Original Research Article

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Estimation of Heterosis for Growth, Yield and Quality Traits in Bottle Gourd [*Lagenaria siceraria* (Mol.) Standl.]

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ABSTRACT

The present investigation was carried out in two different seasons with aim to assess the heterobeltiosis and standard heterosis in bottle gourd. The present study was comprised of 45 crosses developed through diallel mating design using 10 parents namely, NDBG-49-2 (P₁), N. Rashmi (P₂), N. Prabha (P₃), N. Pooja (P₄), Pusa Naveen (P₅), Pb. Komal (P₆), NDBG S-1 (P₇), PBOG-3 (P₈), NDBG-11 (P₉) and Faizabadi Local (P₁₀) at MES, Vegetable Science, NDUA&T, Kumarganj, Faizabad (U.P.) India during *kharif* 2015 (E₁), and *Rabi*, 2015-16 (E₂). The experiments were laid out in RBD with three replications having each experimental unit of single row with spacing of 3.0 m × 0.5 m. The observations were recorded on parents and F₁'s for eighteen quantitative traits including six quality traits viz days to first staminate flower anthesis, days to first pistillate flower anthesis, node number to first staminate flower, node number to first pistillate flower appearance, days to first fruit harvest, vine length at last picking stage (m), number of primary branches per plant, fruit length (cm), fruit circumference (cm), fruit weight (kg), number of fruits per plant, fruit yield per plant (kg), total soluble solids (°B), ascorbic acid (mg/100 g fresh fruit), reducing sugar (%), non-reducing sugar (%), total sugars (%) and dry matter content in fruit (%). The present heterobeltiosis for fruit yield per plant heterosis range from -3.84 (P₂ × P₇) to 64.49 % (P₅ × P₈) in pooled in over better parent. The best five crosses which showed positive and significant heterosis over better parent were P₃ × P₉ (67.26 %), P₅ × P₈ (64.49 %), P₆ × P₉ (63.58 %), P₄ × P₅ (60.66 %) and P₂ × P₄ (58.76 %). Standard heterosis range from were 9.80 (P₄ × P₈) to 69.17 % (P₃ × P₉) in pooled. The best five crosses which showed desirable and significant positive standard heterosis in the pooled analysis were P₃ × P₉ (69.17 %), P₆ × P₉ (65.45 %), P₅ × P₈ (64.49 %), P₄ × P₅ (60.66 %) and P₇ × P₉ (56.80) for fruit yield per plant indicating that there was a great scope of realizing higher yield in bottle gourd through heterosis breeding.

Keywords

Bottle gourd,
Heterobeltiosis,
Economic
heterosis and fruit
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Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl, 2n = 2x = 22] is an important cultivated annual cucurbitaceous crop grown throughout the country. Being warm season vegetable crop it thrives well in warm and humid climate but at present it's off season

cultivation has progressively stretched throughout the year in northern Indian plains. According to De Candolle (1882), bottle gourd has been found in wild form in South Africa and India. However, Cutler and Whitaker (1961) are of the view that probably

it is indigenous to tropical Africa on the basis of variability in seeds and fruits. The tender fruits of bottle gourd can be used as a vegetable or for making sweets (e.g. *Halva*, *kheer*, *petha* and *burfi* etc.), kofta and pickles. The fruit is rich in pectin also, which showed good prospects for jelly preparation. A decoction made from the leaf is a very good medicine for jaundice. The fruit has cooling effect, it is a cardiogenic and diuretic, good for people suffering from biliousness, indigestion and convalescences *i.e.*, regain health after illness. The pulp is good for overcoming constipation, cough, night blindness and as an antidote against certain poisons. The plant extract is used as a cathartic and seeds are used in dropsy. In addition, the seeds and seed oil are edible. The fruits contain 96.3 per cent moisture, 2.9 per cent carbohydrate, 0.2 per cent protein, 0.1 per cent fat, 0.5 per cent mineral matter and 11 mg of vitamin C (Ascorbic acid) per 100 g fresh weight (Thamburaj and Singh, 2005). The exploitation of heterosis is much easier in cross-pollinated vegetable crops. Bottle gourd being monoecious provides ample scope for the utilization of the hybrid vigour for yield improvement of this crop. The selection of suitable parents for hybridization on the basis of phenotypic performance alone is not a sound procedure as phenotypically superior lines may yield poor recombinants in the segregating generations. It is, therefore, essential that parents should be selected on the basis of their genetic potential.

Materials and Methods

The experimental materials consisted of 10 promising parental lines of bottle gourd and their F₁ progenies. The selected parental lines *i.e.* NDBG-49-2 (P₁), N. Rashmi (P₂), N. Prabha (P₃), N. Pooja (P₄), Pusa Naveen (P₅), Pb. Komal (P₆), NDBG S-1 (P₇), PBOG-3 (P₈), NDBG-11 (P₉) and Faizabadi Local (P₁₀) were crossed in the all possible combinations, excluding reciprocals. At NDUA&T,

Kumarganj, Faizabad (U.P.). These experimental materials were grown under Randomized Block Design (RBD) with three replications at Main Experiment Station, Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Faizabad (U.P.) India. The treatments were sown in rows spaced 3.0 meters apart with a plant to plant spacing of 0.5 meter. The experiments were laid out during the *Kharif* season of 2015-16 and off season in winter 2015-16 seeds for the study of heterosis. All the recommended agronomic package of practices and protection measures were followed to raise a good crop. Fertilizers and manures were applied as per recommended dose. Observations were recorded on all the six plants maintained carefully in each plot for eighteen quantitative characters *viz.*, days to first staminate flower anthesis, days to first pistillate flower anthesis, node number to first staminate flower, node number to first pistillate flower appearance, days to first fruit harvest, vine length at last picking stage (m), number of primary branches per plant, fruit length (cm), fruit circumference (cm), fruit weight (kg), number of fruits per plant, fruit yield per plant (kg), total soluble solids (°B), ascorbic acid (mg/100 g fresh fruit), reducing sugar (%), non-reducing sugar (%), total sugars (%) and dry matter content in fruit (%). Analysis of variance was carried out as suggested by Hayes *et al.*, (1955).

Results and Discussion

The exploitation of heterosis refers as the superiority of F₁ hybrid over its parent in terms of yield and its attributing traits. The exploitation of heterosis requires an intensive evaluation of germplasm to find out diverse donors with high nicking of genes and further identification of heterotic crosses. In the present study the estimates of heterosis over better parent (BP) and standard variety (SV) Pusa Naveen were calculated for fifteen F₁'s

during both the seasons (E_1 , E_2) and over seasons (pooled). Perusal of table 1 revealed that nature and magnitude of heterosis differed for different traits and over seasons in various hybrid combinations. The heterobeltiosis for fruit yield per plant -9.77 ($P_2 \times P_7$) to 61.89 % ($P_2 \times P_4$) and -1.96 ($P_3 \times P_5$) to 60.77 % ($P_3 \times P_9$) in *Kharif*, 2015 (E_1), 3.23 ($P_2 \times P_7$) to 99.44 % ($P_3 \times P_9$) and 15.22 ($P_4 \times P_8$) to 80.05 % ($P_3 \times P_9$) in *Rabi*, 2015-16 (E_2) and -3.84 ($P_2 \times P_7$) to 64.49 % ($P_5 \times P_8$) and 9.80 ($P_4 \times P_8$) to 69.17 % ($P_3 \times P_9$) in pooled. A wide range of variations in positive and negative direction of heterosis were also recorded for remaining traits during both the seasons and pooled. A perusal of tables 1 and 2 revealed that crosses exhibiting significant and positive estimates of heterosis for one or both types of heterosis for fruit yield also exhibited significant heterosis for some other important yield and yield attributing traits. In contrast none of the crosses showed significant and desirable heterosis for all the traits. The above results are in conformity with the findings of Sirohi *et al.*, (1985), Kumar *et al.*, (1998) Dubey and Maurya (2003) and Ghuge, *et al.*, (2016).

For maturity traits negative heterosis is desirable. Since hybrids with heterosis for earliness produce first fruit earlier as compared to parents, thereby increasing their productivity per day per unit area and as a consequence fetch good prices in the market by early supply of produce. A close examination of heterosis values of five maturity traits *viz.*, days to first staminate and pistillate flower opening, node number to first staminate and pistillate flower opening, node number to first staminate and pistillate flower appearance and days to first fruit harvest, revealed that none of the hybrids for days to first staminate flower anthesis, four and one hybrids for days to first staminate flower anthesis, five and four hybrids for node number to first staminate flower appearance, two and one hybrids for node number to first

pistillate flower appearance, and none of the and one hybrids for first fruit harvest fruit in pooled exhibited significant and desirable heterosis in respect to better and standard parent respectively. However, top ranked crosses for fruit yield were almost at par for earliness and thereby showing good scope for early hybrids.

Our study further revealed that at least one parent (P_3 , P_4 , P_5 , P_6 , P_7 , P_8 and P_9) with early maturity was invariably involved in the five top ranked F_1 hybrids ($P_3 \times P_9$, $P_6 \times P_9$, $P_5 \times P_8$, $P_4 \times P_5$ and $P_7 \times P_9$) for fruit yield over standard parent in pooled. Further the earliness of parent as well as crosses were directly associated with the crosses having high magnitude of heterosis. It may therefore, safely be concluded that either of parents, P_3 , P_4 , P_5 , P_6 , P_7 , P_8 and P_9 or any two of them may be a better choice in any heterosis breeding programme intended to breed high yielding hybrids with considerable earliness. The present observations are in agreement with the findings of Singh (2008) and Maurya (2010).

Out of significant crosses for fruit yield, very less crosses showed positive and significant heterobeltiosis for quality traits *viz.*, T.S.S., ascorbic acid, reducing and non-reducing sugar total sugars and dry matter. For instance, out of twenty seven crosses which exhibited significant heterobeltiosis for fruit yield, six crosses for T.S.S., two crosses for ascorbic acid, nine crosses for reducing, twelve crosses for non-reducing sugar and twenty three for dry matter content of fruit showed significant and desirable heterosis. However, the number of crosses which showed significant standard heterosis for quality traits along with fruit yield were generally more in number than the crosses for significant better parent heterosis. This showed negative association for heterosis between fruit yield and quality traits.

