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Heterosis studies in bottlegourd [*Lagenaria siceraria* (Mol.) Standl.]

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Abstract

Experiment on heterosis in bottlegourd was conducted involving 9 parents, their 36 F_1 hybrids and one standard check. The crop was raised in RBD with three replications under four environments. The analysis of variance indicated presence of significant genetic variability in the experimental material. Mean squares due to genotypes as well as parents and hybrids, environments and their interaction effects were significant. Hybrids, Banswara Local-1 x IC 92374, Banswara Local-1 x Pusa Naveen and IC 92374 x PSPL were superior and exhibited significant economic heterosis for fruit yield per plant, number of fruits per plant and its contributing traits in all the environments. Most of the heterotic crosses were also heterobeltiotic.

Key words: Heterosis, heterobeltiosis, economic heterosis, breeding, bottlegourd, parents, hybrids, environment

Introduction

Due to high remunerative prices in domestic as well as external market, commercial cultivation of bottlegourd has increased in India. Hybrid varieties play a vital role in increasing vegetable production due to their high yield potential, earliness, quality and resistance attributes. Bottlegourd being monoecious is cross pollinated and heterosis breeding in cross pollinated crops has long been known to offer good potentialities for increased yield. Although, heterosis for yield and yield contributing characters has been reported in bottlegourd by early workers (Choudhary and Singh, 1971, Kolhe, 1972, Tyagi, 1973, Sirohi *et al.,* 1987, Jankiram and Sirohi, 1992), it has not been exploited sufficiently by plant breeder for improvement. It was therefore, felt necessary to initiate steps in this direction with a view to evolve high yielding quality F_1 hybrids through heterosis breeding.

Materials and methods

In the present study, nine genotypes of bottlegourd differing in morphological, phenological, yield as well as fruit characters were selected. The experimental material comprising of nine parents, their 36 F_1 hybrids (excluding reciprocals) and Varad as standard check was evaluated under four environments created by sowing the experimental material on two different dates at two different locations in a randomized block design with three replications. Each treatment consisted of a single row accommodating ten plants. The rows were spaced at 3 m apart and plant at 1 m within the row. The observations were recorded from the randomly selected 5 plants leaving the border plants on the traits, *viz.,* number of female flowers per plant, number of fruits per plant and fruit yield per plant. Heterosis, heterobeltiosis and economic heterosis were estimated for all the characters in each environment as well as over the environment. The data on three important characters of parents and hybrids are presented in the text.

Results and discussion

Analysis of variance (Table 1) indicated presence of significant variability among parents and their hybrids for all the three characters studied. Mean squares due to parents and hybrids were significant for all the characters. This is indicative of presence of

Table 1. Pooled analysis of variance for various characters in bottlegourd

Source of variation	d.f.	Mean squares		
		No. of female flower/plant	No. of fruits /plant	Total fruit yield/ plant
Environments (E)	3	130.68**	33.74**	14.30**
Replication/Environment	8	1.68**	0.52**	0.34**
Genotypes	44	190.00**++	64.41**++	39.76**++
(a) Parents	8	153.99**++	37.78**++	43.40**++
(b) Hybrids	35	166.68**++	55.71**++	35.47**++
(c) Parents vs hybrids	1	1646.58**++	581.88**++	160.63**++
Genotypes x Environments	132	5.99**	0.93**	0.62**
(a) Parents x Environments	24	2.86**	0.29**	0.33**
(b) Hybrids x Environments	105	6.35**	1.03**	0.64**
(c) Parents vs Hybrids x Environments	3	18.40**	2.71**	2.03**
Pooled error	352	0.34	0.13	0.10

*, ** Indicates significant at 5% and 1% level, respectively. ++ Indicates significant against respective environmental interaction at 1% level.

