



PHENOLOGICAL CHARACTERIZATION OF LOW CHILL PEACHES FOR PRO-CREATION OF DESIRABLE INHERENT STUFF

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ABSTRACT : The present investigation was carried out to explore the possibility of peach genotypes grafted on peach seedling rootstocks for their phenological traits to elucidate the desirable genetic stuff. Twenty one genotypes including released varieties, land races and introductions were used in this study for assessment of the traits for yielding the better one through procreation. The study was conducted from 2011 to 2013 at orchard of Department of Fruit Science, PAU, Ludhiana, Punjab. A significant variation was recorded between the traits viz., leaf length (LL), leaf breadth (LB) and leaf area (LA) among different peach genotypes. Leaf length was maximum (156.83 mm) in Tropicsweet and minimum in Redhaven (94.83 mm). The flower size (FS) was recorded maximum (44.00 mm) in genotype Shan-i-Punjab whereas the minimum was in genotype Punjab Nectarine (18.50 mm). Leaf length showed highest ($r=0.71$) correlation with leaf breadth, whereas, leaf breadth was positively and significantly correlated with leaf area, flower disc size, style number but negatively and significantly correlated with number of filaments, filament and style length. Hierarchical cluster analysis obtained by using DARwin 5.0 software allowed the assessment of dissimilarity relationship among the peach genotypes. The boots trap for each of the genotypes for different characters was run for 5000 times which confirmed the authenticity of similarity and dissimilarity among them. UPGMA produced Dendrogram initially have three main clusters, cluster B being the largest having 9 genotypes.

Keywords : *Low chill peach, phenology, land races, similarity.*

Peach is probably the most adapted temperate fruit to the warmer climate. Besides being cultivated in the temperate climate in the hills, it is also cultivated in the foot hills of sub tropics Indian plains of Punjab, Haryana, Utrakhand, Uttar Pradesh and North eastern states having low requirement of chill hours ranging from 120-300 chill units. The subtropical peaches come in the market early in season (mid-April) from which growers can get higher returns due to scarcity of other fresh fruits. Its first commercial crop is obtained within three years of planting which is much earlier than majority of other temperate fruits. Therefore, the cultivation of subtropical peaches has expanded at a faster pace and gaining popularity in the north Indian subtropics due to higher returns on a unit area basis and availability of suitable low chilling peach cultivars. Shan-i-Punjab, Partap and Flordasun are the commercially cultivated cultivars. Fruits of these varieties are available from 3rd week of April to end of May. For extending the period of peach availability, eight low chilling cultivars were introduced from Florida and Texas states in the USA (Chanana, 4).

To understand the genetic background and the breeding value of the available germplasm, systematic study related to characterization and evaluation of germplasm is of great importance for current and future breeding and genetic improvement of the crop (Agong *et al.*, 1). To conserve germplasm resources and rediscover new genotype, it is necessary to characterize the genetic diversity existing in landraces, selections and varieties and even in native population to understand the genetic relationships among these genetic resources (Chang and Huang, 5). Therefore, the complete characterization of the existing germplasm is the one of the basic pre-requirements for framing breeding strategies, and further improvement in any crop largely depends on the availability of germplasm and extent of genetic diversity in them. Morphological characterization is a way for the complete description and classification of germplasm for visually phenotypic characters such as floral, leaf characters, seed shape, growth habits or pigmentation. Morphological characters include both qualitative and quantitative characteristics, which are the strongest determinants of the agronomic value and systematic classification of fruit crops. Compared with other means, morphological evaluations are direct,

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inexpensive and easy, leading to identification of varieties and its wild forms is essential for sustainable fruit production (Ahmed and Sundouri, 2). Therefore, an attempt was made to characterize the available low chill peaches on their phenology traits for framing breeding strategies and creation of gene bank of desired groups.

MATERIALS AND METHODS

Twenty one peach (*Prunus persica*. L) genotypes grafted on peach seedling rootstock, planted at a spacing of 6 x 6 m, were evaluated for phenological studies. Observations were recorded during the years 2011 to 2013 on non-juvenile trees for different morphological characters at different growth and development stages. The orchard soil was deep, well drained and loamy sand. The orchard was laid in square system of plantation and trees were maintained under uniform cultural operations as per the recommended Package of Practices for peach of PAU, Ludhiana. Observations of the peach genotypes were made for the various phenological traits on three random plants/fruits per genotype per replication. Leaf length, breadth, petiole length and thickness of the mature leaf was measured with digital Vernier's Callipers and expressed in mm. Fully expanded flower was selected and size from one end to other end of petal was measured with digital scale and expressed in mm. Petals of already selected flowers were removed and was measured for disc size, filament length and style length with digital scale and expressed in mm. Number of filaments, sepals and style was counted after removing the petal and sepal from the flowers.

