

Variability studies in some nectarine, *Prunus persica* (L) Batsch var *nucipersica* cultivars for different horticultural traits

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ABSTRACT

The present investigations were carried out at the model farm of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during 2014-16 with the objective of studying the variability in five nectarine cultivars. Analysis of variance showed significant differences among all the genotypes for the studied characteristics. The genotype Snow Queen recorded highest yield and performed better for various important horticultural traits among different genotypes. Spring Bright was found to be the most dwarf among the genotypes. The two genotypes may be suggested for cultivation in mid-hill conditions of Himachal Pradesh. High heritability coupled with high genetic gain was obtained for tree volume. High heritability coupled with moderate genetic gain was obtained for yield per tree, fruit volume, trunk girth, stone length, total soluble solids, total sugars, fruit firmness, tree spread, yield efficiency, sugar-acid ratio and reducing sugars.

Keywords: Nectarine; variability; peach; genotypes; characteristics; heritability

INTRODUCTION

Peach (*Prunus persica*) is one of the important stone fruits belonging to the family Rosaceae. Nectarines, *Prunus persica* (L) Batsch var *nucipersica* are smooth-skinned peaches but are non-pubescent. Nectarine is grown throughout the warmer temperate regions in northern and southern hemisphere. It is commercially grown in the mid-hills of the Himalayas between 30°N and 40°S latitudes. The nectarine is an emerging potential stone fruit and is cultivated for table purpose as well as for processing. It can be successfully cultivated up to 2000 m amsl.

China is widely held to be the native land of peaches and nectarines. These are grown in warm temperate zones and sub-tropical regions of India. Nectarines have apparently originated from peach by mutation. The lack of pubescence is controlled by a single recessive gene which is also responsible for the taste and smaller size of the fruit (McGregor 1976). In India there are very few varieties under cultivation

which have led to near genetic uniformity among the cultivars.

The present study was undertaken to assess the variability among nectarine cultivars. It is the variation which if heritable could be used for crop improvement as varieties are the backbone of any orchard system. Therefore prior to recommendation of new cultivars they should be tested and extent of variability present must be adequately assessed so that they perform consistently over a long period of time.

MATERIAL and METHODS

The studies were carried out at model farm of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during 2014-16. The material consisted of five nectarine genotypes viz Mayfire, Sunrise, Silver King, Snow Queen and Spring Bright planted during March 2010. Four uniform trees in each cultivar and five fruit samples per replication were taken for recording the observations.

The morphological traits such as tree height, tree spread, trunk girth, tree volume, annual shoot growth, leaf area, date of opening of first flower, date of full bloom, date of opening of last flower, duration of flowering, flower intensity, fruit set, time of maturity, days from full bloom to harvest, fruit size, fruit shape, fruit colour, fruit weight, fruit volume, fruit firmness, stone size, stone weight, pulp-stone ratio, yield per tree and yield efficiency were observed by using standard methods. The biochemical characteristics such as total soluble solids, titratable acidity, total sugars, reducing sugars, non-reducing sugars and sugar-acid ratio were also observed. The total soluble solid content was determined with digital pocket refractometer (Pal-Atago, Japan), acidity and sugars according to the standard procedures (Anon 1970) and sugar-acid ratio by dividing total sugars with titratable acidity. The two year data were pooled and subjected to the analysis of various traits as described by Gomez and Gomez (1983). The variability parameters were calculated as per the methods suggested by Burton and DeVane (1953) and Johanson et al (1955).

RESULTS and DISCUSSION

Physical fruit characteristics

Data given in Table 1 show that maximum fruit size was recorded in Snow Queen (54.41 x 52.28 mm) and minimum in Mayfire (47.41 x 42.47 mm), fruit weight was maximum (76.86 g) in Snow Queen and minimum (56.90 g) in Mayfire and maximum fruit volume was in Snow Queen (77.76 cm³) and minimum (56.05 cm³) in Mayfire. All the five genotypes recorded significant differences for fruit firmness. Maximum fruit firmness was recorded in Mayfire (12.15 lb/in²) followed by Spring Bright (10.12 lb/in²), Sunrise (9.05 lb/in²), Silver King (7.85 lb/in²) and Snow Queen (7.79 lb/in²).

Maximum stone length was recorded in Snow Queen (31.75 mm) and minimum (21.54 mm) in Spring Bright; stone diameter was maximum (24.15 mm) in Sunrise and minimum (18.84 mm) in Mayfire (Table 2). Stone weight varied from 3.99 to 4.81 g in nectarine genotypes. It was found that all the studied genotypes were statistically similar. The data recorded for pulp-stone ratio showed significant variation among the cultivars. Maximum pulp-stone ratio was recorded in Snow Queen (15.04) while minimum (12.18) in Silver King.

