

Variation in Tree, Foliage, Phenological and Pollen Characters of Low Chill Peach Germplasm Accessions under Mid-hills of Himachal Pradesh

Dinesh Singh*, Gracely Y. Yephthomi and K. Kumar

Dept. of Fruit Science, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh (173 230), India

Article History

Manuscript No. AR796

Received in 28th May, 2014

Received in revised form 15th November, 2014

Accepted in final form 15th January, 2015

Correspondence to

*E-mail: fruitbreeder@rediffmail.com

Keywords

Foliage, germplasm, lowchill peach, phonology, pollen characters, variation

Abstract

The present investigation was carried out in the department of Fruit Science, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, HP, India. Ten peach genotypes namely TropicSweet, Saharanpur Prabhat, Earli Grande, Flordaprince, Tropic Snow, Flordaglo, Valle Grande, Tropic Beauty, Pratap and Florida Grande were evaluated for their tree, foliage, floral and pollen characteristics. Valle Grande recorded maximum tree height (2.73 m) whereas, minimum tree height (1.83 m) was recorded in Flordaprince. Shedding of leaf started from 29th October (Tropic Sweet) and extended till 20th November (Tropic Beauty). Time of full bloom extended from 24th January in Saharanpur Prabhat and Pratap to 2nd February in Tropic Snow and Flordaglo. The longest duration (39 days) of flowering was recorded in Pratap and shortest (28 days) in Tropic Sweet and Earli Grande. Pollen viability ranged from 93.82% to 98.93% when tested by 1.0% acetocarmine and 84.19 to 97.70% by 0.1% erythrosin B. *In vitro* pollen germination varied from 62.26% to 90.39%.

1. Introduction

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, 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 of Himachal Pradesh, may find suitable alternative in low chilling peaches. Moreover, the low chill peaches are early in ripening thereby fetch good returns as compared to mid and late season peach cultivars. 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. Recently introduction of

good low chilling cultivars peach growing has received greater attention both in conventional cooler areas and warmer areas of North India plains. But there are very few good cultivars available for commercial planting.

Furthermore, suitability of particular cultivars in a particular region is not yet known due to lack basic information. The tree growth and vigour, time of bud burst, foliage and flowering characters vary from place to place which affects the successful cultivation of fruit crop in any given area. Therefore, before commercialization of a cultivar it is of utmost importance to have the prior knowledge of its behavior with respect to tree, foliage and blossoming characters.

Before, using different cultivars in breeding programme information regarding their pollen characters are essential. Besides, this will also be useful to ascertain the status of fertility thereby effecting fertilization *vis-a-vis* fruit setting.

Considering the aforesaid facts, and to provide an array of low-chill varieties of peach, the present studies, were therefore, carried out on the available germplasm consisting of ten prominent low-chill peach genotypes to assess their growth, phenology, pollen viability and fertility status under Solan conditions of Himachal Pradesh.



2. Materials and Methods

The present investigations were carried out in the research farm of Department of Fruit Science, Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, HP, India during 2010-2011. The experimental area is located at an altitude of 1220 metres above mean sea level between 31°N Latitude and 77°E Longitude having mild temperate climate. The genotypes undertaken for the studies included Earli Grande, Florida Grande, Flordaglo, Flordaprince, Pratap, Saharanpur Prabhat, Tropic Beauty, Tropic Snow, Tropic Sweet and Valle Grande. Three trees of each genotypes were selected to record observation on tree growth, phenology and pollen characters. Growth habit was categorized on the basis of the geometry of the tree crown as Erect and Semi-spreading.

Tree height was measured from the ground level to the tip of the tallest branch of the tree and it was expressed in metres (m). The spread of the tree was measured in [North-South (N-S) and East-West (E-W)] two directions and the observations were recorded in metres (m). The trunk girth was measured at the height of 15 cm above from the graft union and was expressed in centimetres (cm). The shoot colour of current growth and one year old shoot was recorded by comparing it with the colour charts of Royal Horticultural Society, London. For recording observations on foliage characters thirty leaves from the middle portion of the current growth were selected during the last week of July as suggested by Beyers (1962).