The data recorded during the course of this study was analyzed statistically as Randomized Block Design in Factorials as per the procedures described by Singh *et al.* (10) and results are summarized in tables with average of three replications. Pooling of the data was done using CPCS1 software (Cheema and Singh, 6). Clustering was done by using DARwin 5.0 computer software. Correlation among the traits/characters was carried out by using SAS 9.2 version computer software.

RESULTS AND DISCUSSION

Leaf phenology

A significant variation in leaf length (LL) was observed among different peach genotypes which was maximum (156.83 mm) in Tropicsweet being statistically at par with Partap (147.83 mm), Flordaprince (150.33 mm) and Punjab Nectarine (149.33 mm) and minimum mean leaf length was

found in Redhaven (94.83 mm), which was lower than all the genotypes under investigation. The maximum mean leaf breadth (38.83 mm) was recorded in the genotype Parbhat and it is significantly higher than all the other genotypes and it was followed by the genotypes Tropicsweet, Flordaprince, Punjab Nectarine and Partap, which recorded 34.83, 32.80, 31.50 and 30.32 mm leaf breadth, respectively. The minimum mean leaf breadth (19.17 mm) was found in genotype Tropicbeauty which was significantly lower than all the genotypes under study. Mean leaf area (LA) was maximum (37.88 cm²) in Shan-i-Punjab and it was significantly higher than all the genotypes (Table 1). It was followed by Flordaguard, Parbhat, Flordacrest, Mayfire, Snowqueen, and Sharbati which recorded 30.29, 28.46, 28.29, 27.75, 26.13 and 25.04 cm² leaf area, respectively, whereas, minimum leaf area (15.63 cm²) was recorded in Redhaven and it was significantly lower than all the genotypes. It was followed by Flordagrande (20.33 cm²) and Valleygrande (20.54 cm²) which were statistically at par with each other. The mean petiole length (PL) was recorded maximum in Tropicsnow (10.58 mm) and it was statistically at par with genotypes Flordaguard (10.55 mm) and Tropicsweet (9.89 mm) whereas mean petiole length was recorded minimum in Flordaprince (7.00 mm) and it was statistically non significant with genotypes Redhaven (7.01mm), Earligrande (7.26 mm), Mayfire (7.50 mm), Flordaglo (7.56 mm), Redgold (7.57 mm) and Partap (7.89 mm). The mean maximum (0.99 mm) petiole thickness (PT) was found in the genotype Snowqueen which is statistically at par with genotypes Redgold (0.92 mm) and Partap (0.83) whereas mean minimum petiole thickness was found in genotype Flordaglo (0.48 mm) and it was significantly non significantly with genotypes Tropicsnow, Sunrise, Flordaguard, Redhaven, Sharbati and Suncrest which recorded 0.59, 0.59, 0.61, 0.61, 0.63, and 0.64 mm petiole length, respectively.

The variability with respect to leaf traits (leaf length, leaf breadth, leaf area, petiole length and petiole thickness in different peach genotypes might be due to varietal characteristic and variation in the environment. The results recorded in present study are in accordance with finding of Gonzales (8) who concluded that the traits viz; leaf length, leaf breadth, leaf area, petiole length and petiole thickness are genetically inherited, varied from variety to variety, location and cultivation practices.

Flower phenology

The mean flower size (FS) was recorded maximum (44.00 mm) in genotype Shan-i-Punjab and it was followed by genotype Tropicsnow, Flordaprince and Parbhat which recorded 40.83, 40.33 and 39.67 mm flower size, respectively whereas the minimum mean flower size was recorded in genotype Punjab Nectarine (18.50 mm) and it was statistically at par with genotypes Partap (21.67 mm) and Sunrest (22.17 mm). Data pertaining to the flower size showed a similar trend during the year of studies. The mean flower disc size (DS) was recorded maximum (19.50 mm) in genotype Flordacrest and was statistically at

par with genotype Parbhat which recorded 19.33 mm flower disc size, whereas the mean flower disc size was recorded minimum (13.17 mm) in genotype Flordaguard and it was lowest of all the peach genotypes under study. The mean number of filaments (NOF) was recorded maximum (59.50 number) in genotype Redgold which was statistically at par with the genotypes Flordaprince, Suncrest, Flordaguard, and Sunrise which recorded 59.33, 59.33, 58.67, 57.33 and 55.17 number of filaments, respectively, whereas mean filament number was recorded minimum (30.83 numbers) in genotype Parbhat and it was lower than all the genotypes. The maximum mean (18.00 mm) filament length (FL) was recorded in genotype

Table 1: Phenological characterization of peach genotypes.