Table.1 Estimates of heterosis (%) over better parent (BP) and standard variety (SV) Pusa Naveen during two seasons (E₁, E₂) and pooled

Crosses	Days to first staminate flower anthesis						Days to first pistillate flower anthesis					
	E ₁		E ₂		Pooled		E ₁		E ₂		Pooled	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
P ₁ × P ₂	10.16**	8.34**	9.66**	9.33**	9.82**	9.00**	4.70	11.81**	-3.95	-9.19**	-1.94	-2.20
P ₁ × P ₃	-4.53	-0.94	3.62	4.26	0.88	2.54	-4.44	2.05	2.84	-1.06	0.24	-0.02
P ₁ × P ₄	0.38	4.00	5.31	5.96*	3.60	5.31	5.19	11.65**	2.14	-1.73	3.00	2.73
P ₁ × P ₅	2.04	2.04	0.25	0.25	0.84	0.84	11.96**	11.96**	0.06	-3.73	1.77	1.50
P ₁ × P ₆	6.57*	6.70*	2.54	3.17	2.64	4.33	13.01**	8.85**	5.62*	-2.99	8.16**	0.95
P ₁ × P ₇	-2.86	0.79	0.59	1.21	-0.57	1.07	2.96	9.95**	5.19	1.21	4.40	4.12
P ₁ × P ₈	0.18	3.94	2.99	2.56	1.34	3.01	-0.77	5.96	2.61	-3.06	0.21	-0.05
P ₁ × P ₉	24.48**	29.15**	-0.86	-0.24	7.68**	9.46**	18.37**	26.41**	2.31	-1.57	8.04**	7.75**
P ₁ × P ₁₀	-2.99	0.65	0.63	1.25	-0.59	1.05	-7.62*	-1.34	2.12	-1.75	-1.35	-1.62
P ₂ × P ₃	3.23	1.53	8.10**	7.77**	6.50	5.71	-10.38**	-0.97	0.45	-5.03	-3.54	-3.68
P ₂ × P ₄	3.79	2.08	-0.95	-1.25	0.60	-0.15	-2.16	3.85	0.81	-4.68	-1.70	-1.84
P ₂ × P ₅	5.01	3.29	2.02	1.71	3.00	2.23	2.73	2.73	5.09	-0.64	0.63	0.48
P ₂ × P ₆	2.17	0.48	-0.20	-0.58	0.58	-0.17	2.38	-1.39	-1.54	-9.57**	-0.20	-6.85*
P ₂ × P ₇	12.77**	10.91**	7.97**	7.64**	9.54**	8.72**	2.66	13.44**	-1.48	-6.86**	0.05	-0.10
P ₂ × P ₈	6.08	4.33	0.80	0.37	2.44	1.68	4.17	15.11**	2.64	-3.02	3.16	3.01
P ₂ × P ₉	5.31	3.58	-0.07	-0.37	1.69	0.94	-0.45	9.99**	10.05**	4.05	6.18*	6.03*
P ₂ × P ₁₀	4.68	2.96	1.63	1.32	2.63	1.86	-5.73*	4.16	11.81**	5.72*	5.35	5.20
P ₃ × P ₄	14.66**	18.79**	-3.31	-2.49	1.27	4.53	7.74*	14.35**	-7.29**	-5.59*	-2.15	1.05
P ₃ × P ₅	3.76	3.76	0.51	0.51	1.58	1.58	4.12	4.12	0.52	0.52	1.72	1.72
P ₃ × P ₆	5.21	5.33	1.90	2.76	1.63	3.61	3.23	-0.57	12.03**	2.89	9.00**	1.74
P ₃ × P ₇	7.30*	16.31**	-3.37	-2.55	0.32	3.67	3.40	16.76**	-6.30*	-5.79*	-2.99	1.72
P ₃ × P ₈	2.19	8.40	1.21	1.83	3.59	3.59	-1.30	10.87**	5.20	-0.61	2.78	3.21
P ₃ × P ₉	-4.36	1.32	0.20	1.05	-2.13	1.14	-10.49**	-0.85	-2.85	0.13	-5.52*	-0.19
P ₃ × P ₁₀	-4.63	3.38	0.81	1.66	-1.07	2.23	-14.57**	-3.75	-2.26	0.61	-6.61*	-0.84
P ₄ × P ₅	7.41*	7.41*	1.45	1.45	3.41	3.41	-2.00	-2.00	-1.99	-1.99	-1.99	-1.99
P ₄ × P ₆	3.62	3.75	4.67	7.66**	4.33	6.37*	8.09*	4.11	10.58**	1.56	9.72**	2.41
P ₄ × P ₇	-3.91	-0.44	-6.04*	-3.18	-5.33	-2.28	3.53	9.88**	-5.93*	-5.41*	-3.47	-0.32
P ₄ × P ₈	2.64	6.34	1.17	1.60	1.13	2.87	5.65	12.13**	4.99	-0.81	-7.77**	3.50
P ₄ × P ₉	-4.38	-0.94	-5.26*	-2.38	-4.97	-1.91	-6.79*	-1.07	-8.29**	-6.60**	2.18	-4.76
P ₄ × P ₁₀	0.58	4.20	0.12	3.16	0.28	3.51	4.12	10.51**	1.18	3.04	5.85	5.53*
P ₅ × P ₆	7.01*	7.01*	4.22	4.22	5.14	5.14	5.86	1.96	5.85*	-2.79	3.97	-1.20
P ₅ × P ₇	21.85**	21.85**	-2.57	-2.57	5.49	5.49	23.29**	23.29**	-5.68*	-5.68*	1.42	3.97
P ₅ × P ₈	2.74	2.74	4.90	4.46	3.89	3.89	-1.65	-1.65	8.97**	2.95	2.02	1.42
P ₅ × P ₉	0.40	0.40	4.39	4.39	3.07	3.07	0.25	0.25	2.91	2.91	-1.36	2.02
P ₅ × P ₁₀	12.11**	12.11**	2.19	2.19	5.46	5.46	7.01*	7.01*	-5.54*	-5.54*	10.00**	-1.36
P ₆ × P ₇	10.08**	10.21**	-2.89	-0.12	1.32	3.29	16.94**	12.63**	6.37*	-2.31	2.58	2.67
P ₆ × P ₈	7.99*	8.12*	3.71	3.28	3.10	4.88	4.52	0.67	1.57	-6.72**	7.75**	-4.26
P ₆ × P ₉	8.55**	8.68**	0.86	3.73	3.35	5.36	-0.58	-4.24	12.11**	2.97	9.36**	0.57
P ₆ × P ₁₀	5.99	6.11	-0.92	1.91	1.32	3.29	8.17*	4.19	9.98**	1.01	-2.66	2.07
P ₇ × P ₈	2.88	9.13**	4.74	4.30	4.10	5.89*	-2.46	9.56**	-2.78	-8.15**	-1.25	-2.25
P ₇ × P ₉	5.31	11.56**	1.45	5.67*	2.74	7.61**	-1.10	9.56**	0.00	0.55	-2.67	3.55
P ₇ × P ₁₀	0.36	9.64**	-4.92	-1.81	-3.11	1.97	1.16	13.97**	-4.41	-3.88	4.33	2.06
P ₈ × P ₉	6.75*	13.08**	4.50	4.06	5.23	7.04*	-0.37	10.37**	7.94**	1.98	-0.13	4.77
P ₈ × P ₁₀	5.22	11.62**	8.10**	7.65**	7.11*	8.96**	-2.58	9.42**	1.33	-4.26	0.54	0.29
P ₉ × P ₁₀	7.59*	13.98**	0.15	3.43	2.07	6.91*	2.28	13.29**	-0.26	2.66	-7.77	6.20*
No. of crosses with significant (+) heterosis	15	19	4	7	4	9	9	24	10	1	8	4
No. of crosses with significant (-) heterosis	0	0	2	0	0	0	5	0	5	11	4	1
Range of heterosis	-4.63 to 21.85	-9.94 to 29.15	-6.04 to 9.66	-2.57 to 9.33	-5.33 to 9.82	-2.28 to 9.46	-14.57 to 23.29	-4.24 to 26.41	-8.29 to 12.11	-9.57 to 5.72	-7.77 to 10.00	-6.85 to 7.75

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

Table.1 Cont.....

