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Performance of some low chill peach, *Prunus persica* (L) Batsch germplasm accessions for fruit quality traits in Himachal Pradesh

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ABSTRACT

In the present study 10 low chill peach germplasm accessions were evaluated and characterized to assess their performance for fruit quality traits under Nauni, Solan conditions of Himachal Pradesh during 2010 -2011. Maximum fruit length (56.18 mm) and fruit breadth (59.30 mm) were recorded in Flordaglo whereas minimum fruit length (36.01 mm) and fruit breadth (40.52 mm) were observed in ValleGrande. Heaviest fruits were found in Flordaglo (96.45 g) and lightest fruits were observed in ValleGrande (34.50 g). Fruit firmness varied from 1.02 kg/cm^2 to 1.18 kg/cm^2. Average stone length ranged from 23.00 mm in ValleGrande to 42.02 mm in Saharanpur Prabhat. The average breadth of stone was maximum (22.84 mm) in Flordaprince and minimum (18.14 mm) in ValleGrande. Maximum stone width was recorded in EarliGrande (18.86 mm) and minimum in Saharanpur Prabhat (13.11 mm). Maximum pulp/stone ratio (24.31) was found in Flordaglo and minimum (9.38) in ValleGrande. TSS content of fruit was maximum (15.33^{o}B) in TropicSweet and minimum (11.17 ^{o}B) in Prabhat. Titratable acidity was maximum (0.89%) in Pratap and minimum (0.42%) in Saharanpur Prabhat. Total sugars were maximum (12.94%) in Pratap and minimum (9.26%) in TropicBeauty. Based on the present studies some of these genotypes do possess one or more desirable fruit quality characteristics and may be future commercial varieties provided they are tested multilocationally.

Keywords: Low chilling peach; fruit quality traits; TSS; germplasm accessions

INTRODUCTION

Introduction of new crops or crop varieties has for long prevailed as the most favoured method of fruit crop improvement necessitated by the bottlenecks involved in this very tedious and time consuming endeavour. Thereby the importance associated with the evaluation of the introduced plant material in the targeted agro-ecological conditions can never be overlooked. Peach, *Prunus persica* (L) Batsch is an important fruit crop of Himachal Pradesh valued for its fresh and canned fruits. The total area under peach cultivation in Himachal Pradesh is 5170 ha with the production of 9935 MT during 2008-2009 (Anon 2008-09). Peaches

have relatively performed well at an altitude ranging between 1200-1500 m amsl and July Elberta, Redhaven and Sunhaven are the popular 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 regions (Kuden et al 2004).

With the sudden upsurge of global warming, standard cultivars of peach because of their inability to meet the requisite chilling requirement in mid-hill areas such as Solan may find suitable alternative in low chilling peaches. Besides the over dominance of few peach cultivars in peach growing pockets of HP has at times led to a glut in the market resulting in colossal economic loss to the farmers. There is a vast scope to augment peach production in Himachal Pradesh through its cultivation in warmer areas to meet the demand of not only the early 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 low-chill varieties of peach the available germplasm consisting of some prominent low-chill peach genotypes was studied to assess the performance with context to fruit quality characteristics.

MATERIAL and METHODS

The present investigations were carried out in the research farm of Department of Fruit Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan during the year 2010-2011. The experimental area is located at an altitude of 1220 metres above mean sea level between 31^{o}N Latitude and 77^{o}E Longitude experiencing mild temperate climate. The genotypes undertaken for the studies included EarliGrande, FlordaGrande, Flordaglo, Flordaprince, Pratap, Saharanpur Prabhat, TropicBeauty, TropicSnow, TropicSweet and ValleGrande. Three trees of each genotype were selected.

Morpho-phyical fruit characters

To study physical fruit characters 15 representative fruit samples (5 in each replication) were taken at optimum maturity. The average length and breadth was measured following standard procedure. The weight of ten fruits under three replicates of each genotype was recorded and the average weight per fruit was calculated. The surface colour, fruit skin colour and fruit flesh colour of the fruits were observed by comparing with the colour charts of the Royal Horticultural Society, London. Optimum maturity date was recorded in each genotype as time of fruit maturity. Number of days from full bloom to harvest were counted from the date of full bloom to the date of harvest. Fruit firmness was measured in kg/cm^2 and

average of five fruits (each of 3 replicates) was worked out.

The stone size was recorded by measuring the length, breadth and thickness. Stone shape was classified as per Anon (1984) peach descriptors as rounded, ovate, elongated and very elongated. The weight of ten stones under three replicates of each genotype was recorded and the average weight per stone was calculated.

