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Manifestation of Heterosis in Okra (*Abelmoschus esculentus* (L.) Moench)

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ABSTRACT

Seventeen lines of okra were crossed with four pollen parents in a line x tester fashion. Analysis of variance indicated highly significant differences for all the characters suggesting the presence of genetic variability among the material studied. The extent of heterosis over better parent as well as check hybrid was higher for primary branches per plant followed fruit hair density, internodes per plant, fruit yield per plant, plant height, fruits per plant, fruit weight, fruit hair length, fruit length and days to flower. Cross combinations *viz*., M 172 x *Arka Anamika* and Sel. 2 x GO 2 showed highest heterosis for fruit yield over better parent and standard check, respectively. Among the other cross combinations M 65 x *Arka Anamika*, P 7 x *Parbhani Kranti*, JOL 1 x GO 2, Local Red x HRB 55 and *Arka Abhay* x *Parbhani Kranti* exhibited higher heterosis over better parent as well as check hybrid for fruit yield and other related traits studied in the present investigation. Thus, these can be considered as the promising cross combinations for fruit yield and hence can be exploited for future use.

Key words *Heterosis, okra*

Okra (*Abelmoschus esculentus* (L.) Moench) is an important annual fruit vegetable cultivated extensively in tropical and subtropical parts of the country. Because of high nutritive value and prolonged shelf life, okra captured prominent position among the export oriented vegetable crops and thus act as one of the valuable foreign exchange earner crop. It is being exported to middle east countries, western Europe and USA. First report of hybrid vigour in okra was given by Vijayaraghavan and Warriar, 1946. Further, feasibility of exploitation of hybrid vigour in okra is acknowledged by the several workers due to the ease of emasculation and very high percentage of fruit set. Though a lot of information is available on heterosis and other aspects in okra, yet it holds future promise for further utilization. Therefore, the present study was undertaken to identify suitable cross combinations from adapted parents for commercial exploitation of heterosis on yield as well as yield related component traits.

MATERIALS AND METHODS

The experimental materials were comprised of 17 lines *viz*., HRB 9-2, M 175, VRO 6, M 172, M 65, AOL 02-3, VRO 5, M 173, *Arka Abhay*, JOL 1, Lorm 1, Local Red, NOL 101, Sel. 2, VRO 3, P 7 and JOL (2K)-11, 4 testers *viz*., GO 2, HRB 55, *Arka Anamika* and *Parbhani Kranti*, their 68 hybrids and a standard check GOH 1. The experimental materials were evaluated in randomized block design with three replications at Main Vegetable Research Station, Anand Agricultural University, Anand. The experimental units were consisting of 10 plants at 60 x 30 cm inter and intra row spacing. The observations were recorded on five competitive randomly selected plants for fruit yield and ten related component traits. The recommended agronomic practices were also followed to raise the healthy crop. Analysis was done according to the standard procedure suggested by Kempthorne, 1957.

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences for parents as well as hybrids for all eleven traits studied (Table 1) indicating existance of sufficient genetic diversity among the experimental material for all the traits. The mean sum of squares due to parents vs hybrids was significant for all the traits except days to flower and fruit girth, similarly the mean sum of squares due to check *vs* hybrid was also recorded to be significant for plant height, primary branches per plant, fruit weight and fruit hair length revealing presence of heterosis for these traits. Heterosis in percentage over better parent (BP) and standard check (SC) for eleven different component traits of okra are presented in Table 2 and those characters and crosses having desirable significant heterosis over BP and SC are considered for discussion for brevity purpose.

Early maturing hybrids alongwith better quality fruits (less fruit hair length and density) are desirable for market price point of view. Hence, for the phenological traits like days to flower, fruit hair length and fruit hair density heterosis in negative direction is desirable. For days to flower, only a cross Lorm 1 x *Arka Anamika* (-11.05 %) displayed significant negative heterobeltiosis, while none of the cross exhibited significant negative standard heterosis for this trait. Out of 68 crosses, 17 showed significant negative heterobeltiosis for fruit hair length, among these highest significant and desirable heterobeltiosis shown by Sel. 2 x HRB 55 (-28.21 %) followed by JOL 1 x *Arka Anamika* (-21.07 %), Sel. 2 x *Parbhani Kranti* and VRO-6 x GO-2 (-19.05 %). While, a cross AOL 02-3 x HRB 55 (-8.46 %) depicted significant negative standard heterosis

