

Evaluation of the Performance of Parental Line and their F₁ Hybrids for Yield and Quality Traits in Brinjal (*Solanum melongena* L.)

Original Research Article

ABSTRACT

Brinjal or eggplant (*Solanum melongena* L.) is one of the most important cultivated solanaceous vegetable, mainly grown for its edible fruits. The present investigation was carried out in order to obtain *per se* performance of parents and their cross combinations for genetic improvement in brinjal. Ten parents were crossed in diallel fashion excluding reciprocal. Half diallel set of crosses and their all possible 45 F₁'s (excluding reciprocals) in brinjal (*Solanum melongena* L.) were evaluated in Randomized Complete Block Design (RBD) with three replications for nineteen yield and yield contributing traits during *Kharif* 2020-21 (Y₁) and 2021-22 (Y₂) at the Main Experiment Station (MES) of Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.) India. The study revealed that highly significant differences were observed for most of the traits under study. Based on the *per se* performance, the parent P₉ (2.61 kg) registered highest fruit yield per plant followed by P₇ (2.49 kg) in both the year and pooled. The *per se* performance of crosses viz., P₂ x P₉ (3.11 kg), P₄ x P₆ (2.66 kg), P₁ x P₈ (2.55 kg) and P₆ x P₇ (2.42 kg) were produced significantly highest fruit yield per plant than the general mean. These hybrids may be subjected to multi-locational and multi-seasonal trials for their release for commercial cultivation. The findings with respect to salinity tolerance must be correlated to develop the salt tolerant cultivars.

Keywords: *Per se* performance; brinjal; half diallel; yield; hybrids.

1. INTRODUCTION

Brinjal or eggplant (*Solanum melongena* L. 2n=24) is one of the most cultivated solanaceous vegetable, which is mainly grown for its edible fruit. In India it is known by many regional name viz., Baigan (Hindi), Badanekai (Kannada), Vangi (Marathi), Katharikai (Tamil), Vankai (Telugu) while in worldwide it is popularly known as aubergine (France) or guinea squash. It is the most popular and major fruit vegetable crop in India and many other countries of the world. It is a perennial plant but grown as an annual crop. It is a flexible crop adapted to different agro-climatic regions and can be grown throughout the year. It is an important crop in the tropical regions of world and is being grown commonly in India, China, Turkey, Japan, Italy, Indonesia, Iraq, Syria, Spain and Phillipines.

Its immature fruits are generally used as vegetable and other culinary preparations, unripe fruit is essentially consumed as cooked vegetable in various forms and the dried shoots are used as firewood in rural areas. Brinjal is consumed by many ways like salad, bhaji, stuffed

brinjal, bhārtha, pickles etc., has made the brinjal is more popular vegetables in India. Its fruits are widely consumed in various culinary preparations and are rich source of protective nutrients [1].

Globally, India ranked second in vegetable production next to China and contributed 10.80 M ha and 196.26 MT to global vegetable area and production, respectively. In India, brinjal occupies an area of 0.758 million hectares with 13.154 million tonnes of annual production which have the 17.5 tonnes per hectare productivity [2]. In Uttar Pradesh brinjal is existence in cultivation on an area of 0.080 million hectare with annual production of 2.75 million tonnes with 34.40 tonnes per hectare productivity. In Uttar Pradesh, Agra, Meerut, Lucknow, Kanpur, Aligarh, Chitrakoot and Gorakhpur district share more area and production in the state [3].

The peel of brinjal have a great amount of anthocyanin. A higher anthocyanin (0.16-1.04 g/100 g) and glyco-alkaloid level (6.25-20.50mg/100 g) low in brinjal which are essential for good fruit quality. These antioxidant act as anti-ageing agent. In particular antioxidant found

in brinjal helps prevent skin cancer. Brinjal is also a good source of bone building vitamin K and magnesium as well as heart healthy copper which give nourishment to your scalp and keep it healthy. White brinjal are highly beneficial for regulation of blood sugar levels in human body and also controls absorption of glucose. This makes them the best option for people suffering from diabetes.

A number of cultivars are under cultivation depending upon the yield, consumer preference about the colour, size and shape of the fruit. But it is not possible to have one common cultivar to suit different localities and local preferences. It is therefore required to improve the locally preferred cultivars for yield and adaptation or development of new hybrid combinations. Earlier, egg plant breeding was relied both on mass selection and pure line selection from land races for the development of improved varieties. Brinjal, being native to India and often cross pollinated crop, possesses considerable diversity for plant type, fruit colour, fruit shape, fruit size, yield and other quality traits [4], which offers much scope for improvement through heterosis breeding.

The selection of parents is the important step in heterosis breeding which could combine well and produce desirable hybrids. Several research workers reported the importance of genetic diversity in crops Reddy et al. [5], Triveni et al. [6] and Srivatsava et al. [7] with this perception, the present investigation was carried out with the objective to study the *per se* performance of parents and hybrids for yield and quality traits.

2. MATERIALS AND METHODS

The present investigation was carried out at the main experiment station, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (UP), India, during *Kharif*, 2020-21 (Y_1) and 2021-22 (Y_2). The experimental farm falls under humid subtropical climate and is located between 24.47° and 26.56°N latitude and 82.12° and 83.58°E longitude at an altitude of 113 m above mean sea level. The experimental materials comprised of ten promising and diverse inbreds and varieties of brinjal selected on the basis of genetic variability from the germplasm stock maintained in the department. The selected parental lines *i.e.*; Balfahava (P_1), Punjab Sadabahar (P_2), NDB-3 (P_3), NDB-2 (P_4), NDB White-1 (P_5), PusaKranti (P_6), Pant Samrat (P_7),

MuktaKeshi (P_8), NDB Sel-1 (P_9) and Co-2 (P_{10}) were crossed in all possible cross combinations, excluding reciprocals, following diallel mating design during the year, 2019-20 to get 45 F_1 's for the study of mean performance of parental line and their resultant F_1 . Emasculation followed by covering of flower with fine cotton was done in the evening and pollination was done around 7-9 AM in the next morning.

The experiments were conducted in a Randomized Complete Block Design (RBD) with three replications to assess the performance of 45 F_1 's hybrids and their 10 parental lines of brinjal. The crop was planted in two rows spaced at 75 cm apart with a plant to plant spacing of 60 cm. The experiments were transplanted on 12 August, 2020 and 17 August, 2021 in salinity stress condition. The soil of the experimental plot was saline alkali with pH more than 8, Sodium Absorption Ratio (SAR) 35.12, Cation Exchange Capacity (CEC) 17.60 c mol (p^+) kg^{-1} and the Electrical Conductivity (EC) was 0.31 ds/m.

Observations were recorded for nineteen economic traits including biochemical traits, *viz.* days to 50% flowering, days to first fruit harvest, leaf length (cm), leaf width (cm), plant height (cm), number of primary branches per plant, harvest duration (days), fruit length (cm), fruit equatorial circumference (cm), number of fruits per plant, average fruit weight (kg), marketable fruit yield per plant (kg), unmarketable fruit yield per plant (kg), reducing sugars (%), non-reducing sugar (%), total sugars (%), chlorophyll content (mg/g), total phenol content and total fruit yield per plant (kg). *Per se* performance were evaluated for parents and hybrids following method suggested by Panse and Sukatme [8] for analysis of variance of experimental for nineteen yield and yield contributing traits.

3. RESULTS AND DISCUSSION

The success of any breeding programme depends on the identification of suitable parents and selection of proper breeding methodology for the improvement of a specific trait. The selection of parents with high *per se* performance would be of merit in producing better hybrids and hence the parents selected for crossing programme were evaluated based on their *per se* performance.

Perusal of Table 1 revealed that the pooled analysis of variance divided in the source of variation into environments, replication, environments x replication, genotypes and

environments x genotypes. Mean squares due to environment was found highly significant for all the traits under study except primary branches per plant, reducing sugars, non-reducing sugar and total sugars. Mean squares due to replication and environments x replication were found significant for only one traits *i.e.* primary branches per plant in replication and number of fruits per plant in environments x replication under the study. The mean squares due to genotypes and environments x genotypes were found highly significant for all the traits under study during over season (pooled). The results are in corroboration with findings of Srivatsava et al. [7], Pidigam et al., [9], Ravali et al. [4], Reddy et al. [5] and Triveni et al. [6].