Adherence of flesh to stone was observed visually in each genotype and classified as clingstone, semi-clingstone and freestone. Pulp/stone ratio was worked out by dividing the weight of the fruit pulp by the weight of stone. Presence of grooves/ pits and shape of apex was observed visually in each genotype.

Biochemical fruit character

The total soluble solid content of fruits was determined with digital pocket refractometer (Pal-Atago, Japan). Acidity, sugars and ascorbic acid were estimated as per the standard procedures (Anon 1970). Sugar/acid ratio was worked out by dividing per cent total sugar with per cent titratable acidity.

RESULTS and DISCUSSION

Morpho-physical fruit characteristics

Maximum fruit length (56.18 mm) and fruit breadth (59.30 mm) were recorded in Flordaglo whereas minimum fruit length (36.01 mm) and fruit breadth (40.52 mm) was observed in ValleGrande (Table 1).

Heaviest fruits were found in Flordaglo having 96.45 g average fruit weight and lightest fruits were observed in ValleGrande having 34.50 g average fruit weight. All the ten genotypes recorded significant differences. Maximum fruit weight was recorded in Flordaglo with 96.45 g followed by TropicSnow (95.17 g) and EarliGrande (82.07 g) and minimum in ValleGrande (34.50 g). Kanwar et al (2002) found that ValleGrande had the highest fruit weight (88.8 g) followed by EarliGrande (87.2 g) and the least in TropicSweet (67.3 g) under Punjab conditions. These variations might be due to differences in agro-climatic conditions. Maximum fruit length was recorded in Flordaglo (56.18 mm) followed by FlordaGrande (53.14 mm) and EarliGrande (52.28 mm) and minimum in ValleGrande (36.01 mm). The fruit firmness varied a little between 1.02 kg/cm^2 and 1.18 kg/cm^2 in different peach genotypes. It was found that all the ten genotypes were statistically similar (Table 1). This is an important factor taken into consideration where the fruit has to be transported over long distances and local markets are not available. The colour of fruit (flesh and skin) as well as the adherence of stone to pulp are also important indices to differentiate between various peach cultivars and to some extent are considered as indices of fruit maturity. Morettini (1962) reported the

use of pulp colour in the identification of peach cultivars. However in the present study the peach accessions exhibited no significant variation in fruit skin and flesh colour except that slight variation was observed in the shade of the colour.

The fruit flesh colour was observed to be in Yellow Group (13 A) in EarliGrande and (13 B) in TropicSnow, Yellow Green Group (150 A) in Saharanpur Prabhat and (150 C) in FlordaGrande, (150 D) in TropicSweet and Flordaglo, Yellow Orange Group (15 B) in Flordaprince, (20 A) in ValleGrande and TropicBeauty and (23 B) in Pratap.

Time of maturity fell between 7 May in TropicSnow to 5 June in TropicSweet, EarliGrande and Pratap. The dates of maturity in other genotypes were 19 May (Flordaprince, Flordaglo, ValleGrande and TropicBeauty), 24 May (Saharanpur Prabhat) and 28 May (FlordaGrande).

The fruit skin colour was observed to be in Yellow Group (7 B) in TropicBeauty, (13 C) in TropicSnow and (50 A) in TropicSweet; Green Group (140 C) in FlordaGrande; Yellow Green Group (150 B) in Saharanpur Prabhat, (150 C) in EarliGrande, (153 D) in Flordaprince, (154 B) in Flordaglo, (154 C) in ValleGrande and Yellow Orange Group (20 A) in Pratap.

Significant differences in various fruit characters such as size, weight, colour of skin and flesh were observed in peach genotypes studied. These fruit characters are detrimental in making any variety acceptable to the end user ie the consumer. In general the domestic market has a likeness toward peach fruits which are large in size, sweet in taste, less acidic and juicy and flesh is easily separable from the stone. Several workers have worked on the physical aspects of peach fruits (Kher and Dorjay 2001, Neelam and Ishtiaq 2002) in the past and have reported considerable variation in fruits of different peach cultivars.

Number of days from full bloom to harvest ranged from 94 days in TropicSnow to 155 days in TropicSweet. Time of fruit maturity was from 7 May in TropicSnow to 5 June in TropicSweet, EarliGrande and Pratap. The dates of maturity in other genotypes were 19 May in Flordaprince, Flordaglo, ValleGrande and TropicBeauty, 24 May in Saharanpur Prabhat and 28 May in FlordaGrande. However according to the findings of Singh et al (2009) Flordaprince and Saharanpur Prabhat matured in 4th week of April and EarliGrande in 1st week of May. Josan et al (2009) also reported that Saharanpur Prabhat, EarliGrande, Flordaprince and Pratap matured in 4th week of April. Kanwar et al (2002) reported that the first to attain fruit maturity was Flordaprince on

1 May followed by Earli Grande (4 May), ValleGrande (5 May), Flordaglo (7 May), TropicBeauty (17 May), TropicSweet (26 May), TropicSnow (3 June) and last in FlordaGrande on 4 June.