Table 1. Analysis of variance for various characters of okra

Characters	d.f.	Days to flower	Fruit hair length	Fruit hair density	Plant height	Primary branches per plant	Fruits per plant	Fruit weight	Fruit length	Fruit girth	Internodes per plant	Fruit yield per plant
Replications	2	2.03	742.04	38.60	70.31	0.13	4.80	1.50	0.40	0.09	0.19	510.78
Genotypes	89	8.88**	25142.01	4297.13**	240.06**	0.90**	18.18*	5.80**	3.26**	0.18**	7.98**	3178.83**
Parents	20	7.51*	34653.27**	5141.76*	90.74**	0.42**	10.62**	9.58**	2.36**	0.35**	4.79**	2408.97**
Hybrids	67	9.18**	21970.31**	4104.11**	244.33**	0.97**	16.58**	4.47**	3.60**	0.14**	7.97**	2445.88**
Parent vs Hybrids	1	7.61	51556.00**	3908.50**	2826.09**	5.76**	282.31**	14.54**	0.23	0.01	79.60**	70794.38**
Check vs Hybrids	1	16.25	25704.20**	933.25	480.00**	1.63*	4.58	11.32*	1.90	0.02	2.31	556.05
Error	178	4.24	1109.58	47.56	32.53	0.06	2.38	1.65	0.18	0.05	0.19	309.75

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

for this trait. Similarly for fruit hair density, 44 crosses over BP and 39 over SC exhibited significant negative heterosis. Of which crosses *viz*., P 7 x *Parbhani Kranti* (-67.92 %) and VRO 3 x HRB 55 (-61.83 %) displayed highest significant heterosis over BP and SC, respectively.

Higher plant height alongwith more number of primary branches per plant will be helpful in increasing the number of fruits per plant which in turns gives more fruit yield per plant. For plant height, out of 68 hybrids 16 over BP and 44 over SC displayed significant and positive heterosis. Among these, cross combinations *viz*., *Arka Abhay* x HRB 55 (44.95 %) and Local Red x *Arka Anamika* (66.79 %) exhibited highest significant heterobeltiosis and standard heterosis in desired direction for this trait, respectively. Similarly for primary branches, 21 and 43 crosses showed significant positive heterosis over BP and SC, respectively. Of which, 20 crosses displayed heterosis both over BP as well as SC, among these highest significant and positive heterobeltiosis and standard heterosis for this trait is recorded for HRB 9-2 x *Arka Anamika* (152.38 %) and P 7 x GO 2 (149.42 %), respectively. Similarly high heterosis over BP and SC for above two traits was also reported by Elangovan, *et al*., 1981, Dhankhar, *et al*., 1998 and Dhankhar and Dhankhar, 2001.

Number of fruits per plant and fruit weight is considered to be direct yield contributing traits, which contribute towards increase fruit yield in okra. Out of 68 crosses, 16 over BP and 5 over SC displayed significant and positive heterosis for fruits per plant, of which five crosses *viz*., M 172 x *Arka Anamika*, M 65 x *Arka Anamika*, Sel. 2 x HRB 55, JOL (2K)-11 x HRB 55 and JOL (2K)-11 x *Parbhani Kranti* exhibited significant and positive heterosis both over BP as well as SC. Cross combination M 172 x *Arka Anamika* displayed highest significant heterobeltiosis (43.75 %) as well as standard heterosis (20.60 %) for this trait. For fruit weight, 9 and 33 crosses exhibited significant and positive heterosis over BP and SC, respectively. Of which, P 7 x GO 2 depicted highest significant and positive heterosis over BP (29.81 %) as well as SC (43.22 %), respectively. Similar results for above two traits were also reported by Elangovan, *et al*., 1981, Sundhari, *et al*., 1992 and Chauhan and Singh, 2002.

