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HYBRID VIGOUR IN BRINJAL (*SOLANUM MELONGENA* L.)

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ABSTRACT
The present investigation was undertaken in brinjal to estimate the magnitude of heterosis of some economically important traits. 36 F1 hybrids generated by half diallel crosses of nine pure diverse parent and these F1s along with 9 parents and 2 checks were evaluated in a randomized block design with three replication at Research farm of Department of Horticulture. The results showed considerable heterobeltiosis for traits viz. fruit diameter 60.73 % (Local C-1 x GADB-1), fruit weight 136.67 % (Asond Long x GADB-1), yield/plant 83.33 % (Local-3 x Local-2) and days to 50% flower -24.72% (Asond Long x GADB-1); moderate estimate for infestation of shoot and fruit borer -40.33 % (Asond Long x Selection-167) and chlorophyll content. Crosses displaying significant heterobeltiosis for yield also possessed marked heterotic advantage in one or more component characters emphasizing their role in increasing yield. The present study reveals good scope for isolation of pure lines from the progenies of heterotic F1s as well as commercial exploitation of heterosis in brinjal.

INTRODUCTION

Brinjal (*Solanum melongena* L.) is one of the important Solanaceous vegetable crops. It is widely cultivated in both temperate and tropical regions of the globe mainly for its immature fruits as vegetables. As India is the primary centre of origin of brinjal (Vavilov, 1931 and Bhaduri, 1951) it posses marked diversity. Brinjal continues to be a choice of breeders for exploitation of heterosis due to hardy nature of crop, comparatively large size of flowers and large number of seeds in a single act of pollination. Highly varied consumer acceptance from region to region also demands for development of a large number of high yielding F_1 hybrids. Exploitation of hybrid vigour has become a potential tool for improvement in brinjal (Pal and Singh 1946; Chadha and Sidhu, 1982). One of the best methods employed is exploitation of hybrid vigour through hybridization. Nagai and Kida (1926) were probably the first to observe hybrid vigour, hoping some commercial acceptance in crosses among some Japanese varieties. Since then many public and private sectors have developed various hybrids in India, but these hybrids lacked regional preferences for colour, shape and presence or absence of spines and lacked suitability to specific product preparations. However, the exploitation of hybrid vigour in brinjal has been recognized as a practical tool in providing the breeder a means of increasing yield and other economic traits.

The economic exploitation of heterosis in this crop, has, however been limited to experimental testing of hybrids and it has not yet reached the farmers fields to its potential. In spite of above, this aspect was included in the present investigation, merely to have an idea of the extent of heterosis existing in the material for various agronomic characters studied and to see whether same can be fruitfully utilized in suitable brinjal improvement programme.

The required goals of increasing productivity in the quickest possible time can be achieved only through heterosis breeding, which is feasible in this crop (Kakikazi 1931); Raghvendra Dubey (2014) repoted the maximum heterosis for total yield per plant over better parent in KS-314 x IC-90099 (94.72%) followed by KS-314 x PPC (85.10%).

To address the above issues in brinjal, the present investigation was carried out with the objective to estimate the magnitude of heterosis.

MATERIALS AND METHODS

The experiment was conducted during kharif 2011-12 at Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The study comprised of 9 genotypes viz. Local C-1, Asond long, Local- 3, Selection-167 Local C-2, GADB – 1, Local – 2, AKL-11 and Asond Round which were selected based on their diversity for various traits and were crossed in all possible combinations excluding reciprocals to develop 36 F1 using half diallel mating scheme. All the 36 hybrids, 9 parents and 2 commercial checks viz. Pusa Hybrid-6 and Pusa Hybrid-9 were evaluated in a randomised block design with three replications. Observations on five randomly selected plants were recorded for various quantitative traits viz., plant height, plant spread, days to first flower, days to 50 per cent flower, number of branches per plant, number of flowers per branch, number of fruits per plant, fruit length, fruit diameter, fruit weight, yield per plant, yield per plot, yield per hectare, infestation of shoot and fruit borer, chlorophyll content and protein content. The statistical analysis was done as per Panse and Sukhatme (1985) and the magnitude of per cent heterosis of F_1 over mid parent (MP), better parent (BP) and commercial checks was calculated as per procedure suggested by Fonesca and Paterson (1968):

Heterosis

$$\frac{\overline{F_1} - \overline{MP}}{\overline{MP}} \times 100$$

Where, MP = Mean performance of parent P1 and P2

F1 = Mean performance of hybrid

Heterobeltiosis

$$\frac{\overline{F_1} - \overline{MP}}{\overline{BP}} \times 100$$

Where, BP= Mean performance of better parent

F1 = Mean performance of F1 hybrid

Standard heterosis

$$\frac{\overline{F_1} - \overline{SC}}{\overline{SC}} \times 100$$

Where, SC= Mean performance of standard check

F1 = Mean performance of F1 hybrid

RESULTS AND DISCUSSION

The analysis of variance for 16 characters is presented in Table 1. The ANOVA indicated highly significant differences among the genotypes for all the characters under study except days to first flower, number of branches per plant, infestation of shoot and fruit borer and protein content. This indicated the presence of substantial genetic variability for these characters.

Today heterosis breeding serves as a key to the problems of enhancing the yield of many self and cross pollinated crops. Most of the reports have shown presence of hybrid vigour in the brinjal Patil (1998), Anuroopa (2000), Bulgundi (2000), Bavage (2002), Karaganni (2003), Prabhu *et al.* (2005), Shafeeq *et al.* (2007), Shanmugapriya *et al.* (2009), Chowdhury *et al.* (2010), Sao and Mehta (2010) and Makani *et al.* (2013) have reported the presence of considerable heterosis in economic characters like plant height, plant spread, branches per plant, days to first flower, days to 50% flowering, number of fruits per plant, fruit length, fruit weight, fruit diameter and yield.

The magnitude of heterosis over mid parent *i.e.* heterosis (H_1), over better parent i.e. heterobeltiosis (H_2) and over check variety *i.e.* standard heterosis (H_3) has been presented in Table 2. Standard heterosis for all the characters was calculated over checks *viz.*, Pusa Hybrid-6 and Pusa Hybrid-9.

Out of the 36 hybrids, the significant desirable heterotic effects over their respective mid, better and standard parent for plant height were noticed in 0,0, 19 and 10 crosses and over check Pusa Hybrid-6 and Pusa Hybrid-9 by Selection-167 x Asond long (36.47%) and (31.60%) respectively.

Magnitude of heterosis for plant spread, 11 crosses was found significant positive heterosis, in which Local-2 x AKL-11 (20.17%) showed highly significant positive heterosis. Five crosses showed significant positive heterobeltiosis, in which GADB-1 x Local-2 (17.77%) highly significant followed by

Table 1: Combined Analysis of Variance for sixteen characters of Brinjal.