Genotypes	Leaf length (mm)	Leaf breadth (mm)	Leaf area (cm ²)	Petiole length (mm)	Petiole thickness (mm)	Flower size (mm)	Disc size (mm)	No. of filaments	Filament length (mm)	No. of sepals	No. of style	Style length (mm)
Shan-i-Punjab	143.33	27.33	37.88	8.37	0.77	44.00	17.00	42.00	15.00	5.00	1.00	14.33
Partap	147.83	30.33	21.71	7.89	0.83	21.67	14.50	41.50	14.67	5.00	1.33	15.67
Earligrande	127.17	26.17	22.04	7.26	0.77	24.00	14.17	44.17	11.83	5.00	1.00	15.17
Flordaprince	150.33	32.83	23.13	7.00	0.80	40.33	16.50	59.33	13.67	5.33	1.33	12.17
Flordaguard	131.50	30.17	30.29	10.55	0.61	30.83	13.17	57.33	13.83	5.00	1.00	10.83
Parbhat	152.17	38.83	28.46	8.85	0.74	39.67	19.33	30.83	14.33	5.00	1.00	14.17
Sharbati	108.33	23.83	25.04	8.63	0.63	39.17	16.50	48.50	13.50	5.00	1.00	14.67
Punjab Nectarine	149.33	31.50	23.83	9.22	0.74	18.50	16.33	44.17	11.83	5.00	1.00	13.83
Suncrest	133.33	26.83	22.00	9.03	0.64	22.17	17.50	59.33	13.33	5.50	1.00	14.00
Sunrise	118.50	23.33	23.04	8.91	0.59	24.17	16.83	55.17	16.00	5.00	1.00	13.67
Flordacrest	138.50	29.33	28.29	8.87	0.79	35.17	19.50	58.67	18.00	5.00	1.00	16.50
Flordaglo	117.83	22.33	21.92	7.56	0.48	35.00	15.50	49.67	15.33	5.00	1.00	14.83
Tropicsnow	138.17	24.67	21.88	10.58	0.59	40.83	17.50	48.67	15.50	5.00	1.33	15.67
Tropicsweet	156.83	34.83	22.08	9.89	0.67	38.50	14.00	52.17	16.17	5.33	1.00	13.17
Flordagrande	119.67	23.50	20.33	8.06	0.61	38.00	14.17	53.83	15.33	5.00	1.00	14.83
Valleygrande	121.83	23.17	20.54	8.78	0.69	36.50	16.00	45.67	15.33	5.00	1.00	14.83
Tropicbeauty	115.83	19.17	23.38	8.75	0.71	33.33	15.33	42.33	13.67	5.50	1.00	13.00
Redhaven	94.83	25.83	15.63	7.01	0.61	22.50	17.00	53.50	13.50	5.00	1.00	10.83
Snowqueen	146.50	29.67	26.13	8.26	0.99	34.33	16.83	43.00	11.17	5.00	1.00	14.83
Mayfire	118.33	29.33	27.75	7.50	0.70	21.17	13.17	41.67	10.33	5.50	1.00	5.67
Redgold	116.33	29.67	24.29	7.57	0.92	33.33	14.17	59.50	13.50	5.00	1.00	15.50
Mean	130.78	27.75	24.27	8.50	0.71	32.06	15.95	49.10	14.09	5.10	1.05	13.72
CD (P=0.05%)	8.84	2.55	1.05	0.94	0.88	2.59	1.75	4.91	2.19	0.33	0.24	1.88
CV	5.88	8.00	3.76	9.65	10.79	7.03	9.55	8.70	13.55	5.60	19.76	11.93