Improvement of fruit yield is become possible and easier if progress made through component traits like fruit length, fruit girth and internodes per plant. In the present study for fruit length, 11 and 4 crosses expressed significant and positive heterosis over BP and SC, respectively. Of which crosses *viz*., P-7 x *Arka Anamika* (18.05 %) and Local Red X GO 2 (12.23 %) exhibited highest significant positive heterosis over BP and SC, respectively. Similarly for fruit girth, 5 crosses over BP and 4 over SC displayed significant heterotic value in desired direction. Of which, M 65 x HRB 55 (9.44 %) and Sel. 2 x *Arka Anamika* (8.87 %) displayed highest significant and positive heterobeltiosis and standard heterosis for this trait, respectively. Out of 68 crosses, 26 crosses displayed both significant positive heterobeltiosis as well as standard heterosis for internodes per plant, of which highest significant and positive heterobeltiosis is displayed by *Arka Abhay* x *Arka Anamika* (15.52 %) followed by *Arka Abhay* x HRB 55 (46.54 %), M 172 x *Arka Anamika* (34.89 %) and VRO 6 x GO 2 (34.82 %). Whereas for standard heterosis Lorm 1 x GO-2 (49.41 %) displayed highest significant and positive standard heterosis for these trait. For fruit yield 30 crosses exhibited significant positive heterosis over BP, of which highest significant heterosis over BP displayed by M 172 x *Arka Anamika* (53.17 %) followed by Sel. 2 x HRB 55 (44.99 %), M 65 x *Arka Anamika* (43.38 %) and P 7 x *Parbhani Kranti* (43.14 %). Whereas, 20 crosses exhibited significant positive standard heterosis, among which Sel. 2 x HRB 55 (47.82 %), JOL (2K)-11 x HRB 55 (46.14 %),

Table 2. Estimates of Heterobeltiosis (HB) and Standard Heterosis (SH) for various traits in okra