Crosses	Node number to first staminate flower appearance						Node number to first pistillate flower appearance					
	E ₁		E ₂		Pooled		E ₁		E ₂		Pooled	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
P ₁ × P ₂	-0.39	-18.36**	29.63**	37.21**	10.99	0.98	26.48**	84.26**	18.13*	-2.51	23.60**	42.45**
P ₁ × P ₃	-0.54	-18.49**	14.45**	35.06**	-0.70	0.15	5.90	89.02**	45.36**	12.45*	17.23**	52.12**
P ₁ × P ₄	11.41	-8.69	36.11**	52.18**	11.54*	12.49*	-24.13**	71.85**	50.74**	10.97	-6.91	42.52**
P ₁ × P ₅	16.73**	-4.33	-0.36	-0.36	-2.95	-2.95	32.08**	32.08**	-9.96	-12.80*	10.46	10.46
P ₁ × P ₆	5.06	-14.09**	-28.32**	-2.33	-10.76*	-10.00	46.93**	68.51**	-4.01	-7.04	18.03**	32.11**
P ₁ × P ₇	5.47	-15.37**	29.33**	75.13**	16.77**	16.12**	8.40*	112.13**	70.62**	24.61**	24.43**	69.95**
P ₁ × P ₈	25.74**	3.05	10.73*	17.53**	7.18	8.09	28.54**	152.91**	19.62**	7.14	25.89**	82.67**
P ₁ × P ₉	20.50**	-1.24	-4.41	12.52**	4.94	3.55	47.87**	131.58**	13.22	2.41	35.76**	69.34**
P ₁ × P ₁₀	7.53	-11.87*	0.13	35.60**	3.76	4.65	-60.70**	-23.75**	-1.68	-13.83*	-43.24**	-18.97**
P ₂ × P ₃	5.86	-12.09*	44.85**	53.31**	21.64**	10.66*	3.02	50.07**	49.81**	15.90*	15.93*	33.60**
P ₂ × P ₄	-9.16	-24.56**	27.61**	35.06**	5.72	-3.82	9.02	58.81**	27.61**	-6.05	10.68	27.56**
P ₂ × P ₅	21.07**	0.54	53.67**	53.67**	30.83**	19.02**	38.31**	38.31**	29.46**	6.84	23.14**	23.14**
P ₂ × P ₆	24.28**	1.62	9.86	16.28**	17.31**	6.72	28.73**	47.64**	24.27**	2.56	12.50	25.92**
P ₂ × P ₇	22.88**	-1.40	-4.17	1.43	9.46	-0.41	20.20**	75.10**	48.05**	8.12	23.93**	42.83**
P ₂ × P ₈	26.48**	5.03	33.18**	40.97**	29.19**	17.53**	34.78**	96.34**	27.85**	5.51	32.39**	52.57**
P ₂ × P ₉	39.16**	15.56**	-4.34	1.25	21.55**	10.58*	58.66**	131.12**	7.27	-11.47	40.93**	62.41**
P ₂ × P ₁₀	28.60**	6.81	11.55*	18.07**	21.71**	10.73*	14.67**	67.05**	11.15	-8.27	13.46*	30.76**
P ₃ × P ₄	-10.45*	-11.10*	16.11**	29.82**	-0.48	3.13	72.54**	72.54**	42.11**	4.63	7.75	39.82**
P ₃ × P ₅	5.15	5.15	13.06*	13.06**	7.90	7.90	40.82**	40.82**	7.06	-17.18**	12.88	12.88
P ₃ × P ₆	-2.65	-20.39**	13.09**	33.45**	-7.64	-1.66	24.86**	43.20**	59.86**	23.67**	19.53**	33.79**
P ₃ × P ₇	-8.45	-26.54**	0.35	18.43**	-10.39*	-10.89*	19.49**	113.27**	50.07**	9.60	25.86**	63.32**
P ₃ × P ₈	-2.45	3.98	44.94**	53.85**	13.64**	21.33**	10.92*	97.99**	20.17**	-7.04	13.58*	47.38**
P ₃ × P ₉	86.41**	65.00**	15.25**	35.66**	56.88**	54.79**	26.77**	98.54**	25.19**	-3.15	19.89**	49.54**
P ₃ × P ₁₀	3.80	5.25	30.22**	53.67**	10.43*	22.10**	-10.79*	59.22**	41.79**	9.69	4.31	35.36**
P ₄ × P ₅	-28.72**	-29.24**	35.42**	35.42**	-6.74	-6.74	8.01	8.01	36.70**	0.64	4.46	4.46
P ₄ × P ₆	19.49**	-2.29	19.36**	33.45**	6.29	10.15*	34.28**	54**	43.32**	5.51	16.72*	30.64**
P ₄ × P ₇	-34.73**	-47.63**	23.04**	37.57**	-17.53**	-17.99**	-34.85**	27.51**	28.10**	-6.45	-18.63**	11.15
P ₄ × P ₈	15.19**	14.35**	2.64	8.94	8.53	12.47*	14.38**	125.03**	7.02	-21.21**	6.52	54.56**
P ₄ × P ₉	14.63**	1.46	19.89**	34.05**	14.32**	12.80*	19.17**	86.64**	27.94**	-5.81	13.92	42.09**
P ₄ × P ₁₀	9.84	9.04	16.48**	30.23**	12.33*	16.41**	7.88	109.29**	12.43	-17.22**	3.90	48.33**
P ₅ × P ₆	21.17**	-0.92	39.36**	39.36**	13.09*	13.09*	19.73*	19.73*	-1.53	-1.53	9.49	9.49
P ₅ × P ₇	-34.50**	-47.44**	33.63**	33.63**	-18.78**	-19.23**	13.32	13.32	27.29**	-7.04	3.51	3.51
P ₅ × P ₈	-2.26	-2.26	48.24**	48.24**	15.31**	15.31**	46.41**	46.41**	3.90	-6.94	20.70**	20.70**
P ₅ × P ₉	3.56	-8.34	13.06*	13.06*	0.44	-0.89	28.10**	28.10**	-2.77	-12.06	8.75	8.75
P ₅ × P ₁₀	-12.06*	-12.06*	35.60**	35.60**	4.52	4.52	19.73*	19.73*	17.01*	2.56	11.45	11.45
P ₆ × P ₇	-27.32**	-41.68**	-18.80**	9.96	-23.28**	-23.71**	2.79	17.89*	22.44**	-10.58	-6.93	4.17
P ₆ × P ₈	13.54*	-7.16	23.31**	30.89**	-0.37	6.08	23.62**	41.78**	12.03	0.34	8.83	21.82**
P ₆ × P ₉	19.46**	-2.32	10.69*	30.29**	10.49*	9.02	50.28**	72.36**	-5.22	-14.27*	16.69*	30.61**
P ₆ × P ₁₀	13.54*	-7.16	12.29**	52.06**	6.55	13.44**	24.22**	42.47**	-4.38	-16.19**	2.03	14.20
P ₇ × P ₈	5.59	-15.27**	23.82**	31.43**	1.54	0.98	8.49*	112.31**	17.59*	-14.12*	10.83*	51.39**
P ₇ × P ₉	17.76**	-5.50	25.84**	48.12**	14.68**	13.15*	24.81**	95.47**	52.29**	11.22	24.16**	54.87**
P ₇ × P ₁₀	14.99*	-7.73	-13.08**	17.71**	1.69	1.12	1.75	97.39**	47.51**	7.73	12.88*	54.19**
P ₈ × P ₉	12.40*	-0.51	9.04	15.74**	6.56	5.15	17.53**	84.07**	23.46**	10.58	19.18*	48.66**
P ₈ × P ₁₀	9.85*	11.39*	31.80**	39.89**	13.62**	21.31**	1.56	97.03**	11.79	-2.02	4.58	49.30**
P ₉ × P ₁₀	14.59*	1.43	-5.78	10.91*	6.14	4.73	10.32	72.77**	27.85**	12.06	15.06*	43.51**
No. of crosses with significant (+) heterosis	22	4	32	39	18	19	30	42	29	4	24	34
No. of crosses with significant (-) heterosis	6	15	3	0	5	4	4	1	0	8	2	1
Range of heterosis	-34.73 to 86.41	-47.63 to 65.00	-28.32 to 53.67	-2.33 to 75.13	-23.28 to 56.88	-23.71 to 54.79	-60.70 to 47.87	-23.75 to 125.03	-9.96 to 70.62	-21.21 to 24.61	-43.24 to 40.93	-18.97 to 82.67

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

Table.1 Cont....

Crosses	Days to first fruit harvest						Vine length (m)					
	E ₁		E ₂		Pooled		E ₁		E ₂		Pooled	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
P ₁ × P ₂	1.03	7.28**	-3.96	-4.60	-2.36	-0.79	8.15	39.16**	-35.11**	-49.42**	-7.82	-5.73
P ₁ × P ₃	-5.03	0.85	3.88	4.73	0.93	3.49	0.00	28.67**	-6.40	-28.32**	-2.43	-0.21
P ₁ × P ₄	1.82	5.68*	-0.55	0.26	-0.53	1.99	-10.38	15.31	27.87**	1.50	5.90	8.31
P ₁ × P ₅	9.85**	9.85**	0.30	0.30	3.35	3.35	-11.58	13.78	-20.42**	-20.42**	-5.70	-3.55
P ₁ × P ₆	10.16**	6.47*	7.36**	2.26	8.27**	3.60	-17.66**	25.87**	-41.30**	-49.69**	-26.30**	-12.42
P ₁ × P ₇	0.38	6.60*	1.72	2.56	1.28	3.85	-17.77**	42.03**	-49.42**	-61.27**	-15.28*	-10.31
P ₁ × P ₈	-0.83	5.31	0.01	-0.07	-0.54	1.65	24.14**	90.98**	-44.26**	-40.84**	-4.23	24.18**
P ₁ × P ₉	11.65**	18.56**	1.64	2.47	4.96	7.62**	41.64**	93.15**	-68.94**	-51.06**	-18.38**	20.08**
P ₁ × P ₁₀	-7.36**	-1.62	-0.57	0.24	-2.82	-0.35	8.25	46.85**	-12.77**	-13.48**	-0.77	16.28*
P ₂ × P ₃	-7.29**	-1.35	0.63	-0.04	-2.02	-0.46	75.18**	72.73**	-13.62**	-32.68**	40.10**	19.32**
P ₂ × P ₄	-1.01	2.73	-2.21	-2.85	-2.62	-1.07	40.63**	34.34**	-1.03	-21.44**	21.45**	6.07
P ₂ × P ₅	1.35	1.35	1.40	0.93	0.93	0.73	17.90	17.90	-21.44**	-21.44**	-2.04	-2.04
P ₂ × P ₆	1.16	-2.23	-2.40	-7.04**	-1.25	-5.50*	-6.45	43.01**	16.92**	0.20	2.09	21.32**
P ₂ × P ₇	2.56	9.13**	-3.25	-3.89	-1.30	0.28	0.24	73.15**	30.13**	1.43	29.23**	36.81**
P ₂ × P ₈	3.78	10.43**	0.85	0.19	1.84	3.47	-7.86	41.75**	-37.33**	-33.49**	-20.09**	3.62
P ₂ × P ₉	-1.04	5.30	5.19	4.49	3.10	4.75	1.03	37.76**	-42.16**	-8.85*	-22.42**	14.14*
P ₂ × P ₁₀	-1.18	5.15	3.90	3.21	2.20	3.83	39.48**	89.23**	0.82	0.00	22.90**	44.02**
P ₃ × P ₄	5.79*	9.79**	-4.18	-0.53	-1.86	2.78	43.40**	41.40**	42.62**	13.21**	45.54**	27.11**
P ₃ × P ₅	2.45	2.45	3.71	3.71	3.31	3.31	-0.35	-0.35	5.17	5.17	2.45	2.45
P ₃ × P ₆	2.97	-0.48	9.52**	4.32	7.41*	2.78	-13.31*	32.52**	7.15	-8.17*	-5.83	11.90
P ₃ × P ₇	2.18	9.52**	-2.13	1.60	-0.72	4.14	-38.87**	5.59	27.38**	-8.17*	-6.84	-1.38
P ₃ × P ₈	-0.52	6.50*	3.29	3.21	2.01	4.26	-16.82**	27.97**	-10.26**	-4.77	-14.10**	11.38
P ₃ × P ₉	-7.35**	-0.69	0.19	4.01	-2.28	2.50	38.46**	88.81**	-37.58**	-1.63	-2.81	42.98**
P ₃ × P ₁₀	-9.84**	-3.37	-0.57	3.22	-3.60	1.11	6.70	44.76**	-25.26**	-25.87**	-7.01	8.97
P ₄ × P ₅	-2.31	-2.31	-0.71	-0.71	-1.22	-1.22	40.91**	40.91**	-25.46**	-25.46**	7.28	7.28
P ₄ × P ₆	5.90*	2.35	7.26**	2.16	6.82*	2.22	-12.49*	33.78**	-13.26**	-25.66**	-12.77*	3.66
P ₄ × P ₇	2.26	6.13*	-6.53**	-2.53	-4.28	0.24	-16.03**	45.03**	7.89	-14.36**	8.57	14.94*
P ₄ × P ₈	4.79	8.76**	1.52	1.43	1.54	3.78	-1.27	51.89**	1.15	7.35	-0.27	29.32**
P ₄ × P ₉	-4.97	-1.37	-4.49	0.44	-4.64	-0.14	-20.21**	8.81	-36.54**	0.00	-29.07**	4.35
P ₄ × P ₁₀	3.70	7.63**	-1.71	3.37	0.01	4.73	40.49**	40.49**	-44.47**	-44.93**	-17.04**	-2.79
P ₅ × P ₆	4.28	0.79	4.71	-0.27	4.57	0.07	-21.13**	20.56*	-8.37	-8.37	-10.89	5.90
P ₅ × P ₇	15.14**	15.14**	-1.61	-1.61	3.75	3.75	0.00	72.73**	-42.61**	-42.61**	7.95	14.28*
P ₅ × P ₈	-1.84	-1.84	3.28	3.19	1.58	1.58	25.91**	93.71**	-30.02**	-25.73**	2.71	33.18**
P ₅ × P ₉	1.28	1.28	5.07	5.07	3.86	3.86	-9.28	23.71**	-27.56**	14.16**	-19.20**	18.87**
P ₅ × P ₁₀	4.77	4.77	-0.41	-0.41	1.25	1.25	31.96**	79.02**	-14.30**	-14.30**	12.42**	31.74**
P ₆ × P ₇	9.12*	5.46*	9.10**	3.92	9.11**	4.41	-14.98**	46.85**	51.63**	29.95**	16.37**	38.29**
P ₆ × P ₈	4.79	1.28	4.25	-0.71	4.42	-0.07	12.50*	73.08**	22.13**	29.61**	16.49**	51.05**
P ₆ × P ₉	-0.38	-3.72	10.68**	5.41*	7.10*	2.49	-9.88	37.76**	-40.52**	-6.26	-21.52**	15.45**
P ₆ × P ₁₀	7.00**	3.42	7.81**	2.68	7.55**	2.92	17.43*	79.51**	-12.70**	-13.41**	11.44	32.42**
P ₇ × P ₈	-0.22	6.83*	-2.42	-2.51	-1.69	0.48	-3.28	67.06**	-15.39**	-10.21*	-1.36	27.91**
P ₇ × P ₉	-0.82	6.50*	-0.52	3.73	-0.71	4.61	-12.23*	51.61v	-40.48**	-6.19	-16.86**	22.32**
P ₇ × P ₁₀	1.70	9.52*	-1.61	2.59	-0.53	4.81	-0.77	71.40**	-27.32**	-27.91**	3.33	21.08**
P ₈ × P ₉	-0.88	6.12	2.23	2.14	1.19	3.42	0.82	55.10**	-14.38**	34.92**	-1.52	44.88**
P ₈ × P ₁₀	-1.78	5.16*	0.72	0.63	-0.12	2.08	16.86**	79.79**	10.26**	17.02**	14.13**	47.98**
P ₉ × P ₁₀	0.48	7.90*	-0.84	4.57	-0.59	5.63*	-16.92*	13.29	-40.95**	-6.94	-29.96**	3.04
No. of crosses with significant (+) heterosis	8	21	6	1	6	2	13	37	8	5	9	25
No. of crosses with significant (-) heterosis	4	0	1	1	0	1	12	0	28	27	13	0
Range of heterosis	-9.84 to 15.14	-3.72 to 18.56	-6.53 to 10.68	-7.04 to 5.41	-4.68 to 9.11	-5.50 to 7.62	-38.87 to 75.18	-0.35 to 93.71	-68.94 to 51.63	-61.27 to 34.92	-29.96 to 45.54	-12.42 to 51.05