There was an evident difference in the maturity time of these varieties at Solan as compared to some studies at other places in north India. This can be attributed to the differences in the climatic conditions of Solan which are comparatively moderate during summers ie the harvesting time of peaches. Peach genotypes maturing in the first fortnight of May (eg TropicSnow) hold promise due to non-availability of fruits in the market in the mid-hill areas further so the fruit quality is considerably better than those are in the markets of northern plains during the same time. Most of the genotypes had round stone shape except Pratap (ovate), EarliGrande (elongated) and TropicBeauty (elongated). Average stone length ranged from 23.00 mm in ValleGrande to 42.02 mm in Saharanpur Prabhat. There were significant differences among the peach genotypes with regard to stone length except TropicBeauty and TropicSweet which were statistically at par (Table 2). Highest stone weight was recorded in Saharanpur Prabhat (6.67 g) which was followed by EarliGrande (5.46 g) and lowest in TropicBeauty (3.45 g).

Most of the genotypes were of freestone type except Saharanpur Prabhat and Flordaprince which were of clinging type and Flordaglo which was of semi-clinging type. Pulp/stone ratio is an important criterion to judge the quality of peach fruits. It is evident from Table 2 that highest pulp/stone ratio (24.31) was recorded in Flordaglo while the ratio was lowest (9.38) in ValleGrande.

All the ten genotypes were found to have both grooves and pits on the stone surface. The shape of the apex was found to be round in all the genotypes except EarliGrande and TropicBeauty which had pointed apex.

Bio-chemical characteristics

The TSS content in fruits ranged between 11.17°B in TropicBeauty and 15.33°B in TropicSweet. However according to Kanwar et al (2002) the TSS content in TropicSweet was found to be 10.60°B. It is revealed from Table 3 that highest acidity (0.89%) was in Pratap followed by ValleGrande (0.75%) and lowest (0.42%) in Saharanpur Prabhat. Kanwar et al (2002) recorded the highest mean fruit acidity of 0.74 per cent in ValleGrande. It was significantly higher than the fruit acidity in FlordaGrande (0.55%), Flordaprince (0.56%), TropicBeauty (0.59%) and TropicSweet (0.59%) whereas fruit acidity in Flordaglo (0.64%), EarliGrande (0.68%) and TropicSnow (0.67%) was significantly similar to that of ValleGrande. Singh et al (2009) observed highest acidity in Flordaprince (0.94%) followed by EarliGrande (0.80%) and least

Table 1. Morpho-physical characteristics of fruits of some low chill peach genotypes during 2010 -2011

Genotype	Fruit length (mm)	Fruit breadth (mm)	Fruit weight (g)	Fruit skin colour	Fruit flesh colour	Fruit firmness (kg/cm^2)	Time of maturity	# days from full bloom to harvest
TropicSweet	46.98	53.86	77.33	Yellow group 50 A	Yellow Green Group 150 D	1.10	5th June	155
Saharanpur								
Prabhat	51.22	49.51	64.99	Yellow Green Group 150 B	Yellow Green Group 150 A	1.02	24th May	120
EarliGrande	52.28	53.57	82.07	Yellow Green Group 150 C	Yellow Group 13 A	1.09	5th June	126
Flordaprince	47.86	44.37	58.33	Yellow Green Group 153 D	Yellow Orange Group 15 B	1.07	19th May	109
TropicSnow	50.75	55.96	95.17	Yellow group 13 C	Yellow Group 13 B	1.18	7th May	94
Flordaglo	56.18	59.30	96.45	Yellow Green Group 154 B	Yellow Green Group 150 D	1.11	19th May	106
ValleGrande	36.01	40.52	34.50	Yellow Green Group 154 C	Yellow Orange Group 20 A	1.05	19th May	109
TropicBeauty	47.18	49.67	65.83	Yellow group 7 B	Yellow Orange Group 20 A	1.17	19th May	110
Pratap	46.40	51.93	61.67	Yellow Orange 20 A	Yellow Orange Group 23 B	1.05	5th June	132
FlordaGrande	53.14	54.37	78.66	Green Group 140 C	Yellow Green Group 150 C	1.08	28th May	117
$CD_{0.05}$	1.38	0.91	0.95			0.54		