Crosses	Days to flower		Fruit hair length		Fruit hair density		Plant height		Primary branches/ plant		Fruits per plant	
	HB	SH	HB	SH	HB	SH	HB	SH	HB	SH	HB	SH
HRB 9-2 x GO-2	8.36*	8.71*	-11.43**	7.96*	-9.53**	2.29	7.11	18.71*	-32.35**	7.23	15.49	-2.25
HRB 9-2 x HRB-55	3.63	3.96	7.35*	30.85**	-20.69**	-10.34*	-6.15	2.77	-29.03**	2.56	4.78	-1.50
HRB 9-2 x A. Anamika	3.15	3.49	-0.41	21.39**	-26.88**	-17.33**	41.41**	66.43**	152.38**	147.09**	11.95	-5.24
HRB 9-2 x *P. Kranti*	-1.42	-1.10	-11.84**	7.46	-47.38**	-40.51**	3.52	13.36	17.86	53.85**	5.17	-8.61
M-175 x GO-2	7.95*	13.93**	-6.52*	28.36**	4.82	14.94**	-20.13**	0.24	-23.53**	21.21	-21.35**	-21.35**
M-175 x HRB-55	5.91	7.76	5.43	44.78**	-23.65**	-16.28**	-6.62	17.21*	0.00	44.52**	-28.46**	-28.46**
M-175 x *A. Anamika*	4.20	9.98	-3.26	32.84**	-57.26**	-53.13**	-1.10	24.13**	113.04**	128.44**	-17.60*	-17.60*
M-175 x *P. Kranti*	1.66	6.65	-8.70**	25.37**	-61.26**	-57.52**	0.38	25.99**	39.29**	81.82**	-10.86	-10.86
VRO-6 x GO-2	3.39	6.34	-19.05**	9.95*	28.69**	16.23**	16.67**	29.30**	5.88	67.83**	13.79	-13.48
VRO-6 x HRB-55	3.58	5.39	-11.72**	19.90**	-42.17**	-47.77**	12.40	13.48	-16.13	21.21	11.55	4.87
VRO-6 x *A. Anamika*	2.78	5.70	-1.10	34.33**	-53.73**	-54.45**	11.96	31.77**	6.60	46.85**	22.77**	3.00
VRO-6 x *P. Kranti*	-0.15	2.70	-8.79**	23.88**	42.43**	44.82**	4.89	5.90	31.98**	81.82**	9.48	-4.87
M-172 x GO-2	0.44	8.39*	20.19**	27.36**	-18.42**	-8.24*	12.81	25.03**	0.00	58.51**	0.25	-23.78**
M-172 x HRB-55	-0.16	1.59	1.41	7.46	-27.91**	-18.91**	2.41	7.58	-16.13	21.21	-12.75	-17.98*
M-172 x *A. Anamika*	-6.75	2.70	-0.94	4.98	-27.67**	-18.65**	-1.53	15.88	7.08	44.52**	43.75**	20.60**
M-172 x *P. Kranti*	1.81	6.81	-0.45	10.95**	-48.43**	-42.00**	14.20	19.98*	27.81**	72.49**	6.47	-7.49
M-65 x GO-2	-6.81	-0.47	13.25**	31.84**	69.74**	16.50**	12.92	25.15**	-20.59*	25.87	13.24	-13.48