Among the parents highest *per se* performance (Table 2) for most desirable traits total fruit yield per plant were exhibited by parents P₉ and P₇ in both the season (Y₁, Y₂) and in over season (pooled). The above mentioned genotypes may be used as donor parents in hybridization programme for developing high yielding varieties of respective groups. Some other genotypes exhibiting very high mean performance for the characters other than total fruit yield per plant are also listed in Table-2. In this context, none of the parents found significantly early for days to 50 % flowering and days to first fruit harvest.

For quality traits, most desirable parents P₃ followed by P₁ and P₇ for reducing sugars in both the season (Y₁, Y₂) as well as in over season pooled recorded higher values over the grand mean. Maximum non-reducing sugar among the parents was observed in parent P₁₀ in Y₁, Y₂ and in over season pooled. Maximum total sugars was exhibited by parents P₃ followed by P₁ and P₉ in both the season (Y₁, Y₂) as well as in over season pooled. Parents P₄ and P₈ in Y₁ and in over season pooled while, none of the parents in Y₂ showed significant chlorophyll content among the parents over the grand mean. Parental line P₉ in Y₁ while, the parents P₄ and P₇ in Y₂ and P₄ in over season pooled were exhibited maximum total phenol content over the grand mean. The above results are in confirmity with the findings of earlier workers (Kanchana, et al., [10], Timmareddygar, et al. [11], Kumar et al. [12]).

Among the hybrids highest mean performance (Table 2) for most desirable traits total fruit yield per plant were exhibited by cross combination P₂ x P₉ followed by P₆ x P₇, P₇ x P₈, P₇ x P₉ and P₁ x P₇ in Y₁, P₂ x P₉ followed by P₆ x P₇, P₇ x P₈, P₇ x

Table 1. ANOVA (mean squares) for a set of 10 x 10 diallel crosses for different traits in brinjal during over season pooled

Source of variation	d.f	Days to 50% flowering	Days to first fruit harvest	Leaf length	Leaf width	Plant height	Primary branches per plant	Crop duration	Fruit length	Fruit equatorial circumference	Number of fruits per plant
Environment	1	163.10**	598.05**	5.56**	15.14**	108.10**	0.50	2581.60**	1.30**	1.65**	20.68**
Replication	2	1.09	0.55	1.96	0.37	47.51	1.11**	11.28	0.62	0.75	0.80
Env. x Rep.	2	0.20	0.07	1.03	0.06	19.36	0.35	0.22	0.31	0.08	3.53**
Genotypes	54	11.41**	14.42**	6.87**	4.77**	157.02**	2.19**	26.47**	28.82**	29.24**	107.19**
Env. x geno.	54	10.52**	8.66*	7.35**	3.52**	175.21**	2.35**	19.36**	12.39**	8.01**	78.01**
Error	216	4.38	4.83	0.91	0.16	36.52	0.16	10.46	0.47	0.39	1.51

Source of variation	d.f	Average fruit weight	Marketable fruit yield per plant	Unmarketable fruit yield per plant	Reducing sugar	Non reducing sugar	Total sugar	Chlorophyll content	Total Phenol content	Total fruit yield per plant
Environment	1	57.43**	0.662**	0.597**	0.001	0.000	0.002	0.157**	0.048**	2.419**
Replication	2	31.28	0.017	0.020	0.014	0.003	0.006	0.076	0.006	0.001
Env. x Rep.	2	12.30	0.009	0.000	0.000	0.001	0.001	0.016	0.001	0.012
Genotypes	54	2923.14**	0.591**	0.077**	0.271**	0.034**	0.315**	0.088**	0.102**	0.793**
Env. X geno.	54	1052.30**	0.418**	0.067**	0.107**	0.021**	0.116**	0.061**	0.112**	0.485**
Error	216	25.52	0.008	0.002	0.003	0.001	0.003	0.005	0.002	0.010

*, ** Significant at 5 per cent and 1 per cent probability levels, respectively

Table 2. Mean performance, general mean, range, coefficient of variation and critical difference for nineteen characters of diallel set of 45 F₁'s and their 10 parents in Y₁ (2020-21), Y₂ (2021-22) and pooled

Sr. No.	Genotypes	Days to 50% flowering			Days to first fruit harvest			Leaf length (cm)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
1	P ₁ × P ₂	46.67	45.00	48.33	67.67	64.67	68.50	13.01	13.43	12.69
2	P ₁ × P ₃	47.33	45.67	47.68	70.67	67.67	69.00	13.51	13.50	13.10
3	P ₁ × P ₄	48.00	46.00	49.50	72.67	67.67	68.17	12.84	11.61	12.29
4	P ₁ × P ₅	48.67	45.67	47.33	70.82	69.67	70.67	11.49	14.45	13.89
5	P ₁ × P ₆	51.00	49.00	48.83	71.91	70.33	70.33	13.59	13.34	13.32
6	P ₁ × P ₇	48.67	46.67	49.68	72.19	71.00	70.33	13.39	13.33	11.99
7	P ₁ × P ₈	50.67	48.67	50.00	70.67	69.33	71.33	12.99	13.07	13.02

Sr. No.	Genotypes	Days to 50% flowering			Days to first fruit harvest			Leaf length (cm)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
8	P ₁ × P ₉	47.67	48.33	48.83	69.00	67.67	67.67	13.05	9.50	13.04
9	P ₁ × P ₁₀	49.67	50.33	49.67	70.33	70.33	70.67	13.28	12.91	13.37
10	P ₂ × P ₃	50.33	49.67	51.00	70.73	69.67	72.50	12.20	12.08	11.83
11	P ₂ × P ₄	49.00	47.00	46.83	72.00	69.00	68.33	9.94	9.76	11.38
12	P ₂ × P ₅	46.33	50.33	48.83	69.00	69.33	70.00	14.29	14.61	14.06
13	P ₂ × P ₆	52.33	51.33	49.67	72.01	70.33	71.50	14.36	14.09	13.47
14	P ₂ × P ₇	49.67	48.33	48.50	70.67	69.00	69.91	14.65	13.96	12.72
15	P ₂ × P ₈	49.00	49.67	52.33	72.34	68.67	70.29	11.92	12.19	12.89
16	P ₂ × P ₉	47.00	45.67	47.17	68.33	67.00	69.60	12.83	12.92	13.15
17	P ₂ × P ₁₀	47.00	48.67	49.67	71.67	69.67	70.17	11.82	11.62	12.30
18	P ₃ × P ₄	47.33	46.33	47.00	70.00	67.33	68.17	14.78	15.23	14.14
19	P ₃ × P ₅	48.67	46.33	48.00	71.63	68.33	69.33	16.20	16.63	14.95
20	P ₃ × P ₆	46.67	47.33	48.83	68.63	66.33	68.53	11.87	11.86	12.03
21	P ₃ × P ₇	45.33	48.00	48.50	67.67	66.67	69.33	12.82	13.24	11.69
22	P ₃ × P ₈	45.67	47.00	46.67	65.67	66.00	67.50	10.45	10.77	12.53
23	P ₃ × P ₉	46.67	45.00	48.67	72.33	69.00	70.50	14.65	14.57	14.45
24	P ₃ × P ₁₀	47.00	48.67	49.17	71.51	68.00	69.33	9.74	10.08	12.37
25	P ₄ × P ₅	52.33	49.67	49.33	71.00	69.67	71.00	13.78	13.41	12.66
26	P ₄ × P ₆	50.00	49.33	48.17	71.67	70.67	69.50	12.55	12.24	12.53
27	P ₄ × P ₇	50.67	48.33	47.67	73.00	69.00	70.33	12.08	12.16	11.99
28	P ₄ × P ₈	50.33	48.33	47.83	72.67	69.00	69.50	12.81	13.11	13.95
29	P ₄ × P ₉	52.67	50.00	49.33	71.93	70.33	70.98	12.49	12.33	14.26
30	P ₄ × P ₁₀	49.67	47.67	47.17	70.74	68.00	68.32	11.03	11.55	11.71
31	P ₅ × P ₆	47.67	45.67	45.50	68.05	65.33	66.50	14.56	16.46	14.64
32	P ₅ × P ₇	53.00	51.00	48.33	72.00	69.33	67.50	12.95	12.91	11.68
33	P ₅ × P ₈	47.67	45.67	46.17	67.33	68.33	70.33	16.34	14.20	14.43
34	P ₅ × P ₉	52.00	49.67	48.33	74.82	69.00	70.25	13.79	17.03	13.38
35	P ₅ × P ₁₀	52.33	49.67	51.00	71.78	71.33	71.17	17.51	13.37	13.57
36	P ₆ × P ₇	45.33	44.67	47.33	66.00	63.67	67.67	15.23	15.73	14.14
37	P ₆ × P ₈	50.00	50.00	50.33	69.00	66.33	69.67	14.07	15.53	13.81
38	P ₆ × P ₉	49.00	49.00	49.67	67.19	66.00	69.33	14.33	13.81	13.31
39	P ₆ × P ₁₀	50.33	47.67	50.17	68.31	66.67	69.30	14.58	13.50	13.00
40	P ₇ × P ₈	49.00	46.00	47.83	69.00	65.00	67.87	15.50	15.24	13.13
41	P ₇ × P ₉	49.67	46.00	46.83	68.98	65.00	66.53	14.12	13.35	13.96

