Indian Journal of Agriculture and Allied Sciences
A Refereed Research Journal

ISSN 2395-1109
Volume: 1, No.: 3, Year: 2015

Received: 18.09.2015, Accepted: 27.09.2015

HETEROBELTIOSIS, AVERAGE HETEROSIS AND ECONOMIC HETEROSIS IN FRUIT YIELD OF OKRA [*Abelmoschus esculentus* (L.) Moench]

Neetu[1], Anand Kumar Singh[1] and Rakesh Kumar[2]

[1]Department of Horticulture, Institute of Agricultural Sciences, BHU, Varanasi-221005, E-mail:nitubhu2009@gmail.com and [2]Krishi Vigyan Kendra, Indian Institute of Sugarcane Research, Lucknow-226002, Corresponding Author: Neetu

Abstract: *Thirty six hybrids along with twelve okra parental lines and three testers were evaluated for heterosis and inbreeding depression. Most of the crosses showed significant heterosis over mid-parent, better parent and economic heterosis for these characters. The maximum heterosis for green fruit yield per plant was manifested by IC-140927 × Hissar Unnat followed by SA-29 × Varsha Uphar, IC-43742 × Hissar Unnat and Pusa Makhmali × VRO-5 in same order. Furthermore, these crosses were found excelling for some of the yield contributing characters.*

Keywords: *Okra, heterosis, heterobeltiosis, average heterosis.*

Introduction: Okra is multipurpose crop valued for its tender and delicious fruits. The dried seeds of okra provide oil, protein, vegetable curd and coffee additive or substitute. In India, it is grown on an area of 5.31 lakh hectares with a production of 63.50 lakh metric tones [1]. Major areas of cultivation in India are Uttar Pradesh, Bihar, Orrissa, West Bengal, Andra Pradesh, Karnataka and Assam. Okra is an often cross pollinated vegetable crop belonging to the family Malvaceae. It has vast potential as one of the foreign exchange earner crops and accounts for about 60% of the total export of fresh vegetables. First report on hybrid vigour in okra was given [2]. Further, exploitation of hybrid vigour depends on the direction and magnitude of heterosis, biological feasibility and type of gene action involved. Heterosis and inbreeding depression each the converse of the other are both expression of the same phenomenon. An understanding of heterosis would be helpful in improving the yielding ability as well as yield contributing characters. The present investigation was therefore undertaken with a view to examine the manifestation of heterosis and inbreeding depression in okra.

Materials and Methods

The materials for the present study comprised of fifteen parents, 36 F_1s of okra. The twelve female parents (line) viz., IC-212267, IC-43742, IC-85814, SA-29, IC-288877, IC-140927, VRO-6, SEL.-4, Pusa Makhmali, Kashi Kranti, SEL.-10 and VRO-3 and three pollen parents (testers) were selected for investigation. The crosses were made in line × tester fashion during *summer* 2013. The experimental were grown in randomized block design with three replication at Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, during the summer and rainy, 20012; and summer seasons of 2013. The seeds were sown at a spacing of 60cm x 30cm. The observations were recorded on five randomly selected plants each of parents and F1s in each replication for six quantitative characters namely, days to initiation of flowering, plant height (cm), number of branches per plant, number of fruits per plant, fruit length (cm) and green fruit yield per plant (g). Heterotic effects of F_1s over mid, better and standered heterosis parental values were estimated as per methodology suggested [3].

Results and Discussion

Analysis of variance exhibited significant differences among treatments for all the characters in all the crosses under study. This indicated the presence of appreciable genetic diversity for the characters showing significant variances. Higher yield is the basic objective of all the crop improvement programmes and unless

a new hybrid has a potential equal to or exceeding that of current cultivar or hybrid, it will fetch no success even if it has excellent quality.

Perusal of the data in table 6 revealed that out of 36 crosses, 16 crosses over mid-parent, 14 crosses over better parent and 4 crosses over standard check Larm-1 exhibited significantly positive heterosis for green fruit yield per plant, respectively; thereby indicating that such crosses can be further sorted out for yield increase. The cross combination, IC-140927 × Hissar Unnat had highest positive significant heterosis of 23.15 per cent over standard check (Larm-1) followed by SA-29 × Varsha Uphar (21.22%) and IC-43742 × Hissar Unnat (20.09%). The cross IC-43742 × Hissar Unnat also showed highest significant positive heterosis over mid parent followed by IC-140927 × Hissar Unnat and IC-43742 × VRO-5 i.e., 50.28, 38.24 and 37.57 per cent respectively. Similarly, hybrids (IC-140927 × Hissar Unnat, SA-29 × Varsha Uphar and IC-43742 × Hissar Unnat showed 23.15, 21.22 and 20.09 per cent over standard check respectively. These results were in agreement [4,5].