M-65 x HRB-55	2.64	4.44	-16.24**	-2.49	7.37	-18.72**	3.93	8.30	0.00	44.52**	2.39	-3.75
M-65 x *A. Anamika*	-5.78	0.64	10.26**	28.36**	-8.84*	-10.26*	12.99	32.97**	38.73**	67.83**	36.16**	14.23*
M-65 x *P. Kranti*	2.41	7.45	-2.99	12.94**	5.82	7.60	15.60	20.46*	51.79**	98.14**	10.34	-4.12
AOL-02-3 x GO-2	4.40	12.67**	0.00	-1.99	-32.95**	-18.26**	13.03	25.27**	-29.41**	11.89	12.81	-14.23*
AOL-02-3 x HRB-55	1.87	3.65	-3.16	-8.46*	8.22*	31.92**	19.73*	28.52**	-24.24**	16.55	14.74	7.87
AOL-02-3 x *A. Anamika*	3.81	12.19**	1.92	5.47	-46.70**	-35.02**	-18.30*	-3.85	-18.18	25.87	15.18	-3.37
AOL-02-3 x *P. Kranti*	0.60	5.55	-8.04*	2.49	-44.64**	-32.51**	8.07	16.00	-6.06	44.52**	-10.78	-22.47**
VRO-5 x GO-2	-0.29	7.45	10.78**	27.86**	-18.32**	-10.24**	-15.20*	-6.02	-26.47**	16.55	22.17*	-7.12
VRO-5 x HRB-55	0.47	2.22	-2.59	12.44**	-42.71**	-37.05**	9.63	8.18	-16.13	21.21	-13.94	-19.10**
VRO-5 x *A. Anamika*	-2.35	5.23	-4.74	9.95*	-43.16**	-37.54**	26.02**	48.32**	78.57**	74.83**	22.32**	2.62
VRO-5 x *P. Kranti*	-0.60	4.28	-11.64**	1.99	-23.49**	-15.92**	14.43	11.67	-3.57	25.87	8.62	-5.62
M-173 x GO-2	5.93	13.14**	-5.80	4.98	0.09	9.89*	-8.80	16.00	25.71**	105.13**	3.55	-17.98*
M-173 x HRB-55	6.53	8.39	-9.82**	0.50	-50.77**	-45.94**	-23.46**	-2.65	-40.00**	-2.10	-17.53**	-22.47**
M-173 x *A. Anamika*	4.44	11.56	24.11**	38.31**	4.46	14.69**	27.39**	62.03**	14.29	86.48**	15.63	-3.00
M-173 x *P. Kranti*	-0.15	4.76	6.25	18.41**	-56.89**	-52.67**	-13.15*	10.47	-5.71	53.85**	17.24*	1.87
A. Abhay x GO-2	3.67	11.88**	9.14*	6.97	0.14	-28.69**	7.17	18.77	11.43	81.82**	-13.87	-23.22**
A. Abhay x HRB-55	4.51	6.34	7.89	1.99	18.96**	-9.95*	44.95**	50.18**	-21.43*	28.21*	-4.38	-10.11
A. Abhay x *A. Anamika*	-0.72	9.34*	3.37	6.97	13.94*	12.16**	13.91	34.06**	-11.43	44.52**	-18.07*	-26.97**
A. Abhay x *P. Kranti*	-5.58	-0.94	36.61**	52.24**	-5.82	-4.24	9.18	13.12	5.71	72.49**	23.53**	10.11