Sr. No.	Genotypes	Days to 50% flowering			Days to first fruit harvest			Leaf length (cm)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
42	P ₇ × P ₁₀	47.67	47.00	50.00	67.42	66.33	69.17	13.24	13.60	13.28
43	P ₈ × P ₉	45.33	46.00	46.83	66.03	65.00	66.17	14.51	14.87	15.60
44	P ₈ × P ₁₀	51.00	48.67	50.33	72.67	69.67	72.24	11.27	12.39	13.09
45	P ₉ × P ₁₀	50.00	47.67	50.00	68.65	66.67	69.39	13.66	13.25	15.38
F₁ Hybrid mean		48.93	47.90	48.61	70.19	68.05	69.43	13.34	13.31	13.20
Parents										
1	P ₁	51.67	48.67	50.17	72.33	70.00	71.17	11.95	11.61	11.78
2	P ₂	49.67	49.00	49.33	70.33	69.33	69.83	12.69	12.63	12.66
3	P ₃	53.00	50.00	51.50	68.67	67.33	68.00	12.96	13.57	13.26
4	P ₄	49.00	50.67	49.83	71.67	68.67	70.17	13.33	13.69	13.51
5	P ₅	48.67	48.00	48.33	70.33	67.00	68.67	13.30	13.97	13.64
6	P ₆	49.67	47.33	48.50	69.67	65.67	67.67	10.65	10.71	10.68
7	P ₇	51.33	49.67	50.50	73.33	69.67	71.50	12.97	13.32	13.14
8	P ₈	49.33	48.33	48.83	67.67	67.33	67.50	12.58	12.23	12.41
9	P ₉	49.00	47.00	48.00	71.00	68.00	69.50	13.82	13.61	13.72
10	P ₁₀	52.33	50.67	51.50	75.33	72.00	73.67	11.57	11.42	11.49
Parental mean		50.37	48.93	49.64	71.03	68.50	69.76	12.58	12.67	12.62
Grand mean		49.19	48.08	48.82	70.34	68.13	69.49	13.20	13.19	13.09
CV		4.16	4.33	3.60	3.43	2.93	2.67	6.83	8.17	6.27
CD 5%		3.27	3.33	2.84	3.86	3.19	2.99	1.44	1.72	1.34
Range	Lowest	45.33	44.67	45.5	65.67	63.67	66.17	9.74	9.50	10.68
	Highest	53.00	51.33	52.33	75.33	72.00	73.67	17.51	17.03	15.06

Table 2. Contd...

Sr. No.	Genotypes	Leaf width (cm)			Plant height (cm)			Primary branches /plant		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
1	P ₁ × P ₂	8.46	8.42	7.87	72.63	76.27	78.72	5.13	5.30	5.61
2	P ₁ × P ₃	7.90	7.80	8.06	74.15	73.78	75.00	5.33	5.53	5.70
3	P ₁ × P ₄	9.11	7.25	7.69	72.31	76.26	68.49	6.46	6.58	6.11
4	P ₁ × P ₅	7.50	9.09	8.20	71.15	73.78	71.98	6.07	6.25	5.84
5	P ₁ × P ₆	7.75	7.71	8.14	68.31	70.26	72.06	5.92	6.01	6.17
6	P ₁ × P ₇	7.84	7.64	7.01	92.94	71.36	71.52	5.95	5.86	5.95
7	P ₁ × P ₈	7.54	8.38	7.68	69.50	68.56	86.21	6.16	7.74	6.53

Sr. No.	Genotypes	Leaf width (cm)			Plant height (cm)			Primary branches /plant		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
8	P ₁ × P ₉	7.56	9.46	8.81	72.85	69.21	74.98	5.96	6.49	6.41
9	P ₁ × P ₁₀	7.66	7.53	8.29	70.13	90.06	71.50	6.18	5.87	6.04
10	P ₂ × P ₃	7.56	8.43	7.89	74.42	68.29	83.00	5.96	6.47	6.38
11	P ₂ × P ₄	6.03	6.65	7.56	83.77	71.62	76.56	5.92	6.29	5.71
12	P ₂ × P ₅	8.07	8.77	8.34	74.34	95.62	73.55	5.88	7.48	6.40
13	P ₂ × P ₆	9.19	9.17	9.14	71.89	80.48	83.10	6.54	6.69	6.57
14	P ₂ × P ₇	10.78	9.46	8.48	69.47	72.94	74.61	5.88	6.08	6.07
15	P ₂ × P ₈	7.54	8.20	7.98	94.17	93.88	74.92	6.18	7.87	6.90
16	P ₂ × P ₉	9.55	7.92	7.88	76.95	78.06	83.02	4.68	4.68	5.32
17	P ₂ × P ₁₀	7.62	6.84	7.19	72.11	81.53	79.00	5.00	5.18	5.68
18	P ₃ × P ₄	7.77	6.91	7.24	74.26	73.10	75.03	5.86	5.98	5.97
19	P ₃ × P ₅	9.77	9.96	8.81	68.50	68.50	69.15	6.15	6.15	6.17
20	P ₃ × P ₆	9.26	8.24	7.90	78.48	77.21	75.99	3.64	3.71	4.84
21	P ₃ × P ₇	8.28	8.35	7.19	72.16	68.17	88.77	5.86	5.41	5.67
22	P ₃ × P ₈	7.16	7.26	7.67	95.99	77.56	76.96	6.08	6.15	6.01
23	P ₃ × P ₉	11.17	10.27	9.73	84.82	93.76	81.69	4.42	4.57	5.55
24	P ₃ × P ₁₀	6.55	6.72	8.75	69.25	79.57	71.09	4.50	5.23	5.55
25	P ₄ × P ₅	7.38	8.62	8.08	70.44	91.49	84.07	6.92	6.70	6.44
26	P ₄ × P ₆	6.98	8.09	8.82	68.40	72.71	74.38	6.08	6.50	5.59
27	P ₄ × P ₇	7.91	8.81	8.22	72.84	73.97	74.30	5.38	5.57	5.28
28	P ₄ × P ₈	8.36	10.50	9.13	68.90	71.82	73.30	4.96	4.66	5.26
29	P ₄ × P ₉	10.16	11.39	10.58	72.60	76.48	68.73	6.03	6.27	6.21
30	P ₄ × P ₁₀	8.24	8.80	9.09	95.31	72.34	75.64	5.79	6.49	5.07
31	P ₅ × P ₆	7.87	9.20	8.74	66.92	68.97	80.14	6.46	4.82	5.34
32	P ₅ × P ₇	8.63	8.63	7.90	76.15	72.79	84.17	5.69	6.16	6.12
33	P ₅ × P ₈	9.03	9.13	10.15	77.05	88.12	74.20	4.88	7.46	5.94
34	P ₅ × P ₉	7.51	10.78	8.66	75.62	72.35	74.47	3.68	6.55	5.52
35	P ₅ × P ₁₀	12.76	7.66	7.52	78.26	63.57	71.14	5.63	4.59	5.75
36	P ₆ × P ₇	11.52	10.97	8.97	85.19	79.68	73.67	5.30	5.78	5.93
37	P ₆ × P ₈	11.34	8.06	7.99	72.36	71.84	82.22	3.64	4.15	4.77
38	P ₆ × P ₉	9.75	9.75	9.05	76.06	78.94	74.38	4.79	4.81	4.88
39	P ₆ × P ₁₀	8.85	9.84	10.00	79.89	91.60	81.29	4.21	3.64	4.83
40	P ₇ × P ₈	11.06	10.88	9.56	71.43	79.87	85.15	6.37	6.31	6.05
41	P ₇ × P ₉	8.90	8.81	8.34	93.08	89.98	66.34	4.88	4.85	5.66