In case of days to initiation of flowering, 13, 7 and 14 showed significant negative heterosis over mid parent, better parent and standard check respectively which is desirable since early maturing genotypes results in better returns. The cross IC-212267 × Varsha Uphar, VRO-6 × VRO-5 and IC-212267 × VRO-5 showed -18.56, -17.85 and -15.77 per cent significantly negative average heterosis. The crosses *viz.*; VRO-6 × VRO-5, IC-212267 × Varsha Uphar and IC-212267 × VRO-5 exhibited significant negative heterobeltiosis to the extent of -15.42, -15.36 and -13.52 per cent respectively. The crosses IC-212267 × Varsha Uphar, IC-212267 × Hissar Unnat and IC-43742 × Varsha Uphar had maximum standard heterosis (-22.90), (-17.82) and (-17.30) respectively for days to initiation of flowering. These finding were in accordance [6,7,5].

Among the 36 hybrids evaluated, 22, 19 and 15 hybrids for plant height, 16, 15 and 32 hybrids for number of branches per plant, 10, 8 and 5 hybrids for number of fruits per plant, 7 and 2 hybrids for fruit length, 34 and 31 hybrids for number of fruits per plant exhibited significant positive heterosis over mid parent and better parent, respectively (Table 1-6).

Table 1: Magnitude of heterobeltiosis, average heterosis and economic heterosis for Days to first flowering.

Crosses	Days to initiation of flowering		
	MP	BP	EH
IC-212267 × Varsha Uphar	-18.56**	-15.36**	-22.90**
IC-212267 × Hissar Unnat	-14.08**	-11.65**	-17.82**
IC-212267 × VRO-5	-15.77*	-13.52**	-15.03**
IC-43742 × Varsha Uphar	-13.84**	-9.21**	-17.30**
IC-43742 × Hissar Unnat	12.53**	17.29**	9.10**
IC-43742 × VRO-5	5.72**	5.72**	6.65**
IC-85814 × Varsha Uphar	22.74**	33.71**	3.33
IC-85814 × Hissar Unnat	1.03	11.31**	-13.98**
IC-85814 × VRO-5	20.51**	38.91**	7.35**
SA-29 × Varsha Uphar	26.89**	27.26**	15.92**
SA-29 × Hissar Unnat	31.44**	32.44**	21.34**
SA-29 × VRO-5	31.70**	38.36**	26.76**
IC-288877 × Varsha Uphar	25.07**	31.67**	19.94**
IC-288877 × Hissar Unnat	20.22**	25.19**	16.44**
IC-288877 × VRO-5	31.31**	31.42**	32.35**
IC-140927 × Varsha Uphar	5.97**	19.19**	8.58**
IC-140927 × Hissar Unnat	-2.11	8.83**	1.23
IC-140927 × VRO-5	-8.63**	-2.77	-1.91
VRO-6 × Varsha Uphar	-5.83**	2.30	-6.81**
VRO-6 × Hissar Unnat	-4.81**	2.26	-4.89**
VRO-6 × VRO-5	-17.85**	-15.42**	-14.68**
SEL.-4 × Varsha Uphar	0.88	10.36**	0.53
SEL.-4 × Hissar Unnat	-2.52	5.45**	-1.91
SEL.-4 × VRO-5	-1.67	1.91	2.81
Pusa Makhmali × Varsha Uphar	3.59*	16.31**	5.95**
Pusa Makhmali × Hissar Unnat	-2.62	8.08**	0.53
Pusa Makhmali × VRO-5	8.81**	15.60**	16.62**
Kashi Kranti × Varsha Uphar	28.51**	36.28**	24.14**
Kashi Kranti × Hissar Unnat	-4.84**	-0.19	-7.16**
Kashi Kranti × VRO-5	3.88*	4.51*	5.43**
SEL.-10 × Varsha Uphar	0.30	5.74*	-13.10**
SEL.-10 × Hissar Unnat	10.38**	17.66**	-3.31
SEL.-10 × VRO-5	4.87**	16.81**	-4.01**

VRO-3 × Varsha Uphar	19.45**	21.71**	6.83**
VRO-3 × Hissar Unnat	35.01**	39.04**	22.04**
VRO-3 × VRO-5	26.04**	35.46**	18.89**
S.Em±	0.64	0.74	0.74

**, ** Significant at 5% and 1% probability levels, respectively*

Table 2: Magnitude of heterobeltiosis, average heterosis and economic heterosis for Plant height.