Sourceof Variations	d.f.	Mean Sum Squares Plant Height (cm)	Plant Spread (cm)	Daysto first Flower	Daysto 50 percent Flower	No. Branches Per plant	No. Flower per branch	No. Fruits perpl	Fruit Length (cm)	Fruit Diameter (cm)	Fruit Weight (g)	Yield Perplant (kg)	Yield Perplot (kg)	Yield PerHa (q)	Infestation ofSFB(%)	Chlorophyll (%)	Protein (%)
Replicates	2	47.79	179.7310	64.317	115.700	4.174	6.173	13.080	1.943	0.449	366.78	0.039	13.376	3190.920	1.011	1.578	0.001
Treatments	44	145.164*	188.777**	98.520	149.264**	2.013	32.327**	45.757**	4.067**	3.588**	7810.249**	0.510**	164.700**	39228.190**	1.307	13.810**	0.000
Parents	8	206.621*	180.8370	151.254	227.379**	4.122	11.90*	41.015**	2.025	7.521**	4368.991**	0.379*	122.857*	29256.640*	1.235	14.436**	0.000
Crosses	35	124.327	139.734*	89.215	130.416*	1.065	35.517**	48.084**	3.973**	2.015**	7093.793**	0.243*	78.326*	18661.040*	1.340	14.025**	0.000
ParentVs.Crosses	1	382.773*	1968.791**	2.342	184.007	18.312*	84.080**	2.247	23.701**	27.180**	60416.250**	10.897**	3522.528**	838850.500**	0.696	1.300	0.000
Error	88	82.279	88.4700	78.339	74.193	3.718	5.429	9.078	1.323	0.713	213.084	0.152	48.991	11667.380	0.932	1.964	0.001

* Significant at 5 percent and ; ** Significant at 1 percent

Table 2: Estimates of Heterosis (H_1), Heterobeltiosis (H_2) and Standard Heterosis (H_3).

Crosses	Plant Height (cm)				Plant spread (cm)				Days to first flower				Days to 50 per cent Flower			
	H_1	H_2	H_3 H_3(A)	H_3(B)	H_1	H_2	H_3 H_3(A)	H_3(B)	H_1	H_2	H_3 H_3(A)	H_3(B)	H_1	H_2	H_3 H_3(A)	H_3(B)
Local C – 1X Asond long	17.75 **	6.78	32.91 **	28.17 **	16.85 **	6.83	36.06 **	33.05 **	0.19	-4.56	14.24	9.24	-17.80 *	-23.49 **	-7.5	-17.42 *
Local C – 1X Local – 3	11.88	3.18	23.74 **	19.32 *	12.97 *	12.18	20.04 *	17.38 *	1.01	-5.05	16.89	11.78	3.26	-3.51	15.68	3.28
Local C – 1 X Selection – 167	6.96	-1.95	19.15 *	14.9	4.79	-2.07	18.88 *	16.26 *	-1.89	-6.13	1.7	-2.74	15.67	11.60	16.25	3.79
Local C – 1 X Local C – 2	4.3	2.54	7.47	3.64	1.97	1.06	8.56	6.16	-4.43	-10.03	10.41	5.58	-13.42	-19.19 *	-2.88	-13.29
Local C – 1X GADB – 1	6.68	3.87	11.03	7.07	15.66 *	14.48 *	23.30 **	20.57 **	-1.43	-4.06	3.94	-0.60	8.65	2.50	6.77	-4.67
Local C – 1 X Local – 2	7.1	7.03	8.53	4.66	5.48	4.4	12.46	9.98	8.04	0.66	26.31 *	20.79	0.22	-1.77	2.33	-8.64
Local C – 1 X AKL – 11	7.8	1.02	17.03 *	12.86	16.22 **	10.74	29.00 **	26.15 **	6.17	-1.13	24.20 *	18.77	5.91	-1.43	19.21 *	6.43
Local C – 1 X Asond Round	0.67	-5.89	9.59	5.68	4.01	-0.92	15.48 *	12.93	3.12	-3.18	19.49	14.27	13.73	11.49	20.90 *	7.94
Asond long X Local – 3	-4.03	-5.66	17.11 *	12.94	2.8	-5.43	20.48 **	17.82 *	2.79	1.51	24.97 *	19.51	-3.51	-4.08	16.36	3.89
Asond long X Selection – 167	2.35	1.27	25.72 **	21.24 **	2.91	0.48	28.02 **	25.19 **	1.99	-6.96	11.7	6.81	-6.44	-15.88 *	2.05	-8.89
Asond long X Local C – 2	-3.41	-10.94	10.57	6.62	0.17	-7.68	17.62 *	15.02 *	-3.36	-4.41	17.31	12.18	-20.13 **	-20.50 **	-3.56	-13.9
Asond long X GADB – 1	-0.46	-7.37	14.99	10.89	3.28	-4.71	21.41 **	18.73 *	-2.03	-9.17	9.04	4.27	-14.52	-24.72 **	-8.68	-18.47 *
Asond long X Local – 2	0.61	-8.6	13.46	9.42	1.82	-6.04	19.70 *	17.06 *	2.6	0.38	25.96 *	20.45 *	3.94	-5.17	15.03	2.70