The data on time of leaf bud burst was recorded in each genotype, as the date on which the first bud had sprouted. The leaf length, leaf width and 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. The surface colour of emerging and mature leaves was determined by using Colour charts of the Royal Horticultural Society, London.

Leaf shape was observed visually following Standard Cyclopaedia of Horticulture (Bailey, 1963). The leaf margin was examined for the presence or absence of serration in each genotype. The hairiness of the upper and lower surfaces of mature leaves of each genotype was observed with the help of hand lens. 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.

As regard flower characters time of opening of first flower (date on which first flower opened), the date of full bloom (the date on which about 75% flowers had opened) and the date of opening of last flower was recorded on which last flower opened in each genotype.

The number of days from the date of opening of first flower to the date of opening of last flower in each genotype was determined as the duration of flowering. Pollen viability was studied through staining test using acetocarmine (1.0%) and 0.1% erythrosin B solutions while pollen fertility was ascertained through *in vitro* pollen germination by using (10%) Sucrose+100 ppm Boric acid solution. The data was statistically analysed in Completely Randomised Block Design as suggested by Panse and Sukhatme (1961)

3. Results and Discussion

Out of ten peach genotypes, as many as five genotypes namely, Tropic Sweet, Earli Grande, Flordaprince, Valle Grande, and Florida Grande were found to have spreading type of growth habit (Table 1), whereas, Saharanpur Prabhat, Flordaglo and Pratap had erect growth habit. Only two genotypes, Tropic Snow and Tropic Beauty exhibited semi-spreading type of growth habit.

Tree height in all the ten low chilling peach genotypes studied ranged between 1.83 m (Flordaprince) and 2.73 m (Valle Grande). Maximum value of tree spread in N-S direction was recorded as 1.33 m in Valle Grande and corresponding minimum value was 0.70 m in Pratap. Maximum tree spread in E-W direction was 1.86 m in Flordaprince whereas, Earli Grande recorded a minimum value of only 0.83 m. Mean value for this growth characteristic was 1.02 m in N-S direction and 1.11 m in E-W direction.

Maximum trunk girth (22.60 cm) was recorded in Flordaprince followed by Earli Grande (20.60 cm), Tropic Sweet and Valle Grande (19.60 cm) and minimum (12.60 cm) in Saharanpur Prabhat. Mean value of trunk girth was determined as 18.09 cm. Among the ten peach genotypes studied, Valle Grande recorded maximum tree height while Flordaprince recorded the least values suggesting considerable variation in tree vigour. Such variation in growth characters has also been reported by previous workers (Kanwar et al., 2002; Singh et al., 2005; Tandon, 2006). Maximum trunk girth was observed in Flordaprince and minimum in Saharanpur Prabhat. Maximum value of tree spread in N-S direction was recorded in Valle Grande and minimum in Pratap whereas Flordaprince was found to have maximum tree spread in E-W direction and minimum in Earli Grande. Tropic Sweet, Earli Grande, Valle Grande, Flordaprince and Florida Grande have spreading type of growth habit whereas, Saharanpur Prabhat, Flordaglo and Pratap had erect growth habit whereas Tropic Snow and Tropic Beauty exhibited semi-spreading of growth habit. Erect growth habit recorded here in Saharanpur Prabhat, Flordaglo and Pratap suggests their suitability under high density planting systems, if otherwise good or use as gene source to develop



short-statured peach scion varieties.

The shoot colour of the current growth was observed to be in Grey-Orange Group (177 A) in Tropic Sweet, Saharanpur Prabhat, Tropic Beauty and Pratap; Grey-Purple Group (185 A) in Tropic Snow and Florda Grande; Grey-Purple Group (187 A) in Earli Grande, Flordaprince and Flordaglo and Grey-Purple Group (187 B) in Valle Grande. As regards the colour of one year old growth, it was found to be in Grey Group (201 A) in Tropic Sweet, Flordaglo, Tropic Beauty and Pratap; Grey Group (201 B) in Earli Grande, Flordaprince, Valle Grande and Florda Grande and Grey-Purple Group (187 A) in Saharanpur Prabhat and Tropic Snow.