Crosses	Plant height (cm)		
	MP	BP	EH
IC-212267 × Varsha Uphar	20.29**	19.97**	5.14
IC-212267 × Hissar Unnat	47.39**	39.99**	22.94**
IC-212267 × VRO-5	46.72**	39.06**	22.06**
IC-43742 × Varsha Uphar	42.31**	40.19**	21.93**
IC-43742 × Hissar Unnat	28.33**	24.19**	4.77
IC-43742 × VRO-5	38.14**	36.22**	14.91**
IC-85814 × Varsha Uphar	55.26**	53.99**	36.19**
IC-85814 × Hissar Unnat	24.94**	18.23**	4.56
IC-85814 × VRO-5	19.06**	14.78**	1.44
SA-29 × Varsha Uphar	-6.68	-15.76**	-8.87
SA-29 × Hissar Unnat	-17.70*	-28.80**	-22.98**
SA-29 × VRO-5	7.36	-5.64	2.10
IC-288877 × Varsha Uphar	-23.39**	-32.17**	-23.20**
IC-288877 × Hissar Unnat	-12.01**	-25.34**	-15.29**
IC-288877 × VRO-5	-6.60	-19.64**	-8.48
IC-140927 × Varsha Uphar	-0.53	-10.65*	-2.28
IC-140927 × Hissar Unnat	26.44**	8.80*	19.08**
IC-140927 × VRO-5	5.46	-7.74	0.93
VRO-6 × Varsha Uphar	-43.57**	-49.19**	-43.84*
VRO-6 × Hissar Unnat	-31.68**	-40.99**	-34.92**
VRO-6 × VRO-5	-15.10**	-25.11**	-18.01**
SEL.-4 × Varsha Uphar	-16.00**	-18.02**	-24.99**
SEL.-4 × Hissar Unnat	11.80*	4.08	-4.70
SEL.-4 × VRO-5	3.19	-2.19	-10.45*
Pusa Makhmali × Varsha Uphar	-4.57	-13.74**	-7.14
Pusa Makhmali × Hissar Unnat	21.97*	5.65	13.82**
Pusa Makhmali × VRO-5	25.75**	10.79*	19.26**
Kashi Kranti × Varsha Uphar	15.33**	11.80*	-2.66
Kashi Kranti × Hissar Unnat	11.35*	9.48	-10.53*
Kashi Kranti × VRO-5	11.68*	11.50*	-8.57
SEL.-10 × Varsha Uphar	11.57*	12.33*	-3.56
SEL.-10 × Hissar Unnat	9.74*	5.31	-9.56*
SEL.-10 × VRO-5	-5.93	-8.02	-21.04**
VRO-3 × Varsha Uphar	24.38**	20.86**	11.50*
VRO-3 × Hissar Unnat	-1.57	-8.48	-15.81**
VRO-3 × VRO-5	-12.40**	-17.16**	-23.77**
S.Em±	2.28	2.63	2.63

**, ** Significant at 5% and 1% probability levels, respectively*

Table3: Magnitude of heterobeltiosis, average heterosis and economic heterosis for Number of branches per plant

Crosses	Number of branches per plant		
	MP	BP	EH
IC-212267 × Varsha Uphar	-21.66*	-29.76**	11.78
IC-212267 × Hissar Unnat	-5.06	-17.22	3.79
IC-212267 × VRO-5	14.89*	17.72	67.66**
IC-43742 × Varsha Uphar	15.40	20.85	75.65**
IC-43742 × Hissar Unnat	4.76	-14.43	23.75
IC-43742 × VRO-5	-28.67**	-28.68**	3.79
IC-85814 × Varsha Uphar	-32.97**	-34.52**	3.79
IC-85814 × Hissar Unnat	-9.34	-27.39**	7.78
IC-85814 × VRO-5	-54.08**	-55.36**	-32.14*
SA-29 × Varsha Uphar	-23.01**	-29.81**	35.73*
SA-29 × Hissar Unnat	-25.45**	-45.09**	7.78
SA-29 × VRO-5	-29.31**	-38.06**	19.76
IC-288877 × Varsha Uphar	-16.76	-19.84	27.74
IC-288877 × Hissar Unnat	-13.52	-29.49**	3.79
IC-288877 × VRO-5	-15.25	-16.45	23.75
IC-140927 × Varsha Uphar	-14.58	-10.22	27.74
IC-140927 × Hissar Unnat	100.67**	65.66**	131.54*
IC-140927 × VRO-5	-32.68**	-33.70**	-4.19
VRO-6 × Varsha Uphar	35.66**	5.16**	67.66**
VRO-6 × Hissar Unnat	24.52	22.75	11.78
VRO-6 × VRO-5	38.74**	11.87**	59.68**
SEL.-4 × Varsha Uphar	39.68**	20.63**	91.62**