Table 2. Estimates of heterosis for various characters in bottlegourd

S. No.	Crosses	Number of female flowers/plant					Number of fruit per plant					Fruit yield/plant				
		E_1	E_2	E_3	E_4	Pooled	E_1	E_2	E_3	E_4	Pooled	E_1	E_2	E_3	E_4	Pooled
1	Banswara Local-1 x Long White Profilic	16.93**	19.48**	3.78	8.77**	12.36**	47.02**	55.96**	16.38**	49.83**	41.62**	29.99**	34.40**	14.12**	30.16**	27.19**
2	Banswara Local-1 x Pusa Naveen	34.91**	19.25**	26.80**	20.92**	25.56**	39.90**	43.77**	29.14**	41.24**	38.36**	46.20**	34.65**	27.39**	30.40**	34.61**
3	Banswara Local-1 x Raichur Local-1	40.90**	5.65**	30.74**	6.20**	20.63**	43.75**	28.85**	29.34**	16.61**	29.54**	35.91**	21.38**	24.70**	4.88	21.49**
4	Banswara Local-1 x Udaipur Local-1	29.42**	9.66**	31.09**	8.99**	20.03**	50.00**	36.21**	44.79**	22.15**	38.88**	25.72**	-14.67**	16.90**	8.67*	8.95*
5	Banswara Local-1 x IC 92352A	12.86**	3.08	12.38**	18.55**	11.61**	36.36**	33.33**	10.49	25.87**	26.49**	29.01**	25.34**	10.47**	14.66**	19.95**
6	Banswara Local-1 x IC 92374	34.22**	18.68**	32.14**	27.49**	28.15**	71.43**	80.82**	62.19**	67.65**	70.56**	70.29**	71.19**	62.11**	58.54**	65.49**
7	Banswara Local-1 x IC 42361	15.81**	-9.83**	6.90**	7.23**	5.22*	37.84**	25.53**	25.71**	28.63**	29.56**	18.00**	4.75	-0.58	4.86	6.75
8	Banswara Local-1 x PSPL	38.90**	32.43**	40.56**	30.10**	35.52**	44.41**	50.41**	39.89**	46.24**	45.19**	25.11**	25.67**	22.11**	25.96**	24.68**
9	Long White Profilic x Pusa Naveen	24.88**	35.23**	23.30**	36.08**	29.63**	48.94**	71.43**	52.91**	44.81**	54.62**	2.32	23.10**	20.88**	5.38	12.97**
10	Long White Profilic x Raichur Local-1	40.98**	6.83*	12.77**	11.34**	17.80**	51.16**	46.07**	28.62**	4.10	32.89**	24.07**	15.82**	20.35**	-21.03**	9.79*
11	Long White Profilic x Udaipur Local-1	23.48**	10.45**	28.65**	42.75**	26.25**	61.78**	62.38**	55.76**	83.00**	64.73**	-9.16	-18.50**	-10.72**	28.37**	-3.96
12	Long White Profilic x IC 92352A	12.38**	6.74*	-0.66	35.78**	12.66**	49.22**	23.08**	39.68**	48.08**	40.00**	23.16**	-7.97**	42.01**	29.49**	21.00**
13	Long White Profilic x IC 92374	23.00**	16.16**	29.19**	23.11**	22.86**	64.74**	55.73**	61.98**	36.69**	55.28**	66.67**	52.19**	67.61**	27.26**	53.62**
14	Long White Profilic x IC 42361	13.86**	12.05**	2.18	10.21**	9.59**	55.64**	36.71**	30.08**	49.02**	42.92**	62.80**	34.57**	39.34**	51.94**	47.29**
15	Long White Profilic x PSPL	28.95**	42.06**	23.22**	44.17**	34.39**	36.05**	33.96**	32.16**	41.02**	35.64**	25.11**	25.36**	24.71**	21.33**	24.15**
16	Pusa Naveen x Raichur Local-1	50.74**	35.47**	36.37**	29.06**	37.64**	78.05**	63.32**	68.72**	67.95**	69.39**	25.18**	17.63**	24.40**	7.11	18.44**
17	Pusa Naveen x Udaipur Local-1	39.18**	18.34**	35.20**	36.14**	32.34**	52.60**	64.49**	46.46**	62.94**	51.76**	22.06**	9.11*	10.09**	27.46**	16.75**