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

Table.1 Cont.....

Crosses	Number of primary branches per plant						Fruit length (cm)					
	E ₁		E ₂		Pooled		E ₁		E ₂		Pooled	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
P ₁ × P ₂	-1.23	9.20	-44.65**	-22.03*	-17.31**	-0.67	-18.49**	-1.17	-17.08**	2.86	-17.83**	0.68
P ₁ × P ₃	-29.82**	-15.50*	18.70*	39.02**	-14.78*	1.71	-4.92	20.79**	-5.74	23.00**	-5.30	21.81**
P ₁ × P ₄	4.92	-20.81**	-11.12	37.74**	-2.89	-2.32	-14.40**	-6.32	-0.71	4.10	-1.28	-1.53
P ₁ × P ₅	-9.52	-9.52	2.90	6.64	-4.42	-4.42	-6.03	-6.03	-16.45**	-12.40**	-8.97*	-8.97*
P ₁ × P ₆	31.21**	33.07**	25.88**	74.27**	29.15**	46.08**	5.56	-24.07**	-25.67**	-22.07**	-11.76*	-23.15**
P ₁ × P ₇	-4.70	6.28	-32.61**	16.28	-16.33**	9.44	-13.67**	-15.11**	-12.43**	-0.60	-13.06**	-8.42*
P ₁ × P ₈	2.68	27.41**	64.24**	94.76**	21.53**	48.68**	-25.58**	-4.59	4.49	21.85**	-12.44**	7.59*
P ₁ × P ₉	9.33	27.73**	39.62**	44.70**	22.95**	33.09**	-8.22*	4.69	1.34	18.53**	-3.75	11.06**
P ₁ × P ₁₀	-23.22**	12.29*	72.89**	79.18**	0.84	33.41**	-11.55**	1.15	-17.37**	-0.16	-14.31**	0.54
P ₂ × P ₃	-5.39	13.91*	-28.01**	1.40	-8.46	9.96	3.56	31.57**	-26.17**	-3.65	-10.33**	15.35**
P ₂ × P ₄	15.38**	27.56**	-30.57**	7.60	0.94	21.25**	-0.63	20.49**	9.40**	35.69**	4.05	27.49**
P ₂ × P ₅	-0.75	9.73	4.35	47.00**	1.14	21.50**	-2.95	17.67**	-8.93**	12.95**	-5.74	15.50**
P ₂ × P ₆	-27.35**	-19.69**	-11.20	25.10**	-21.37**	-5.55	-14.41**	3.78	-7.58*	14.63**	-11.23**	8.77
P ₂ × P ₇	-31.74**	-23.87**	-47.41**	-9.26	-38.27**	-19.26**	0.11	21.38**	2.19	26.75**	1.08	23.85**
P ₂ × P ₈	0.02	24.11**	17.36**	65.33**	12.08*	37.12**	-14.36**	9.80*	-3.73	19.41**	-7.04*	14.23**
P ₂ × P ₉	-5.70	10.17	-17.45**	16.28	-6.68	12.10	-9.72**	9.46*	-11.31**	10.00*	-10.46**	9.71*
P ₂ × P ₁₀	-14.09**	25.64**	13.28*	59.58**	3.06	36.36**	-2.96	17.66**	3.77	28.72**	0.18	22.75**
P ₃ × P ₄	-8.67	9.96	-37.33**	-2.87	-11.27	5.91	-7.65*	17.32**	-6.28*	22.30**	-7.01*	19.62**
P ₃ × P ₅	-3.84	15.77**	25.90**	47.45**	5.7	25.77**	-9.60**	14.85**	-9.54**	18.04**	-9.57**	16.32**
P ₃ × P ₆	-18.16**	-1.47	29.20**	78.86**	3.80	23.90**	-26.55**	-6.68	-14.26**	11.89**	-20.81**	1.87
P ₃ × P ₇	-11.29*	6.81	-30.83**	19.35*	-15.31**	10.77	-15.78**	7.00	-3.29	26.20**	-9.94**	15.84**
P ₃ × P ₈	-6.32	16.24**	-15.46*	0.26	-9.11	11.19	-20.69**	1.69	-9.02**	18.72**	-14.85**	9.53*
P ₃ × P ₉	-16.25**	0.83	46.51**	71.58**	3.19	23.17**	-3.85	22.15**	-13.50**	12.87**	-8.36**	17.88**
P ₃ × P ₁₀	-12.27**	28.29**	-17.07*	-2.87	-10.47	18.45**	-2.34	24.08**	-5.94	22.75**	-4.02	23.47**
P ₄ × P ₅	9.87	9.87	-8.28	42.15**	19.37**	20.06**	-12.10**	-3.81	-4.70	-4.70	-4.22	-4.22
P ₄ × P ₆	1.92	3.36	7.13	66.03**	8.88	23.15**	-21.83**	-14.46**	21.70**	14.38**	-0.93	-1.17
P ₄ × P ₇	-36.31**	-28.97**	-12.25*	51.40**	-26.29**	-3.59	9.65*	19.99**	-14.45**	-2.89	3.91	9.45*
P ₄ × P ₈	-10.36*	11.23	-18.09**	26.95**	-5.03	16.19*	-5.93	20.61**	-13.04**	1.40	-9.04**	11.77**
P ₄ × P ₉	8.32	26.55**	-30.57**	7.60	11.38	20.57**	12.55**	28.37**	24.99**	46.20**	18.36**	36.58**
P ₄ × P ₁₀	-12.23**	28.35**	12.81*	74.84**	8.11	43.03**	0.17	14.56**	5.31	27.23**	2.61	20.39**
P ₅ × P ₆	6.04	7.54	17.53**	62.71**	10.48	24.96**	-12.13**	-12.13**	-2.22	-2.22	-7.57*	-7.57*
P ₅ × P ₇	-35.23**	-27.76**	-42.23**	-0.32	-38.14**	-19.10**	-4.72	-4.72	-9.80**	2.39	-6.43	-1.44
P ₅ × P ₈	9.62	36.02**	64.73**	95.34**	26.49**	54.75**	-3.28	24.01**	2.83	19.92**	-0.61	22.12
P ₅ × P ₉	2.67	19.95**	39.21**	39.21**	16.43*	26.03**	-4.12	9.36*	-8.72*	6.76	-6.27	8.16*
P ₅ × P ₁₀	-39.10**	-10.93	29.77**	32.50**	-22.31**	2.78	-6.10	7.38	-9.54**	9.29*	-7.73*	8.26*
P ₆ × P ₇	-30.71**	-22.72**	-16.84**	43.49**	-24.93**	-1.81	36.37**	34.11**	-9.62**	2.60	13.54**	19.60**
P ₆ × P ₈	9.86*	36.31**	14.81*	58.94**	17.26**	43.46**	-22.29**	-0.37	-6.61	8.90*	-15.44**	3.90
P ₆ × P ₉	-27.85**	-15.71*	19.42**	65.33**	-2.85	9.88	-34.95**	-25.81**	-15.01**	-0.59	-25.64**	-14.19**
P ₆ × P ₁₀	-7.80	34.84**	15.13*	59.39**	7.77	42.59**	-27.78**	-17.41**	-11.50**	6.93	-20.06**	-6.20
P ₇ × P ₈	2.99	27.79**	-17.51**	42.34**	1.22	32.39	-14.94**	9.06*	0.52	17.22**	-8.18*	12.82**
P ₇ × P ₉	13.40*	32.48**	-6.14	61.94**	8.40	41.78**	-9.13*	3.65	-15.22**	-0.83	-11.97**	1.58
P ₇ × P ₁₀	0.95	47.63**	-49.74**	-13.28	-2.96	28.39**	-4.07	9.70*	-3.86	16.15**	-3.97	12.67**
P ₈ × P ₉	8.22	34.28**	50.73**	78.74**	21.23**	48.32**	-12.96**	11.60**	-0.69	16.16**	-7.47*	13.70**
P ₈ × P ₁₀	-3.87	40.58**	35.92**	61.17**	11.17*	47.09**	-6.06	20.44**	0.11	20.95**	-1.79	20.67**
P ₉ × P ₁₀	-25.43**	9.05	73.80**	77.46**	-1.25	30.65**	-28.47**	-1.41	19.11**	-15.64**	-1.02	
No. of crosses with significant (+) heterosis	4	22	21	32	10	27	3	23	3	28	2	27
No. of crosses with significant (-) heterosis	17	8	17	1	10	2	23	7	23	2	25	5
Range of heterosis	-39.10 to 31.21	-28.97 to 47.63	-49.74 to 73.80	-22.03 to 95.34	-38.27 to 29.15	-19.26 to 54.75	-34.95 to 36.37	-25.81 to 34.11	-26.17 to 24.99	-22.07 to 46.20	-25.64 to 18.36	-23.15 to 36.58

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

Table.1 Cont.....