SEL.-4 × Hissar Unnat	65.58**	48.52**	71.66**
SEL.-4 × VRO-5	-25.74*	-32.56	-4.19
Pusa Makhmali × Varsha Uphar	66.18**	36.51**	115.57**
Pusa Makhmali × Hissar Unnat	85.32**	78.84**	75.65**
Pusa Makhmali × VRO-5	76.82**	49.28**	111.58**
Kashi Kranti × Varsha Uphar	32.64**	21.03*	91.62**
Kashi Kranti × Hissar Unnat	42.69**	23.03	59.68**
Kashi Kranti × VRO-5	-7.14	-10.22	27.74
SEL.-10 × Varsha Uphar	-5.72	-7.33	51.70**
SEL.-10 × Hissar Unnat	-15.38	-34.43**	7.78
SEL.-10 × VRO-5	21.54*	15.02	87.62**
VRO-3 × Varsha Uphar	-22.08	-25.00	19.76
VRO-3 × Hissar Unnat	-43.57**	-54.29**	-32.14*
VRO-3 × VRO-5	29.36*	28.50*	87.62**
S.Em±	0.22	0.26	0.26

**, ** Significant at 5% and 1% probability levels, respectively*

Table 4: Magnitude of heterobeltiosis, average heterosis and economic heterosis for Number of fruits per plant

Crosses	**Number of fruits per plant**		
	MP	**BP**	**EH**
IC-212267 × Varsha Uphar	-20.92**	-31.02**	-31.02**
IC-212267 × Hissar Unnat	-12.92*	-23.47**	-24.54**
IC-212267 × VRO-5	13.59*	12.57	-8.80
IC-43742 × Varsha Uphar	-13.19*	-22.22**	-22.22**
IC-43742 × Hissar Unnat	-6.11	-15.49*	-16.67**
IC-43742 × VRO-5	21.61**	20.57**	-2.31
IC-85814 × Varsha Uphar	-6.77	-15.74*	-15.74*
IC-85814 × Hissar Unnat	-3.22	-12.21*	-13.43*
IC-85814 × VRO-5	16.93*	16.57*	-5.56
SA-29 × Varsha Uphar	4.43	-5.56	-5.56
SA-29 × Hissar Unnat	-23.54**	-30.52**	-31.48**
SA-29 × VRO-5	-5.96	-5.71	-23.61**
IC-288877 × Varsha Uphar	1.20	-10.19	-10.19
IC-288877 × Hissar Unnat	-1.37	-11.27	-12.50*
IC-288877 × VRO-5	6.31	4.57	-15.28*
IC-140927 × Varsha Uphar	-1.67	-7.38	4.63
IC-140927 × Hissar Unnat	-8.52	-14.34**	-3.24
IC-140927 × VRO-5	-14.52**	-26.64**	-17.13**
VRO-6 × Varsha Uphar	-25.09**	-31.94**	-31.94**
VRO-6 × Hissar Unnat	-26.04**	-32.39**	-33.33**
VRO-6 × VRO-5	-21.23**	-21.14**	-36.11**
SEL.-4 × Varsha Uphar	-19.44**	-28.47**	-9.26
SEL.-4 × Hissar Unnat	-23.63**	-32.12**	-13.89*
SEL.-4 × VRO-5	-20.31**	-35.04**	-17.59**
Pusa Makhmali × Varsha Uphar	-6.69	-10.65	-10.65
Pusa Makhmali × Hissar Unnat	-3.43	-7.04	-8.33
Pusa Makhmali × VRO-5	39.93**	31.98**	20.37**
Kashi Kranti × Varsha Uphar	15.74**	5.56	5.56
Kashi Kranti × Hissar Unnat	-6.26	-13.62*	-14.81*
Kashi Kranti × VRO-5	7.44	8.57	-12.04*
SEL.-10 × Varsha Uphar	-2.14	-18.98**	-18.98**
SEL.-10 × Hissar Unnat	-11.38	-25.82**	-26.85**
SEL.-10 × VRO-5	23.58**	12.00	-9.26
VRO-3 × Varsha Uphar	-29.29**	-32.20**	-25.93**
VRO-3 × Hissar Unnat	-25.57**	-29.24**	-22.69**
VRO-3 × VRO-5	-1.99	-14.83**	-6.94
S.Em±	0.76	0.87	0.87

**, ** Significant at 5% and 1% probability levels, respectively*

Table 5: Magnitude of heterobeltiosis, average heterosis and economic heterosis for Fruit length (cm).

