) and minimum (2.07 m) in Nishiki. Shedding of leaves started from 12th November (Suncoast) to 11th December (FlordaBelle). Time of full bloom extended from as early as (29th January) in FlordaBelle to (20th March) in Fertilia and Hale Haven. Pollen viability as tested in acetocarmine and in erythrosin B ranged from 91.35% in Suncoast to 98.47% in Belle of Georgia and 58.68 % in Kanto-5 to 93.90% in FlordaBelle, respectively. *In vitro* pollen germination was maximum (84.33%) in Flordasun and minimum (11.54%) in Yum Yong under 10% sucrose solution. Pollen germination under 15% sucrose solution was maximum (74.22%) in FlordaBelle and minimum (11.56%) in Ambri.

Keywords: Accession, characterization, evaluation, flowering, peach

1. Introduction

Peach [*Prunus persica* (L.) Batsch.] is an important fruit crop of Himachal Pradesh valued for its fresh and canned fruits. The fruits of peach are attractive, delicious and highly nutritious. They are very rich source of potassium, iron, fiber, vitamin A, vitamin C and also contains high concentrations of phytochemicals such as carotenoides, flavonols and anthocyanins (Hancock and Scorza, 2008; Byrne, 2002). In India, peach is grown on a commercial scale in mid hills of Himachal Pradesh, Jammu and Kashmir, hilly area of Uttrakhand and subtropical plains of north India (Uttar Pradesh, Punjab and Haryana) to limited extent in the hill region of eastern states.

The total area under peach cultivation in Himachal Pradesh 5076 hectares with the production of 4097 metric tonnes during 2017-2018 (Government of HP, 2019). Peaches have relatively performed well at altitude ranging between 1200-1500 m amsl. July Elberta, Redhaven and Sunhaven Suncrest and Glohaven are leading cultivars. However, peach production in recent times has seen a declining trend associated with number of factors such as diseases, overdependence on a select band of cultivars coupled with global warming. Although, peach is a temperate zone fruit, low chilling peach cultivars have been developed and found suitable for sub-tropical region (Kunden et al., 2004).

Besides, the overdominance of few peach cultivars in peach growing pockets of HP resulted in a glut in the market resulting in colossal economic losses to the farmers. This situation may only be countered by broadening the base of germplasm through introduction and evaluation of new varieties of peaches.

The development of new fruit cultivars has generally been based on genetic resources. Germplasm collection, evaluation and characterization are essential stages of breeding programs and are also the decisive factors for its adoption by the orchardists. Main germplasm collection and characterization is performed by describing phenological, pomological and morphological characteristics (Yilmaz et al., 2009).

There is a vast scope to augment peach production in temperate regions of Himachal Pradesh through varietal diversification not only to meet the demand of fresh fruit market but also to provide raw material to the agro-processing units.

Keeping in mind the above and to provide an array of

varieties, the present study was carried out on some peach germplasm accessions available in the field gene bank of NBPGR, Regional Station, Phagli, Shimla with the objective to describe and evaluate peach germplasm for growth and floral characteristics.

2. Materials and Methods

The present investigation entitled 'Comparative Response of Some Peach [*Prunus persica* (L.) Batsch.] Accessions for Tree, Foliage and Floral Traits' was carried out in the field gene bank of National Bureau of Plant Genetics Resources, Regional Station Phagli, Shimla at an elevation of 1924 m amsl during the year 2017-2018. The climate of location is wet temperate. The peach germplasm accessions undertaken for studies were: Ambri, Belle of Georgia, Early Amber, Kanto-5, Yum Yong, Fertilia, Flordasun, Summerglo, Hale Haven, Suncoast, Shan-i-Punjab, Early Redhaven, FlordaBelle, Fire Prince, Okubo and Nishiki. Three plants of each of the accession were selected for various observations. These plants are 15-18 years old and are grafted on wild peach rootstock.