Crosses	Fruit circumference (cm)						Fruit weight (kg)					
	E ₁		E ₂		Pooled		E ₁		E ₂		Pooled	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
P ₁ × P ₂	-20.41**	10.51*	-30.47**	11.28**	-25.87**	10.90*	-6.91	3.33	-18.79**	7.63	-12.82	5.28
P ₁ × P ₃	-27.07**	1.26	-11.04**	42.39**	-18.38**	22.10**	-22.52**	-14.00	-11.52	17.27	-17.04*	0.18
P ₁ × P ₄	-9.59**	25.53**	-30.47**	11.30**	-20.91**	18.31**	-14.41	-5.00	-14.24*	13.65	-14.33*	3.46
P ₁ × P ₅	-8.86*	26.55**	-37.24**	0.46	-24.25**	13.33**	-21.02**	-12.33	-30.91**	-8.43	-25.94**	-10.56
P ₁ × P ₆	8.01**	94.25**	-35.08**	8.68*	-13.06**	50.88**	-17.12*	-8.00	-22.98**	22.49*	-12.37	5.83
P ₁ × P ₇	-10.97**	23.61**	-33.22**	6.89	-23.03**	15.14**	-8.71	1.33	-48.68**	-6.02	-29.21**	-2.00
P ₁ × P ₈	-20.43**	10.48*	-22.83**	23.51**	-21.73**	17.08**	-8.41	1.67	5.15	39.36**	-1.66	18.76*
P ₁ × P ₉	-26.68**	1.81	-20.91**	26.58**	-23.55**	14.36**	-18.02*	-9.00	-17.58*	9.24	-17.80*	-0.73
P ₁ × P ₁₀	-6.66	29.59**	-38.44**	-1.47	-23.89**	13.85**	-4.20	6.33	-3.18	59.04**	5.77	30.24**
P ₂ × P ₃	7.15	11.64*	-15.39**	-1.31	-0.02	5.07	42.49**	48.67**	-14.48	-0.40	16.44*	26.41**
P ₂ × P ₄	-7.63	1.71	18.82**	15.30**	4.94	8.60	-14.51	-9.67	17.24*	36.55**	1.50	11.29
P ₂ × P ₅	1.16	5.40	-7.43	-7.43	-1.10	-7.43	-26.80**	-25.33**	10.69	28.92**	-8.56	-0.73
P ₂ × P ₆	-45.48**	-1.95	-25.81**	24.20**	-35.86**	11.30*	-7.19	-5.33	-36.11**	1.61	-15.83*	-2.19
P ₂ × P ₇	10.18*	14.80**	-7.15*	20.61**	2.52	17.74**	-18.63*	-17.00*	-52.63**	-13.25	-38.82**	-15.30
P ₂ × P ₈	8.40	15.28**	-4.84	-5.43	1.91	4.79	-8.17	-6.33	16.90*	36.14**	4.03	12.93
P ₂ × P ₉	-3.30	0.75	19.16**	5.72	7.60	3.27	-14.05	-12.33	15.86*	34.94**	0.50	9.11
P ₂ × P ₁₀	-3.32	4.19	10.45*	7.14	3.29	5.69	-16.01*	-14.33	-33.25**	9.64	-21.60**	-3.46
P ₃ × P ₄	-9.32*	-0.14	-22.83**	-10.00*	-9.74*	-5.14	-10.33	-14.74	-2.41	-14.95*	-6.74	
P ₃ × P ₅	1.92	1.92	-6.58	8.96*	0.37	5.48	-26.84**	-23.67**	12.45	12.45	-9.27	-7.29
P ₃ × P ₆	-35.90**	15.28**	-28.21**	20.18**	-32.14**	17.76**	-22.68**	-19.33*	-28.79**	13.25	-17.87*	-4.55
P ₃ × P ₇	8.06	7.38	-4.92	23.51**	0.62	15.56**	-30.99**	-28.00**	-45.83**	-0.80	-39.08**	-15.66
P ₃ × P ₈	-4.25	1.82	-6.40	9.17*	0.43	5.55	-9.90	-6.00	8.06	7.63	-1.96	0.18
P ₃ × P ₉	23.24**	19.97**	31.06**	52.86**	30.01**	36.64**	-8.31	-4.33	43.95**	43.37**	14.80*	17.30*
P ₃ × P ₁₀	6.92	15.24**	-26.87**	-14.70**	-4.79	0.06	-19.17*	-15.67	-54.28**	-24.90**	-34.91**	-19.85*
P ₄ × P ₅	-13.42**	-4.67	43.79**	43.79**	15.86**	19.89**	32.49**	40.00**	31.58**	50.60**	32.06**	44.81**
P ₄ × P ₆	-17.62**	48.16**	-32.78**	12.53**	-25.03**	30.11**	-11.36	-6.33	-27.02**	16.06	-10.66	3.83
P ₄ × P ₇	-9.71*	-0.58	-12.00**	14.31**	-6.86	6.96	-11.67	-6.67	-50.22**	-8.84	-33.29**	-7.65
P ₄ × P ₈	5.16	15.80**	11.67**	10.99*	9.54*	13.36**	-11.36	-6.33	19.65*	36.95**	3.32	13.30
P ₄ × P ₉	11.44**	22.71**	18.16**	14.66**	14.64**	18.63**	-0.32	5.33	3.16	18.07	1.33	11.11
P ₄ × P ₁₀	8.79*	19.79**	12.32**	8.99*	10.47*	14.32**	-8.20	-3.00	-6.60	53.41**	-0.44	22.59**
P ₅ × P ₆	-17.84**	47.77**	-25.17**	25.27**	-21.42**	36.37**	-26.33**	-26.33**	-18.94**	28.92**	-15.05*	-1.28
P ₅ × P ₇	-7.24	-7.24	-11.63**	14.80**	-9.50*	3.93	-17.43*	-16.33*	-51.32**	-10.84	-37.76**	-13.84
P ₅ × P ₈	-2.58	3.60	24.27**	24.27**	10.95*	14.08**	5.67	5.67	93.57**	93.57**	45.54**	45.54**
P ₅ × P ₉	5.12	5.12	-2.78	-2.78	1.12	1.12	35.00**	35.00**	-21.29*	-21.29*	9.47	9.47
P ₅ × P ₁₀	-7.65	-0.47	-11.92**	-11.92**	-8.40	-6.28	-2.33	-2.33	-49.39**	-16.87	-26.04**	-8.93
P ₆ × P ₇	-37.01**	13.29**	-9.37**	51.73**	-23.49**	32.77**	-8.22	-7.00	10.09*	101.61**	2.76	42.26**
P ₆ × P ₈	-12.31**	57.71**	-23.32**	28.37**	-17.69**	42.84**	-5.32	-11.00	-26.01**	17.67	-12.23	2.00
P ₆ × P ₉	-29.34**	27.08**	-21.69**	31.09**	-25.60**	29.11**	-4.07	-13.67	-21.46**	24.90**	-10.66	3.83
P ₆ × P ₁₀	-12.70**	57.01**	-27.02**	22.18**	-19.70**	39.36**	6.74	-5.00	27.14**	108.84**	19.08**	46.63**
P ₇ × P ₈	0.97	7.38	-4.80	23.66**	0.69	15.63**	-17.43*	-16.33*	-36.40**	16.47	-28.82**	-1.46
P ₇ × P ₉	5.75	5.09	1.32	31.61**	3.21	18.53**	-8.88	-7.67	-23.25**	40.56**	-17.50**	14.21
P ₇ × P ₁₀	0.71	8.55	-11.20**	15.35**	-2.48	11.99**	-3.62	-2.33	-42.32**	5.62	-26.84**	1.28
P ₈ × P ₉	8.01	14.86**	4.74	4.10	6.40	9.41*	-2.84	-8.67	28.22*	4.02	12.92	-2.91
P ₈ × P ₁₀	15.44**	24.41**	6.91	6.25	12.05**	15.21**	1.42	-4.67	-32.76**	10.44	-17.01*	2.19
P ₉ × P ₁₀	3.47	11.51*	39.39**	35.22**	20.73**	23.53**	12.22	1.00	-32.03**	11.65	-14.05*	5.83
No. of crosses with significant (+) heterosis	6	25	10	31	8	31	3	3	9	17	5	9
No. of crosses with significant (-) heterosis	18	0	25	3	19	0	14	8	25	2	22	1
Range of heterosis	-45.48 to 23.24	-7.24 to 94.25	-38.44 to 43.79	-14.70 to 52.86	-35.86 to 20.73	-6.28 to 50.88	-30.99 to 42.49	-28.00 to 48.67	-54.28 to 93.57	-24.90 to 108.84	-39.08 to 45.54	-19.85 to 46.63

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

Table.1 Cont.....