18	Pusa Naveen x IC 92352A	37.71**	15.45**	23.20**	30.30**	26.50**	58.90**	55.70**	55.35**	36.88**	51.97**	27.79**	37.69**	37.32**	6.25	27.56**
19	Pusa Naveen x IC 92374	41.62**	25.20**	39.08**	32.89**	34.70**	86.72**	81.05**	81.67**	59.11**	77.35**	44.23**	38.69**	39.70**	21.97**	36.12**
20	Pusa Naveen x IC 42361	24.23**	-0.19	17.22**	11.20**	13.30**	75.00**	52.98**	58.26**	46.13**	58.52**	59.91**	40.22**	40.68**	30.95**	43.17**
21	Pusa Naveen x PSPL	32.29**	18.68**	34.10**	18.21**	25.89**	36.25**	26.50**	29.02**	28.87**	30.11**	25.68**	30.52**	21.71**	19.17**	24.22**
22	Raichur Local-1 x Udaipur Local-1	36.62**	36.48**	27.26**	23.30**	30.64**	27.07**	20.83**	28.17**	43.32**	29.40**	18.95**	6.81	8.48*	27.50**	14.96**
23	Raichur Local-1 x IC 92352A	38.57**	26.85**	6.35*	41.98**	27.75**	50.00**	15.07**	37.67**	10.58	28.24**	29.45**	-6.56	24.18**	-11.33	8.34
24	Raichur Local-1 x IC 92374	48.98**	31.01**	38.43**	35.30**	38.17**	59.89**	44.44**	54.35**	42.30**	50.14**	42.36**	29.25**	41.84**	17.93**	32.40**
25	Raichur Local-1 x IC 42361	12.53**	11.01**	-1.22	-7.97**	3.33	34.86**	14.41*	39.71**	-6.86	20.75**	22.67**	-2.04	15.19**	-25.18**	2.34
26	Raichur Local-1 x PSPL	30.72**	16.05**	36.17**	7.04**	22.24**	72.69**	60.40**	62.62**	62.03**	64.22**	36.37**	27.68**	32.74**	24.15**	30.06**
27	Udaipur Local-1 x IC 92352A	29.42**	24.75**	28.51**	42.34**	31.05**	25.00**	22.35**	36.76**	37.44**	30.01**	20.91**	5.13	21.60**	28.72**	18.49**
28	Udaipur Local-1 x IC 92374	38.21**	15.62**	38.05**	19.61**	27.99**	75.80**	63.77**	72.41**	62.22**	68.71**	51.53**	34.24**	42.86**	38.68**	41.75**
29	Udaipur Local-1 x IC 42361	6.05*	8.08*	3.52	14.44**	7.92**	35.77**	23.26**	54.66**	54.59**	41.18**	30.86**	10.03	20.37**	43.62**	25.13**
30	Udaipur Local-1 x PSPL	26.17**	29.77**	26.87**	27.97**	27.68**	55.96**	39.82**	51.60**	46.31**	48.43**	27.24**	1.15	17.66**	22.39**	16.84**
31	IC 92352A x IC 92374	42.98**	-2.7	32.03**	6.15*	19.68**	70.61**	32.17**	56.08**	-0.31	40.30**	66.92**	29.46**	56.88**	-3.1	37.79**
32	IC 92352A x IC 42361	27.30**	14.02**	33.50**	23.70**	24.72*	88.89**	61.90**	110.11**	47.62**	77.90**	87.53**	58.93**	94.39**	53.85**	75.13**
33	IC 92352A x PSPL	37.12**	19.08**	33.41**	6.51*	24.25**	83.64**	37.78**	83.21**	25.87**	58.02**	29.38**	1.21	31.15**	-3.04	14.95**
34	IC 92374 x IC 42361	35.89**	33.40**	44.69**	58.85**	42.98**	59.66**	68.97**	78.25**	76.66**	70.58**	93.86**	106.21**	102.05**	103.99**	101.49**
35	IC 92374 x PSPL	48.93**	28.75**	47.84**	38.56**	40.91**	52.20**	41.26**	58.31**	45.10**	49.22**	53.18**	45.22**	62.17**	38.96**	49.84**
36	IC 42361 x PSPL	37.26**	28.31**	26.69**	31.54**	30.94**	53.41**	49.45**	64.93**	70.20**	59.26**	41.83**	22.73**	38.71**	22.27**	31.56**