Table 2. Stone characteristics of low chill peach genotypes

Genotype	Stone size (mm)			Stone weight (g)	Pulp/ stone ratio	Stone shape	Adherence of flesh to stone	Presence of grooves /pits	Shape of apex
	Length	Breadth	Width						
TropicSweet	24.84	20.77	13.70	3.54	21.79	Round	Freestone	Present	Round
Saharanpur Prabhat	42.02	18.20	13.11	6.67	9.73	Round	Clingstone	Present	Round
EarliGrande	31.79	22.40	18.86	5.46	15.02	Elongated	Freestone	Present	Pointed
Flordaprince	26.38	22.84	14.84	3.68	15.82	Round	Clingstone	Present	Round
TropicSnow	28.31	21.51	15.86	4.92	19.18	Round	Freestone	Present	Round
Flordaglo	27.59	18.53	16.36	3.96	24.31	Round	Semi-clingstone	Present	Round
ValleGrande	23.00	18.14	14.33	3.67	9.38	Round	Freestone	Present	Round
TropicBeauty	24.66	22.17	16.48	3.45	19.04	Elongated	Freestone	Present	Pointed
Pratap	25.34	20.48	15.21	4.17	14.79	Ovate	Freestone	Present	Round
FlordaGrande	28.36	19.62	15.13	3.70	21.25	Round	Freestone	Present	Round
$CD_{0.05}$	0.19	0.08	0.09	0.15	0.57				

in Saharanpur Prabhat (0.31%). The total sugar content ranged from 9.26 per cent in TropicBeauty to 12.94 per cent in Pratap.

Reducing sugars varied from 7.09 per cent in TropicBeauty to 9.66 per cent in Pratap. Pratap and TropicSweet were at par and so were Flordaprince and ValleGrande. The reducing sugar content in other genotypes was 9.49 per cent in TropicSweet, 9.18 per cent in Flordaprince, 9.10 per cent in ValleGrande, 8.75 per cent in EarliGrande and Tropicsnow, 8.49 per cent in Saharanpur Prabhat and FlordaGrande and 8.00 per cent in Flordaglo.

Maximum content of non-reducing sugars was 3.85 per cent in TropicSnow followed by Saharanpur Prabhat (3.32%), TropicSweet (3.14%), Pratap (3.10%) and the lowest was 1.60 per cent in Flordaprince. Saharanpur Prabhat was found to be statistically at par with TropicSweet and Pratap (Table 3).

The highest sugar/acid ratio recorded was 28.66 in Saharanpur Prabhat followed by TropicSweet (24.69), TropicSnow (20.67), FlordaGrande (19.62) and the lowest was 2.01 in Pratap. EarliGrande and TropicBeauty; Flordaprince, Flordaglo, ValleGrande and Pratap as well as TropicSnow and FlordaGrande were statistically at par. The total sugar content ranged from 9.26 per cent in TropicBeauty to 12.94 per cent in Pratap. However Chadha et al (1968)

Table 3. Biochemical characteristics of fruits of some low chill peach genotypes

Genotype	Titratable acidity (%) as malic acid	Total soluble solids (°B)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Sugar/acid ratio
TropicSweet	0.52	15.33	12.80	9.49	3.14	24.69
Saharanpur Prabhat	0.42	12.60	11.98	8.49	3.32	28.66
EarliGrande	0.62	13.93	10.49	8.75	1.65	16.94
Flordaprince	0.73	12.73	10.87	9.18	1.60	14.90
TropicSnow	0.62	13.70	12.80	8.75	3.85	20.67
Flordaglo	0.69	11.83	10.67	8.00	2.53	15.47
ValleGrande	0.75	13.93	11.40	9.10	2.18	15.08
TropicBeauty	0.53	11.17	9.26	7.09	2.06	17.51
Pratap	0.89	14.60	12.94	9.66	3.10	14.48
FlordaGrande	0.57	12.27	11.31	8.49	2.67	19.62
$CD_{0.05}$	0.01	0.32	0.12	0.19	0.22	1.64

recorded total sugars ranging from 10.50 per cent to 16.10 per cent in another set of peach cultivars. Maximum content of non-reducing sugars was 3.85 per cent in TropicSnow followed by Saharanpur Prabhat (3.32%), TropicSweet (3.14%), Pratap (3.10%) and the lowest was 1.60 per cent in Flordaprince. However Ravi and Tshering (2001) found that non-reducing sugars ranged from 3.93 per cent to 4.12 per cent. Such variations may be due to different agro-climatic conditions influencing synthesis of biochemical constituents in the developing fruits and the duration of fruit development period.

On the whole the present findings do indicate that some of these genotypes viz Tropic Sweet (high TSS content, free stone, high pulp/stone ratio), EarliGrande (large and firm fruits, high TSS content), TropicSnow (large and firm fruits, early maturity, free stone) and Flordaglo (large and firm fruits) do possess one or more desirable fruit quality characteristics and can be future commercial varieties provided they are tested multilocationally.

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