Asond long X AKL – 11	-3.06	-6.3	16.32 *	12.17	-0.13	-4.41	21.79 **	19.10 *	2.41	0.14	25.80 *	20.30 *	-12.16	-12.29	6.40	-5.01
Asond long X Asond round	7.14	3.82	28.89 **	24.29 **	6.35	1.82	29.72 **	26.86 **	0.11	-1.25	21.87 *	16.54	-6.13	-11.11	7.83	-3.73
Local – 3 X Selection – 167	-1.42	-2.12	18.94 *	14.69	5.81	-0.24	21.09 **	18.42 *	-1.7	-11.29	9.10	4.33	-13.8	-22.11 **	-6.54	-16.56 *
Local – 3 X Local C – 2	3.95	-2.55	16.74 *	12.57	9.34	9.30	17.49 *	14.90 *	-1.04	-1.14	21.58 *	16.26	-18.57 **	-18.63 *	-2.21	-12.69
Local – 3 X GADB – 1	1.59	-3.88	15.14	11.04	15.72 *	15.61 *	24.52 **	21.76 **	3.99	-4.65	17.26	12.13	0.46	-11.11	6.66	-4.77
Local – 3 X Local – 2	4.73	-3.3	15.83	11.7	12.71 *	12.59	21.28 **	18.60 *	-1.18	-2.17	22.76 *	17.39	-6.08	-13.89	3.32	-7.75
Local – 3 X AKL – 11	-3.5	-5.09	13.69	9.63	2.14	-1.8	14.39	11.86	1.34	0.27	25.96 *	20.45 *	-2.20	-2.59	17.81	5.18
Local – 3 X Asond Round	-1.26	-2.64	16.63 *	12.47	13.67 *	9.25	27.34 **	24.52 **	0.65	0.47	24.00 *	18.57	-11.91	-16.15 *	0.61	-10.18
Selection – 167 X Local C – 2	10.48	2.71	25.27 **	20.80 **	8.73	2.46	24.42 **	21.67 **	8.54	-1.7	20.63	15.35	0.39	-9.60	8.64	-3.00
Selection – 167 X GADB – 1	5.75	-0.79	21.01 *	16.69 *	10.56	4.31	26.67 **	23.87 **	-1.64	-3.08	-0.61	-4.95	-5.08	-7.00	-10.48	-20.08 *
Selection – 167 X Local – 2	9.97	0.71	22.82 **	18.44 *	7.24	1.19	22.87 **	20.16 **	6.72	-4.31	20.08	14.83	10.20	8.12	8.15	-3.44
Selection – 167 X AKL – 11	-1.09	-3.57	17.61 *	13.41	-1.53	-3.54	17.14 *	14.55	0.26	-10.14	12.88	7.95	-6.38	-15.94 *	1.67	-9.23
Selection – 167 X Asond Round	14.48 *	11.89	36.47 **	31.60 **	17.82 **	15.45 *	40.20 **	37.10 **	-4.36	-13.6	6.63	1.97	-6.17	-11.44	-3.96	-14.26
Local C - 2 X GADB – 1	0.42	-0.69	6.16	2.37	5.08	4.98	13.07	10.57	5.41	-3.35	18.87	13.67	0.83	-10.78	7.05	-4.42
Local C - 2 X Local – 2	2.71	1.17	5.76	1.99	9.39	9.27	17.71 *	15.11 *	0.19	-0.81	24.47 *	19.03	1.91	-6.57	12.1	0.09
Local C –2 X AKL – 11	-0.98	-5.81	9.11	5.22	8.84	4.64	21.89 **	19.20 *	-1.13	-2.17	22.89 *	17.52	-8.12	-8.48	10.68	-1.18
Local C - 2 X Asond round	0.99	-4.18	11.59	7.61	8.44	4.23	21.48 **	18.80 *	0.42	0.24	23.72 *	18.31	-2.44	-7.14	11.42	-0.52
GADB – 1 X Local – 2	10.23	7.49	14.71	10.62	17.90 **	17.77 *	26.87 **	24.06 **	-7.38	-15.87	5.57	0.96	-1.12	-4.94	-4.92	-15.11
GADB -1 X AKL -11	5.76	1.59	17.69 *	13.49	16.22 **	11.74	30.16 **	27.28 **	-3.88	-12.73	9.63	4.83	-7.40	-18.36 *	-1.27	-11.85
GADB – 1 X Asond Round	3.51	-0.82	15.5	11.38	2.87	-1.12	15.25 *	12.70	-5.49	-13.51	6.75	2.08	-4.21	-11.34	-3.86	-14.16
Local – 2 X AKL – 11	10.5	3.55	19.96 *	15.68 *	20.17 **	15.53 *	34.58 **	31.61 **	-0.95	-1.06	24.57 *	19.12	1.46	-7.23	12.19	0.17
Local – 2 X Asond Round	6.39	-0.55	15.82	11.69	9.27	5.02	22.41 **	19.71 **	-1.32	-2.3	23.01 *	17.64	6.20	2.17	10.79	-1.08
AKL – 11 X Asond Round	4.51	4.05	21.17 *	16.85 *	9.89	9.84	28.03 **	25.20 **	0.56	-0.44	25.36 *	19.88	-1.72	-6.93	12.9	0.80
S.E.(d) +	6.41	7.40	7.406		6.65	7.68	7.68		6.25	7.22	7.22		6.09	7.03	7.03	
C.D. (5%)	12.74	14.71	14.71		13.21	15.62	15.26		12.43	14.36	14.36		12.10	13.97	13.97	
C.D. (1%)	16.88	19.45	19.45		17.51	20.21	20.21		16.47	19.02	19.02		16.03	18.51	18.51	