Yield

Maximum yield (20.96 kg/tree) was recorded in Snow Queen and minimum (14.78 kg/tree) in Spring Bright whereas the highest yield efficiency (21.15 kg/m²) was recorded in Spring Bright (Table 1).

These observations suggest that there were significant variations in various fruit characteristics in nectarine genotypes studied. These fruit characteristics are detrimental in making any variety acceptable. In general the market has a likeness towards fruits that are large in size, sweet in taste, less acidic, more juicy and having easily separable flesh with smaller stone size. The genotypes which had the desirable characters in the present study were Silver King, Snow Queen and Sunrise. Several workers worked on the phenological characters of nectarine (Albuquerque et al 1998, Forcada et al 2014) and also reported considerable variations in fruits of different nectarine cultivars.

Chemical characteristics

The TSS content ranged from 8.81°B in Mayfire to 14.64°B in Silver King (Table 3). Seker et al (2005) recorded the TSS ranging from 8.5 to 14.4°B. Maximum titratable acidity was recorded in Silver King (0.62%) followed by Snow Queen (0.60%) and minimum in Spring Bright (0.57%). The total sugar content varied from 6.40 per cent in Mayfire to 9.34 per cent in Silver King; reducing sugars varied from 2.23 per cent in Mayfire to 3.88 per cent in Silver King and Snow Queen each. Non-reducing sugar content was found maximum in Silver King (5.18%) followed by Snow Queen (4.98 %) while minimum in Mayfire (3.9%). The highest sugar-acid ratio was found in Silver King (23.75) followed by Spring Bright (22.51) and minimum in Mayfire (15.30).

Variability parameters

Coefficient of variability: The phenotypic coefficient of variation indicated higher values than genotypic coefficient of variation for all traits though with narrow differences for most of the characters (Table 4). This indicates that most of these characters were less influenced by environmental factors. The highest phenotypic coefficient of variation was observed for the character tree volume (37.23%) followed by moderate values of reducing sugars (24.87%), total soluble solids (19.73%), fruit firmness (17.91%), sugar-acid ratio (17.46%), stone length (16.68%), total sugars

Table 1. Physical characteristics of nectarine fruits

Genotype	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (g)	Fruit volume (cm ³)	Fruit firmness (lb/in ²)	Yield (kg/tree)	Yield efficiency (kg/m ²)
Mayfire	47.41	42.47	56.90	56.05	12.15	14.95	16.29
Sunrise	49.68	50.46	65.86	68.66	9.05	17.64	14.56
Silver King	52.57	45.49	61.60	62.78	7.85	19.92	14.84
Snow Queen	54.41	52.28	76.86	77.76	7.79	20.96	16.78
Spring Bright	48.45	47.42	59.46	61.97	10.12	14.78	21.15
CD _{0.05}	0.24	0.19	0.52	0.54	0.03	0.64	1.04

Table 2. Stone characteristics of nectarine fruits

Genotype	Stone length (mm)	Stone diameter (mm)	Stone weight (g)	Pulp-stone ratio
Mayfire	21.69	18.84	4.00	13.23
Sunrise	29.19	24.15	4.63	13.28
Silver King	28.75	21.90	4.72	12.18
Snow Queen	31.75	22.79	4.81	15.04
Spring Bright	21.54	18.95	3.99	13.93
CD _{0.05}	0.34	0.33	0.38	1.08

Table 3. Chemical characteristics of nectarine fruits

Genotype	TSS (°Brix)	Acidity (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Sugar-acid ratio
Mayfire	8.81	0.58	6.40	2.23	3.96	15.30
Sunrise	9.74	0.56	6.88	2.46	4.20	17.36
Silver King	14.64	0.62	9.34	3.88	5.18	23.75
Snow Queen	12.75	0.60	9.12	3.88	4.98	21.17
Spring Bright	10.69	0.48	7.27	3.06	4.00	22.51
CD _{0.05}	0.27	0.04	0.24	0.46	0.40	1.64

(16.36 %) and yield efficiency (16.00%). Greater improvement therefore could be obtained for these characters.

The low phenotypic coefficient of variation was shown by the characters like tree spread (15.00%), duration of flowering (13.85%), flower intensity (13.38), non-reducing sugars (13.30%), trunk girth (13.03%), tree height (12.40%), fruit volume (12.35%), fruit weight (11.99%), stone diameter (10.62%), leaf area (10.60%), titratable acidity (10.33%), stone weight (10.03%), pulp to stone ratio (8.91%), fruit diameter (8.01%), number of days from full bloom to maturity (7.35%), fruit length (5.85%), annual shoot growth (4.22%) and fruit set (1.76%). The low variation indicates the highly stable nature of these characters

among different genotypes studied and less scope of improvement in them.