Sr. No.	Genotypes	Leaf width (cm)			Plant height (cm)			Primary branches /plant		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
42	P ₇ × P ₁₀	7.91	9.33	8.98	69.22	75.00	83.12	4.88	5.06	5.38
43	P ₈ × P ₉	9.31	9.38	9.20	79.28	65.76	74.02	3.71	3.83	4.35
44	P ₈ × P ₁₀	8.18	8.22	7.87	72.89	90.09	72.43	4.59	5.22	4.45
45	P ₉ × P ₁₀	8.93	8.80	10.78	70.79	70.99	72.75	3.46	3.80	4.71
F₁ Hybrid mean		8.63	8.17	8.46	75.94	76.77	76.37	5.40	5.71	5.70
Parents										
1	P ₁	7.32	7.80	7.56	81.17	76.95	79.06	5.91	6.43	6.17
2	P ₂	8.32	8.21	8.27	76.22	78.27	77.25	5.88	5.69	5.79
3	P ₃	8.13	8.36	8.24	66.71	70.05	68.38	5.65	5.71	5.68
4	P ₄	7.31	7.13	7.22	72.60	76.90	74.75	5.44	5.62	5.53
5	P ₅	8.56	8.84	8.70	75.56	75.68	75.62	6.32	6.87	6.59
6	P ₆	6.37	6.90	6.64	73.84	77.53	75.68	6.04	7.32	6.68
7	P ₇	6.99	7.28	7.13	82.36	76.81	79.58	5.31	5.06	5.19
8	P ₈	8.17	8.17	8.17	81.66	78.25	79.95	6.33	6.69	6.51
9	P ₉	9.06	8.84	8.95	71.37	74.94	73.15	6.20	6.61	6.41
10	P ₁₀	7.35	7.50	7.43	70.39	73.91	72.15	6.28	7.43	6.86
Parental mean		7.76	7.90	7.83	75.19	75.92	75.55	5.94	6.34	6.14
Grand mean		8.47	8.57	8.35	75.80	76.62	76.22	5.50	5.81	5.78
CV		4.61	5.33	4.09	8.89	7.65	7.03	8.31	5.91	5.78
CD 5%		0.62	0.73	0.57	10.79	9.38	8.68	0.73	0.55	0.53
Range										
Lowest		6.03	6.65	6.64	66.71	63.57	66.34	3.46	3.64	4.35
Highest		12.76	11.39	1.78	95.99	95.62	88.77	6.92	7.87	6.90

Table 2. Contd...

Sr. No.	Genotypes	Crop duration (Days)			Fruit length (cm)			Fruit equatorial circumference (cm)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
1	P ₁ × P ₂	194.00	198.00	196.17	15.82	16.32	13.69	12.45	11.83	12.82

Sr. No.	Genotypes	Crop duration (Days)			Fruit length (cm)			Fruit equatorial circumference (cm)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
2	P ₁ × P ₃	193.00	198.00	192.50	13.56	13.56	15.02	10.51	10.90	9.26
3	P ₁ × P ₄	188.67	200.33	196.83	16.58	16.77	16.92	14.71	11.47	9.26
4	P ₁ × P ₅	195.67	193.67	191.83	16.64	16.48	17.84	12.59	13.14	10.82
5	P ₁ × P ₆	189.67	193.67	193.67	15.45	15.71	13.37	13.66	13.36	12.74
6	P ₁ × P ₇	185.33	196.00	193.00	12.29	15.30	14.16	13.96	12.64	14.26
7	P ₁ × P ₈	191.33	190.00	190.33	13.35	12.93	11.90	15.20	13.55	14.67
8	P ₁ × P ₉	191.33	196.00	195.00	15.11	13.90	13.64	12.30	14.36	15.76
9	P ₁ × P ₁₀	194.67	199.67	196.33	13.09	12.99	13.72	16.12	15.69	16.72
10	P ₂ × P ₃	196.00	200.67	194.67	16.97	16.57	11.92	7.75	8.29	10.44
11	P ₂ × P ₄	192.00	197.33	195.83	18.47	18.14	16.98	12.59	12.62	12.53
12	P ₂ × P ₅	193.67	196.00	194.50	13.89	15.53	14.55	12.59	10.75	10.63
13	P ₂ × P ₆	191.67	196.67	194.83	13.26	13.95	15.26	16.44	15.93	15.32
14	P ₂ × P ₇	188.00	198.33	196.50	14.20	13.89	15.27	10.01	12.66	12.62
15	P ₂ × P ₈	190.67	195.67	194.33	17.04	16.81	16.13	14.56	14.56	14.11
16	P ₂ × P ₉	190.00	195.00	191.33	16.72	16.21	14.25	11.63	12.29	13.13
17	P ₂ × P ₁₀	192.00	197.33	194.83	12.74	12.95	13.15	12.94	13.27	14.24
18	P ₃ × P ₄	188.67	194.00	192.67	18.72	17.92	16.52	10.56	11.29	11.79
19	P ₃ × P ₅	191.33	196.33	195.50	18.29	17.64	15.37	9.39	10.05	13.09
20	P ₃ × P ₆	188.33	193.33	194.00	17.62	17.13	17.05	9.94	10.98	9.36
21	P ₃ × P ₇	189.00	194.00	193.00	14.35	13.83	16.15	11.67	11.56	12.07
22	P ₃ × P ₈	198.00	168.67	199.00	13.13	13.47	13.68	11.32	11.61	12.10
23	P ₃ × P ₉	190.67	198.67	195.17	16.70	16.10	14.68	10.96	12.29	14.37
24	P ₃ × P ₁₀	193.67	198.67	194.50	15.34	14.85	14.52	11.95	12.19	11.10
25	P ₄ × P ₅	195.00	200.00	195.33	17.29	16.55	16.80	11.35	11.20	12.88
26	P ₄ × P ₆	191.67	197.00	193.50	18.19	17.46	17.09	11.76	12.06	11.84
27	P ₄ × P ₇	196.67	200.67	197.50	17.07	16.74	14.74	11.60	11.76	12.35
28	P ₄ × P ₈	194.67	199.33	195.67	13.17	13.03	15.88	13.14	12.50	11.53
29	P ₄ × P ₉	192.33	197.00	194.17	16.04	15.29	16.79	12.55	12.23	10.81
30	P ₄ × P ₁₀	194.00	198.00	193.17	13.99	13.99	15.80	12.14	12.13	11.03
31	P ₅ × P ₆	190.67	200.33	194.67	16.37	11.17	12.76	13.98	12.91	12.29
32	P ₅ × P ₇	191.33	196.33	197.17	14.74	14.66	13.90	15.10	15.10	13.31
33	P ₅ × P ₈	196.33	195.67	193.17	11.65	16.37	16.54	13.49	13.46	12.31
34	P ₅ × P ₉	194.00	198.00	195.83	13.82	12.09	13.71	12.78	13.23	12.59
35	P ₅ × P ₁₀	193.33	199.33	197.17	12.09	13.53	15.41	13.14	13.36	12.36