Table 2: Cont......

Crosses	Number of Branches per plant				Number of flowers per branch				Number of fruits per plant				Fruit Length (cm)			
	H_1 H_3(A)	H_2 H_3(B)	H_3		H_1	H_2	H_3		H_1 H_3(A)	H_2 H_3(B)	H_3		H_1 H_3(A)	H_2 H_3(B)	H_3 H_3(A)	H_3(B)
Local C – 1X Asond long	39.21	31.60	9.91	29.44	0.86	-7.48	15.69	31.67 *	-30.94 *	-46.58 **	-32.23 *	24.24	34.72 **	22.29 *	60.58 **	45.25 **
Local C – 1X Local – 3	23.33	22.28	3.90	22.36	10.43	7.12	33.95 **	52.44 **	0.66	-14.58	8.36	98.66 **	-0.40	-2.64	9.18	-1.25
Local C – 1 X Selection – 167	13.64	0.93	8.57	27.87	1.96	1.10	26.43 *	43.88 **	-25.04 *	-32.24 **	-14.05	57.58 *	37.55 **	33.10 *	42.53 **	28.92 *
Local C – 1 X Local C – 2	27.15	14.46	19.43	40.66	-13.38	-16.20	12.09	27.56 *	-22.83 *	-28.27 *	-9.01	66.81 *	-1.74	-7.66	12.44	1.71
Local C – 1X GADB – 1	26.96	19.82	12.75	32.79	3.63	2.42	28.07 *	45.75 **	-0.32	-7.35	17.53	115.47 **	-3.89	-11.6	12.75	1.98
Local C – 1 X Local – 2	12.64	-6.29	17.87	38.82	-3.88	-14.45	6.98	21.75	2.25	-18.29	3.65	90.03 **	5.71	-2.15	23.1	11.35
Local C – 1 X AKL – 11	16.68	-4.69	25.61	47.93	-15.46	-20.88 *	-1.06	12.59	-12.85	-34.09 **	-16.39	53.28 *	13.82	0.14	41.15 **	27.68 *
Local C – 1 X Asond Round	8.45	-6.31	7.52	26.62	-6.05	-15.78	5.31	19.85	-39.60 **	-50.73 **	-37.50 **	14.59	38.53 **	29.88 *	58.95 **	43.77 **
Asond long X Local – 3	14.23	2.03	-13.31	2.1	-27.15 **	-30.64 **	-18.47	-7.21	-11.85	-21.45	-30.52 *	27.38	8.55	-1.52	35.59 *	22.65
Asond long X Selection – 167	35.31	9.68	17.98	38.95	-34.47 **	-38.90 **	-24.89 *	-14.52	-29.32 *	-40.80 **	-39.34 **	11.21	31.52 **	13.59	56.40 **	41.47 **
Asond long X Local C – 2	32.73	8.86	13.59	33.77	-22.75 **	-30.68 **	-7.27	5.53	-24.39	-38.19 **	-32.65 *	23.47	9.83	3.48	42.48 **	28.87 *
Asond long X GADB – 1	47.96	26.51	19.04	40.2	-45.80 **	-49.31 **	-38.10 **	-29.55 *	-38.31 **	-49.57 **	-45.05 **	0.74	33.90 **	28.96 **	77.56 **	60.61 **
Asond long X Local – 2	17.95	-9.69	13.59	33.77	-17.55	-20.94	-15.96	-4.36	3.56	-1.01	-24.87	37.74	8.11	3.44	42.43 **	28.83 *
Asond long X AKL – 11	19.32	-10.10	18.49	39.54	21.34 *	19.83	30.62 *	48.65 **	-23.33	-25.64	-48.55 **	-5.67	2.16	0.98	42.33 **	28.74 *
Asond long X Asond round	32.78	5.05	20.55	41.97	28.56 **	24.24 *	32.06 **	50.28 **	41.74 *	32.07	5.82	94.01 **	-0.08	-5.63	29.93 *	17.53
Local – 3 X Selection – 167	29.43	14.96	23.66	45.64	-4.87	-6.48	14.99	30.86 *	-1.11	-8.82	-6.57	71.28 **	29.43 *	25.24	34.12 *	21.31
Local – 3 X Local C – 2	15.71	4.16	8.69	28.00	-13.07	-17.93 *	9.77	24.93	8.23	-2.93	5.77	93.90 **	19.74	12.52	37.02 *	23.94
Local – 3 X GADB – 1	43.70	35.62	27.62	50.30	6.64	5.19	28.45 *	46.18 **	30.87 *	17.38	27.89	134.46 **	21.84 *	12.08	42.94 **	29.29 *
Local – 3 X Local – 2	10.03	-8.46	15.14	35.61	-1.16	-10.00	6.92	21.68	23.14	15.6	-0.02	83.30 **	11.45	3.16	29.78 *	17.39
Local – 3 X AKL – 11	15.80	-5.41	24.67	46.82	-7.65	-11.46	5.19	19.71	21.43	6.36	-8.01	68.64 **	2.92	-9.44	27.64	15.45
Local – 3 X Asond Round	17.05	1.12	16.04	36.66	-20.32 *	-26.91 **	-13.17	-1.19	0.20	-3.49	-16.53	53.03 *	14.00	6.88	30.80 *	18.31
Selection – 167 X Local C – 2	21.34	18.94	24.11	46.16	-19.07 *	-21.70 *	4.73	19.19	6.33	3.81	13.11	107.36 **	11.01	4.31	27.03	14.90
Selection – 167 X GADB – 1	37.19	33.00	33.30	56.98	-41.39 **	-42.08 **	-27.57 *	-17.58	-25.63 *	-27.39 *	-20.89	45.03	18.24	8.76	38.70 **	25.46
Selection – 167 X Local – 2	0.71	-9.52	13.81	34.03	-6.99	-17.22	3.52	17.81	-14.99	-26.41	-23.62	40.03	18.20	9.40	37.63 *	24.49
Selection – 167 X AKL – 11	6.07	-6.63	23.05	44.92	-37.56 **	-41.57 **	-26.93 *	-16.84	-12.76	-29.06 *	-26.37	34.99	-6.00	-17.29	16.57	5.44
Selection – 167 X AsondRound	19.97	12.37	28.95	51.87	2.15	-8.43	14.51	30.31 *	0.05	-11.35	-8.00	68.68 **	17.60	10.25	34.93 *	22.05
Local C - 2 X GADB – 1	6.76	3.5	3.73	22.16	2.15	-1.43	29.43 *	47.30 **	-9.39	-9.63	-1.00	81.50 **	11.45	9.20	39.27 **	25.97 *
Local C - 2 X Local – 2	-0.22	-10.36	12.75	32.79	-9.64	-21.25 *	3.40	17.67	-2.25	-17.26	-9.36	66.17 *	13.87	12.32	41.31 **	27.81 *
Local C –2 X AKL – 11	17.59	3.51	36.41	60.66	-41.84 **	-46.78 **	-30.12 *	-20.47	-27.05	-41.88 **	-36.33 *	16.74	3.14	-3.65	35.80 *	22.83
Local C - 2 X Asond round	8.83	1.94	16.98	37.77	-24.86 **	-34.06 **	-13.42	-1.47	-39.75 **	-47.84 **	-42.86 **	4.76	55.96 **	55.96 **	90.87 **	72.65 **
GADB – 1 X Local – 2	4.51	-6.11	18.10	39.08	18.24	5.23	31.60 **	49.76 **	68.45 **	42.58 **	56.20 **	186.36 **	-2.57	-3.89	20.91	9.36
GADB -1 X AKL -11	11.02	-2.28	28.79	51.67	2.26	-4.30	19.67	36.20 **	34.98 *	7.54	17.82	116.00 **	13.59	6.11	49.57 **	35.29 **
GADB – 1 X Asond Round	1.37	-5.05	8.96	28.33	-5.48	-15.27	5.96	20.59	16.16	0.56	10.17	101.97 **	7.67	7.67	31.77 *	19.19
Local – 2 X AKL – 11	0.10	-0.58	32.85	56.46	-33.08 **	-35.83 **	-30.05 *	-20.40	32.91	24.10	-6.98	70.54 **	-20.88 *	-26.09 *	4.18	-5.77
Local – 2 X Asond Round	-5.13	-11.83	17.82	38.75	-22.59 *	-22.94	-22.91	-12.26	25.54	21.49	-2.65	78.47 **	4.38	4.38	27.74	15.54
AKL – 11 X Asond Round	6.34	-1.17	32.07	55.54	-27.20 **	-29.65 **	-25.22 *	-14.90	60.82 **	44.06 *	15.43	111.63 **	15.14	8.74	49.72 **	35.42 **
S.E.(d) +	1.36	1.57	1.57		1.64	1.90	1.90		2.13	2.46	2.46		0.81	0.93	0.93	
C.D. (5%)	2.70	3.12	3.12		3.27	3.78	3.78		4.23	4.88	4.88		1.61	1.86	1.86	
C.D. (1%)	3.58	4.14	4.14		4.33	5.00	5.00		5.60	6.47	6.47		2.14	2.47	2.47	

Continued Table 2......