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

Table 2 Contd…

Crosses	Days to flower		Fruit hair length		Fruit hair density		Plant height		Primary branches/ plant		Fruits per plant	
	HB	SH	HB	SH	HB	SH	HB	SH	HB	SH	HB	SH
JOL-1 x GO-2	2.24	8.55*	-2.89	16.92**	20.49**	-17.31**	9.34	21.18*	-23.53**	21.21	24.14*	-5.62
JOL-1 x HRB-55	1.24	3.01	4.55	25.87**	11.46*	-15.62**	9.76	8.30	-32.26**	-2.10	-10.36	-15.73*
JOL-1 x *A. Anamika*	0.60	6.81	-21.07**	-4.98	-49.67**	-50.45**	17.28	38.03**	96.00**	128.44**	5.36	-11.61
JOL-1 x *P. Kranti*	-6.18	-1.57	3.31	24.38**	12.94**	14.84**	10.81	8.54	71.43**	123.78**	28.02**	11.24
Lorm-1 x GO-2	3.09	10.77**	-2.54	-4.48	-7.11*	19.06**	-20.52**	-11.91	-35.29**	2.56	4.15	-15.36*
Lorm-1 x HRB-55	5.75	7.60	5.26	-0.50	-17.32**	5.97	3.97	13.48	7.69	63.17**	-24.30**	-28.84**
Lorm-1 x *A. Anamika*	-11.05**	-4.42	-0.96	2.49	-55.71**	-43.24**	15.54*	35.98**	-32.31**	2.56	10.71	-7.12
Lorm-1 x *P. Kranti*	0.90	5.86	-1.34	9.95*	-13.48**	10.89**	8.71	18.65*	1.54	53.85**	-10.34	-22.10**
Local Red x GO-2	8.27	8.71	-7.76*	6.47	-8.46*	14.43**	15.74*	28.28**	-38.24**	-2.10	17.73	-10.49
Local Red x HRB-55	-2.60	-2.21	-5.17	9.45*	-30.98**	-13.72**	14.98	21.90**	-19.35*	16.55	20.32**	13.11
Local Red x *A. Anamika*	6.23	6.65	9.05**	25.87**	-10.20**	12.26**	41.72**	66.79**	10.00	2.56	19.64*	0.37
Local Red x *P. Kranti*	-1.97	-1.57	6.47	22.89**	-23.79**	-4.73	17.25	24.31**	32.14**	72.49**	-3.88	-16.48*
NOL-101 x GO-2	-2.35	5.39	-6.75	9.95*	-19.89**	-45.02**	17.21*	34.42**	5.88	67.83**	39.41**	5.99
NOL-101 x HRB-55	1.56	3.33	-10.97**	4.98	-40.60**	-55.03**	10.55	26.77**	54.84**	123.78**	-9.96	-15.36*
NOL-101 x *A. Anamika*	-0.87	7.76	4.22	22.89**	-16.76**	-18.06**	4.19	22.62**	27.27	30.54*	-3.57	-19.10**
NOL-101 x *P. Kranti*	1.06	6.02	5.91	24.88**	-6.71	-5.14	-10.28	2.89	10.71	44.52**	-14.66	-25.84**
Sel.2 x GO-2	-4.27	2.86	-8.57**	27.36**	-3.76	28.51**	6.56	25.03**	-29.41**	11.89	-10.84	-32.21**
Sel.2 x HRB-55	-0.47	1.27	-28.21**	0.00	-7.96**	22.91**	24.72**	46.33**	12.90	63.17**	23.11**	15.73*
Sel.2 x *A. Anamika*	-1.91	5.39	-10.71**	24.38**	-9.60**	20.71**	2.76	20.94*	16.00	35.20*	-0.45	-16.48*
Sel.2 x *P. Kranti*	-4.37	0.32	-20.71**	10.45**	-51.82**	-35.66**	13.23	32.85**	28.57**	67.83**	15.52	0.37
VRO-3 x GO-2	4.69	12.98**	-3.03	-4.48	64.03**	12.57**	0.95	28.04**	11.76	77.16**	7.39	-18.35*
VRO-3 x HRB-55	4.82	6.65	13.13**	11.44**	-49.58**	-61.83**	4.27	32.25**	-16.13	21.21	11.16	4.49
VRO-3 x *A. Anamika*	-2.49	5.39	7.69	11.44**	-35.38**	-36.39**	14.99*	45.85**	72.00**	100.47**	33.48**	11.99
VRO-3 x *P. Kranti*	-0.30	4.60	7.14	19.40**	-35.14**	-34.05**	-11.01	12.88	25.00*	63.17**	10.78	-3.75
P-7 x GO-2	9.51**	12.98**	0.00	-1.99	-50.62**	-33.90**	18.35*	31.17**	57.35**	149.42**	-20.50**	-28.84**
P-7 x HRB-55	3.58	5.39	24.21**	17.41**	-1.80	31.44**	3.74	6.74	-22.58*	11.89	2.39	-3.75
P-7 x *A. Anamika*	1.99	5.23	8.65*	12.44**	-13.60**	15.64**	6.65	25.51**	51.61**	119.11**	-10.25	-19.66**
P-7 x *P. Kranti*	1.07	4.28	4.91	16.92**	-67.92**	-57.06**	23.98**	27.56**	19.35*	72.49**	10.04	-1.50
JOL-(2K)-11 x GO-2	3.76	9.19*	3.92	5.47	9.80	-24.64**	6.39	24.31**	-42.03**	-6.76	-19.82*	-33.33**
JOL-(2K)-11 x HRB-55	1.71	3.49	11.27**	12.94**	31.00**	-0.83	15.40*	34.84**	25.36**	101.63**	22.31**	14.98*
JOL-(2K)-11 x *A. Anamika*	2.26	7.60	20.67**	24.88**	18.74**	16.89**	0.41	18.17*	-21.74*	25.87	2.01	-14.42*
JOL-(2K)-11 x *P. Kranti*	-6.49	-1.89	-4.46	6.47	12.15**	14.04**	33.99**	56.56**	-13.04	39.86**	31.90**	14.61*
Range: Maximum	9.51	13.93	36.61	52.24	69.74	44.82	44.95	66.79	152.38	149.42	43.75	20.60
Minimum	-11.05	-4.42	-28.21	-8.46	-67.92	-61.83	-23.46	-11.91	-42.03	-6.76	-28.46	-33.33
SE ±	1.68	1.68	27.31	27.31	5.66	5.66	4.68	4.68	0.20	0.20	1.27	1.27