Sr. No.	Genotypes	Crop duration (Days)			Fruit length (cm)			Fruit equatorial circumference (cm)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
36	P ₆ × P ₇	191.33	196.67	194.17	17.19	19.27	18.73	13.21	12.88	12.32
37	P ₆ × P ₈	195.33	199.33	199.83	12.63	12.93	15.00	12.46	15.96	13.78
38	P ₆ × P ₉	192.33	196.67	195.67	13.02	12.54	12.85	13.99	13.96	13.55
39	P ₆ × P ₁₀	195.67	200.33	196.33	12.89	13.30	14.67	15.99	12.34	12.44
40	P ₇ × P ₈	197.00	201.67	197.83	17.26	16.48	15.23	10.88	10.51	11.33
41	P ₇ × P ₉	192.67	194.67	192.67	12.85	12.85	14.61	12.17	16.61	15.30
42	P ₇ × P ₁₀	189.67	196.67	195.67	12.85	12.67	13.17	16.85	12.11	13.61
43	P ₈ × P ₉	197.00	201.00	198.67	10.89	11.23	11.44	13.89	14.29	13.89
44	P ₈ × P ₁₀	190.33	195.33	194.67	7.72	11.16	12.49	14.74	15.28	14.03
45	P ₉ × P ₁₀	197.33	201.33	197.33	8.92	8.44	10.26	13.88	13.36	13.25
F₁ Hybrid mean		192.58	196.70	195.03	14.67	14.68	14.74	12.78	12.77	12.66
Parents										
1	P ₁	194.33	199.33	196.83	11.05	11.29	11.17	13.82	13.88	13.85
2	P ₂	187.00	194.33	190.67	16.47	16.79	16.63	7.63	7.32	7.47
3	P ₃	193.33	198.00	195.67	17.07	17.20	17.13	7.04	7.44	7.24
4	P ₄	190.00	194.00	192.00	19.20	17.45	18.32	8.49	8.16	8.33
5	P ₅	192.33	198.00	195.17	11.03	10.90	10.96	12.13	11.63	11.88
6	P ₆	190.00	194.33	192.17	13.03	13.63	13.33	15.88	15.16	15.52
7	P ₇	190.33	195.00	192.67	10.88	11.98	11.43	15.78	15.65	15.71
8	P ₈	192.00	197.00	195.50	13.39	12.99	13.19	17.15	16.91	17.03
9	P ₉	191.00	195.33	193.17	14.44	14.32	14.38	17.74	17.99	17.87
10	P ₁₀	189.00	194.00	191.50	7.27	7.14	7.30	12.58	12.52	12.55
Parental mean		190.93	195.93	193.53	13.38	13.36	13.38	12.82	12.66	12.74
Grand mean		192.28	196.56	194.76	13.43	14.44	14.49	12.78	12.75	12.68
CV		1.58	1.70	1.33	4.06	5.24	3.79	5.52	5.22	4.36
CD 5%		4.88	5.93	4.19	0.93	1.21	0.89	1.13	1.06	0.90
Range										
Lowest		185.33	168.27	190.33	7.27	7.14	7.3	7.04	7.32	7.24
Highest		198.00	201.67	199.83	19.20	19.27	18.73	17.74	17.99	17.87

Table 2. Contd...

Sr. No.	Genotypes	Number of fruits /plant			Average fruit weight (g)			Marketable fruit yield per plant (kg)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled

Sr. No.	Genotypes	Number of fruits /plant			Average fruit weight (g)			Marketable fruit yield per plant (kg)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
1	P ₁ × P ₂	16.90	16.57	16.24	108.47	108.69	115.56	1.04	1.00	1.29
2	P ₁ × P ₃	20.24	22.58	26.28	80.07	80.44	65.04	1.24	1.21	1.03
3	P ₁ × P ₄	31.20	22.92	27.88	78.12	84.71	69.86	1.48	1.33	1.18
4	P ₁ × P ₅	22.55	28.42	27.06	83.77	77.93	67.06	1.34	1.44	1.12
5	P ₁ × P ₆	23.18	23.18	23.02	78.54	78.42	77.85	1.09	1.09	1.20
6	P ₁ × P ₇	31.69	26.55	22.47	102.87	76.95	92.21	1.81	1.39	1.43
7	P ₁ × P ₈	23.88	28.60	24.27	112.46	95.78	109.72	1.92	1.82	1.87
8	P ₁ × P ₉	23.83	22.88	19.35	76.26	107.39	117.03	1.37	1.93	1.73
9	P ₁ × P ₁₀	31.36	30.93	24.17	58.46	63.07	107.32	1.13	1.19	1.59
10	P ₂ × P ₃	34.63	34.75	32.90	45.75	43.58	56.90	0.94	0.97	0.97
11	P ₂ × P ₄	26.62	25.58	21.24	66.33	65.16	86.82	1.17	1.23	1.13
12	P ₂ × P ₅	21.81	31.62	25.93	111.35	63.77	71.92	1.92	1.45	1.34
13	P ₂ × P ₆	21.83	22.77	26.99	73.69	78.61	78.36	1.20	1.22	1.35
14	P ₂ × P ₇	33.22	22.58	22.57	63.90	111.03	97.40	1.43	1.93	1.64
15	P ₂ × P ₈	21.32	21.52	22.35	79.73	80.39	79.47	1.42	1.45	1.27
16	P ₂ × P ₉	35.88	35.62	33.65	101.30	102.35	102.61	2.40	2.46	2.13
17	P ₂ × P ₁₀	27.84	29.11	26.50	60.59	60.95	86.70	1.16	1.21	1.56
18	P ₃ × P ₄	36.45	36.91	30.37	51.75	51.93	64.10	1.28	1.30	1.34
19	P ₃ × P ₅	18.29	18.26	24.81	81.49	79.53	69.00	1.15	1.18	1.16
20	P ₃ × P ₆	18.27	18.68	26.66	82.38	83.17	64.46	1.21	1.25	1.09
21	P ₃ × P ₇	31.73	26.61	26.61	55.99	63.86	65.9	1.34	1.39	1.28
22	P ₃ × P ₈	19.34	19.76	20.78	85.13	85.65	98.50	1.13	1.19	1.55
23	P ₃ × P ₉	18.26	20.15	20.99	109.15	110.52	92.11	1.44	1.48	1.34
24	P ₃ × P ₁₀	25.26	24.96	29.09	58.95	59.91	61.90	0.83	0.86	1.14
25	P ₄ × P ₅	22.21	22.48	21.90	67.47	68.44	74.08	0.92	0.93	1.18
26	P ₄ × P ₆	25.48	24.87	30.38	76.56	76.10	88.70	1.34	1.43	1.91
27	P ₄ × P ₇	19.65	20.19	24.02	75.70	76.94	68.77	1.18	1.23	1.19
28	P ₄ × P ₈	17.31	17.43	26.94	101.53	103.35	77.55	1.44	1.46	1.37
29	P ₄ × P ₉	16.46	17.67	17.98	73.41	72.20	76.85	0.81	0.84	1.00
30	P ₄ × P ₁₀	22.11	23.47	20.87	67.36	65.60	73.99	0.91	0.92	1.06

Sr. No.	Genotypes	Number of fruits /plant			Average fruit weight (g)			Marketable fruit yield per plant (kg)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
31	P ₅ × P ₆	21.92	17.21	24.47	105.34	91.13	73.56	1.66	1.24	1.29
32	P ₅ × P ₇	19.53	20.35	19.85	104.25	103.44	94.28	1.39	1.41	1.27
33	P ₅ × P ₈	16.78	26.79	22.52	91.38	105.32	107.23	1.20	1.69	1.57
34	P ₅ × P ₉	25.18	20.65	22.95	101.99	68.53	63.74	2.28	0.93	0.88
35	P ₅ × P ₁₀	19.86	25.55	23.88	70.08	102.33	84.90	0.90	2.30	1.61
36	P ₆ × P ₇	30.34	27.76	26.62	115.21	116.07	96.32	2.18	2.22	1.78
37	P ₆ × P ₈	26.23	23.78	21.71	87.10	84.97	80.34	1.72	1.21	1.20
38	P ₆ × P ₉	20.88	26.42	21.86	103.43	104.47	103.00	1.84	1.91	1.68
39	P ₆ × P ₁₀	23.80	26.68	21.57	82.49	89.03	81.22	1.17	1.74	1.28
40	P ₇ × P ₈	21.88	23.31	22.71	127.14	127.81	97.58	2.28	2.34	1.62
41	P ₇ × P ₉	21.41	19.35	20.63	135.60	84.33	94.83	2.26	0.92	1.29
42	P ₇ × P ₁₀	16.63	21.80	20.67	84.50	122.87	113.56	0.89	2.28	1.84
43	P ₈ × P ₉	24.27	24.02	20.40	116.35	114.84	103.11	2.28	2.33	1.77
44	P ₈ × P ₁₀	18.35	18.56	21.87	95.95	96.57	99.28	1.35	1.38	1.83
45	P ₉ × P ₁₀	25.52	26.36	23.11	73.54	77.12	73.60	1.28	1.34	1.12
F₁ Hybrid mean		23.81	24.14	23.97	85.84	85.89	82.67	1.42	1.44	1.38
Parents										
1	P ₁	15.92	17.59	16.75	122.43	128.97	125.70	1.58	1.64	1.61
2	P ₂	29.98	32.73	31.36	49.65	43.19	46.42	0.84	0.88	0.86
3	P ₃	32.85	33.85	33.55	55.02	47.93	51.48	1.03	1.02	1.03
4	P ₄	25.69	27.51	26.60	56.19	52.33	54.26	0.80	0.83	0.81
5	P ₅	22.86	23.44	23.15	77.27	75.42	76.35	1.32	1.30	1.31
6	P ₆	18.38	20.41	19.39	107.47	97.33	102.40	1.47	1.45	1.46
7	P ₇	19.94	21.92	20.93	123.66	123.99	123.83	1.92	1.85	1.89
8	P ₈	15.82	17.58	16.70	126.68	123.86	125.27	1.53	1.53	1.53
9	P ₉	17.41	18.74	18.08	151.57	160.72	156.15	1.99	1.89	1.94
10	P ₁₀	31.05	29.60	30.33	70.23	47.45	58.84	0.97	0.94	0.95
Parental mean		22.99	24.33	23.68	94.02	90.12	92.07	1.35	1.33	1.33
Grand mean		23.66	24.17	23.92	87.33	86.66	84.38	1.40	1.42	1.37
CV		5.25	4.79	4.30	6.02	5.98	5.28	7.40	5.32	5.79