Table 3. Estimates of heterobeltiosis for various characters in bottlegourd

S.	Number of female flowers/plant					Number of fruit per plant					Fruit yield/plant				
No.	E_1	E_2	E_3	E_4	Pooled	E_1	E_2	E_3	E_4	Pooled	E_1	E_2	E_3	E_4	Pooled
1	9.09**	8.58**	-5.81**	5.83**	1.48	34.97**	37.10**	6.19	27.15**	26.22**	13.46**	15.04**	-7.46**	6.68	6.80
2	31.89**	18.88**	26.33**	17.48**	23.98**	27.35**	31.84**	17.87**	27.44**	26.00**	45.10**	32.59**	25.86**	30.11**	33.35**
3	10.13**	-9.52**	12.82**	-6.75**	1.86	13.11*	8.06	5.67	-0.58	6.66	5.19	0.23	-1.53	-10.91**	-1.68
4	18.33**	-0.78	21.91**	0.46	10.17**	40.98**	27.42**	32.47**	5.20	26.90**	12.80**	-19.98**	8.26**	-7.94*	-1.64
5	-14.31**	-19.03**	-13.41**	-14.72**	-15.33**	6.56	0.00	-18.56**	-5.78	-4.62	-18.89**	-24.12**	-33.41**	-31.98**	-27.12**
6	27.72**	17.94**	26.23**	21.63**	23.45**	50.00**	57.14**	45.31**	45.53**	49.59**	47.69**	48.68**	39.00**	42.63**	44.47**
7	-4.47*	-26.99**	-13.41**	-14.72**	-14.76**	11.48*	-4.84	-9.28	-5.20	-2.04	-19.16**	-30.28**	-33.05**	-32.04**	-28.66**
8	22.65**	22.62**	27.57**	19.33**	23.07**	37.70**	46.77**	35.57**	46.24**	41.44**	18.54**	18.47**	16.50**	24.02**	19.32**
9	19.03**	23.23**	11.54**	20.21**	18.53**	25.56**	39.91**	28.51**	13.49**	27.01**	-10.11*	6.75	-1.06	-13.48**	-4.41
10	16.35**	0.00	6.58*	9.53**	9.11**	27.45**	38.30**	13.75*	14.10	21.35**	7.61	10.92	16.25**	-24.40**	4.88
11	20.83**	9.92**	25.30**	33.27**	24.16**	57.76**	51.85**	55.28**	80.80**	60.26**	-11.95*	-26.12**	-22.79**	23.28**	-11.48**
12	-10.15**	-9.35**	-17.37**	8.60**	-7.61**	24.84**	2.13	10.00	26.23**	15.45*	-17.16**	-40.36**	-5.51	-16.37**	-20.34**
13	20.46**	6.16*	22.42**	11.55**	14.99**	34.02*	21.43**	33.88**	3.83	23.46**	65.53**	49.59**	56.68**	14.44**	46.77**
14	-0.34	-1.53	-10.05**	-0.42	-3.15	35.29**	14.89**	0.00	24.59**	18.23**	21.81**	-1.41	8.53	11.17	10.12
15	21.51**	39.19**	23.22**	35.29**	33.71**	30.72**	20.34**	24.18**	20.23**	23.78**	14.68**	13.06**	5.04	0.67	8.22*
16	19.81**	16.33**	17.31**	16.26**	17.44**	30.94**	27.80**	28.51**	31.63**	29.69**	-2.59	-1.65	-0.88	-8.84**	-3.45
17	29.95**	7.38**	25.30**	28.94**	22.89**	31.69**	26.46**	23.40**	28.84**	27.46**	10.25**	3.83	3.11	8.16**	6.30