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

Table 2 Contd…

Crosses	Fruit weight		Fruit length		Fruit girth		Internodes per plant		Fruit yield per plant	
	HB	SH	HB	SH	HB	SH	HB	SH	HB	SH
HRB 9-2 x GO-2	3.40	16.50	-8.33**	-6.51**	-6.51*	-8.41**	-8.24**	-1.76	19.42*	15.44*
HRB 9-2 x HRB-55	9.21	23.04*	-4.79	-12.74**	-0.47	-2.49	-0.55	6.47*	18.85**	22.81**
HRB 9-2 x *A. Anamika*	-3.23	9.03	3.39	-4.29	-0.59	-2.61	-14.29**	-8.24**	8.17	4.56
HRB 9-2 x *P. Kranti*	3.31	16.39	-0.05	-1.66	-3.47	3.19	1.92	9.12**	11.62	7.89
M-175 x GO-2	1.34	11.81	-3.06	-0.65	-6.50*	-6.67*	-8.25**	11.18**	-18.82**	-10.70
M-175 x HRB-55	27.00**	37.67**	-5.86*	-3.51	-2.56	-2.72	-2.67	17.94**	-9.57	-0.53
M-175 x *A. Anamika*	15.72	25.40**	-7.30	-4.99*	-5.46	-5.62	-22.57**	-6.18	-4.94	4.56
M-175 x *P. Kranti*	-9.25	-1.29	-25.68**	-23.82**	-10.52**	-4.35	-16.26**	1.47	-18.50**	-10.35
VRO-6 x GO-2	3.19	28.03	-8.78**	-6.97**	0.18	-2.26	34.84**	36.47**	25.49**	12.28
VRO-6 x HRB-55	-12.65	8.38	-16.18**	-25.62**	4.10	1.57	-6.42*	-5.29	11.21	14.91*
VRO-6 x *A. Anamika*	-1.88	21.75*	-4.59	-11.68**	-4.22	-6.55*	-0.61	0.59	38.39**	26.49**
VRO-6 x *P. Kranti*	-7.36	14.95	-7.32**	-8.82**	-10.63**	-4.46	-2.35	-1.18	15.90*	11.23
M-172 x GO-2	10.82	33.52**	-5.50*	-3.62	-6.81*	-7.13*	-1.87	-7.35*	14.90	2.81
M-172 x HRB-55	9.34	31.74**	-11.10**	-13.62**	-0.06	-0.41	15.58**	9.12**	6.11	9.65
M-172 x *A. Anamika*	-5.07	14.38	1.83	-1.06	0.76	0.41	34.89**	27.35**	53.17**	40.00**
M-172 x *P. Kranti*	1.84	22.70*	-2.96	-4.52	0.22	7.13*	14.20**	8.82**	19.20*	14.39
M-65 x GO-2	6.16	19.96*	-10.28**	-8.49**	2.74	-2.26	27.74**	16.47**	17.84*	5.44
M-65 x HRB-55	4.16	17.71	2.25	-8.59**	9.44**	6.20*	6.92*	0.00	9.85**	13.51
M-65 x *A. Anamika*	-0.41	12.54	-2.49	-9.74**	7.98*	2.72	27.76**	12.35**	43.38	31.05**
M-65 x *P. Kranti*	-0.02	12.99	-9.43**	-10.90**	-12.69**	-6.67*	-2.47	-7.06*	14.81	10.18
AOL-02-3 x GO-2	0.59	24.22*	-11.88**	-7.89**	-1.06	-2.96	4.85	1.76	26.95**	8.25
AOL-02-3 x HRB-55	-15.84*	3.93	-8.77**	-4.64	5.91	3.88	26.06**	22.35**	10.36	14.04
AOL-02-3 x *A. Anamika*	-9.98	11.16	-4.81*	-0.51	-0.12	-2.03	24.85**	21.18**	19.00*	8.77
AOL-02-3 x *P. Kranti*	1.69	25.58**	-3.93	0.42	-8.57**	-2.26	4.85	1.76	1.65	-2.46
VRO-5 x GO-2	-21.20**	16.44	-8.10**	-6.28**	-2.92	-3.77	-4.79	5.29	5.37	10.18
VRO-5 x HRB-55	-17.58**	21.79*	13.24**	6.00*	-0.35	-1.22	17.82**	30.29**	-4.36	0.00
VRO-5 x *A. Anamika*	-17.99**	21.18*	4.81	-1.89	0.82	-0.06	8.51**	20.00**	20.81**	26.32**
VRO-5 x *P. Kranti*	-14.03*	27.02**	0.05	-1.57	-5.86*	0.64	7.45**	18.82**	15.94*	21.23**
M-173 x GO-2	7.52	18.63	-18.42**	-16.81**	-5.84	-4.58	6.45	-2.94	13.37	-3.33
M-173 x HRB-55	18.94*	28.95**	-23.31**	-27.24**	-2.17	-0.87	-10.69**	-16.47**	-2.04	1.23
M-173 x *A. Anamika*	5.92	14.22	-6.33*	-11.13**	-5.72	-4.46	11.04**	-2.35	23.22**	12.63
M-173 x *P. Kranti*	3.73	12.84	-4.79	-6.33**	-7.27*	-0.87	-11.11**	-15.29**	20.84**	15.96*
A. Abhay x GO-2	11.70	23.24*	-2.35	-0.42	6.40*	0.29	18.06**	7.65*	12.55	-4.04
A. Abhay x HRB-55	0.14	8.56	-5.82*	-12.51**	1.91	-1.10	46.54**	37.06**	-5.43	-2.28
A. Abhay x *A. Anamika*	-4.93	2.52	3.83	-3.55	5.73	-1.57	55.52**	36.76**	-16.89*	-24.04**
A. Abhay x *P. Kranti*	4.18	13.33	5.44*	3.74	-8.03**	-1.68	-1.85	-6.47*	31.99**	26.67**