Sr. No.	Genotypes	Number of fruits /plant			Average fruit weight (g)			Marketable fruit yield per plant (kg)		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
CD 5%		1.99	1.85	1.67	8.42	8.30	7.45	0.16	0.12	0.13
Range	Lowest	15.82	16.57	16.24	45.75	43.19	46.42	0.80	0.83	0.81
	Highest	36.45	36.91	33.65	151.57	160.72	156.15	2.40	2.46	2.13

Table 2. Contd...

Sr. No.	Genotypes	Unmarketable fruit yield per plant (kg)			Reducing sugar			Non reducing sugar		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
1	P ₁ × P ₂	0.79	0.81	0.60	1.22	1.24	1.28	0.53	0.53	0.51
2	P ₁ × P ₃	0.43	0.50	0.55	1.14	1.15	1.15	0.45	0.40	0.38
3	P ₁ × P ₄	0.53	0.58	0.53	0.69	1.25	1.31	0.41	0.59	.55
4	P ₁ × P ₅	0.55	0.57	0.55	1.24	0.78	0.91	0.63	0.39	0.44
5	P ₁ × P ₆	0.48	0.53	0.43	0.95	0.99	0.68	0.53	0.55	0.39
6	P ₁ × P ₇	0.87	0.60	0.51	0.94	1.09	1.09	0.58	0.62	0.57
7	P ₁ × P ₈	0.38	0.79	0.69	1.17	0.95	1.10	0.55	0.58	0.55
8	P ₁ × P ₉	0.56	0.46	0.48	1.07	1.18	1.21	0.65	0.53	0.46
9	P ₁ × P ₁₀	0.47	0.57	0.62	0.97	1.01	1.10	0.60	0.60	0.55
10	P ₂ × P ₃	0.51	0.58	0.53	1.23	1.21	1.13	0.51	0.49	0.55
11	P ₂ × P ₄	0.44	0.52	0.65	1.33	1.38	1.30	0.41	0.41	0.47
12	P ₂ × P ₅	0.26	0.56	0.49	0.98	0.69	0.91	0.63	0.52	0.49
13	P ₂ × P ₆	0.36	0.48	0.51	1.30	1.30	0.99	0.52	0.48	0.45
14	P ₂ × P ₇	0.46	0.35	0.45	0.63	1.06	1.15	0.53	0.63	0.63
15	P ₂ × P ₈	0.25	0.35	0.42	1.08	1.14	1.05	0.52	0.52	0.52
16	P ₂ × P ₉	0.98	1.09	0.98	1.32	1.35	1.14	0.46	0.46	0.52
17	P ₂ × P ₁₀	0.62	0.73	0.56	1.00	1.04	1.10	0.63	0.63	0.59
18	P ₃ × P ₄	0.66	0.74	0.65	1.21	1.23	1.15	0.60	0.60	0.62
19	P ₃ × P ₅	0.28	0.48	0.47	0.88	0.90	0.93	0.41	0.41	0.50
20	P ₃ × P ₆	0.24	0.39	0.45	1.32	1.30	1.26	0.56	0.57	0.54
21	P ₃ × P ₇	0.35	0.46	0.45	0.74	0.74	1.03	0.51	0.55	0.48

Sr. No.	Genotypes	Unmarketable fruit yield per plant (kg)			Reducing sugar			Non reducing sugar		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
22	P ₃ × P ₈	0.52	0.61	0.44	0.99	0.97	0.97	0.49	0.49	0.56
23	P ₃ × P ₉	0.61	0.72	0.54	0.73	0.80	1.05	0.67	0.67	0.60
24	P ₃ × P ₁₀	0.72	0.80	0.63	0.69	0.75	0.69	0.67	0.64	0.58
25	P ₄ × P ₅	0.51	0.65	0.45	0.54	0.62	0.85	0.49	0.49	0.51
26	P ₄ × P ₆	0.36	0.52	0.75	0.67	0.86	1.09	0.69	0.63	0.54
27	P ₄ × P ₇	0.24	0.34	0.48	0.99	1.04	1.02	0.48	0.45	0.54
28	P ₄ × P ₈	0.32	0.40	0.53	0.78	0.80	1.00	0.50	0.50	0.55
29	P ₄ × P ₉	0.34	0.42	0.35	0.97	0.98	0.93	0.58	0.58	0.49
30	P ₄ × P ₁₀	0.52	0.62	0.43	0.91	0.90	1.11	0.44	0.41	0.49
31	P ₅ × P ₆	0.74	0.36	0.36	0.60	0.82	0.78	0.59	0.30	0.41
32	P ₅ × P ₇	0.37	0.41	0.46	0.66	0.71	0.85	0.58	0.53	0.51
33	P ₅ × P ₈	0.30	0.81	0.71	0.80	0.62	0.68	0.30	0.60	0.63
34	P ₅ × P ₉	0.28	0.48	0.60	0.60	0.64	0.66	0.57	0.59	0.63
35	P ₅ × P ₁₀	0.42	0.35	0.43	0.65	0.63	0.59	0.60	0.57	0.53
36	P ₆ × P ₇	0.90	0.92	0.64	0.85	0.83	0.75	0.47	0.47	0.58
37	P ₆ × P ₈	0.60	0.77	0.50	1.13	1.01	1.00	0.56	0.51	0.49
38	P ₆ × P ₉	0.48	0.54	0.43	0.79	0.88	0.83	0.64	0.63	0.56
39	P ₆ × P ₁₀	0.71	0.66	0.50	1.04	1.10	1.04	0.54	0.54	0.56
40	P ₇ × P ₈	0.59	0.64	0.58	1.18	1.11	1.01	0.44	0.44	0.44
41	P ₇ × P ₉	0.49	0.59	0.67	0.98	0.75	0.68	0.40	0.49	0.54
42	P ₇ × P ₁₀	0.53	0.55	0.46	0.77	0.94	0.80	0.49	0.40	0.49
43	P ₈ × P ₉	0.39	0.46	0.38	1.14	1.05	0.92	0.56	0.56	0.43
44	P ₈ × P ₁₀	0.37	0.45	0.37	1.31	1.29	0.94	0.45	0.44	0.51
45	P ₉ × P ₁₀	0.60	0.61	0.51	0.87	0.92	0.78	0.53	0.52	0.56
F₁ Hybrid mean		0.50	0.57	0.52	0.96	0.98	0.97	0.53	0.52	0.52
Parents										
1	P ₁	0.39	0.54	0.47	1.33	1.37	1.35	0.50	0.50	0.50
2	P ₂	0.59	0.63	0.61	1.16	1.21	1.18	0.36	0.36	0.36
3	P ₃	0.48	0.52	0.50	1.36	1.36	1.36	0.50	0.52	0.51
4	P ₄	0.53	0.57	0.55	1.05	1.07	1.06	0.49	0.49	0.49

Sr. No.	Genotypes	Unmarketable fruit yield per plant (kg)			Reducing sugar			Non reducing sugar		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
5	P ₅	0.34	0.43	0.38	0.37	0.36	0.37	0.24	0.23	0.24
6	P ₆	0.42	0.46	0.44	1.08	1.04	1.06	0.52	0.51	0.51
7	P ₇	0.58	0.62	0.60	1.24	1.31	1.28	0.43	0.43	0.43
8	P ₈	0.50	0.54	0.82	1.23	1.24	1.24	0.38	0.33	0.36
9	P ₉	0.68	0.67	0.68	1.20	1.27	1.24	0.50	0.49	0.49
10	P ₁₀	0.48	0.52	0.50	1.05	1.09	1.07	0.61	0.58	0.60
Parental mean		0.50	0.55	0.55	1.10	1.13	1.12	0.45	0.51	0.44
Grand mean		0.50	0.57	0.53	0.98	1.01	1.00	0.52	0.51	0.50
CV		10.48	8.53	8.11	4.76	5.75	4.39	6.26	6.51	4.45
CD 5%		0.08	0.07	0.07	0.07	0.09	0.07	0.05	0.05	0.05
Range	Lowest	0.24	0.34	0.35	0.37	0.36	0.37	2.24	0.23	0.24
	Highest	0.98	1.09	0.98	1.36	1.38	1.36	0.69	0.67	0.63

Table 2. Contd...