2.1. Tree characters

Growth habit was categorized on the basis of the geometry of the tree crown i.e., upright, semi-upright and spreading. The height of the tree was measured with the help of calibrated staff from ground level to the tip of tallest branch of the tree and it was expressed in meters (m). The spread of the tree was measured by calibrated staff in two directions i.e. North-South (N-S) and East-West (E-W) and the observations were recorded in meters (m). The trunk girth was measured at the height of 15 cm above from the graft union with the help of measuring tape and was expressed in centimeters (cm).

2.2. Foliage characters

Thirty leaves from the middle portion of the current growth were selected during the last week of July for recording observations as suggested by Beyers (1962). The time of leaf bud burst was recorded in each accession. For this, the date on which the first bud had sprouted was taken. The length of the leaf was measured by a scale from tip of the apex to the base. The width of the leaf was measured with a scale at its broadest expand. Leaf area was worked out using the digital leaf area meter (LICOR - model 3100 A). Average area of ten leaves was considered as one replication and three such replications were made.

Colour charts of the Royal Horticultural Society, London were used to determine the surface colour of the leaves. Leaf shape was observed visually following Standard Cyclopedia of Horticulture (Bailey, 1963). The leaf margin was examined for the presence or absence of serration in each accession. The hairiness of the upper and lower surfaces in mature leaves of each accession was observed. Hand lens was used for observing presence or absence of hairiness. The Petiole length of fifteen petioles was measured using hand scale and average value was worked out for three replications. Presence or absence of glands was observed visually and an average of ten leaves was considered as one replication and three such replications were made. The observations on leaf fall were recorded as the date on which there was 80-85 % leaf fall.

2.3. Time and duration of flowering

The time of opening of first flower was recorded on which first flower opened in each accession. Date of full bloom was recorded on the date on which about 75 % flowers had opened was recorded as the date of full bloom. Date of opening of last flower was recorded on which last flower opened in each accession. The duration of flowering was recorded as number of days from the date of opening of first flower to the date of opening of last flower in each accession was determined.

2.4. Pollen studies

Pollen viability under acetocarmine test was recorded as pollen grains were stained in acetocarmine (2%) and erythrosin B (0.1%) solution. Deeply stained and normal looking pollen grains were considered as viable whereas shrivelled, lightly stained or colourless pollen grains were counted as non-viable when tested with acetocarmine. In case of erythrosin B the unstained pollen grains were considered viable in this method.

The freshly dehisced pollen grains were used for *in-vitro* pollen germination test. Different concentration of sucrose i.e. 10 and 15 % sucrose solutions were used for testing pollen germination. Pollen tube growth was assessed for each cultivar under microscope after 24 hours. The pollen grains having pollen tubes at least two times longer than pollen size were considered to be germinated and percentage of germinated pollen grains under three microscopic fields was worked out.

3. Results and Discussion

3.1. Tree characters

Flordasun recorded maximum plant height (6.13 m) and girth (73.67 cm), tree spread in N-S (5.23 m) and in E-W direction (5.30 m) was maximum in Shan-i-Punjab. While, minimum tree height (2.07 m) and trunk girth (15.00 cm) was recorded in Nishiki. The tree spread was minimum in N-S (1.30 m) and E-W (1.74 m) in FlordaBelle and Nishiki, respectively (Table 1). Such variation in growth characters has also been reported by previous workers (Badiyala and Lakhanpal, 1994; Singh et al., 2005; Yepthomi, 2011; Jana, 2015; Chauhan, 2016).