The time of leaf bud burst was earliest in Flordaprince on 23rd January followed by Saharanpur Prabhat, Earli Grande and Florda Grande on 24th January, Tropic Snow on 25th January, Flordaglo on 26th January, Tropic Sweet on 27th January, Valle Grande and Pratap on 28th January and the last in Tropic Beauty on 29th January. Leaf length was recorded highest in Tropic Beauty (17.91 cm) closely followed by Tropic Sweet (17.52 cm), Tropic Snow (17.47 cm), Valle Grande (16.82 cm) and the least in Pratap (14.37 cm). All were statistically at par except Pratap.

Leaf width was recorded maximum in Tropic Sweet with 4.49 cm followed by Tropic Snow (3.16 cm), Earli Grande and Valle Grande (2.93 cm) and minimum in Pratap with 2.56 cm (Table 2). Tropic Snow was statistically at par with all other genotypes except Tropic Sweet which differed significantly. The maximum leaf area (47.72 cm²) was recorded in Tropic Sweet followed by Tropic Snow (46.87 cm²), Tropic Beauty (46.50 cm²) and the minimum (37.56 cm²) was observed in Pratap. It was found that all the ten genotypes were statistically similar.

Leaf colour of the emerging leaves in all the genotypes was in Yellow-Green Group (152) however slight variation was observed in the shade of the colour. These were 152 A in TropicSweet, Saharanpur Prabhat, Earli Grande, Tropic Snow and Flordaglo and 152 B in Flordaprince, Valle Grande, Tropic Beauty, Pratap and Florda Grande, whereas, colour of mature leaves was under Green Group (137 A) and Yellow-Green Group (146A). These were 137 A in Tropic Sweet, Saharanpur Prabhat, Earli Grande, Tropic Snow, Flordaglo and Valle Grande and 146 A in Flordaprince, Tropic Beauty, Pratap and Florda Grande. Leaf color indicates colour of flesh. The yellow-fleshed cultivars have yellowish green leaves with a yellowish tinge to the leaf midrib on the lower surface whereas white-fleshed peaches have whitish green leaves with whitish leaf midribs. In all the ten peach genotypes, lanceolate leaf shape with serrated margins and pubescent surface was observed.

Petiole length was found to be maximum (1.38 cm) in Florda Grande which was closely followed by Tropic Snow (1.37 cm) and minimum (0.98 cm) was in Saharanpur Prabhat and Earli Grande. Florda Grande was found to be statistically at par with all the genotypes except Pratap, Saharanpur Prabhat and Earli Grande. Glands were found to be present in all the ten genotypes. Peach varieties lacking leaf glands are more susceptible to powery mildew than those possess leaf glands (Strand, 1999) .

Shedding of leaves was recorded as early as on 29th October in Tropic Sweet and as late as on 20th November in Tropic Beauty (Table 3). The dates of leaf fall in other genotypes were 3rd November in Tropic Snow, 12th November in Valle Grande, 16th November in Flordaglo, 18th November in Saharanpur Prabhat, Earli Grande and Flordaprince and 19th November in Pratap and Florda Grande.