Sr. No.	Genotypes	Total sugar			Chlorophyll content (mg/g)			Total Phenol content		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
1	P ₁ × P ₂	1.75	1.77	1.80	1.38	1.47	1.35	1.38	1.19	1.06
2	P ₁ × P ₃	1.59	1.55	1.53	1.09	1.19	0.70	0.94	0.82	0.97
3	P ₁ × P ₄	1.10	1.84	1.86	1.39	1.32	1.30	1.19	1.13	1.13
4	P ₁ × P ₅	1.87	1.18	1.35	1.29	1.40	1.45	0.83	1.15	1.03
5	P ₁ × P ₆	1.48	1.54	1.08	1.13	1.17	1.17	0.99	1.08	0.95
6	P ₁ × P ₇	1.52	1.71	1.65	1.40	0.98	1.14	1.12	1.44	1.14
7	P ₁ × P ₈	1.72	1.53	1.60	1.32	1.42	1.28	1.42	1.12	1.12
8	P ₁ × P ₉	1.72	1.71	1.66	0.93	1.38	1.41	0.83	0.76	0.83
9	P ₁ × P ₁₀	1.57	1.61	1.65	1.22	1.27	1.12	0.79	1.16	1.15
10	P ₂ × P ₃	1.74	1.70	1.68	1.03	1.07	1.14	1.21	1.41	1.09
11	P ₂ × P ₄	1.74	1.79	1.77	1.03	1.09	1.24	1.12	0.94	1.16
12	P ₂ × P ₅	1.60	1.21	1.40	1.42	1.34	1.21	0.86	0.99	0.96
13	P ₂ × P ₆	1.82	1.78	1.44	1.23	1.25	1.31	0.86	0.91	1.05
14	P ₂ × P ₇	1.16	1.69	1.78	1.29	1.47	1.38	1.41	0.90	0.86
15	P ₂ × P ₈	1.60	1.66	1.57	1.22	1.26	1.20	1.32	0.84	0.92

Sr. No.	Genotypes	Total sugar			Chlorophyll content (mg/g)			Total Phenol content		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
16	P ₂ × P ₉	1.78	1.80	1.66	1.31	1.39	1.39	0.88	1.21	1.16
17	P ₂ × P ₁₀	1.63	1.67	1.70	1.05	1.11	1.21	1.08	1.12	1.27
18	P ₃ × P ₄	1.80	1.83	1.77	1.11	1.16	1.04	1.09	0.86	0.84
19	P ₃ × P ₅	1.29	1.31	1.44	1.01	1.07	1.15	0.94	0.86	0.82
20	P ₃ × P ₆	1.88	1.87	1.80	1.22	1.28	1.16	1.11	0.94	1.07
21	P ₃ × P ₇	1.25	1.29	1.52	1.48	1.48	1.25	1.35	1.09	1.11
22	P ₃ × P ₈	1.48	1.46	1.53	1.34	1.35	1.39	1.44	0.88	0.87
23	P ₃ × P ₉	1.40	1.47	1.65	1.45	1.51	1.37	0.86	1.16	1.01
24	P ₃ × P ₁₀	1.36	1.38	1.27	1.17	1.21	1.25	0.76	0.88	1.15
25	P ₄ × P ₅	1.03	1.11	1.36	1.06	1.09	1.15	1.25	0.82	1.07
26	P ₄ × P ₆	1.35	1.48	1.63	1.00	1.08	1.19	1.16	1.32	1.10
27	P ₄ × P ₇	1.47	1.48	1.55	1.22	1.28	1.17	0.94	0.87	0.97
28	P ₄ × P ₈	1.28	1.29	1.55	1.31	1.29	1.20	0.87	1.35	1.22
29	P ₄ × P ₉	1.55	1.56	1.42	1.38	1.41	1.21	1.13	1.21	1.07
30	P ₄ × P ₁₀	1.35	1.31	1.60	1.33	1.31	1.27	0.98	0.94	1.02
31	P ₅ × P ₆	1.19	1.12	1.19	1.49	1.44	1.46	0.88	1.26	1.30
32	P ₅ × P ₇	1.24	1.24	1.36	1.36	1.40	1.37	1.19	1.13	1.28
33	P ₅ × P ₈	1.10	1.22	1.31	1.41	1.54	1.49	1.21	1.01	0.94
34	P ₅ × P ₉	1.17	1.23	1.29	1.03	0.95	1.06	1.32	1.19	0.98
35	P ₅ × P ₁₀	1.25	1.20	1.12	0.91	1.09	1.07	0.82	0.94	1.10
36	P ₆ × P ₇	1.32	1.30	1.33	1.43	1.44	1.22	0.94	0.86	1.01
37	P ₆ × P ₈	1.69	1.52	1.50	1.35	1.25	1.24	1.17	1.32	1.13
38	P ₆ × P ₉	1.43	1.51	1.40	1.37	1.41	1.36	1.16	1.17	1.02
39	P ₆ × P ₁₀	1.58	1.64	1.59	1.22	1.39	1.38	0.99	0.99	1.06
40	P ₇ × P ₈	1.62	1.55	1.45	1.09	1.12	1.22	0.88	1.33	1.15
41	P ₇ × P ₉	1.37	1.24	1.22	1.03	1.21	1.35	1.17	1.19	1.04
42	P ₇ × P ₁₀	1.26	1.33	1.29	1.20	1.08	1.22	1.23	0.99	1.09
43	P ₈ × P ₉	1.71	1.61	1.36	1.42	1.42	1.41	1.34	1.17	1.19
44	P ₈ × P ₁₀	1.76	1.73	1.45	1.32	1.35	1.19	1.19	1.22	1.27
45	P ₉ × P ₁₀	1.40	1.44	1.34	1.39	1.42	1.17	0.99	0.88	0.85
F₁ Hybrid mean		1.49	1.50	1.49	1.24	1.28	1.24	1.08	1.07	1.05
Parents										
1	P ₁	1.82	1.87	1.85	1.23	1.26	1.25	0.94	0.78	0.86
2	P ₂	1.51	1.57	1.54	0.96	0.97	0.97	1.12	1.12	1.12

Sr. No.	Genotypes	Total sugar			Chlorophyll content (mg/g)			Total Phenol content		
		Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled	Y ₁	Y ₂	Pooled
3	P ₃	1.88	1.88	1.88	1.28	1.31	1.30	1.13	0.83	0.98
4	P ₄	1.53	1.56	1.55	1.49	1.34	1.42	0.91	1.42	1.16
5	P ₅	0.62	0.59	0.60	1.17	1.18	1.18	0.83	0.94	0.88
6	P ₆	1.60	1.55	1.57	1.30	1.32	1.31	0.84	1.12	0.98
7	P ₇	1.67	1.74	1.71	1.15	1.18	1.17	1.12	1.38	1.25
8	P ₈	1.61	1.57	1.59	1.43	1.35	1.39	0.90	0.83	0.86
9	P ₉	1.69	1.76	1.73	0.97	1.02	1.00	1.15	1.12	1.13
10	P ₁₀	1.66	1.67	1.67	1.21	1.24	1.23	0.78	0.79	0.79
Parental mean		1.56	1.57	1.56	1.22	1.21	1.22	0.97	1.03	1.00
Grand mean		1.50	1.51	1.51	1.24	1.27	1.24	1.06	1.06	1.04
CV		3.83	4.11	3.23	5.60	5.10	4.58	4.28	4.46	3.06
CD 5%		0.09	0.09	0.08	0.11	0.10	0.09	0.07	0.07	0.05
Range	Lowest	0.62	0.59	0.60	0.91	0.95	0.7	0.76	0.76	0.79
	Highest	1.88	1.88	1.88	1.49	1.54	1.49	1.44	1.44	1.30

Table 2. Contd...