18	6.24**	-9.11**	-5.33*	-4.55*	-3.19	16.14**	10.31*	8.09*	-4.19	7.70	-19.40**	-16.19**	-16.87**	-36.93**	-22.24**
19	37.75**	24.80**	32.40**	30.41**	31.37**	78.69**	70.63**	77.96**	52.34**	70.08**	25.90**	22.06**	21.02**	10.02**	19.80**
20	4.37*	-19.00**	-5.33*	9.59**	-7.32**	31.84**	9.42*	8.09*	0.93	12.61**	10.01*	-5.94	-4.67	-15.05**	-3.87
21	19.19**	10.20**	21.30**	11.38**	15.65**	18.83**	13.45**	14.47**	16.28**	15.74**	19.94**	24.87**	17.48	17.58**	19.56**
22	14.75**	28.32**	17.33**	16.91**	19.16**	4.97	7.41	13.04*	41.60**	15.27**	0.49	-6.85	-8.88**	27.06**	1.61
23	33.07**	14.22**	-7.19*	12.17**	11.85**	48.57**	0.00	20.33*	-5.74	14.50	-4.86	-38.17**	-15.87**	-43.84**	-26.99**
24	20.96**	12.80**	24.39**	23.99**	20.43**	14.34**	8.33*	15.92**	8.09**	11.68**	24.66**	21.76**	28.39**	10.45*	21.09**
25	5.05	3.72	-8.42**	-18.05**	-1.82	30.09**	0.79	18.70*	-22.13**	8.19	2.78	-26.13**	-7.92	-46.81**	-20.99**
26	13.42**	6.59**	28.70**	2.02	12.69**	40.96**	37.29**	36.26**	38.15**	38.11**	9.93*	10.82*	8.71**	6.84	9.04*
27	5.22**	6.36	4.68	8.18**	6.09*	2.48	-3.70	7.45	16.00**	4.93	-19.95*	-34.78**	-24.53**	-18.36**	-24.94**
28	32.51**	5.21	34.21**	15.37**	21.70**	45.90**	34.52**	42.86**	24.26**	36.99**	45.82**	23.63**	31.37**	29.47**	36.51**
29	-5.40*	-4.62	-10.92**	-2.73	-5.99*	15.53**	-1.85	18.63**	28.00**	14.29**	-4.08	-24.17**	-15.32**	2.45	-11.30*
30	21.40**	26.56**	23.57**	27.27**	26.20**	53.61**	33.99**	42.86**	26.01**	38.97**	20.09**	0.58	14.03**	5.03	9.92*
31	12.54**	-23.22**	5.24*	-21.28**	-6.76**	21.31**	-9.52*	7.35	-31.91**	-2.97	12.71*	-16.76**	1.00	-40.27**	-11.24*
32	14.45**	9.57*	25.00**	7.79*	14.38**	80.53**	59.37**	103.26**	44.19**	77.19**	58.98**	30.03*	54.82**	25.33*	43.55**
33	14.98**	-0.55	10.97**	-18.75**	1.49	48.80**	5.08	37.91**	-5.78	21.35**	-16.70**	-37.35**	-19.58**	-42.19**	-29.00**
34	16.83**	8.53**	21.60**	31.08**	19.33**	16.80**	16.67**	20.41**	19.15**	18.24**	45.78**	49.44**	50.03**	49.74**	46.18**
35	37.62**	19.91**	40.10**	32.94**	32.51**	27.87**	20.24**	37.96**	25.96**	27.97**	39.45**	33.05**	44.92**	26.86**	36.08**
36	26.85**	10.81**	11.52**	12.32**	15.20**	28.92**	15.25**	21.43**	25.43**	22.64**	0.25	-15.68**	-4.16	-20.18*	-10.00*