Table 1: Tree growth characteristics of low chill peach genotypes

Genotype	Growth habit	Tree height (m)	Tree spread (m)		Trunk girth (cm)	Shoot colour	
			N-S	E-W		Current growth	One year old growth
Tropic Sweet	Spreading	2.66	1.03	0.96	19.60	Grey-orange 177 A	Grey 201 A
Saharanpur Prabhat	Erect	2.20	0.93	0.96	12.60	Grey-orange 177 A	Grey-purple 187 A
Earli Grande	Spreading	2.36	0.90	0.83	20.60	Grey-purple 187 A	Grey 201 B
Flordaprince	Spreading	1.83	1.16	1.86	22.60	Grey-purple 187 A	Grey 201 B
Tropic Snow	Semi-spreading	2.30	1.26	1.10	18.60	Grey-purple 185 A	Grey-purple 187 A
Flordaglo	Erect	2.10	1.03	1.00	16.60	Grey-purple 187 A	Grey 201 A
Valle Grande	Spreading	2.73	1.33	1.50	19.60	Grey-purple 187 B	Grey 201 B
Tropic Beauty	Semi-spreading	2.40	0.90	0.96	18.60	Grey-orange 177 A	Grey 201 A
Pratap	Erect	1.90	0.70	0.86	14.30	Grey-orange 177 A	Grey 201 A
Florda Grande	Spreading	2.30	0.96	1.13	17.30	Grey-purple 185 A	Grey 201 B
Mean		2.28	1.02	1.11	18.09		
SD		0.29	0.18	0.32	2.96		

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 as well as colour except for some in leaf length, width and area. The leaf area varied from 37.56 cm² to 47.72 cm². The colour of mature leaves was green and yellow green in all the genotypes except for slight variation in the shade. Such variation in foliage characters has also been reported by various workers (Deol and Singh, 1986; Singh et al., 2005; Tandon, 2006) in the past. Leaf shape was recorded to be lanceolate and margin serrate in all the genotypes. This has also been reported by Deol and Singh (1986). The time of leaf emergence extended from 23rd January in Flordaprince to 29th January in Tropic Beauty. However, Singh et al. (2005) reported that bud sprouting occurred between 1st February (Flordaprince) to 14th March (Shan-i-Punjab).

The late leafing peach introduction holds promise for avoiding possible damage due to spring frosts. The leaf fall occurred between 29th October in Tropic Sweet and 20th November in Tropic Beauty (Table 3) in the year 2010. However, Sharma and Mehta (1992) has reported earlier that leaf fall occurred between first week of December and second week of December in various peach cultivars introduced at Solan (Nauni). The difference in time of leaf emergence and leaf fall in various studies might be due to the genetic constitution of the cultivars and prevailing climatic conditions in the corresponding seasons.

The flower initiation was earliest in Prabhat on 17th January followed by Pratap on 18th January, Flordaprince on 21st January whereas, Tropic Beauty was the last to initiate flowering on 25th January. The period of full bloom varied among all the

genotypes. The full bloom was observed in Saharanpur Prabhat and Pratap as early as on 24th January. In case of Tropic Beauty it was observed on 29th January, whereas Earli Grande, Flordaprince and Valle Grande recorded full bloom on 30th January, Tropic Beauty on 1st February and Tropic Snow and Flordaglo were last to do so on 2nd February.

The data in Table 4 indicate that Prabhat was earliest (16th February) in terms of date of opening of last flower followed by Earli Grande (20th February), Tropic Sweet (22nd February) and Flordaglo was the last to do so on 26th February. The longest duration (39 days) of flowering was recorded in Pratap and shortest (28 days) was in Tropic Sweet and Earli Grande. The duration of flowering in other genotypes were 30 days in Saharanpur Prabhat, 31 days in Tropic Beauty, 32 days in Tropic Snow and Florda Grande, 34 days in Flordaglo, 35 days in Valle Grande, 36 days in Flordaprince. The flowering (full bloom) was earliest in the fifth week of January in Saharanpur Prabhat and Pratap and the last was Tropic Sweet, Tropic Snow and Flordaglo in first week of February during the year 2010. The variation in time of flowering may be due to the differences in chilling hour requirement to break bud dormancy in various genotypes. This finds support from the findings of Butatovic (1959), Tabuenca and Herrero (1966) and Lawrynowicz (1968). However, Kanwar et al. (2002) reported that full bloom under Punjab conditions was found earliest in Florda Grande with the full bloom date of 10th February followed by 12th February in Flordaglo and Tropic Beauty and the last in Earli Grande, Valle Grande and Tropic Sweet with full bloom date of 15th February. The duration of flowering was found to be longest in Pratap (39 days) and shortest in Tropic Sweet and Earli Grande (28 days). Similar results were recorded by Josan et al. (1999) for Pratap.