Crosses	Fruit Diameter (cm)				Fruit Weight (gm)				Yield per plant (kg)				Yield per Plot (kg)			
	H_1	H_2	H_3		H_1	H_2	H_3		H_1	H_2	H_3		H_1	H_2	H_3	
			H_3(A)	H_3(B)			H_3(A)	H_3(B)			H_3(A)	H_3(B)			H_3(A)	H_3(B)
Local C – 1X Asond long	49.25 **	30.39 *	24.79 *	-2.38	144.79 **	78.03 **	78.29 **	-18.83 **	94.97 **	75.27 **	21.14	0.61	90.34 **	75.37 **	20.98	0.31
Local C – 1X Local – 3	28.79 *	13.46	6.50	-16.69	55.79 **	22.13	-2.11	-55.43 **	69.21 **	51.05 *	6.07	-11.91	65.25 **	51.19 *	5.92	-12.18
Local C – 1 X Selection – 167	48.52 **	35.25 *	17.76	-7.88	47.35 **	7.93	5.66	-51.90 **	15.9	-10.38	-9.56	-24.89	13.83	-10.24	-9.58	-25.02
Local C – 1 X Local C – 2	31.27 *	16.74	7.21	-16.13	60.47 **	21.77	7.07	-51.25 **	24.41	-3.49	-3.49	-19.85	21.87	-3.62	-3.68	-20.14
Local C – 1X GADB – 1	62.39 **	60.73 **	17.34	-8.21	38.23 *	12.13	-17.98	-62.66 **	38.88	17.55	-6.43	-22.29	35.61	17.36	-6.66	-22.6
Local C – 1 X Local – 2	38.32 **	17.55	20.14	-6.01	52.09 **	15.53	1.28	-53.89 **	74.17 **	58.47 *	6.62	-11.45	69.83 **	58.28 *	6.51	-11.69
Local C – 1 X AKL – 11	6.74	-22.78 **	23.60	-3.31	54.54 **	-2.45	69.22 **	-22.96 **	67.58 **	24.8	40.62 *	16.79	64.66 **	24.86	40.53 *	16.52
Local C – 1 X Asond Round	23.73 *	-4.00	24.43	-2.66	113.27 **	44.54 **	85.11 **	-15.72 **	46.36 *	12.04	16.36	-3.36	43.53 *	11.96	16.22	-3.64
Asond long X Local – 3	26.24 *	23.24	15.67	-9.51	90.24 **	70.96 **	71.86 **	-21.75 **	89.44 **	69.11 **	18.75	-1.37	68.87 **	68.49 **	18.57	-1.68
Asond long X Selection – 167	50.02 **	48.07 **	32.36 *	3.54	93.64 **	91.09 **	92.10 **	-12.54 *	49.12 *	15.3	16.36	-3.36	35.76 *	15.3	16.16	-3.69
Asond long X Local C – 2	36.60 **	34.78 *	23.78	-3.17	90.38 **	78.45 **	79.39 **	-18.32 **	57.35 **	22.06	22.06	1.37	43.35 *	22.15	22.07	1.22
Asond long X GADB – 1	66.53 **	51.27 **	35.22 **	5.78	173.98 **	136.67 **	137.92 **	8.32	96.73 **	66.51 **	32.54	10.08	76.47 **	66.31 **	32.27	9.67
Asond long X Local – 2	57.01 **	47.17 **	50.42 **	17.67	49.31 **	39.76 **	40.50 **	-36.03 **	73.57 **	57.92 *	6.25	-11.76	54.17 *	50.80 *	6.12	-12.01
Asond long X AKL – 11	1.39	-21.00 **	26.46 *	-1.07	83.65 **	45.04 **	151.60 **	14.55 **	54.65 **	15.17	29.78	7.79	41.75 *	15.19	29.65	7.5
Asond long X Asond round	11.24	-6.02	21.81	-4.71	3.30	-7.81	18.07	-46.25 **	57.92 **	20.88	25.55	4.27	43.95 *	20.77	25.36	3.95
Local – 3 X Selection – 167	42.38 **	40.53 **	25.63 *	-1.72	43.27 **	30.63 **	27.87 *	-41.78 **	53.83 **	18.94	20.04	-0.31	40.23 *	19.09	19.98	-0.52
Local – 3 X Local C – 2	35.02 **	33.23 *	22.35	-4.29	27.52 *	22.21	7.46	-51.07 **	47.16 *	14.15	14.15	-5.19	33.78	13.99	13.92	-5.54
Local – 3 X GADB – 1	56.04 **	41.73 **	26.70 *	-0.89	18.42	12.93	-8.96	-58.55 **	73.26 **	46.65 *	16.73	-3.05	55.38 **	46.43 *	16.46	-3.43
Local – 3 X Local – 2	8.62	1.81	4.05	-18.60	44.06 **	38.26 **	21.21	-44.81 **	101.50 **	83.33 **	23.35	2.44	79.11 **	75.19 **	23.28	2.22
Local – 3 X AKL – 11	-5.40	-26.28 **	18.00	-7.69	-0.18	-26.90 **	26.81 *	-42.26 **	38.23 *	2.94	15.99	-3.66	26.68	2.94	15.87	-3.92
Local – 3 X Asond Round	9.44	-7.54	19.85	-6.25	57.90 **	28.64 **	64.76 **	-24.99 **	75.03 **	33.98 *	39.15 *	15.57	59.88 **	34.13 *	39.24 *	15.45
Selection – 167 X Local C – 2	36.40 **	34.59 *	23.60	-3.31	18.89	12.96	10.34	-49.76 **	19.76	14.17	25.92	4.58	25.01	24.37	25.58	4.13
Selection – 167 X GADB – 1	53.98 **	39.87 **	25.03 *	-2.19	93.74 **	69.41 **	65.48 **	-24.66 **	38.63 *	19.33	31.62	9.31	45.55 **	30.1	31.36	8.92
Selection – 167 X Local – 2	39.60 **	30.85 *	33.73 **	4.62	66.62 **	58.07 **	54.41 **	-29.70 **	33.13	7.17	18.2	-1.83	40.26 *	16.87	18.00	-2.16
Selection – 167 X AKL – 11	-9.84	-29.75 **	12.46	-12.03	26.98 **	-0.76	72.16 **	-21.62 **	12.61	11.42	25.55	4.27	17.52	11.47	25.47	4.03
Selection – 167 X Asond Round	0.14	-15.40	9.65	-14.22	36.77 **	20.54 *	54.38 **	-29.71 **	31.50 *	27.67	40.81 *	16.95	37.21 *	35.34 *	40.49 *	16.49
Local C - 2 X GADB – 1	16.55	5.87	-5.36	-25.97 **	35.17 **	23.63	9.04	-50.35 **	14.62	-1.33	8.82	-9.62	20.36	7.59	8.63	-9.93
Local C - 2 X Local – 2	27.96 *	19.94	22.59	-4.10	81.26 **	80.71 **	59.39 **	-27.43 **	63.35 **	31.5	45.04 *	20.46	71.90 **	43.23 *	44.62 *	19.92
Local C –2 X AKL – 11	13.38	-11.65	41.42 **	10.63	66.96 **	25.92 **	118.45 **	-0.54	25.14	23.82	39.52 *	15.88	30.45 *	23.74	39.28 *	15.48
Local C - 2 X Asond round	35.84 **	14.76	48.75 **	16.36	141.24 **	103.69 **	160.86 **	18.77 **	41.97 **	37.83 *	52.02 **	26.26	46.99 **	44.98 **	50.49 **	24.79
GADB – 1 X Local – 2	-18.28	-30.55 *	-29.02 *	-44.48 **	-9.18	-16.77	-27.03 *	-66.78 **	84.98 **	68.31 *	13.24	-5.95	53.99 *	42.13*	13.06	-6.25
GADB -1 X AKL -11	-10.29	-35.11 **	3.87	-18.74	0.66	-28.48 **	24.06 *	-43.52 **	75.03 **	30.34	46.88 **	21.98	52.87 **	30.45	46.83 **	21.75
GADB – 1 X Asond Round	10.87	-13.98	11.50	-12.77	29.97 **	2.04	30.69 **	-40.50 **	83.58 **	40.53 *	45.96 *	21.22	59.26 **	40.66 *	46.01 *	21.07
Local – 2 X AKL – 11	-8.92	-23.94 **	21.75	-4.76	15.93 *	-12.88	51.13 **	-31.19 **	68.24 **	25.29	41.18 *	17.25	56.79 **	25.28	41.01 *	16.92
Local – 2 X Asond Round	15.52	5.56	36.83 **	7.04	33.90 **	12.56	44.16 **	-34.37 **	74.80 **	33.81 *	38.97 *	15.42	62.38 **	33.84 *	38.93 *	15.2
AKL – 11 X Asond Round	-21.19 **	-28.85 **	14.48	-10.44	-21.97 **	-32.20 **	17.67	-46.42 **	27.55	23.83	36.58 *	13.44	25.79	20.57	36.49 *	13.18
S.E.(d) +	0.59	0.68	0.68		10.32	11.91	11.91		0.27	0.31	0.31		4.94	5.71	5.71	
C.D. (5%)	1.18	1.36	1.36		20.51	23.68	23.68		0.54	0.63	0.63		9.83	11.35	11.35	
C.D. (1%)	1.57	1.81	1.81		27.17	31.38	31.38		0.72	0.83	0.83		13.03	15.04	15.04	