3.2. Foliage characters

Leaf characters are commonly used to distinguish and identify various fruit crop species and varieties. However, in the present study, no marked variation was observed in leaf shape, surface, margin, presence and absence of glands as well as colour (Table 2) except for some in leaf length, width, area and petiole length. Maximum leaf length (19.23 cm) was observed in Okubo and leaf width (5.03 cm) was found in Okubo and Nishiki whereas Fertilia was recorded to have minimum values

Table 1: Tree characters of some peach accessions

Accession	Growth habit	Height (m)	Girth (cm)	Spread (m)	
				N-S	E-W
Shan-i-Punjab	Spreading	6.09	73.67	5.23	5.30
Kanto-5	Spreading	3.33	60.67	2.83	4.07
Fertilia	Semi upright	4.32	41.67	2.87	3.50
Yum Yong	Semi upright	3.95	35.00	3.13	3.03
Flordasun	Spreading	6.13	60.87	3.83	3.60
Summerglo	Semi upright	4.03	35.00	2.97	2.93
Suncoast	Spreading	2.20	22.67	2.06	2.20
Florda belle	Upright	2.43	32.50	1.30	2.09
Ambri	Semi upright	5.57	64.33	1.83	2.33
Early red-haven	Spreading	4.06	18.33	2.22	2.55
Okubo	Semi upright	2.53	22.67	2.00	2.53
Early amber	Spreading	3.63	44.00	2.33	3.51
Fire prince	Spreading	3.50	31.67	2.67	2.10
Belle of georgia	Semi upright	4.07	19.33	1.39	7.03
Hale haven	Semi upright	4.40	36.00	3.16	2.51
Nishiki	Spreading	2.07	15.00	2.27	1.74
Mean		3.89	38.34	2.63	3.19
CD (p=0.05)		0.51	2.69	0.42	0.43

of leaf length (11.03 cm) and width (2.86 cm). Leaf area was maximum (193.43 cm^2) in Okubo and minimum (54.83 cm^2) in Shan-i-Punjab. The petiole length was maximum (1.20 cm) in Ambri and minimum (0.40 cm) in Hale Haven. Time of leaf emergence was earliest (18th January) in FlordaBelle and last (11th March) in Fertilia. Shedding of leaves started from 12th November (Suncoast) to 11th December (FlordaBelle). Such variation in foliage characters has also been reported by various workers (Wolfe and Strang, 2010; Byrne and Anderson, 2012; Chauhan, 2016) in the past. The difference in time of leaf emergence and leaf fall in various studies might be due to genetic constitution of the cultivars and prevailing climatic conditions in the corresponding seasons.

3.3. Time and duration of flowering

The flower initiation was earliest in FlordaBelle on 20th January followed by Shan-i-Punjab on 27th January, Flordasun on 29th January whereas, Fertilia was the last to initiate flowering on 14th March (Table 3). The flowering (full bloom) was earliest in the last week of January in FlordaBelle and the last was Okubo, Summerglo, Fertilia and Hale Haven in third week of March. The variation in time of flowering may be due to the differences in chilling hour requirement to break bud dormancy in various accessions. This find support from the findings of Kanwar (2002), Meena et al. (2011) and Tandon (2006). The data in Table 1 indicate that FlordaBelle was earliest (10th February) in terms of date of opening of last flower followed by Shan-i-Punjab (20th February), Flordasun (25th February) and Fertilia was the last to do so on 5th April. The longest duration of flowering was recorded in Flordasun

Table 2: Foliage characters of some peach accessions

Accession	Time of leaf bud burst	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Leaf colour		Leaf shape	LM	PL	LS	P/AG	Time of leaf fall
					Emerging leaves	Mature leaves						
Shan-i-Punjab	25th January	12.33	3.36	54.83	Yellow green group 152 A	Green group 137 A	Lanceolate	SS	0.80	P	Present	2nd December
Kanto-5	4th March	18.46	4.46	154.63	Yellow green group 152 A	Green group 136 A	Lanceolate	SS	1.13	P	Present	20th November
Fertilia	11th March	11.03	2.86	104.40	Yellow green group 152 A	Green group 139 A	Lanceolate	SS	0.70	P	Present	4th December
Yum Yong	3rd March	16.66	3.95	144.40	Yellow green group 152 B	Yellow green group 146 A	Lanceolate	SS	0.77	P	Present	18th November
Flordasun	27th January	13.10	4.25	109.26	Yellow green group 152 A	Green group 133 A	Lanceolate	SS	0.77	P	Present	3rd December
Summerglo	10th March	12.70	3.56	102.03	Yellow green group 152 A	Green group 137 A	Lanceolate	SS	0.53	P	Present	16th November
Suncoast	2nd March	18.50	4.03	145.56	Yellow green group 152 B	Green group 137 A	Lanceolate	SS	1.10	P	Present	12th November