Stainability tests though not sure tests of pollen viability, but is employed widely as an index of pollen viability. The highest pollen viability was recorded in Pratap (98.93%) which was at par with Tropic Beauty (98.79%) and minimum in Valle Grande (93.82%) when tested by 1.0% acetocarmine. Pollen viability was statistically at par in Tropic Sweet, Saharanpur Prabhat and Tropic Snow and so was in Flordaprince and Flordaglo.

Pollen viability was found to be highest in Tropic Beauty (97.70%) followed by Valle Grande (96.98%) and least in Florda Grande (84.19%) when tested with 0.1% erythrosin B. It was found that Tropic Beauty was statistically at par with Tropic Sweet, Tropic Snow with Flordaglo and Flordaprince with Saharanpur Prabhat. Pollen germination under *in vitro* was maximum (90.39%) in Saharanpur Prabhat which was statistically at par with Flordaglo (83.85%) and Pratap (85.94%) and minimum (62.26%) in Flordaprince (Table 5). Pollen viability ranged from 93.82% in Valle Grande to 98.93% in Pratap when tested by acetocarmine and 84.19% in Florda

Table 2: Metric foliage characteristics of low chill peach genotypes

Genotype	Time of leaf bud burst	Leaf length (cm)	Leaf width (cm)	Leaf area (cm ²)	Petiole length (cm)
Tropic Sweet	27 th January	17.52	4.49	47.72	1.31
Saharanpur Prabhat	24 th January	16.44	2.63	45.40	0.98
Earli Grande	24 th January	15.48	2.93	44.08	0.98
Flordaprince	23 rd January	16.79	2.90	45.83	1.22
Tropic Snow	25 th January	17.47	3.16	46.87	1.37
Flordaglo	26 th January	16.58	2.90	43.36	1.27
Valle Grande	28 th January	16.82	2.93	43.60	1.34
Tropic Beauty	29 th January	17.91	2.63	46.50	1.29
Pratap	28 th January	14.37	2.56	37.56	1.04
Florda Grande	24 th January	16.54	2.63	42.72	1.38
CD (<i>p</i> =0.05)		2.83	0.86	13.15	0.32



Grande to 97.70% in Tropic Beauty by 0.01% erythrosin B. The *in vitro* pollen germination in all the peach genotypes under study varied from 62.26% in Flordaprince to 90.39% in Saharanpur Prabhat. No definite relationship however, could be established among the staining tests (acetocarmine and erythrosin B) and the pollen germination test. Similar

results were observed by Sharma and Tripathi (1979); Tandon (2006) but in different peach cultivars. The variation in pollen germination percentage so observed may be attributed to the genotypic constitution of the pollen in different cultivars. These results corroborate those reported earlier by Thakur (1969) in drupes and Singh (1961) in peaches.

Table 3: Non-metric foliage characteristics in low chill peach genotypes

Genotype	Leaf colour		Leaf shape	Leaf margin	Leaf surface	Presence/ absence of glands	Time of leaf fall
	Emerging leaves	Mature leaves					
Tropic Sweet	Yellow green group 152 A	Green group 137 A	Lanceolate	Serrate	Pubescent	Present	29 th October
Saharanpur Prabhat	Yellow green group 152 A	Green group 137 A	Lanceolate	Serrate	Pubescent	Present	18 th November
Earli Grande	Yellow green group 152 A	Green group 137 A	Lanceolate	Serrate	Pubescent	Present	18 th November
Flordaprince	Yellow green group 152 B	Yellow green group 146 A	Lanceolate	Serrate	Pubescent	Present	18 th November
Tropic Snow	Yellow green group 152 A	Green group 137 A	Lanceolate	Serrate	Pubescent	Present	3 rd November
Flordaglo	Yellow green group 152 A	Green group 137 A	Lanceolate	Serrate	Pubescent	Present	16 th November
Valle Grande	Yellow green group 152 B	Green group 137 A	Lanceolate	Serrate	Pubescent	Present	12 th November
Tropic Beauty	Yellow green group 152 B	Yellow green group 146 A	Lanceolate	Serrate	Pubescent	Present	20 th November
Pratap	Yellow green group 152 B	Yellow green group 146 A	Lanceolate	Serrate	Pubescent	Present	19 th November
Florda Grande	Yellow green group 152 B	Yellow green group 146 A	Lanceolate	Serrate	Pubescent	Present	19 th November