Continued Table 2......

Crosses	Yield per ha. (q)				Shoot & Fruit Infestation (%)				Chlorophyll Content (%)				Protein Content (%)			
	H_1	H_2	H_3		H_1	H_2	H_3		H_1	H_2	H_3		H_1	H_2	H_3	
			H_3(A)	H_3(B)			H_3(A)	H_3(B)			H_3(A)	H_3(B)			H_3(A)	H_3(B)
Local C – 1X Asond long	88.63 **	75.36 **	20.97	0.31	-11.51	-17.99	18.6	7.06	12.76 **	10.77 **	8.25 **	5.28 *	-10.87 **	-19.33 **	0.21	0.00
Local C – 1X Local – 3	63.78 **	51.18 *	5.91	-12.17	2.02	-10.86	47.24 *	32.91	3.33	1.43	2.92	0.09	-10.23 **	-18.83 **	0.83	0.62
Local C – 1 X Selection – 167	13.00	-10.26	-9.59	-25.03	-1.13	-4.53	26.58	14.26	3.24	0.56	3.66	0.82	-10.49 **	-19.67 **	-0.21	-0.41
Local C – 1 X Local C – 2	20.97	-3.64	-3.70	-20.14	28.05 *	24.47	53.66 **	38.71 *	-2.95	-7.91 **	0.25	-2.5	-10.49 **	-19.67 **	-0.21	-0.41
Local C – 1X GADB – 1	34.48	17.36	-6.66	-22.6	22.79	20.17	54.98 **	39.90 *	8.57 **	8.52 **	6.15 *	3.24	-10.20 **	-19.33 **	0.21	0.00
Local C – 1 X Local – 2	68.27 **	58.25 *	6.49	-11.69	1.06	-7.24	37.04	23.70	4.52 *	1.85	4.89 *	2.02	-11.19 **	-20.00 **	-0.62	-0.83
Local C – 1 X AKL – 11	63.57 **	24.86	40.53 *	16.54	-3.21	-8.29	26.50	14.19	8.28 **	5.30 *	8.90 **	5.91 *	-11.79 **	-20.17 **	-0.83	-1.03
Local C – 1 X Asond Round	42.52 *	11.96	16.22	-3.63	-20.10	-24.15	4.20	-5.94	5.24 *	0.91	7.45 **	4.5	-11.54 **	-20.17 **	-0.83	-1.03
Asond long X Local – 3	70.55 **	69.26 **	18.58	-1.67	-22.72 *	-26.71 *	21.07	9.29	3.95	-0.10	1.37	-1.41	-11.52 **	-20.00 **	-0.62	-0.83
Asond long X Selection – 167	36.86 *	15.30	16.15	-3.68	-37.03 **	-40.33 **	-11.60	-20.21	-5.63 **	-9.98 **	-7.21 **	-9.75 **	-11.05 **	-20.17 **	-0.83	-1.03
Asond long X Local C – 2	44.52 *	22.15	22.07	1.23	-4.66	-14.83	26.17	13.89	-3.33	-10.12 **	-2.16	-4.84 *	-11.98 **	-21.00 **	-1.86	-2.07
Asond long X GADB – 1	78.10 **	66.30 **	32.27	9.68	-15.18	-20.67	17.53	6.09	5.08 *	2.80	0.56	-2.2	-10.58 **	-19.67 **	-0.21	-0.41
Asond long X Local – 2	55.72 *	53.80 *	6.11	-12	-6.98	-7.11	37.61	24.22	10.79 **	5.72 *	8.88 **	5.89 *	-11.01 **	-19.83 **	-0.41	-0.62
Asond long X AKL – 11	42.82 *	15.18	29.64	7.5	6.27	2.61	52.02 **	37.22 *	4.49 *	-0.48	2.92	0.09	-12.15 **	-20.50 **	-1.24	-1.45
Asond long X Asond round	45.10 *	20.77	25.36	3.96	-3.55	-7.06	37.7	24.29	2.96	-3.29	2.98	0.16	-10.80 **	-19.50 **	0.00	-0.21
Local – 3 X Selection – 167	40.56 *	19.10	19.99	-0.5	4.55	-7.62	9.67 **	44.13 *	-2.31	-2.87	0.12	-2.63	-10.12 **	-19.33 **	0.21	0.00
Local – 3 X Local C – 2	34.08	13.98	13.91	-5.54	-10.69	-25.24 *	29.22	16.64	-3.02	-6.12 **	2.20	0.61	-11.05 **	-20.17 **	-0.83	-1.03
Local – 3 X GADB – 1	55.78 **	46.43 *	16.46	-3.42	-1.72	-14.19	48.31 *	33.88	3.91	1.84	3.76	0.91	-10.58 **	-19.67 **	-0.21	-0.41
Local – 3 X Local – 2	79.62 **	76.16 **	23.29	2.24	-16.41	-22.48 *	33.99	20.95	-3.69	-4.21	-1.34	-4.05	-11.19 **	-20.00 **	-0.62	-0.83
Local – 3 X AKL – 11	26.95	2.94	15.87	-3.92	-9.85	-18.95	40.08 *	26.45	1.86	1.11	4.56	1.69	-11.23 **	-19.67 **	-0.21	-0.41
Local – 3 X Asond Round	60.24 **	34.14 *	39.24 *	15.47	-10.00	-19.24	39.59 *	26.00	2.36	0.15	6.64 **	3.71	-11.54 **	-20.17 **	-0.83	-1.03
Selection – 167 X Local C – 2	25.18	24.69	25.59	4.14	11.45	8.33	33.74	20.73	6.76 **	4.35 *	13.61 **	10.49 **	-11.42 **	-20.50 **	-1.24	-1.45
Selection – 167 X GADB – 1	45.77 **	30.44	31.37	8.94	11.64	9.25	40.91 *	27.19	1.61	-1.39	2.52	-0.29	-10.39 **	-19.50 **	0.00	-0.21