Flordacrest which was statistically at par with genotype Tropicsweet (16.17 mm) and Sunrise (16.00 mm) and minimum (10.33 mm) in genotype Mayfire which was statistically at par with genotypes Snowqueen, Punjab Nectarine and Earligrande which recorded filament length of 11.17, 11.83 and 11.83 mm, respectively. The number of sepal (NOS) and style number (SN) did not show much variation among peach genotypes. The mean lowest (5.00) number of sepal was observed in most of the genotypes under study except in genotypes Flordaprince, Tropicsweet, Suncrest and Tropicbeauty which showed highest number of sepal during the present studies. The highest number of sepal (5.67) was observed in genotype Mayfire in 2011, whereas, in 2013 it was in genotypes Tropicbeauty and Suncrest (5.67). The mean highest number of style (1.33) was found in genotypes Partap, Flordaprince and Tropicsnow, whereas rest of the genotypes did not differ significantly among themselves and recorded lowest style number (1.00). The mean longest style length (16.50 mm) was recorded in genotype Flordacrest, which was statistically at par with genotypes Partap, Tropicsnow (both with 15.67 mm), Redgold (15.50 mm), Earligrande (15.17 mm), Flordaglo (14.83 mm) and Sharbati (14.67 mm), whereas mean least style length (5.67 mm) was recorded in Mayfire genotype and it was significantly lower than all the genotypes.

The flower characters *viz.*, flower size, disc size, number of filaments, number of style and style length are considered as a quantitative trait in peach and

other *Prunus* species (Dirlewanger *et al.*, 7; Vargas and Romero, 11) and these are greatly influenced by the environmental conditions like temperature, which affect their development and growth. Thus variation observed in the present study might be due to their inherent character and influence of temperature as also reported by Kumar (9), whereas, Blake (3) also recorded that flower size of Elberta peaches was 1.25 inches and that of Balle peach, it was 1.37 inches.

Correlation studies

The data pertaining to correlation studies based on the leaf and flower characters are presented in Table 2. Data revealed that leaf length showed significant and positive correlation with all the characters except for number of filament which is negatively correlated. Leaf length showed maximum ($r=0.71$) correlation with leaf breadth and was significant at 5%. Leaf breadth was positively and significantly correlated with leaf area, flower disc size, style number but negatively and significantly correlated with number of filaments, filament and style length. It was also highly correlated with petiole thickness ($r=0.43$) at 5%. Leaf area showed significant and positive correlation with petiole length, petiole thickness, flower size and disc size, while, it was negatively correlated with number of filament, number of sepal, style length and style number. Petiole length and petiole thickness was positively and significantly correlated with flower size, disc size and style length. Likewise, flower and disc size was positively correlated

Table 2: Correlation matrix among the peach genotypes based on the leaf and flower phenology.

Traits	LL	LB	LA	PL	PT	FS	DS	NOF	FL	NOS	SN	SL
LL	1.000											
LB	0.711**	1.000										
LA	0.372	0.302	1.000									
PL	0.347	0.085	0.227	1.000								
PT	0.415	0.437*	0.285	-0.278	1.000							
FS	0.218	0.039	0.340	0.204	0.015	1.000						
DS	0.204	0.120	0.126	0.127	0.050	0.252	1.000					
NOF	-0.231	-0.159	-0.251	0.034	-0.181	-0.022	-0.084	1.000				
FL	0.104	-0.109	-0.012	0.344	-0.330	0.466*	0.346	0.319	1.000			
NOS	0.040	0.004	-0.053	-0.038	-0.044	-0.160	-0.200	0.080	-0.273	1.000		
SN	0.367	0.138	-0.187	-0.005	0.110	0.118	0.050	0.040	0.121	0.015	1.000	
SL	0.236	-0.125	-0.080	0.147	0.197	0.344	0.400	0.047	0.505*	-0.541	0.138	1.000

*, ** Correlations significant at $P < 0.05$ (0.430) and $P < 0.01$ (0.548), respectively.

Legend : LL: Leaf Length, LB: Leaf Breadth, LA: Leaf Area, PL: Petiole Length, PT: Petiole Thickness, FS: Flower Diameter, DS: Disc Diameter, NOF: Number of Filaments, FL: Filament Length, NOS: Number of Sepals, SN: Style Number, SL: Style Length.

with style number and style length. Filament length was highly correlated ($r=0.50$) with style length at 1% level of significance. Style number and style length was positively correlated with leaf length, flower size, disc size, and number of filament but negatively correlated with leaf area.