Table 4. Estimates of economic heterosis (per cent) for various characters in bottlegourd

S.	Number of female flowers/plant					Number of fruit per plant					Fruit yield/plant				
No.	E_1	E_2	E_3	E_4	Pooled	E_1	E_2	E_3	E_4	Pooled	E_1	E_2	E_3	E_4	Pooled
1	7.65**	14.29**	-3.51**	-2.23	3.97	10.76*	19.72**	-9.25*	12.18**	8.02*	6.05	12.77**	-18.25**	5.12	0.74
2	30.15**	25.12**	30.38**	21.97**	27.02**	27.35**	38.03**	22.03**	39.09**	31.28**	35.62**	29.98**	11.19**	28.21**	25.79**
3	8.68**	-4.76	15.57**	-3.18	4.35	-7.17	-5.63	-9.69*	-12.69**	-8.72*	-1.68	-1.74	-13.01*	-12.21**	-7.26*
4	16.76**	4.43	24.89**	4.36**	12.87**	15.70**	11.27*	13.22**	-7.61*	8.60*	5.43	-21.56**	-4.36	-9.29*	-7.22*
5	-15.44**	-14.78**	-11.30**	-11.46**	-13.26**	-12.56**	-12.68**	-30.40**	-17.26**	-18.37**	-24.18**	-25.62**	-41.17**	-32.98**	-31.26**
6	26.03**	24.14**	29.31**	26.27**	26.48**	64.13**	85.92**	56.83**	73.60**	69.77**	38.05**	45.75**	22.80**	40.54**	36.28**
7	-5.74**	-23.15**	-11.30**	-11.46**	-12.67**	-8.52*	-16.90**	-22.47**	-16.75**	-16.16**	-24.44**	-31.65**	-40.85**	-33.04**	-32.71**
8	21.03**	29.06**	30.69**	23.89**	26.09**	13.00**	28.17**	15.86**	28.43**	21.05**	10.80**	16.14**	2.92	22.20**	12.55**
9	12.21**	28.90**	15.11**	18.31**	18.39**	25.56**	46.48**	33.04**	23.86**	32.33**	-17.24**	1.45	-14.69**	-15.12**	-11.52**
10	-0.59	-13.96**	-10.99**	-14.01**	-9.68**	-12.56**	-8.45	-19.82**	-35.53**	-18.72**	-24.99**	-22.60**	-36.15**	-47.93**	-32.79**
11	3.24	-5.42	10.38**	16.72**	6.30**	13.90**	15.49**	10.13*	14.72**	13.49**	-34.62**	-36.59**	-41.88**	-15.67**	-32.73**
12	-23.24**	-22.00**	-30.99**	-17.52**	-23.52**	-14.35**	-32.39**	-22.47**	-21.83**	-22.67**	-42.26**	-58.38**	-48.10**	-47.33**	-48.95**
13	7.35**	10.34**	14.20**	4.78*	9.18**	46.64**	43.66**	44.49**	23.86**	40.12**	15.38**	8.08*	-1.04	-9.73	3.28
14	-14.85**	-15.27**	-24.89**	-24.36**	-19.83**	-7.17	-23.94**	-29.52**	-22.84**	-20.81**	-15.10**	-31.20**	-40.39**	-29.98**	-29.43**
15	3.82	24.79**	2.90	17.20**	11.82**	-2.69	0.00	-0.44	5.58	0.47	-4.07	-1.85	-15.73**	-3.86	-6.71
16	12.94**	21.67**	21.07**	13.85**	17.30**	30.94**	33.80**	33.04**	43.65**	35.12**	-10.32**	-6.54	-14.53**	-10.57**	-10.63**
17	22.50**	12.32**	29.31**	26.27**	22.74**	31.39**	32.39**	27.75**	40.61**	32.79**	1.50	-1.33	-11.10**	6.11	-1.61