LM: Leaf margin; PL: Petiole length (cm); LS: Leaf surface; P/AG: Presence/absence of glands; SS: Shallow Serrate; P: Pubescent

Table 2: Continue...

Accession	Time of leaf bud burst	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Leaf colour		Leaf shape	LM	PL	LS	P/AG	Time of leaf fall
					Emerging leaves	Mature leaves						
Florda-belle	18th January	15.63	3.56	106.16	Yellow green Group 152 B	Green group 133 A	Lan-ceolate	SS	0.60	P	Present	11th De-cember
Ambri	4th March	14.90	3.70	124.70	Yellow green Group 152 B	Yellow green group 146 A	Lan-ceolate	SS	1.20	P	Present	25th No-vember
Early redhaven	3rd March	15.03	3.33	104.58	Yellow green group 152 B	Yellow green group 137 A	Lan-ceolate	SS	0.83	P	Present	30th No-vember
Okubo	8th March	19.23	5.03	193.43	Yellow green group 152 A	Yellow green group 133 A	Lan-ceolate	SS	0.73	P	Present	19th No-vember
Early am-ber	24th Feb-ruary	15.16	4.16	90.66	Yellow green group 152 B	Yellow green group 136 A	Lan-ceolate	SS	0.90	P	Present	23rd No-vember
Fire prince	5th March	16.33	3.66	149.20	Yellow green group 152 A	Yellow green group 139 A	Lan-ceolate	SS	0.80	P	Present	3rd De-cember
Belle of georgia	3rd March	14.00	3.76	131.67	Yellow green group 152 A	Yellow green group 137 A	Lan-ceolate	SS	0.70	P	Present	5th De-cember
Hale ha-ven	6th March	14.75	3.43	111.23	Yellow green group 152 B	Yellow green group 135 A	Lan-ceolate	SS	0.40	P	Present	10th De-cember
Nishiki	4th March	17.46	5.03	165.40	Yellow green group 152 B	Yellow green group 135 A	Lan-ceolate	SS	0.83	P	Present	25th No-vember
Mean		15.33	3.97	124.51					0.80			
CD (*p*=0.05)		2.17	0.63	1.84					0.29			

LM: Leaf margin; PL: Petiole length (cm); LS: Leaf surface; P/AG: Presence/absence of glands; SS: Shallow Serrate; P: Pubescent

Table 3: Time and duration of flowering in some peach accessions

Accession	Time of opening of first flower	Date of full bloom	Date of opening of last flower	Duration of Flowering (Days)
Shan-i-Punjab	27th January	5th February	20th February	24
Kanto-5	6th March	11th March	26th March	20
Fertilia	14th March	20th March	5th April	21
Yum Yong	4th March	10th March	24th March	20
Flordasun	29th January	5th February	25th February	27
Summerglo	11th March	17th March	29th March	18
Suncoast	3rd March	10th March	22th March	20
Florda belle	20th January	29th January	10th February	21
Ambri	6th March	15th March	26th March	20
Early redhaven	5th March	12th March	27th March	22
Okubo	10th March	16th March	31th March	21
Early amber	25th February	4th March	20th March	23
Fire prince	7th March	18th March	26th March	19
Belle of georgia	5th March	11th March	26th March	21
Hale haven	8th March	20th March	29th March	22
Nishiki	2nd March	11th March	22nd March	21

(27 days) and the shortest in Summerglo (18 days). The similar type of variation in duration of flowering was reported by Sharma and Verma (2014), Kumar (2015) and Joshi et al. (2017).