Sr. No.	Genotypes	Total fruit yield per plant (kg)		
		Y ₁	Y ₂	Pooled
1	P ₁ × P ₂	1.83	1.81	1.90
2	P ₁ × P ₃	1.67	1.71	1.57
3	P ₁ × P ₄	2.06	1.91	1.71
4	P ₁ × P ₅	1.89	2.04	1.69
5	P ₁ × P ₆	1.57	1.62	1.64
6	P ₁ × P ₇	2.68	1.99	1.95
7	P ₁ × P ₈	2.30	2.60	2.55
8	P ₁ × P ₉	1.94	2.39	2.21
9	P ₁ × P ₁₀	1.60	1.76	2.21
10	P ₂ × P ₃	1.44	1.55	1.50
11	P ₂ × P ₄	1.60	1.75	1.79
12	P ₂ × P ₅	2.18	2.00	1.84
13	P ₂ × P ₆	1.57	1.70	1.88
14	P ₂ × P ₇	1.89	2.28	2.09
15	P ₂ × P ₈	1.67	1.80	1.68

Sr. No.	Genotypes	Total fruit yield per plant (kg)		
		Y ₁	Y ₂	Pooled
16	P ₂ × P ₉	3.38	3.54	3.11
17	P ₂ × P ₁₀	1.78	1.94	2.12
18	P ₃ × P ₄	1.94	2.04	1.99
19	P ₃ × P ₅	1.43	1.66	1.63
20	P ₃ × P ₆	1.45	1.64	1.54
21	P ₃ × P ₇	1.66	1.78	1.69
22	P ₃ × P ₈	1.64	1.80	1.99
23	P ₃ × P ₉	2.06	2.21	1.89
24	P ₃ × P ₁₀	1.55	1.66	1.77
25	P ₄ × P ₅	1.42	1.58	1.62
26	P ₄ × P ₆	1.70	1.95	2.66
27	P ₄ × P ₇	1.42	1.57	1.68
28	P ₄ × P ₈	1.76	1.86	1.90
29	P ₄ × P ₉	1.15	1.26	1.35
30	P ₄ × P ₁₀	1.42	1.54	1.50
31	P ₅ × P ₆	2.40	1.60	1.63
32	P ₅ × P ₇	1.76	1.82	1.73
33	P ₅ × P ₈	1.50	2.50	2.28
34	P ₅ × P ₉	2.56	1.41	1.48
35	P ₅ × P ₁₀	1.32	2.65	2.03
36	P ₆ × P ₇	3.08	3.14	2.42
37	P ₆ × P ₈	2.32	1.97	1.70
38	P ₆ × P ₉	2.32	2.45	2.10
39	P ₆ × P ₁₀	1.88	2.41	1.78
40	P ₇ × P ₈	2.87	2.98	2.28
41	P ₇ × P ₉	2.75	1.51	1.96
42	P ₇ × P ₁₀	1.41	2.83	2.30
43	P ₈ × P ₉	2.67	2.79	2.15
44	P ₈ × P ₁₀	1.72	1.83	2.20
45	P ₉ × P ₁₀	1.87	1.94	1.63
F₁ Hybrid mean		1.91	2.02	1.91
Parents				
1	P ₁	1.99	2.10	2.05
2	P ₂	1.43	1.51	1.47

Sr. No.	Genotypes	Total fruit yield per plant (kg)		
		Y ₁	Y ₂	Pooled
3	P ₃	1.51	1.55	1.53
4	P ₄	1.33	1.40	1.37
5	P ₅	1.65	1.73	1.69
6	P ₆	1.90	1.91	1.91
7	P ₇	2.50	2.47	2.49
8	P ₈	2.03	2.07	2.05
9	P ₉	2.67	2.56	2.61
10	P ₁₀	1.45	1.46	1.46
Parental mean		1.84	1.87	1.86
Grand mean		1.90	1.99	1.90
CV			6.24	4.93
CD 5%			0.19	0.16
Range	Lowest	1.15	1.26	1.35
	Highest	3.38	3.54	3.11

P₁₀ and P₈ x P₉ in Y₂ while, crosses P₂ x P₉ followed by P₄ x P₆, P₁ x P₈, P₆ x P₇ and P₇ x P₁₀ in over season pooled. Some other crosses exhibiting very high mean performance for the characters other than total fruit yield per plant are also listed in Table-2. In this context, the most desirable cross combination which produced significantly early 50 % flower than the grand mean were P₆ x P₇ followed by P₃ x P₇, P₈ x P₉ in Y₁, P₆ x P₇ in Y₂ and P₅ x P₆ in over season pooled. Cross combination P₃ x P₈ followed by P₆ x P₇ and P₈ x P₉ in Y₁, P₆ x P₇ and P₁ x P₂ in Y₂ and P₈ x P₉ followed by P₅ x P₆ and P₇ x P₉ in over season pooled found significantly early for days to first fruit harvest. Increased yield in crosses in accordance with findings of Chaddha et al. [13]; Bhatt et al. [14]; Dubey et al. [15].

Among the crosses (Table 2), quality traits *viz.* reducing sugars, non-reducing sugar, total sugars, chlorophyll content and total phenol content were more anticipated traits would be useful to identify the best hybrid combination for exploitation of superior hybrids. Out of forty five crosses, top three cross combination P₂ x P₄ followed by P₂ x P₉, P₃ x P₆ in Y₁; P₂ x P₄ followed by P₂ x P₉, P₃ x P₆ in Y₂ and P₂ x P₄ followed by P₂ x P₉ and P₈ x P₁₀ in over season pooled produced significantly high reducing sugars than the general mean. The cross combination P₄ x P₆ followed by P₃ x P₁₀ and P₃ x P₉ in Y₁; P₃ x P₉ followed by P₃ x P₁₀ and P₄ x P₆ in Y₂ and P₃ x P₈ followed by P₃ x P₁₀ and P₄ x P₆ in over season pooled exhibited significantly high non-reducing sugars than the general mean. Cross combination for total sugars were P₃ x P₆ followed by P₁ x P₅ and P₂ x P₆ in Y₁; P₃ x P₆ followed by P₁ x P₄ and P₃ x P₄ in Y₂ and P₃ x P₆ followed by P₄ x P₄ and P₂ x P₉ in over season pooled showed significantly highest total sugars than the general mean. Crosses which produced significantly highest chlorophyll content than the general mean were P₅ x P₆ followed by P₃ x P₇ and P₃ x P₉ in Y₁; P₅ x P₈ followed by P₃ x P₉ and P₃ x P₇ in Y₂; P₃ x P₉ followed by P₅ x P₆ and P₁ x P₅ in over season pooled. The crosses that produced significantly maximum total phenol content than the general mean were P₃ x P₈ followed by P₁ x P₈ and P₂ x P₇ in Y₁; P₁ x P₇ followed by P₂ x P₃ and P₄ x P₈ in Y₂ and P₅ x P₆ followed by P₅ x P₇ and P₂ x P₁₀ in over season pooled. The superiority of the F₁'s than parents is might be due to the additive and dominance both type of gene action and could be exploit for heterosis breeding. The superiority of *per se* performance of parents and F₁ for various traits in seasons and over season (pooled) have also

been reported by earlier workers (Kanchana, et al. [10]; Tripathy, et al. [16]; Timmareddygari, et al. [11]; Gadhiya, et al. [17]).

5. CONCLUSION

It may be concluded from the present study that, on the basis of *per se* performance, Parents P₉ and P₇ along with four F₁ crosses *viz.* P₂ x P₉ followed by P₄ x P₆, P₁ x P₈ and P₆ x P₇ were identified as superior crosses for total fruit yield plant. These parents (P₉ and P₇) may be used in future breeding plan likewise, the best performing F₁ (P₂ x P₉, P₄ x P₆, P₁ x P₈ and P₆ x P₇) may be recommended for multi-locational trials for commercialization of the crop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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