Crosses	**Fruit length (cm)**		
	MP	**BP**	**EH**
IC-212267 × Varsha Uphar	-4.35	-7.51	-7.37
IC-212267 × Hissar Unnat	45.79**	34.09**	34.29**
IC-212267 × VRO-5	64.22**	30.80**	31.00**
IC-43742 × Varsha Uphar	19.44**	17.95**	10.31*
IC-43742 × Hissar Unnat	25.53**	20.64**	10.01*
IC-43742 × VRO-5	42.43**	24.59**	13.61**
IC-85814 × Varsha Uphar	-3.25	-11.96**	0.42
IC-85814 × Hissar Unnat	-3.78	-16.43**	-4.68
IC-85814 × VRO-5	15.69**	-7.49	5.52
SA-29 × Varsha Uphar	-8.88*	-16.97**	-5.58
SA-29 × Hissar Unnat	-9.08*	-20.93**	-10.07*

SA-29 × VRO-5	15.57**	-7.49	5.22
IC-288877 × Varsha Uphar	20.03**	10.01*	23.50**
IC-288877 × Hissar Unnat	20.31**	5.21	18.11**
IC-288877 × VRO-5	38.09**	11.08**	24.70**
IC-140927 × Varsha Uphar	4.39	2.88	-3.78
IC-140927 × Hissar Unnat	13.80**	9.57	-0.48
IC-140927 × VRO-5	23.92**	8.58	-1.38
VRO-6 × Varsha Uphar	12.17**	8.01	9.11*
VRO-6 × Hissar Unnat	24.70**	14.24**	15.41**
VRO-6 × VRO-5	27.08**	6.53	7.61
SEL.-4 × Varsha Uphar	-7.34	-9.94*	-15.77**
SEL.-4 × Hissar Unnat	-14.78**	-16.81**	-26.56**
SEL.-4 × VRO-5	29.76**	15.11**	1.62
Pusa Makhmali × Varsha Uphar	-17.68**	-19.57**	-21.16**
Pusa Makhmali × Hissar Unnat	-2.39	-9.33*	-11.12*
Pusa Makhmali × VRO-5	56.04**	32.42**	29.80**
Kashi Kranti × Varsha Uphar	30.26**	21.50**	31.29**
Kashi Kranti × Hissar Unnat	43.84**	27.88**	38.19**
Kashi Kranti × VRO-5	76.72**	44.24**	55.88**
SEL.-10 × Varsha Uphar	0.67	-5.49	0.72
SEL.-10 × Hissar Unnat	23.58**	10.55*	17.81**
SEL.-10 × VRO-5	26.48**	3.80	10.61*
VRO-3 × Varsha Uphar	16.89**	7.05**	0.12
VRO-3 × Hissar Unnat	56.30**	50.45**	26.50**
VRO-3 × VRO-5	2.56	-3.66	-25.06**
S.Em±	0.43	0.50	0.50

**, ** Significant at 5% and 1% probability levels, respectively*

Table 6: Magnitude of heterobeltiosis, average heterosis and economic heterosis for Fruit yield per plant (g).