Cluster analysis

Hierarchical cluster analysis obtained by using DARwin 5.0 software allowed the assessment of dissimilarity and further clarified the relationship among

Valleygrande and Sharbati) which was characterized by maximum leaf breadth and leaf area. The highest similarity level (69 %) was recorded between Flordagrande and Flordaglo was 68 per cent, whereas its similarity level was 32 and 22 per cent between these genotypes and genotype Valleygrande and Sharbati, respectively. The sub cluster IIB comprised of 2 genotypes (Sunrise and Redhaven) which showed similarity level of 19 per cent whereas, sub cluster IIC had 3 genotypes (Mayfire, Tropicbeauty and Suncrest). The similarity level of 22 per cent found between

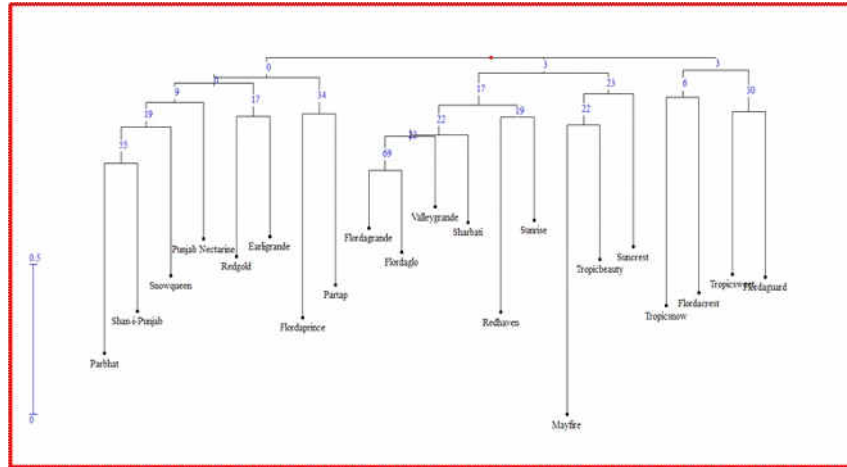


Figure 1: Dendrogram grouping of peach genotypes.

the peach genotypes. The bootstrap for each of the genotypes for different characters was run for 5000 times which confirmed the authenticity of similarity and dissimilarity among them. UPGMA produced Dendrogram initially have three main clusters (Fig. 1), cluster B being the largest having 9 genotypes.

The main cluster (I) was divided into three (IA, IB and IC) sub clusters. The sub cluster (IA) comprised of 4 genotypes (Flordagrande, Flordaglo, Valleygrande and Sharbati). All these were characterized by the maximum petiole length except genotype Punjab Nectarine. The similarity level (55%) was obtained between genotype Parbhat and Shan-i-Punjab, whereas genotypes Snowqueen and Punjab Nectarine had 19 and 9 per cent similarity level with genotypes Parbhat and Shan-i-Punjab. The second sub cluster (IB) had two genotypes (Earligrande and Redgold) having similarity level of 17 per cent, whereas, third sub cluster (IC) included genotypes Flordaprince, and Partap with maximum style numbers. The similarity level of 34 per cent was recorded between genotype Flordaprince and Partap.

The main second cluster was grouped into further three sub clusters (IIA, IIB and IIC). The sub cluster IIA consisted of 4 genotypes (Flordagrande, Flordaglo,

Mayfire and Tropicbeauty whereas, both these genotype showed 23 per cent similarity level with Suncrest. The sub cluster IIC showed 3 per cent similarity with sub cluster IIA and IIB whereas, it was 17 per cent between Sub cluster IIB and IIA.

The third sub cluster was divided into 2 sub clusters (IIIA and IIIB) which included genotypes Tropicssnow, Flordacrest, Tropicssweet and Flordaguard. Both the sub clusters had two genotypes each. The genotypes (Tropicssnow and Flordacrest) in sub cluster IIIA showed similarity of 6 per cent whereas genotypes (Tropicssweet and Flordaguard) in sub cluster IIIB had 30 per cent similarity level for high style length and flower disc size. But, level of similarity was 3 per cent between the genotypes in sub cluster IIIA and IIIB.

CONCLUSION

From the present study, it was observed that leaf breadth showed positive and significant correlation with leaf area, flower disc and style number which reflects that it had positive effect on the flower disc and style number responsible for the fruit size and number. On the other side, clustering grouped the genotypes according to their similarity level, which open the choice for the selection of particular genotype for the procreation of an inherent trait.

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