Crosses	Number of fruits per plant						Fruit yield per plant (kg)					
	E ₁		E ₂		Pooled		E ₁		E ₂		Pooled	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
P ₁ × P ₂	36.11**	20.01	66.93**	45.80**	50.88**	32.44**	26.40**	24.09**	35.42**	57.06**	30.70**	38.45**
P ₁ × P ₃	70.52**	50.36**	32.69**	20.07*	53.85**	35.77**	31.85**	29.44**	20.70**	39.98**	26.53**	34.03**
P ₁ × P ₄	40.97**	24.30*	38.19**	20.70*	39.64**	22.57*	20.41*	18.21*	17.20*	35.93**	18.88*	25.93**
P ₁ × P ₅	12.22	12.22	36.50**	36.50**	23.91*	23.91*	-1.37	-1.37	7.58	24.77**	3.86	10.02
P ₁ × P ₆	13.17	32.29**	40.59**	22.80*	38.80**	27.72**	24.40**	22.13**	30.17**	50.97**	27.16**	34.70**
P ₁ × P ₇	1.53	12.41	71.66**	49.93**	46.58**	30.48**	1.24	12.27	17.25**	41.34**	8.54	24.94**
P ₁ × P ₈	14.24	37.62**	-20.69**	-4.06	-2.62	17.55	24.21**	40.34**	14.87*	33.22**	29.55**	37.24**
P ₁ × P ₉	0.50	30.21**	22.44*	23.64*	9.71	27.05**	0.95	18.28*	16.62*	35.25**	18.64*	25.67**
P ₁ × P ₁₀	3.24	22.09*	10.65	18.62*	18.62*	9.83	22.54**	29.50**	33.09**	54.35**	32.02**	40.33**
P ₂ × P ₃	5.28	-9.29	56.03**	41.19**	30.34**	15.02	50.80**	35.05**	34.40**	38.72**	49.42**	36.65**
P ₂ × P ₄	90.07**	53.02**	35.56**	15.17	63.08**	34.79**	61.89**	36.42**	51.68**	56.55**	58.76**	45.19**
P ₂ × P ₅	70.37**	70.37**	15.59	15.59	43.99**	15.59	24.48**	24.48**	43.65**	48.27**	34.84**	34.84**
P ₂ × P ₆	-4.34	11.83	40.49**	19.37*	25.48*	15.46	10.46	4.11	16.34*	21.56**	13.17	11.71
P ₂ × P ₇	9.27	20.99	69.05**	43.64**	48.16**	31.90**	-9.77	0.07	3.23	24.43**	-3.84	10.68
P ₂ × P ₈	11.81	34.70**	-12.31	6.08	0.17	20.92*	11.61	26.11**	39.07**	43.53**	34.49**	33.70**
P ₂ × P ₉	19.11*	54.32**	4.36	5.38	12.91	30.75**	14.87*	34.60**	37.51**	41.93**	36.23**	37.79**
P ₂ × P ₁₀	35.66**	60.43**	59.34**	35.38**	60.24**	48.37**	30.20**	37.60**	38.28**	48.10**	33.75**	42.17**
P ₃ × P ₄	54.37**	33.01**	70.02**	53.85**	62.10**	43.04**	33.75**	19.78*	63.49**	50.63**	48.24**	33.22**
P ₃ × P ₅	29.11**	29.11**	8.53	8.53	19.20*	19.20	-1.96	-1.96	22.23**	22.23**	8.58	8.58
P ₃ × P ₆	44.58**	69.01**	35.08**	22.24*	59.19**	46.48**	44.53**	36.23**	32.36**	38.29**	38.92**	37.13**
P ₃ × P ₇	52.00**	68.29**	70.79**	54.55**	81.61**	61.67**	9.36	21.28**	24.89**	50.55**	16.45*	34.03**
P ₃ × P ₈	8.79	31.06**	14.74	38.81**	11.66	34.79**	9.01	23.17**	63.48**	47.59**	34.61**	33.81**
P ₃ × P ₉	29.34**	67.58**	24.65*	25.87**	27.37**	47.49**	37.21**	60.77**	99.44**	80.05**	67.26**	69.17**
P ₃ × P ₁₀	27.53**	50.81**	97.99**	79.16**	77.63**	64.47**	20.20**	27.02**	35.25**	22.87**	22.87**	30.61**
P ₄ × P ₅	8.45	8.45	14.55	14.55	11.38	11.38	51.31**	51.31**	72.78**	72.78**	60.66**	60.66**
P ₄ × P ₆	5.11	22.87*	32.52**	6.85	25.15*	15.16	22.30**	15.27	18.93*	24.26**	20.75*	19.19*
P ₄ × P ₇	31.92**	46.07**	107.29**	67.13**	75.48	56.21**	23.66**	37.14**	26.44**	52.41**	24.93**	43.79**
P ₄ × P ₈	-6.69	12.41	-29.71**	-14.97	-17.80*	-0.77	-6.53	5.61	25.05**	15.22	10.45	9.80
P ₄ × P ₉	-10.63	15.79	21.47*	22.66*	2.85	19.10	2.84	20.50*	56.79**	44.46**	29.46**	30.94**
P ₄ × P ₁₀	13.19	33.85**	35.13**	8.95	31.61**	21.86*	23.35**	30.35**	56.43**	67.54**	37.87**	46.56**
P ₅ × P ₆	47.19**	72.06**	26.92**	26.92**	50.32**	50.32**	27.28**	27.28**	56.15**	63.14**	42.91**	42.91**
P ₅ × P ₇	25.65**	39.12**	53.78**	53.78**	46.18**	46.18**	5.12	16.58*	13.32*	36.60**	8.86	25.30**
P ₅ × P ₈	22.33*	47.37**	-25.26**	-9.58	-0.64	19.94	38.07**	56.01**	75.49**	75.49**	64.49**	64.49**
P ₅ × P ₉	-33.75**	-14.17	80.06**	81.82**	14.05	32.06**	-1.67	15.21	43.20**	43.20**	25.97**	27.40**
P ₅ × P ₁₀	9.34	29.30**	68.95**	68.95**	48.40**	48.40**	19.70*	26.50**	32.44**	41.84**	25.29	33.19**
P ₆ × P ₇	18.18	38.14**	22.79*	22.79*	-19.37*	20.02*	15.95*	28.59**	34.85**	62.55**	24.58**	43.39**
P ₆ × P ₈	17.21	41.20**	-2.66	17.76	7.62	29.91**	11.73	26.24**	32.85**	38.80**	32.49**	31.71**
P ₆ × P ₉	39.67**	80.96**	40.37*	41.75**	39.97**	62.07**	33.37**	56.27**	69.74**	77.35**	63.58**	65.45**
P ₆ × P ₁₀	18.85*	40.55**	24.76*	-18.60	21.03*	12.06	26.87**	34.07**	57.85**	69.06**	40.47**	49.32**
P ₇ × P ₈	32.74**	59.91**	3.82	25.59**	18.78*	43.38**	18.89**	34.33**	21.60**	46.58**	21.34**	39.67**
P ₇ × P ₉	20.36*	55.95**	22.85*	24.06	21.41*	40.59**	23.45**	44.65**	43.13**	72.53**	36.22**	56.80**
P ₇ × P ₁₀	6.04	25.41*	99.36**	30.91**	38.30**	28.06**	10.89	22.98**	14.73*	38.29**	12.64	29.65**
P ₈ × P ₉	7.37	39.12**	-0.69	20.14*	7.67	29.98**	8.97	27.68**	53.10**	25.27**	25.20**	26.63**
P ₈ × P ₁₀	28.80**	55.17**	5.43	27.55**	17.52*	41.87**	31.48**	48.56**	31.49**	40.83**	36.59**	45.19**
P ₉ × P ₁₀	-15.15	9.94	8.73	9.79	-5.12	9.87	-4.57	11.81	14.36*	22.49**	9.56	16.46*
No. of crosses with significant (+) heterosis	22	34	30	28	31	32	28	36	43	44	35	40
No. of crosses with significant (-) heterosis	1	0	3	2	1	0	0	0	0	0	0	0
Range of heterosis	-33.75 to 90.07	-14.17 to 80.96	-29.71 to 99.36	-18.60 to 79.16	-17.80 to 81.61	-0.77 to 64.47	-9.77 to 61.89	-1.96 to 60.77	3.23 to 99.44	15.22 to 80.05	-3.84 to 67.26	9.80 to 69.17

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

Table.1 Cont.....

Crosses	Total soluble solids (TSS)						Ascorbic acid (mg/100 g fresh fruit)					
	E ₁		E ₂		Pooled		E ₁		E ₂		Pooled	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
P ₁ × P ₂	26.81**	62.86**	16.76**	46.74**	21.59**	54.39**	4.70*	8.31**	3.94	8.78**	4.32	8.54**
P ₁ × P ₃	15.28**	62.26**	15.22**	57.34**	15.25**	59.67**	-13.73**	-10.76**	-2.81	1.72	-8.32**	-4.61
P ₁ × P ₄	17.77**	68.42**	-12.45*	21.33**	2.13	43.68**	-4.18	6.16*	-18.75**	-9.73**	-11.37**	-1.67
P ₁ × P ₅	-8.67*	17.29**	31.68**	65.49**	12.31*	42.61**	2.83	6.38**	1.17	5.88*	2.01	6.13*
P ₁ × P ₆	-5.48	40.15**	-2.56	39.67**	-3.97	39.90**	-4.40	-0.82	-6.16**	-0.61	-5.28*	-0.71
P ₁ × P ₇	13.73**	66.92**	22.30**	73.64**	18.16**	70.45**	2.80	6.34**	-9.95**	-5.76*	-3.52	0.38
P ₁ × P ₈	7.10	58.80**	-2.10	39.67**	2.36	48.75**	-2.33	5.75*	-0.15	4.50	-1.24	5.13*
P ₁ × P ₉	3.52	50.38**	2.22	43.75**	2.85	46.90**	-9.11**	2.89	-9.07**	3.28	-9.09**	3.08
P ₁ × P ₁₀	-3.15	80.15**	-18.88**	38.32**	-11.08**	58.17**	-3.05	0.30	6.20**	11.14**	1.54	5.64*
P ₂ × P ₃	-0.11	40.60**	0.80	37.64**	0.36	39.04**	-3.58	-10.98**	-0.75	-8.58**	-2.18	-9.80**
P ₂ × P ₄	0.95	44.36**	-3.63	33.56**	-1.42	38.69**	-4.29	6.05*	-5.60*	4.88*	-4.93*	5.47*
P ₂ × P ₅	3.42	31.73**	8.95	35.60**	6.30	33.76**	3.89	3.89	8.09**	8.09**	5.96*	5.96*
P ₂ × P ₆	-3.45	43.16**	-3.51	38.32**	-3.48	40.61**	2.32	6.16*	7.28**	13.62**	4.79*	9.84**
P ₂ × P ₇	-3.69	41.35**	-11.20*	26.09**	-7.57	33.33**	2.49	-0.74	3.59	0.23	3.03	-0.26
P ₂ × P ₈	-0.61	47.37**	0.76	43.75**	0.10	45.47**	-1.54	6.60**	8.54**	13.51**	3.34	10.01**
P ₂ × P ₉	9.32*	58.80**	-27.73**	1.63	-9.85*	28.77**	0.59	13.87**	-0.97	12.48**	-0.18	13.18**
P ₂ × P ₁₀	-8.25**	70.68**	-14.90**	45.11**	-11.60**	57.24**	0.87	-1.00	1.13	-0.80	1.00	-0.90
P ₃ × P ₄	13.56**	62.41**	-0.20	38.32**	6.44	49.75**	-20.62**	-12.05**	0.17	11.29**	-10.36**	-0.55
P ₃ × P ₅	2.56	44.36**	-14.63**	16.58*	-6.34	29.76**	-5.38*	-5.38*	-5.30*	-5.30*	-5.34*	-5.34*
P ₃ × P ₆	5.48	56.39**	1.23	45.11**	3.28	50.46**	-15.80**	-12.65**	0.76	6.71**	-7.55**	-3.10
P ₃ × P ₇	2.46	50.38**	3.16	46.47**	2.82	48.32**	-0.88	-4.01	-5.28*	-8.36**	-3.05	-6.15*
P ₃ × P ₈	-3.65	42.86**	-2.10	39.67**	-2.85	41.18**	-15.18**	-8.16**	-2.44	2.02	-9.01**	-3.14
P ₃ × P ₉	7.66*	56.39**	14.78**	61.41**	11.34*	59.03**	-14.52**	-3.23	-20.36**	-9.54**	-17.40**	-6.34**
P ₃ × P ₁₀	-13.50**	60.90**	-27.25**	24.05**	-20.43**	41.54**	15.27**	13.13**	-1.05	-2.94	7.23**	5.21*
P ₄ × P ₅	-16.51**	19.40**	-15.88**	16.58*	-16.18**	17.92**	-13.02**	-3.64	-3.74	6.94**	-8.44**	1.58
P ₄ × P ₆	10.04**	63.16**	7.58	54.21**	8.77*	58.46**	-11.22**	-1.63	-8.69**	1.45	-9.97**	-0.11
P ₄ × P ₇	1.43	48.87**	-12.25*	24.59**	-5.64	36.12**	2.41	13.46**	-2.16	8.70**	0.15	11.12**
P ₄ × P ₈	-13.66**	25.41**	-11.88*	23.91**	-12.74**	24.63**	0.46	13.72**	-1.68	11.67**	-0.60	12.71**
P ₄ × P ₉	-6.22*	74.44**	-1.35	68.21**	-3.77	71.16**	-0.27	10.50**	-0.31	10.76**	-0.29	10.63**
P ₄ × P ₁₀	-11.26**	31.58**	17.35**	68.21**	3.53	50.82**	-4.58	-1.00	0.86	6.83**	-1.87	2.86
P ₅ × P ₇	-14.96**	24.81**	-4.50	35.60**	-9.55*	30.48**	7.90**	7.90**	9.88**	9.88**	8.88**	8.88**
P ₅ × P ₈	-17.85**	21.80**	5.71	50.82**	-5.70	37.04**	-4.01	3.93	-3.94	0.46	-3.98	2.22
P ₅ × P ₉	-21.33**	14.29*	-17.10**	16.58*	-19.14**	15.49*	-12.12**	-0.52	-12.23**	-0.31	-12.17**	-0.41
P ₅ × P ₁₀	-14.31**	59.40**	-37.21**	7.07	-25.84**	31.91**	15.21**	15.21**	-0.88	-0.88	7.28**	7.28**
P ₆ × P ₇	-10.75**	32.33**	-8.72	30.84**	-9.70*	31.55**	6.79**	10.79**	3.49	9.61**	5.15*	10.21**
P ₆ × P ₈	5.58	56.54**	6.07	52.04**	5.83	54.18**	-6.20**	1.56	-3.85	1.83	-4.47*	1.69
P ₆ × P ₉	-17.34**	22.56**	13.55**	62.77**	-1.37	43.68**	-20.22**	-9.68**	-6.18**	6.56**	-13.29**	-1.67
P ₆ × P ₁₀	-9.86**	67.67**	-7.09	58.42**	-8.47*	62.81**	-3.58	0.04	-5.33*	0.27	-4.45	0.15
P ₇ × P ₈	11.66**	65.56**	12.29*	60.19**	11.98**	62.74**	-1.95	6.16*	1.90	6.56**	-0.09	6.36**
P ₇ × P ₉	8.30*	58.95**	11.29*	58.02**	9.85*	58.46**	-10.62**	1.19	-9.88**	2.37	-10.25**	1.77
P ₇ × P ₁₀	-16.57**	55.19**	-18.09**	39.67**	-17.34**	47.04**	6.65**	4.67	12.37**	10.23**	9.47**	7.41**
P ₈ × P ₉	1.83	50.98**	3.05	47.01**	2.46	48.89**	-0.43	12.72**	-3.90	9.16**	-2.14	10.96**
P ₈ × P ₁₀	-10.99**	65.56**	-6.06	60.19**	-8.51*	62.74**	2.16	10.61**	-0.29	4.27	0.97	7.49**
P ₉ × P ₁₀	-12.69**	62.41**	-38.01**	5.71	-25.44**	32.62**	-8.16**	3.97	-9.47**	2.82	-8.81**	3.40
No. of crosses with significant (+) heterosis	10	45	10	42	9	45	6	20	6	22	7	21
No. of crosses with significant (-) 'heterosis	16	0	14	0	14	0	15	7	15	6	18	4
Range of heterosis	-17.85 to 26.81	-14.29 to 74.44	-38.01 to 31.68	1.63 to 73.64	-25.84 to 21.59	15.49 to -71.16	-20.62 to 15.27	-12.65 to 15.21	-20.36 to 12.37	-9.73 to 11.67	-13.29 to 9.47	-9.80 to 13.18