Selection – 167 X Local – 2	40.47 *	17.16	18.00	-2.15	7.50	-1.34	45.76 *	31.58	-0.06	-0.53	3.42	0.58	-10.64 **	-19.50 **	0.00	-0.21
Selection – 167 X AKL – 11	17.66	11.48	25.47	4.04	14.86	8.83	50.12 *	35.51 *	-3.11	-3.37	0.46	-2.29	-11.79 **	-20.17 **	-0.83	-1.03
Selection – 167 X Asond Round	37.38 *	35.34 *	40.49 *	16.5	5.96	0.60	38.19	24.74	-6.83 **	-7.93 **	-1.97	-4.66 *	-11.36 **	-20.00 **	-0.62	-0.83
Local C - 2 X GADB – 1	21.05	8.70	8.62	-9.93	-10.40	-12.32	13.09	2.08	2.21	-2.65	5.25 *	2.37	-11.13 **	-20.17 **	-0.83	-1.03
Local C - 2 X Local – 2	72.97 **	44.73 *	44.62 *	19.93	-19.03	-25.68	9.79	-0.89	1.93	-0.49	7.59 **	4.64 *	-11.56 **	-20.33 **	-1.04	-1.24
Local C –2 X AKL – 11	31.10 *	23.74	39.27 *	15.49	5.29	-0.24	37.61	24.22	-7.22 **	-9.24 **	-1.86	-4.56	-12.34 **	-20.67 **	-1.45	-1.65
Local C - 2 X Asond round	47.75 **	44.99 **	50.50 **	24.81	7.73	2.28	40.49 *	26.82	-10.41 **	-11.09 **	-3.87	-6.50 **	-11.54 **	-20.17 **	-0.83	-1.03
GADB – 1 X Local – 2	54.03 *	42.20*	13.05	-6.25	-19.94	-26.52 *	8.56	-2.01	-1.80	-4.31	-1.45	-4.15	-10.27 **	-19.17 **	0.41	0.21
GADB -1 X AKL -11	52.91 **	30.46	46.83 **	21.76	-13.35	-17.90	13.25	2.23	0.69	-2.08	1.26	-1.52	-11.23 **	-19.67 **	-0.21	-0.41
GADB – 1 X Asond Round	59.30 **	40.66 *	46.01 *	21.08	-9.31	-13.90	18.27	6.76	-4.62 *	-8.54 **	-2.61	-5.28 *	-10.80 **	-19.50 **	0.00	-0.21
Local – 2 X AKL – 11	56.87 **	25.27	41.00 *	16.92	-0.81	-4.22	41.89 *	28.08	-8.56 **	-8.80 **	-5.18 *	-7.79 **	-11.23 **	-19.67 **	-0.21	-0.41
Local – 2 X Asond Round	62.47 **	33.84 *	38.93 *	15.21	-2.97	-6.50	38.52	25.04	-8.17 **	-9.26 **	-3.38	-6.03 *	-10.99 **	-19.67 **	-0.21	-0.41
AKL – 11 X Asond Round	26.14	21.20	36.49 *	13.19	-24.01 *	-26.78 *	8.48	-2.08	-1.71	-2.87	3.42	0.59	-11.54 **	-20.17 **	-0.83	-1.03
S.E.(d) +	76.37	88.19	88.19		0.68	0.78	0.78		0.99	1.14	1.14		0.01	0.01	0.01	
C.D. (5%)	151.78	175.26	175.26		1.35	1.56	1.56		1.96	2.27	2.27		0.03	0.03	0.03	
C.D. (1%)	201.09	232.20	232.20		1.79	2.07	2.07		2.60	3.01	3.01		0.04	0.05	0.05	

* Significant at 5 percent; ** Significant at 1 percent

Local-3 x GADB-1 (15.61%), Local-2 x AKL-11 (15.53%), Selection-167 x Asond Round (15.45%) and Local C-1 x GADB-1 (14.48%). 32 crosses over Pusa Hybrid-6 and 29 over Pusa Hybrid-9 respectively out of which Selection-167 x Asond Round (40.20%) and (37.10%) recorded maximum significant positive standard heterosis.

The negative values for days to first flower indicate favorable earliness and for number of branches per plant none of cross showed significant negative heterosis, heterobeltiosis and heterosis over both the check viz. Pusa Hybrid-6 and Pusa Hybrid-9. Whereas for days to 50% flower significant negative heterosis was observed in three crosses and it was highest in Asond Long x Local C-2 (-20.13%). While, 10 crosses exhibit significant negative heterobeltiosis and highest in Asond Long x GADB-1 (-24.72%). Whereas none of the cross showed the magnitude of significant negative standard heterosis for considered trait over Pusa Hybrid-6 and over Pusa Hybrid-9.

The magnitude of heterosis for number of flowers per branch, 2 crosses recorded significant positive mid parent heterosis, only one cross Asond Long x Asond round (24.24%) showed significant positive heterobeltiosis. Over Pusa Hybrid-6 and Pusa Hybrid-9, 8 and 19 crosses showed significant positive standard heterosis, in which Local C-1 x Local-3 (33.95%) and (52.44%) showed highly significant respectively.