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

Table 2 Contd…

Crosses	Fruit weight		Fruit length		Fruit girth		Internodes per plant		Fruit yield per plant	
	HB	SH	HB	SH	HB	SH	HB	SH	HB	SH
JOL-1 x GO-2	-0.59	23.91*	2.26	4.29	7.63*	1.45	30.00**	18.53**	38.40**	18.25*
JOL-1 x HRB-55	-10.98	10.96	3.79	-6.51**	0.24	-2.72	5.03	-1.76	-8.49	-5.44
JOL-1 x *A. Anamika*	-21.09**	-1.64	10.12**	1.94	0.87	-6.09	29.77**	14.12**	-3.65	-11.93
JOL-1 x *P. Kranti*	-14.82	6.18	9.20**	7.43**	-7.92**	-1.57	5.56	0.59	23.95**	18.95*
Lorm-1 x GO-2	9.42	20.73*	-3.76	-1.85	0.84	-2.72	25.74**	49.41**	20.78**	2.98
Lorm-1 x HRB-55	13.51	23.05*	-13.98**	-15.37**	6.09	2.96	-10.40**	6.47*	-15.28*	-12.46
Lorm-1 x *A. Anamika*	1.97	9.96	5.73*	4.02	1.44	-2.14	0.50	19.41**	12.67	2.98
Lorm-1 x *P. Kranti*	2.73	11.75	-6.80**	-8.31**	-8.13**	-1.80	-17.33**	-1.76	-9.32	-12.98
Local Red x GO-2	11.97	23.54*	10.05**	12.23**	1.17	0.17	-4.19	-5.88	31.48**	12.11
Local Red x HRB-55	11.36	20.72*	7.08**	-4.99*	8.31**	7.25*	4.19	2.35	34.13**	38.60**
Local Red x *A. Anamika*	-0.93	6.83	6.18*	-1.71	-0.59	-1.57	-2.69	-4.41	18.43*	8.25
Local Red x *P. Kranti*	-5.89	2.37	3.33	1.66	-3.25	3.42	5.99	4.12	-9.51	-13.16
NOL-101 x GO-2	-22.49**	-5.50	-8.33**	-6.51**	-8.98**	-2.49	11.61**	1.76	14.65	1.58
NOL-101 x HRB-55	-9.71	10.09	-12.42**	-13.07**	-13.10**	-6.90*	10.38**	3.24	-9.00	-5.96
NOL-101 x *A. Anamika*	-6.64	13.83	-3.12	-3.83	-11.90**	-5.62	19.06**	4.71	2.30	-6.49
NOL-101 x *P. Kranti*	16.45*	42.00**	2.23	1.48	-9.63**	-3.19	24.69**	18.82**	10.60	6.14
Sel.2 x GO-2	23.34**	36.08**	-22.32**	-20.78**	-14.27**	-7.36*	-8.14**	-7.06*	9.88	-6.32
Sel.2 x HRB-55	17.58*	27.54**	8.95**	-3.32	-8.05**	-0.64	26.16**	27.65**	44.99**	49.82**
Sel.2 x *A. Anamika*	10.89	20.29*	-4.94	-12.00**	0.75	8.87**	-0.58	0.59	11.32	1.75
Sel.2 x *P. Kranti*	-0.80	7.92	-3.75	-5.31*	-7.08*	0.41	-11.63**	-10.59**	14.08	9.47
VRO-3 x GO-2	12.49	24.11*	-5.66	-3.79	2.78	-1.57	1.29	-7.65*	19.55*	1.93
VRO-3 x HRB-55	3.84	12.57	2.91	-8.68**	1.55	-1.45	22.64**	14.71**	15.11*	18.95**
VRO-3 x *A. Anamika*	-2.79	4.83	8.48**	0.42	0.00	-4.23	27.74**	16.47**	30.13**	18.95**
VRO-3 x *P. Kranti*	13.32	23.27*	4.15	2.47	-1.84	4.93	8.02*	2.94	25.78**	20.70**
P-7 x GO-2	29.81**	43.22**	-8.60**	-6.79**	-2.71	-8.29**	23.98**	24.71**	12.30	0.88
P-7 x HRB-55	22.26*	32.54**	-0.73	-8.80**	3.58	0.52	26.61**	27.35**	24.96**	29.12**
P-7 x *A. Anamika*	19.92	29.32**	18.05**	9.28**	6.10	-1.22	33.92**	34.71**	15.36	5.44
P-7 x *P. Kranti*	26.93**	38.08**	1.50	-0.14	-5.86*	0.64	11.70**	12.35**	43.14**	37.37**
JOL-(2K)-11 x GO-2	-16.01*	28.73**	-7.99**	-5.91*	-8.32**	0.99	-14.46**	-16.47**	-33.65**	-14.21
JOL-(2K)-11 x HRB-55	-18.15**	25.45**	-16.98**	-15.10**	-9.26**	-0.06	12.65**	10.00**	13.03*	46.14**
JOL-(2K)-11 x *A. Anamika*	-22.01**	19.53*	-8.44**	-6.37**	-10.95**	-1.91	-6.02	-8.24**	-19.67**	3.86
JOL-(2K)-11 x *P. Kranti*	-44.80**	-15.39	-3.34	-1.15	-8.00**	1.33	1.20	-1.18	-24.02**	-1.75
Range: Maximum	29.81	43.22	18.05	12.23	9.44	8.87	55.62	49.41	53.17	49.82
Minimum	-44.80	-15.39	-25.68	-27.24	-14.27	-8.41	-22.57	-16.47	-33.65	-24.04
SE ±	1.06	1.06	0.35	0.35	0.18	0.18	0.36	0.36	14.44	14.44

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

M 172 x *Arka Anamika* (40.00 %), Local Red x HRB 55 (38.60 %) and P 7 x *Parbhani Kranti* (37.37 %) were the most significant potential heterotic hybrids over SC for this trait. Shukla and Gautam, 1990, Sundhari, *et al*., 1992, Dhankhar, *et al*., 1996 and Chauhan and Singh, 2002 also depicted similar results for these yield and its contributing traits of okra.

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