3.4. Pollen studies

3.4.1. Pollen viability

Pollen viability ranged from 91.35% in Suncoast to 98.47% in Belle of Georgia when tested by 2% acetocarmine and 58.68% in Kanto-5 to 93.90% in FlordaBelle by 0.1% erythrosin B (Table 4).

3.4.2. In vitro pollen germination

The *in vitro* pollen germination in all the peach accessions under study varied from 11.54% in Yum Yong to 84.33% in Flordasun under 10% sucrose solution and 11.56% in Ambri to 74.22% in FlordaBelle under 15% sucrose solution. No definite relationship however, could be established among the staining tests (acetocarmine and erythrosin B) and the pollen germination test. Similar results were observed in different sets of varieties by Josan and Chohan (1980), Kumar et al. (2004), Tandon (2006), Fakim et al. (2011), Yepthomi (2011) and Joshi et al. (2017). The variation in pollen germination percentage so observed may be attributed to the genotypic constitution of the pollen in different accessions.

Table 4: Pollen viability and germination of some peach accessions

Accession	Pollen viability (%)		Pollen germination (%)	
	Acetocarmine (2%)*	Erythrosin B (0.1%)**	Sucrose (10%)**	Sucrose (15%)**
Shan-i-Punjab	92.80 (9.68)	82.26 (65.07)	31.80 (34.24)	63.60 (52.94)
Kanto-5	93.33 (9.71)	58.68 (50.07)	67.31 (55.32)	57.34 (49.28)
Fertilia	98.00 (9.95)	62.97 (52.58)	20.26 (26.18)	15.59 (23.11)
Yum Yong	92.33 (9.66)	70.15 (57.01)	11.54 (19.85)	42.93 (40.91)
Flordasun	92.81 (9.68)	87.99 (69.73)	84.33 (66.71)	66.24 (55.67)
Summerglo	94.48 (9.77)	69.70 (56.77)	60.46 (51.01)	38.84 (38.49)
Suncoast	91.35 (9.60)	61.41 (51.63)	19.82 (26.41)	46.37 (42.88)
Florda belle	96.39 (9.86)	93.90 (76.14)	64.98 (53.71)	74.22 (60.17)
Ambri	96.17 (9.85)	75.61 (60.39)	18.53 (25.09)	11.56 (19.83)
Early redhaven	93.77 (9.73)	76.33 (60.86)	57.20 (49.12)	47.54 (43.57)
Okubo	97.18 (9.90)	61.29 (51.67)	55.60 (48.23)	15.00 (22.58)
Early amber	97.94 (9.94)	68.87 (56.11)	26.78 (31.12)	34.09 (35.45)
Fire prince	97.89 (9.94)	69.11 (56.75)	27.68 (31.73)	26.45 (30.93)
Belle of georgia	98.47 (9.97)	86.32 (68.28)	25.19 (29.92)	22.64 (28.21)
Hale Haven	93.75 (9.73)	75.08 (68.03)	17.23 (24.50)	41.52 (39.44)
Nishiki	95.16 (9.80)	76.00 (60.66)	39.83 (39.09)	54.52 (47.64)
Mean	95.12	73.48	39.29	41.16
CD (p=0.05)	0.13	8.36	6.73	11.70

Figure in parenthesis are square root (*) and arc sign (**) transformed

4. Conclusion

From the foregoing discussion, it is concluded that the results obtained are preliminary and there is further need to evaluate these peach accessions in the subsequent years. However, the present studies do indicate that the early flowering varieties have low chilling requirement and can be recommended for cultivation in low hills. and the accessions with high pollen germination can be used as pollinizer in the breeding programme.

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