Table 4: Time and duration of flowering in low chill peach genotypes during 2010

A	B	C	D	E
Tropic Sweet	24 th January	1 st February	22 nd February	28
Saharanpur Prabhat	17 th January	24 th January	16 th February	30
Earli Grande	22 nd January	30 th January	20 th February	28
Flordaprince	21 st January	30 th January	25 th February	36
Tropic Snow	24 th January	2 nd February	25 th February	32
Flordaglo	23 rd January	2 nd February	26 th February	34
Valle Grande	23 rd January	30 th January	25 th February	35
Tropic Beauty	25 th January	29 th January	24 th February	31
Pratap	18 th January	24 th January	24 th February	39
Florda Grande	24 th January	31 st January	25 th February	32

A: Genotype; B: Time of opening of first flower; C: Date of full bloom; D: Date of opening of last flower; E: Duration of flowering (No. of days)

Figure 1: Pollen viability and *in vitro* pollen germination in low chill peach genotypes

Genotype	Pollen viability		In vitro pollen germination (%)
	Acetocarmine (1%)	Erythrosin B (0.1%)	
Tropic Sweet	94.82	95.53	74.11
Saharanpur Prabhat	94.86	93.15	90.39
Earli Grande	95.63	89.50	67.60
Flordaprince	97.44	93.38	62.26
Tropic Snow	94.82	94.94	77.80
Flordaglo	97.68	94.74	83.85
Valle Grande	93.82	96.98	68.48
Tropic Beauty	98.79	97.70	69.73
Pratap	98.93	95.70	85.94
Florda Grande	94.51	84.19	64.01
CD ($p=0.05$)	5.09	5.29	8.74



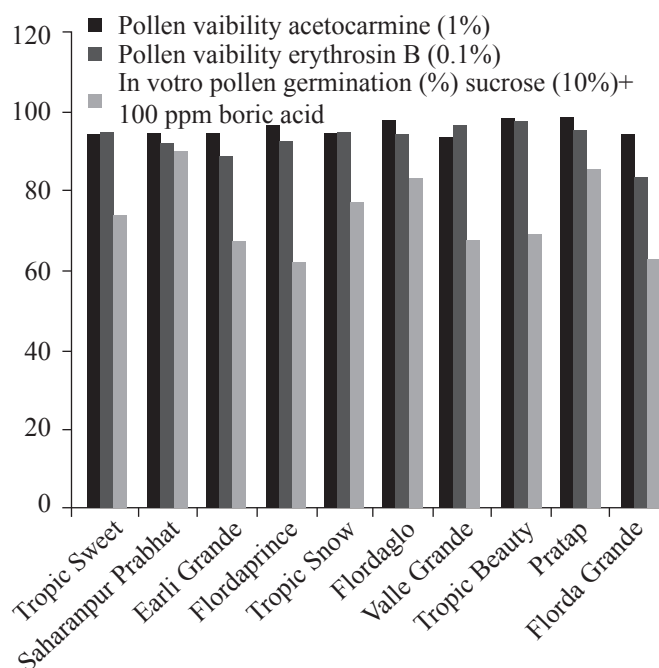


Figure 1: Pollen viability and *in vitro* pollen germination in low chill peach genotypes