Heritability and genetic gain: The heritability estimates were high for the characters viz fruit diameter (99.86%), fruit volume (99.53%), fruit weight (99.34%), fruit length (99.08%), trunk girth (98.91%), stone length (98.90%), total soluble solids (98.76%), total sugars (98.07%), yield per tree (97.21%), leaf area (97.20%), tree volume (96.60%), fruit firmness (96.59%), number of days from full bloom to maturity (96.34%), stone diameter (95.15%), tree height (94.11%), tree spread (93.75%), yield efficiency (93.30%), sugar-acid ratio (90.6 %), flower intensity (89.86%), reducing sugars (85.05%) and annual shoot growth (83.66%). High heritability estimates indicate

Table 4. Variability parameters of nectarines

Character	Mean	Range	Coefficient of variation (%)		Heritability (%)	Genetic advance	Genetic gain (%)
			Phenotypic	Genotypic			
Tree height (m)	3.35	2.76-3.72	12.40	12.22	94.11	0.79	23.86
Tree spread (m)	2.66	2.24-3.01	15.00	14.66	93.75	0.77	29.04
Trunk girth (cm)	36.71	29.67-41.12	13.03	12.96	98.91	9.74	26.55
Tree volume (m ³)	13.12	7.39-17.85	37.23	36.59	96.60	9.72	74.09
Annual shoot growth (cm)	81.28	78.23-85.29	4.22	3.86	83.66	5.91	7.27
Leaf area (cm ²)	34.32	29.53-38.69	10.60	10.45	97.20	7.28	21.22
Duration of flowering (days)	14.90	13.50-16.00	13.85	11.93	74.18	3.15	21.16
Flower intensity	13.88	11.49-15.99	13.38	12.68	89.86	3.44	24.77
Fruit set (%)	65.53	64.17-66.74	1.76	1.56	78.20	1.86	2.83
Number of days from full bloom to maturity	83.20	75.50-89.50	7.35	7.22	96.34	12.14	14.59
Fruit length (mm)	50.50	47.41-54.41	5.85	5.83	99.08	6.03	11.95
Fruit diameter (mm)	47.62	42.46-52.28	8.01	8.00	99.86	7.84	16.48
Fruit weight (g)	64.14	56.90-76.86	11.99	11.95	99.34	15.74	24.53
Fruit volume (cm ³)	65.44	56.05-77.75	12.35	12.32	99.53	16.57	25.32
Fruit firmness (psi)	9.39	7.79-12.15	18.23	17.91	96.59	3.41	36.26
Stone length (mm)	26.58	21.53-31.75	16.68	16.59	98.90	9.03	33.98
Stone diameter (mm)	21.33	18.84-24.15	10.62	10.36	95.15	4.44	20.82
Stone weight (g)	4.43	3.98-4.90	10.03	8.31	68.59	0.63	14.18
Pulp-stone ratio	13.53	12.18-15.04	8.91	7.24	66.20	1.64	12.13
Yield/plant (kg)	17.65	14.78-20.96	15.44	15.22	97.21	5.46	30.92
Yield efficiency (kg/m ²)	16.76	14.83-21.18	16.00	15.46	93.30	5.15	30.76
Total soluble solids (°B)	11.33	8.81-14.64	19.73	19.60	98.76	4.55	40.13
Titrateable acidity (%)	0.57	0.48-0.62	10.33	8.70	70.94	0.09	15.09
Total sugars (%)	7.80	6.39-9.33	16.36	16.20	98.07	2.58	33.05
Reducing sugars (%)	3.10	2.23-3.88	24.87	22.94	85.05	1.35	43.58
Non-reducing sugars (%)	4.46	3.95-5.18	13.30	11.28	78.99	0.97	21.64
Sugar-acid ratio	20.02	15.30-23.75	17.46	16.63	90.69	6.53	32.62

that selection for these character will be effective being less influenced by the environmental effects. Johanson et al (1955) observed that heritability values along with estimation of genetic gain were more useful than heritability value alone in predicting the effect of selection. High heritability with high genetic gain was obtained for the character tree volume whereas high heritability with moderate genetic gain was obtained for the characters viz fruit volume, trunk girth, stone length, total soluble solids, total sugars, fruit firmness, tree spread, yield efficiency, sugar-acid ratio and reducing sugars. This indicates that selection for these traits would be effective.

The variety Snow Queen was found promising for fruit yield, fruit set, fruit weight, fruit volume, total soluble solids and reducing sugars followed by Silver King. On the basis of plant growth characteristics it was also concluded that Spring Bright can be used as a dwarf variety with higher fruit yield efficiency.

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