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

Table.1 Cont.....

Crosses	Reducing sugar (%)						Non-reducing sugar (%)					
	ENV1		ENV2		Pooled		ENV1		ENV2		Pooled	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
P ₁ × P ₂	-22.42**	5.41**	-24.21**	7.78**	-23.26**	6.50**	16.40**	15.48**	61.14**	59.32**	34.82**	33.57**
P ₁ × P ₃	24.11**	33.07**	29.35**	40.33**	26.53**	36.40**	-21.64**	-16.67**	1.04	10.17*	-12.15**	-5.59
P ₁ × P ₄	3.93*	16.63**	31.75**	50.71**	16.84**	12.40**	12.40**	11.51**	10.86*	9.60*	11.76**	10.72**
P ₁ × P ₅	7.58**	13.83**	25.17**	33.73**	15.70**	22.97**	9.52**	9.52**	27.12**	27.12**	16.78**	16.78**
P ₁ × P ₆	33.14**	40.88**	39.96**	49.53**	36.29**	44.85**	-21.40**	-19.84**	2.75	5.65	-11.39**	-9.32*
P ₁ × P ₇	-8.63**	16.63**	-9.25**	20.28**	-8.92**	18.31**	5.60	4.76	48.57**	46.89**	23.29**	22.14**
P ₁ × P ₈	23.41**	32.06**	28.54**	39.15**	25.78**	35.32**	-19.93**	-12.30**	2.49	16.38**	-10.48**	-0.47
P ₁ × P ₉	20.08**	27.05**	24.72**	33.25**	22.22**	29.90**	-16.08**	-4.76	6.64	27.12**	-6.44*	8.39*
P ₁ × P ₁₀	-6.45**	4.61*	-6.21*	6.84*	-6.34**	5.63*	14.40**	13.49**	62.86**	61.02**	34.35**	33.10**
P ₂ × P ₃	-8.41**	24.45**	-8.46**	30.19**	-8.43**	27.09**	-3.73	2.38	25.91**	37.29**	8.68*	16.78**
P ₂ × P ₄	-12.83**	18.44**	-13.43**	23.11**	-13.11**	20.59**	8.23*	4.37	47.62**	40.11**	24.33**	19.11**
P ₂ × P ₅	-26.40**	0.00	-28.69**	1.42	-27.48**	0.65	5.95	5.95	42.37**	42.37**	20.98**	20.98**
P ₂ × P ₆	-8.55**	24.25**	-8.62**	29.95**	-8.59**	26.87**	-0.78	1.19	31.87**	35.59**	12.76**	15.38**
P ₂ × P ₇	-7.52**	25.65**	-7.46**	31.60**	-7.49**	28.39**	24.24**	-2.38	87.80**	30.51**	48.60**	11.19**
P ₂ × P ₈	-11.95**	19.64**	-12.44**	24.53**	-12.18**	21.89**	-3.26	5.95	25.37**	42.37**	8.81**	20.98**
P ₂ × P ₉	-14.60**	16.03**	-15.42**	20.28**	-14.99**	17.98**	-1.75	11.51**	26.07**	50.28**	10.06**	27.51**
P ₂ × P ₁₀	-7.52**	25.65**	-7.46**	31.60**	-7.49**	28.39**	0.86	-7.14*	39.49**	23.73**	16.45**	5.59
P ₃ × P ₄	14.64**	28.66**	18.14**	35.14**	16.27**	31.64**	-10.45**	-4.76	16.58**	27.12**	0.87	8.39*
P ₃ × P ₅	36.82**	46.69**	44.13**	56.37**	40.20**	51.14**	-35.45**	-31.35**	-18.13**	-10.73**	-28.20**	-22.84**
P ₃ × P ₆	2.06	9.42**	3.70	12.50**	2.81	10.83**	5.60	12.30**	38.86**	51.41**	19.52**	28.44**
P ₃ × P ₇	17.27**	49.70**	20.64**	59.91**	18.85**	54.39**	-39.93**	-36.11**	-24.35**	-17.51**	-33.41**	-28.44**
P ₃ × P ₈	14.39**	22.65**	18.04**	28.07**	16.08**	25.14**	-5.43	3.57	22.39**	38.98**	6.29	18.18**
P ₃ × P ₉	8.22**	16.03**	11.52**	20.99**	9.75**	18.31**	-3.85	9.13**	18.01**	40.68**	5.43	22.14**
P ₃ × P ₁₀	-0.36	11.42**	0.83	14.86**	0.19	13.00**	7.84**	14.68**	41.97**	54.80**	22.13**	31.24**
P ₄ × P ₅	13.57**	27.45**	2.89	17.69**	8.61**	22.97**	-4.76	-4.76	47.46**	47.46**	16.78**	16.78**
P ₄ × P ₆	20.89**	35.67**	23.92**	41.75**	22.30**	38.46**	-10.89**	-9.13**	6.04	9.04*	-3.87	-1.63
P ₄ × P ₇	-18.52**	4.01	-19.93**	6.13*	-19.18**	4.98*	27.16**	22.62**	75.00**	66.10**	46.72**	40.56**
P ₄ × P ₈	10.54**	24.05**	13.40**	29.72**	11.87**	26.65**	-7.97**	0.79	18.91**	35.03**	3.35	14.92**
P ₄ × P ₉	10.71**	24.25**	13.61**	29.95**	12.06**	26.87**	-7.69	4.76	18.01**	40.68**	3.22	19.58**
P ₄ × P ₁₀	-6.07**	5.41*	-5.77*	7.78**	-5.93**	6.50**	20.58**	16.27**	65.48**	57.06**	38.93**	33.10**
P ₅ × P ₆	35.51**	41.48**	42.83**	50.24**	38.88**	45.50**	-24.12**	-22.62**	-1.10	1.69	-14.58**	-12.59**
P ₅ × P ₇	-15.07**	8.42**	-16.01**	11.32**	-15.51**	9.75**	10.71**	10.71**	49.15**	49.15**	26.57**	26.57**
P ₅ × P ₈	20.22**	28.66**	23.53**	33.73**	21.75**	30.99**	-15.22**	-7.14*	11.94**	27.12**	-3.77	6.99
P ₅ × P ₉	34.47**	34.47**	41.98**	41.98**	37.92**	37.92**	-27.62**	-17.86**	-9.00*	8.47	-19.72**	-6.99
P ₅ × P ₁₀	-6.45**	4.61*	-6.21*	6.84*	-6.34**	5.63*	17.86**	17.86**	59.32**	59.32**	34.97**	34.97**
P ₆ × P ₇	-16.01**	7.21**	-17.08**	9.91**	-16.51**	8.45**	14.01**	16.27**	52.75**	57.06**	30.07**	33.10**
P ₆ × P ₈	23.03**	31.66**	28.10**	38.68**	25.38**	34.89**	-18.48**	-10.71**	4.48	18.64**	-8.81**	1.40
P ₆ × P ₉	35.89**	41.88**	15.02**	20.99**	26.27**	32.29**	-26.92**	-17.06**	26.07**	50.28**	-4.43	10.72**
P ₆ × P ₁₀	21.51**	35.87**	26.09**	43.63**	23.63**	39.44**	-10.89**	-9.13	17.58**	20.90**	0.91	3.26
P ₇ × P ₈	-7.22**	18.44**	-7.12**	23.11**	-7.17**	20.59**	-4.35	4.76	23.88**	40.68**	7.55*	19.58**
P ₇ × P ₉	5.18**	34.27**	8.19**	43.40**	6.59**	38.46**	-27.27**	-17.46**	1.42	20.90**	-15.09**	-1.63
P ₇ × P ₁₀	-0.16	27.45**	1.96	35.14**	0.83	30.99**	3.45	-4.76	39.49**	23.73**	17.99**	6.99
P ₈ × P ₉	6.55**	14.03**	8.93**	17.92**	7.65**	15.82**	-0.35	13.10**	27.96**	52.54**	11.67**	29.37**
P ₈ × P ₁₀	-4.84*	6.41**	-4.35	8.96**	-4.61*	7.58**	5.80	15.87**	40.30**	59.32**	20.34**	33.80**
P ₉ × P ₁₀	9.14**	22.04**	11.80**	27.36**	10.37**	24.49**	-26.92**	-17.06**	-8.06*	9.60*	-18.91**	-6.06
No. of crosses with significant (+) heterosis	24	43	23	44	24	44	12	15	33	40	25	30
No. of crosses with significant (-) heterosis	18	0	17	0	18	0	17	14	4	2	11	4
Range of heterosis	-26.40 to 35.89	4.01 to 49.70	-28.69 to 44.13	-1.42 to 56.37	-23.26 to 40.20	-0.65 to 54.39	-39.93 to 27.16	-36.11 to 22.62	-24.35 to 87.80	-17.51 to 61.02	-28.20 to 48.60	-28.44 to 40.56

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

Table.1 Cont.....