Crosses	**Green fruit yield per plant (g)**		
	MP	**BP**	**EH**
IC-212267 × Varsha Uphar	-25.62**	-36.68**	-30.32**
IC-212267 × Hissar Unnat	10.40	3.12	-7.55
IC-212267 × VRO-5	29.84**	18.35*	1.27
IC-43742 × Varsha Uphar	-32.85**	-45.09**	-39.58**
IC-43742 × Hissar Unnat	50.28**	33.95**	20.09**
IC-43742 × VRO-5	37.57**	24.94**	6.91
IC-85814 × Varsha Uphar	-42.04**	-52.20**	-47.40**
IC-85814 × Hissar Unnat	22.51**	10.20	-1.20
IC-85814 × VRO-5	32.85**	21.90**	4.30
SA-29 × Varsha Uphar	31.96**	10.16	21.22**
SA-29 × Hissar Unnat	-29.24**	-35.40**	-42.08**
SA-29 × VRO-5	6.16	-0.94	-15.24*
IC-288877 × Varsha Uphar	-26.54**	-37.81**	-31.56**
IC-288877 × Hissar Unnat	20.99**	12.05	0.46
IC-288877 × VRO-5	-18.19**	-22.47**	-33.66**
IC-140927 × Varsha Uphar	13.00*	1.42	11.60
IC-140927 × Hissar Unnat	38.24**	37.37**	23.15**
IC-140927 × VRO-5	4.91	2.52	-9.34
VRO-6 × Varsha Uphar	-14.10*	-31.72**	-24.87**
VRO-6 × Hissar Unnat	-33.33**	-52.72**	-47.98**
VRO-6 × VRO-5	-37.54**	-44.37**	-52.40**
SEL.-4 × Varsha Uphar	-2.66	-5.76	10.27
SEL.-4 × Hissar Unnat	-3.86	-15.04**	-0.58
SEL.-4 × VRO-5	-22.17**	-32.66**	-21.21**
Pusa Makhmali × Varsha Uphar	-11.96*	-20.17**	-12.16
Pusa Makhmali × Hissar Unnat	8.78	9.29	-2.02
Pusa Makhmali × VRO-5	30.76**	34.24**	14.87*
Kashi Kranti × Varsha Uphar	-25.24**	-33.61**	-26.94**
Kashi Kranti × Hissar Unnat	-3.86	-5.54	-15.32*
Kashi Kranti × VRO-5	4.52	4.79	-10.33*
SEL.-10 × Varsha Uphar	-10.84*	-16.33**	-7.94
SEL.-10 × Hissar Unnat	-21.06**	-24.16**	-26.16**
SEL.-10 × VRO-5	4.82	-1.67	-4.27
VRO-3 × Varsha Uphar	-53.01**	-60.35**	-37.90**
VRO-3 × Hissar Unnat	-41.14**	-53.80**	-27.63**
VRO-3 × VRO-5	-35.21**	-50.47**	-22.42**
S.Em±	11.97	13.82	13.82

**, ** Significant at 5% and 1% probability levels, respectively*

The best cross combination having maximum hybrid vigour over mid parent, better parent and standard heterosis were IC-140927 × Hissar Unnat, Pusa Makhmali × Hissar Unnat and IC-140927 × Hissar Unnat for number of branches per plant, Pusa Makhmali × VRO-5 for number of fruits per plant, IC-85814 × Varsha Uphar for plant height, and IC-212267 × VRO-5, VRO-3 × Hissar Unnat and Kashi Kranti × VRO-5 for fruit length. Similar results were reported Plant height, number of branches per plant, number of fruits per plant and fruit length [6,8].

References

1. Anonymous. (2014). Hand Book on Horticulture Statistics, Ministry of Agriculture, Govt. of India. Pp. 11.
2. Vijayaraghvan, C. and Warriar, U.A. (1946). Evaluation of high yielding hybrid bhindi (*Hibiscus esculentus*). *Int. 33rd Indian Science Congress*. 33: 1654.
3. Hays, B.K., Immer, I.R. and Smith, O.C. (1955). *Methods of Plant Breeding*. Mc Graw Hill Co., New York, pp 254
4. Vachhani, J. H., Shekhat, H. G., Kachhadia, V. H., Jivani, L. L., Padhar, P. R. (2011). Heterosis and inbreeding depression in okra [*Abelmoschus esculentus* (L.) Moench], *Research on Crops*; 12(2):556-560.
5. Singh, D. R. and Syamal, M.M., (2006). Heterosis in okra [*Abelmoschus esculentus* (L.) Moench], *Orissa J. Hort.*, 34 (2): 124-127.
6. Singh, B., Kumar, Deepak, Singh, K.V. and Chaudhary Vinita. (2009). Heterobeltiosis and inbreeding depression in okra [*Abelmoschus esculentus* (L.) Moench], *Advances in Plant Sci.*, 22 (1): 273-275.
7. More, D.C. and Patil, H.S. (1997). Heterosis and inbreeding depression for yield and yield components in okra, *Indian J. Agric. Res.*, 31 (3): 141-148.
8. Eswaran, R., Thrugnana Kumar, S., Sampath Kumar, C.P., Anandan, A. and Padnaban, C. (2007). Studies on genetic causes of heterosis in okra [*Abelmoschus esculentus* (L.) Moench], *Plant Archives*, 7 (2): 721-724.