18	0.15	-4.93	-2.29	-6.53**	-3.30	16.14**	15.49**	11.89**	4.57	12.21**	-25.80**	-20.35**	-28.33**	-38.13**	-28.02**
19	29.85**	30.54**	36.64**	27.71**	31.22**	95.52**	101.88**	92.07**	81.73**	93.02**	15.91**	16.00**	4.35	7.93*	10.89**
20	-1.62	-15.27**	-2.29	-11.46**	-7.43**	31.84**	14.55**	11.89**	10.15**	17.33**	1.28	-10.61*	-17.80**	-16.66**	-11.02**
21	12.35**	15.27**	25.19**	9.08**	15.51**	18.83**	18.78**	18.50**	26.90**	20.58**	10.42**	18.67**	1.30	15.35**	11.03**
22	-6.18**	9.36**	3.36	2.39	2.02	-24.22**	-18.31**	-19.82**	-10.15**	-18.37**	-25.38**	-20.06**	-31.41**	-12.49**	-22.78**
23	-26.03**	-14.29**	-30.99**	-11.94**	-21.07**	-30.04**	-40.85**	-34.80**	-41.62**	-36.63**	-51.28**	-60.51**	-56.94**	-61.32**	-57.40**
24	7.79**	17.24**	16.03**	16.88**	14.35**	25.11**	28.17**	25.11**	28.93**	26.74**	-14.68**	-12.03**	-18.91**	-12.88**	-14.79**
25	-32.65**	-22.17**	-31.91**	-35.67**	-30.72**	-34.08**	-40.38**	-35.68**	-51.78**	-40.12**	-47.37**	-52.81**	-52.87**	-63.36**	-53.90**
26	-14.26**	-4.43	-7.48**	-11.62**	-5.75*	4.93	14.08**	9.25*	21.32**	12.09**	-8.04*	-3.80	-12.78**	2.03	-6.00
27	-13.97**	-9.36**	-7.79**	-5.25*	-9.18**	-26.01**	-26.76**	-23.79**	-26.40**	-25.70**	-40.56**	-44.03**	-43.19**	-44.16**	-42.96**
28	18.09**	9.36**	25.19**	8.76**	15.55**	59.64**	59.15**	54.19**	48.22**	55.47**	8.28*	6.11	-1.11	2.12	3.74
29	-22.65**	-18.72**	-21.53**	-14.81**	-19.52**	-16.59**	-25.35**	-15.86*	-18.78**	-19.07**	-28.77**	-34.92**	-36.25**	-29.92**	-32.60**
30	-0.74	13.46**	8.85**	11.46**	8.05**	14.35**	11.27*	14.54**	10.66**	12.79**	0.46	-12.69**	-8.52**	0.30	-5.25
31	0.29	-20.20**	-1.83	-25.80**	-11.47**	32.74**	7.04	15.86**	-18.78**	10.12*	-22.61**	-39.86**	-36.21**	-52.89**	-37.54**
32	-26.62**	-28.57**	-20.61**	-33.92**	-27.33**	-8.52*	-28.17**	-17.62**	-37.06**	-22.33**	-44.99**	-57.78**	-52.56**	-63.42**	-54.44**
33	-13.09**	-10.84**	-7.33**	-29.62**	-15.12**	10.76*	-12.68**	10.57*	-17.26**	-1.51	-30.32**	-45.61**	-35.48**	-44.80**	-38.79**
34	4.12*	12.81**	13.44**	23.57**	13.36**	27.80**	38.03**	29.96**	42.13**	34.19**	0.10	7.97	-5.24*	10.22**	2.86
35	22.65**	24.63**	30.69**	25.32**	25.82**	39.91**	42.25**	48.90**	50.25**	45.23**	16.66**	15.49**	16.26**	21.15**	17.30**
36	-4.12*	-0.66	-6.87**	-2.71	-3.65b	-4.04	-4.23	-2.64	10.15**	-0.47	-16.14**	-26.81**	-23.11**	-23.78**	-22.42**