Crosses	Total sugar (%)						Dry matter content in fruit					
	E ₁		E ₂		Pooled		E ₁		E ₂		Pooled	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
P ₁ × P ₂	-4.89**	8.79**	4.23*	22.96**	-0.77	15.09**	-23.12**	-15.05**	-2.58	-12.58**	-6.78	-13.74**
P ₁ × P ₃	8.84**	16.38**	20.98**	31.45**	14.29**	23.08**	17.03**	11.20**	12.64**	1.08	14.76**	5.82
P ₁ × P ₄	7.47**	14.91**	27.57**	38.60**	25.44**	16.48**	-20.45**	-16.27**	-15.93**	-12.04**	-18.05**	-14.02**
P ₁ × P ₅	8.48**	12.38**	26.11**	31.78**	16.36**	21.01**	13.91**	13.91**	1.47	1.47	7.30*	7.30*
P ₁ × P ₆	16.32**	20.51**	30.73**	36.61**	22.76**	27.66**	-13.26**	-17.59**	-5.07	-14.81**	-9.03*	-16.11**
P ₁ × P ₇	1.32	12.65**	12.41**	28.12**	6.32**	19.53**	-10.41**	-14.87**	-4.90	-1.23	-5.81	-7.63*
P ₁ × P ₈	8.64**	17.18**	20.61**	32.45**	14.01**	23.96**	-11.19**	-4.90	-7.48*	-1.70	-9.23*	-3.20
P ₁ × P ₉	12.34**	16.38**	25.80**	31.45**	18.35**	23.08**	28.27**	21.87**	30.56**	19.98**	31.08**	20.87**
P ₁ × P ₁₀	2.28	7.59**	15.31**	22.80**	8.11**	14.35**	4.25	0.79	7.15	4.01	5.80	2.50
P ₂ × P ₃	2.33	17.04**	12.13**	32.28**	6.76**	23.82**	-23.12**	-15.05**	9.66*	-15.90**	-8.68*	-15.50**
P ₂ × P ₄	-0.58	13.72**	8.60**	28.12**	3.57*	20.12**	0.16	10.67**	-24.26**	-20.76**	-10.43**	-6.03
P ₂ × P ₅	-10.83**	2.00	-3.81	13.48**	-7.65**	7.10**	-27.55**	-19.95**	-16.90**	-16.90**	-18.33**	-18.33**
P ₂ × P ₆	1.86	16.51**	11.57**	31.61**	6.25**	23.22**	-18.05**	-9.45**	18.05**	-7.64*	-1.11	-8.49*
P ₂ × P ₇	1.63	16.25**	11.28**	31.28**	5.99**	22.93**	-29.93**	-22.57**	-22.21**	-19.21**	-19.23**	-20.79**
P ₂ × P ₈	0.58	15.05**	10.01**	29.78**	4.85**	21.60**	-15.12**	-6.21*	-10.38**	-4.78	-11.34**	-5.45
P ₂ × P ₉	0.12	14.51**	9.45**	29.12**	4.34*	21.01**	9.42**	20.91**	29.64**	19.14**	29.64**	19.97**
P ₂ × P ₁₀	0.23	14.65**	9.59**	29.28**	4.46*	21.15**	-12.75**	-3.59	0.48	-2.47	0.13	-2.99
P ₃ × P ₄	9.84**	17.44**	22.21**	32.78**	15.38**	24.26**	3.49	8.92**	3.76	8.56*	3.63	8.73**
P ₃ × P ₅	12.70**	20.51**	25.73**	36.61**	18.54**	27.66**	-12.60**	-12.60**	-10.42**	-10.42**	-11.44**	-11.44**
P ₃ × P ₆	3.24	10.39**	14.09**	23.96**	8.10**	16.42**	53.77**	15.84**	46.55**	14.66**	49.87**	15.21**
P ₃ × P ₇	8.74**	20.91**	20.29**	37.10**	13.95**	28.11**	-40.54**	-45.58**	-18.05**	-14.89**	-27.88**	-29.27**
P ₃ × P ₈	7.78**	16.25**	19.55**	31.28**	13.06**	22.93**	-18.22**	-12.42**	-18.01**	-12.89**	-18.11**	-12.67**
P ₃ × P ₉	6.35**	13.72**	16.69**	26.79**	10.99**	19.53**	0.87	-8.40**	-4.70	-12.42**	-2.11	-10.54**
P ₃ × P ₁₀	5.23**	12.52**	16.54**	26.62**	10.30**	18.79**	-8.69**	-11.72**	-7.31	-10.03**	-7.96**	-10.82**
P ₄ × P ₅	9.09**	16.64**	16.39**	26.46**	12.36**	21.01**	-21.70**	-17.59**	8.92*	13.97**	-5.47	-0.82
P ₄ × P ₆	12.83**	20.64**	21.59**	32.11**	16.76**	25.74**	-8.89**	-4.11	2.95	7.72*	-2.62	2.17
P ₄ × P ₇	-0.84	10.25**	8.61**	23.79**	3.42	16.27**	-17.71**	-13.39**	-25.96**	-22.53**	-22.08**	-18.25**
P ₄ × P ₈	7.78**	16.25**	19.55**	31.28**	13.06**	22.93**	6.37*	13.91**	6.32	12.96**	6.34**	13.41**
P ₄ × P ₉	10.09**	17.71**	22.51**	33.11**	15.66**	24.56**	0.83	6.12*	-15.27**	-11.34**	-7.70**	-3.16
P ₄ × P ₁₀	1.99	9.05**	12.56**	22.30**	6.73**	14.94**	-5.74*	-0.79	-28.47**	-25.15**	-17.78**	-13.74**
P ₅ × P ₆	15.81**	19.97**	30.10**	35.94**	22.19**	27.07**	-23.71**	-23.71**	-8.56*	-8.56*	-15.66**	-15.66**
P ₅ × P ₇	-1.80	9.19**	7.45**	22.46**	2.37	15.09**	6.91*	6.91*	2.82	6.79	6.85	6.85
P ₅ × P ₈	8.15**	16.64**	20.00**	31.78**	13.47**	23.37**	-11.93**	-5.69	-20.55**	-15.59**	-16.49**	-10.95**
P ₅ × P ₉	15.83**	16.91**	30.59**	32.11**	22.40**	23.67**	-0.17	-0.17	-18.75**	-18.75**	-10.05**	-10.05**
P ₅ × P ₁₀	3.67*	9.05**	14.84**	22.30**	8.67**	14.94**	-14.70**	-14.70**	-9.95**	-9.95**	-12.18**	-12.18**
P ₆ × P ₇	-0.84	10.25**	8.61**	23.79**	3.42	16.27**	-3.54	-11.72**	9.36**	13.58**	3.72	1.72
P ₆ × P ₈	8.89**	17.44**	20.91**	32.78**	14.29**	24.26**	-11.76**	-5.51	-0.15	6.10	-5.61	0.66
P ₆ × P ₉	17.87**	22.10**	24.04**	29.62**	20.63**	25.44**	-5.78	-14.44**	-3.02	-10.88**	-4.31	-12.55**
P ₆ × P ₁₀	14.81**	20.77**	28.59**	36.94**	20.98**	27.96**	4.89	1.40	5.01	1.93	4.95	1.68
P ₇ × P ₈	2.40	13.85**	12.55**	28.29**	6.97**	20.27**	-17.57**	-11.72**	-14.96**	-9.65**	-16.19**	-10.62**
P ₇ × P ₉	5.15**	16.91**	20.00**	36.77**	11.84**	25.74**	17.97**	7.96**	-21.77**	-18.75**	-4.39	-6.23
P ₇ × P ₁₀	4.91**	16.64**	15.62**	31.78**	9.74**	23.37**	-0.45	-3.76	-7.88*	-4.32	-2.17	-4.06
P ₈ × P ₉	5.43**	13.72**	16.67**	28.12**	10.48**	20.12**	-6.94*	-0.35	-24.26**	-19.52**	-16.11**	-10.54**
P ₈ × P ₁₀	1.60	9.59**	12.73**	23.79**	6.60**	15.90**	-5.64*	1.05	20.84**	28.40**	8.38**	15.58**
P ₉ × P ₁₀	3.54*	8.92**	14.69**	22.13**	8.53**	14.79**	1.45	-1.92	8.43*	5.25	5.16	1.89
No. of crosses with significant (+) heterosis	27	43	44	45	40	45	8	11	10	9	7	7
No. of crosses with significant (-) heterosis	2	0	0	0	1	0	26	21	20	24	21	21
Range of heterosis	-10.83 to 17.87	2.00 to 22.10	-3.81 to 30.73	13.48 to 38.60	-7.65 to 22.76	7.10 to 28.11	-40.54 to 53.77	-23.71 to 21.87	-28.47 to 46.55	-25.15 to 28.40	-27.88 to 49.87	-29.27 to 20.87

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

Thirty five crosses over better parent and forty crosses over standard parents showed significant heterosis over seasons for fruit yield (Tables 2 and 3). Increased yield in crosses of bottle gourd observed in present investigation is in conformity with the findings of various workers (Janakiram and Sirohi, 1992, Singh *et al.*, 1996 Sirohi *et al.*, 2005 and Gayakawad *et al.*, (2016)). Fruit yield per plant being complex trait is a multiplicative product of several basic component traits of yield. The improvement in heterosis for yield component may not necessarily be reflected in increased yield. Contrarily the increased fruit yield will definitely be cause of increase in one or more component traits. In the present study, the best performing heterobeltiotic F₁ (P₃ x P₉) for yield common over seasons also showed significant and top ranked heterobeltiosis for number of fruits per plant in over seasons. This hybrid also showed significant and desirable heterosis for fruit circumference and fruit weight. Likewise, out of twenty seven crosses found significant heterotic over standard parent common over seasons. Among top heterotic crosses some of the parents were more frequently involved. The above findings indicated that some inbreds had more heterotic capability compared to other ones during hybridization process. As the performance of hybrids depends upon the heterotic capability of parents involved, from economic point of view it will be useful to select and utilize the parental inbreds with strong heterotic capability for important economic traits associated with yield in order to achieve higher gains in F₁ hybrids through exploitation of heterosis.

A perusal of table 1 which showed best five crosses on the basis of desirable significant heterobeltiosis, *per se* performance and common crosses for eighteen traits in pooled revealed that common crosses on the basis of *per se* performance and better parent heterosis

for fruit yield per plant were P₃ x P₉, P₅ x P₈, P₄ x P₅, P₈ x P₁₀ and P₇ x P₉ were common crosses on the basis of *per se* performance and out of these common crosses P₆ x P₉, P₅ x P₈ and P₄ x P₅ were also found common in respect to *per se* performance and better parent heterosis for fruit yield as well as some other traits studied. Standard heterosis of five best crosses combinations along with *per se* performance and common crosses for different characters had been presented in table 1 the extent of heterosis of five best crosses (56.80 to 69.17%) fruit yield per plant revealed that there was a great scope of realizing higher yield in bottle gourd through heterosis breeding.

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