It can be seen from tables that wide range of heterobeltiosis was present for growth parameters viz. plant height, plant spread, branches per plant etc. in positive direction over mid parent, better parent and specially in check first Pusa Hybrid-6 whereas for branches per plant in over check second Pusa Hybrid-9 and for days first flower, days to 50 per cent flower in negative direction over better parents.

Out of 36 crosses, 5 and 14 crosses showed significant positive heterosis and heterobeltiosis for number of fruits per plant. There was significant positive standard heterosis in GADB-1 x Local-2 (56.20%) over check Pusa Hybrid-6 and 23 crosses exhibited significant positive heterosis over Pusa Hybrid-9. The findings of Shafeeq *et al.* (2007) who obtained range of heterosis over better parent (-40.68 to 22.76 per cent), Prakash *et al.* (1993) (-10.53 to 23.53 per cent); Bhutani *et al.* (1980) (-61.65 to 47.66 per cent) for number of branches per plant; Singh *et al.* (1988) 13.5 to 54.4 per cent for number of fruits per plant in 15 and 20 F_1 hybrids respectively.

Eight crosses exhibited significant positive heterosis over mid parent and 5 crosses over better for fruit length. The magnitude of standard heterosis over check Pusa hybrid-6 i.e. 90.87% in Local C-2 x Asond Round and 26 crosses showed significant positive heterosis over Pusa Hybrid-6 and 15 crosses over Pusa Hybrid-9.

The extent of heterosis for fruit diameter over mid parent in Asond Long x GADB-1 (66.53) per cent was highly significant along with 21 crosses. Heterobeltiosis was 60.73 (Local C-1 x GADB-1) per cent, while, 13 crosses showed significantly positive heterosis over better parent. 12 crosses showed positive significance of heterosis over check Pusa Hybrid-6 with maximum was 50.42 % in Asond Long x Local-2. None of the cross showed positive significance heterosis over check Pusa Hybrid-9.

Out of total crosses, 29 and 17 crosses showed significant desirable heterosis over MP and BP in positive direction with 173.98 % and 136.67 % in Asond Long x GADB-1 respectively for fruit weight. In 24 and 32 crosses, heterosis was noticed significant in positive direction over check Pusa Hybrid-6 and over check Pusa Hybrid-9 with highest in Local C-2 x Asond Round 160.86 and 18.77 % respectively. Heterosis for fruit diameter, fruit weight and yield was reported by Bayla (1918), Nagai and kida (1926), Patil (1998), Anuroopa (2000), Bulgundi (2000) and Bavage (2002). Thus, it would appear that more phenotypic superiority of parents does not necessarily indicate their performance in hybrid combinations and that measurement of heterosis may be necessary to provide required information for selecting parents for hybridization.

The findings of Shafeeq *et al.* (2007) who obtained range of heterosis over better parent fruit length (-50.0 to 18.46 per cent), fruit diameter (-24.37 to 1.98 per cent), fruit weight (-20.18 to 69.22 per cent) broadly in agreement with the findings of present investigation for relevant traits, indicating possibilities for combining high yield and its components. The role of important characters viz. number of fruits per plant, fruit length, fruit diameter and fruit weight as yield contributing traits has been widely emphasized by Chadha and Paul (1984), Nainer *et al.* (1990), Prathibha *et al.* (2004) and Makani *et al.* (2013) noticed that highest level of heterosis in yield per plant followed by number of fruits per plant and fruit weight and other contributing positively to higher yield.

The quantum of for yield per plant over mid parent in 27 crosses and over better parent in 13 crosses with highly significant in Local-3 x Local-2 (101.50 %) and (83.33%) respectively followed by Local C-1 x Asond Long (75.27%). As many as 11 crosses exhibited positive significant heterosis over Pusa Hybrid-6 which was highly significant in Local C-2 x Asond Round (52.02 percent), while, one of the cross showed significant heterosis over Pusa Hybrid-9.

Positive significant heterosis was exhibited by 27 crosses each for yield per plot and yield per hectare with highly significant in Local C-1 x Asond Long (90.34 %) and (88.63 %) over MP respectively. While, 15 crosses for both yield per plot and per hectare exhibited significant heterobeltosis with 75.37 % (Local C-1 x Asond Long) and 76.16 % (Selection-167 x Local-2) respectively.

The wide range of heterobeltiosis was present (-10.38 to 83.33 per cent) for yield per plant, (-10.24 to 75.37 per cent) for yield per plot and (-10.26 to 76.16 per cent) for yield per hectare and the results were confirmed with findings Dharmegowda *et al.* (1979), Bhutani *et al.* (1980), Singh and Kalda (1989), Chadha *et al.* (1990), Singh and Rai (1990), Sawant *et al.* (1991) and Prakash *et al.* (1993). Raghvendra Dubey (2014) repoted the maximum heterosis for total yield per plant over better parent was exhibited by the cross KS-314 x IC-90099 (94.72%) followed by KS-314 x PPC (85.10%).

The crosses showed significant heterobeltiosis involving either one or both the parents, which are otherwise low or medium in yield potential. The cross combinations which showed significant maximum heterosis over better parent viz. Local– 3 X Local– 2 (83.33 per cent), Local C– 1 X Asond long (75.27 per cent), Asond long X Local– 3 (69.11 per cent) and GADB– 1 X Local – 2 (68.31 per cent) had either one or both the parents with medium or low yield potential, however the cross

GADB– 1 X Asond Round showed highest yield per plant over both the parents but per cent of heterosis over better parent is lowest (40.53 per cent), also in cross combination Asond long X GADB–1 obtained high yield but medium heterobeltiosis was seen (66.51 per cent) among all the crosses medium x high and medium x medium yielding parents were involved.

The negative values for infestation of shoot and fruit borer are desirable. 3 crosses showed significant negative relative heterosis with maximum in Asond Long x Selection-167 (-37.03%) followed by AKL-11 x Asond Round (-24.01%) and Asond Long x Local-3 (-22.72%). Whereas, 6 crosses over BP and highest (-40.33%) in Asond Long x Selection-167. None of the cross exhibited significance over Pusa Hybrid-6 and Pusa Hybrid-9.

Positive significant heterosis was exhibited by 16 crosses over MP and 5 crosses over BP for chlorophyll content and range of heterobeltiosis showed in same crosses as in heterosis over MP viz. Local C-2 x Asond Round (-11.09%) and Local C-1 x Asond Long (10.77%) respectively. 5 crosses exhibited significant positive heterobeltosis. Out of 12 significant crosses, 10 crosses exhibited positive significant heterosis over check Pusa Hybrid-6. Whereas, 5 crosses showed positive significant heterosis over check Pusa Hybrid-9.

All the crosses exhibited negative significant heterosis over MP and BP for protein content. While none of the cross showed significant standard heterosis over both the check viz. Pusa Hybrid-6 and Pusa Hybrid-9.

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