heterosis for all the characters. The mean squares due to environment and the interaction of genotypes, parents and hybrids with the environment were significant for all the characters. This suggested differential response of genotypes to the environments.

For commercial exploitation of heterosis, a hybrid must have sufficient level of superiority over the standard check. In the present study, the economic heterosis for fruit yield as well as related traits were calculated over the standard check Mahyco variety in all the environments. The most significant economic heterosis for fruit yield per plant was observed in crosses, Banswara Local-1 x IC 92374 (38.05), Banswara Local-1 x Pusa Naveen (35.62), IC 92374 x PSPL (16.66), Long white Prolofic x IC 92374 (15.38), Banswara Local x PSPL (10.80), Pusa Naveen x IC 92374 (10.42) and Udaipur Local-1 x IC 92374 (8.28) under E_1, Banswara Local-1 x IC 92374 (45.75), Banswara Local-1 x Pusa Naveen (29.98), Pusa Naveen x PSPL (18.87), Banswara Local-1 x PSPL (16.14), Pusa Naveen x IC 92374 (16.00), IC 92374 x PSPL (15.44), Banswara Local-1 x Long white prolific (12.77) and Long white prolific x IC 92374 (8.08) under E_2, Banswara Local-1 x IC 92374 (22.80), IC 92374 x PSPL (16.26) and Banswara Local-1 x Pusa Naveen (11.19) under E_3 and the cross Banswara Local-1 x IC 92374 (40.54), Banswara Local-1 x Pusa Naveen (28.21), IC 92374 x PSPL (21.15), Banswara Local-1 x PSPL (20.20), Pusa Naveen x PSPL (15.35), IC 92374 x IC 42361 (10.22) and Pusa Naveen x IC 92374 (7.93) under E_4. In pooled analysis, siginificant economic heterosis for fruit yield per plant was depicted in the cross Banswara Local-1 x IC 92374 (36.28), Banswara Local-1 x Pusa Naveen (25.79), IC 92374 x PSPL (17.30), Banswara Local-1 x PSPL (12.55), Pusa Naveen x PSPL (11.03) and Pusa Naveen x IC 92374 (10.89).

However, in all the environments three crosses namely, Banswara Local-1 x IC 92374, Banswara Local-1 x Pusa Naveen and IC 92374 x PSPL exhibited significant economic heterosis for fruit yield per plant. All these crosses also exhibited significant economic heterosis for number of fruits, number of female flowers. These crosses may be identified as potential ones in individual environment as well as over the environments for the commercial exploitation of heterosis.

In the present study, in all the environments significant heterosis for fruit yield per plant was exhibited in the cross Banswara Local-1 x Pusa Naveen, Banswara Local-1 x IC 92374, Banswara Local-1 x PSPL, Long white Prolific x IC 92374, Pusa Naveen x IC 92374, Raichur Local-1 x IC 92374, Udaipur Local-1 x IC 92374, IC 92353A x IC 42361, IC 92374 x IC 42361 and IC 92374 x PSPL and most of these crosses also exhibits significant heterosis for fruit yield per plant alongwith number of female flower and number of fruits. Similar results were also reported by Choudhary and Singh (1971), Kolhe (1972), Tyagi (1973), Sirohi *et al.* (1987) and Jankiram and Sirohi (1992) in one or more of the above characters in cucurbits.

References

Choudhrary, B. and B. Singh, 1971. Pusa Meghdoot and Pusa Manjari-two high yielding bottlegourd hybrids. *Indian Hort.,* 16(1):15-32.

Jankiram, T. and P.S. Sirohi, 1992. Studies on heterosis for quantitative characters in bottlegourd. *J. Maharashtra Agric. Univ.,* 17(2):204-206.

Kolhe, A.K. 1972. Exploration of hybrid vigour in cucurbits. *Indian J. Hort*., 29(1):77-80.

Sirohi, P.S., N. Sivakami and B. Chaoudhary, 1987. Studies on exploitation of heterosis in bottlegourd. *Veg. Sci*., 14: 37-41.

Tyagi, I.D. 1973. Heterosis in bottlegourd. *Indian J. Hort*., 29:219-222.