4. Conclusion

Valle Grande recorded maximum tree height (2.73 m) whereas, minimum tree height (1.83 m) was recorded in Flordaprince. Shedding of leaf started from 29th October (Tropic Sweet) and extended till 20th November (Tropic Beauty). Time of full bloom extended from 24th January in Saharanpur, Prabhat and Pratap to 2nd February in Tropic Snow and Flordaglo. The longest duration (39 days) of flowering was recorded in Pratap and shortest (28 days) in Tropic Sweet and Earli Grande. Pollen viability ranged from 93.82% to 98.93% when tested by 1.0% acetocarmine and 84.19 to 97.70% by 0.1% erythrosin B. *In vitro* pollen germination varied from 62.26% to 90.39%.

4. References

- Bailey, L.H., 1963. The Standard cyclopedia of horticulture. McMillan Company, New York 3, 2423-3639.
- Beyers, E., 1962. Diagnostic leaf analysis for deciduous fruits. South African Journal of Agricultural Sciences 5, 315-329.
- Butatovic, S., 1959. A contribution to the study of the flowering period and causes of bud, flower and fruit drop in peaches in Daubian region near Smedarvo. Zborn Rad Polioferiv Fak Beograd 7(278), 1-72.
- Deol, I.S., Singh, O.S., 1986. Studies on morphological characters of peach (*Prunus persica* Batsch) cultivars under Punjab conditions. The Punjab Horticultural Journal 26(1/4), 56-60.
- Josan, J.S., Sharma, J.N., Arora, P.K., Vij, V.K., 1999. Evaluation of low chilling peaches under arid irrigated region of Punjab. Indian Journal of Horticulture 56(1), 19-22.
- Kanwar, J.S., Chanana, Y.R., Kaundal, G.S., 2002. Development of new cultivars of peach for the sub-tropics of India. Acta Horticulturae 592, 103-107.
- Kuden, A., Imrak, B., Rehber, Y., 2004. Peach, Nectarine and plum growing possibilities under subtropical conditions of Turkey and North Cyprus. Acta Horticulturae 662, 119-121.
- Panse, V.G., Sukhatme, P.V., 1961. Statistical methods for agricultural workers. 2nd edition, ICAR, New Delhi. 361.
- Lawrynowicz, R., 1968. Investigation on the relationship between the start of flowering of fruit trees and the weather. Ber-dtsch Wetterdiest Offenboch 15(111), 1-32.
- Sharma, S.D., Mehta, N.K., 1992. Studies on the floral biology, duration of leaf fall and dormancy of some introduced peach cultivars. The Horticultural Journal 5(2), 73-77.
- Sharma, S.D., Tripathi, S.N., 1979. Note on the pollen viability and germination of peach cultivars. Indian Journal of Horticulture 36(2), 126-127.
- Singh, A.K., Sharma, R.M., Kher, R., Jasrotia, A., 2005. Introduction and evaluation of pear and peach cultivars under sub-tropics of Jammu region. Acta Horticulturae 696, 25-29.
- Singh, D., Yeptomhi, G.I., Kumar, K., 2014. Performance of some lowchill peach, *Prunus persica* (L.) Batsch germplasm accessions for fruit quality traits in himachal Pradesh. International Journal of farm Science 4(3), 72-80.
- Singh, S.N., 1961. Studies on the pollen germination of peaches. Horticulture Advance 3, 76-81.
- Strand, L.L., 1999. Integrated pest management for stone fruits. University of California, Division of Agriculture and Natural Resources, 1111 Franklin Street, Oakland CA. 121.
- Tabuenca, M.C., Herrero, J., 1966. The effect of temperature on time of flowering in fruit trees. Anales de la Estacion. Experimental de Aula Dei 8, 115-153.
- Tandon, S., 2006. Studies on evaluation of some apricot, peach and plum introductions. M.Sc. Thesis, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, India.
- Thakur, S.S., 1969. Studies on pollen morphology and pollen germination in some drupes. M.Sc. Thesis, Punjab University.