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Heterosis studies in okra [*Abelmoschus esculentus* (L.) Moench] for growth and earliness parameters through half diallel analysis

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Abstract
Twenty eight F_1 hybrids were generated from eight parents through half diallel mating design, these F_1's along with 8 parents and 2 commercial checks were evaluated to study the magnitude and direction of heterosis for growth and earliness characters in okra. Significant heterosis was found over better parent, best parent and commercial checks for all the traits studied in desirable direction. Maximum desirable heterosis was observed in the cross KO1603 x KO1606 for internodal length and number of nodes on the main stem over better parent (-35.65% and 55.23%), the best parent (-23.32% and 18.51%) and the commercial checks Arka Anamika (-17.01% and 38.58%) and MHY-10 (-24.10% and 25.04%). The cross KO1601 x KO1608 showed highest heterosis over better parent (46.15%), the best parent (18.75%) and the commercial checks Arka Anamika (88.89%) and MHY-10 (58.33%) for number of branches per plant. The cross KO1601 x KO1602 exhibited maximum standard heterosis over the commercial checks Arka Anamika (-14.42%) and MHY-10 (-10.10%) for days to 50 pe [r cent flowering. High estimates of heterosis obtained in hybrid combinations revealed considerable genetic divergence among the parental lines and also reveals good scope for commercial exploitation of heterosis in okra.

Keywords: Heterosis, standard heterosis, heterobeltiosis, okra

Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] is a fast growing annual which has captured a prominent position among the vegetables and is commonly known as Bhendi or lady's finger in India. Okra is specially valued for its tender, delicious green fruits which are cooked, canned and consumed in various forms in different parts of the country. Okra is being an often cross-pollinated crop, outcrossing to an extent of 20 per cent by insects is reported (Patil, 1995) [11], which renders a considerable amount of variability. However, the exploitation of hybrid vigour in okra has been recognized as a practical tool in providing the breeders a means of increasing yield and other economic characters. Hybrid vigour in okra has been first reported by Vijayaraghavan and Warier (1946) [19]. Several research workers have reported remarkable heterosis for growth, yield and yield related traits (Lyngdoh *et al*., 2013, Nagesh *et al.*, 2014, Tiwari *et al.*, 2015, and Koli *et al*., 2020) [8, 10, 17, 6]. The magnitude of heterosis provides a basis for genetic diversity and a guide to the choice of desirable parents for developing superior F_1 hybrids. Besides, F_1 hybrids are early maturing and uniform than varieties and thereby reducing cost in grading and harvesting. Thus, heterosis breeding in okra for growth and earliness parameters offers quantum jump in yield and quality in short time. Therefore, an attempt has been made with an objective to assess the magnitude and direction of heterosis for growth and earliness parameters in okra.

Materials and Methods
The investigation on heterosis studies in okra was carried out at the Department of Vegetable Science, K.R.C. College of Horticulture, Arabhavi, Gokak Taluk, Belagavi district of Karnataka state. The experimental material comprised of 8 parents, which were collected from the department itself and their 28 F_1 hybrids along with two commercial checks (Arka Anamika and MHY-10). Each of the 8 parents crossed among each other in half diallel fashion (Jinks and Hayman, 1953) [5] without reciprocal crosses to derive 28 F_1 hybrids. The experiment was laid out in randomized block design with two replications. Each treatment or a genotype in each replication was represented by one row each accommodating 20 plants at a row to row spacing of 60cm and 30cm from plant to plant. Five plants were randomly selected

for each genotype from each replication and evaluated for the quantitative characters and the replicated mean values of various characters of parents and hybrids were subjected to half diallel analysis.

Results and Discussion

The analysis of variance revealed significant differences among treatments for all the traits indicating the presence of appreciable genetic diversity among the parents and cross combinations. Heterosis for growth parameters is an indication of heterosis for yield as growth and yield parameters are strongly associated (Bhatt *et al.,* 2016) [1]. Significant and high magnitude of heterobeltiosis and standard heterosis was observed in the desirable direction for all the growth and earliness parameters. Heterosis for growth and earliness parameters were presented in Table 1 to 3.

For plant height four crosses over better parent, one cross over the best parent, eight crosses over the commercial check Arka Anamika and seven crosses over the commercial check MHY-10 exhibited significantly positive heterosis. Maximum heterosis was observed in the cross KO1601 x KO1603 (18.14%) over better parent and the cross KO1606 x KO1608 exhibited significant and positive heterosis over the best parent (7.72%) and the commercial checks Arka Anamika (22.09%) and MHY-10 (18.11%). Similar magnitude of standard heterosis was also reported by Rynjah *et al*. (2020) [12], Sapavadiya *et al.* (2019) [13] and Kumar and Reddy (2016) [7] for plant height.

Among 28 crosses, six crosses over better parent, three crosses over the best parent, nine crosses over the commercial check Arka Anamika and three crosses over the commercial check MHY-10 showed significantly positive heterosis for number of leaves. Maximum heterosis was observed in the cross KO1603 x KO1606 over better parent (24.61%) and the cross KO1604 x KO1608 exhibited significant and positive heterosis over the best parent (7.42%) and the commercial checks Arka Anamika (28.23%) and MHY-10 (20.14%). Similar magnitude of standard heterosis was also reported by Jaiprakashnarayan (2003) [4].

Negative heterosis is considered to be desirable for the trait intermodal length as it can facilitates more number of nodes where one can expect more fruits per plant. Among 28 crosses, seven crosses over better parent, four crosses over the best parent and three crosses over the commercial check Arka Anamika and five crosses over the commercial check MHY-10 showed significantly negative heterosis for intermodal length. Maximum negative heterosis was observed in the cross KO1603 x KO1606 over better parent (-35.65%), the best parent (-23.32%) and the commercial checks Arka Anamika (-17.01%) and MHY-10 (-24.10%). These results are in agreement with the reports of Rynjah *et al*. (2020) [12], Koli *et al*. (2020) [6], Sapavadiya *et al.* (2019) [13] and Satish *et al*. (2017) [14].

Out of 28 crosses, three crosses over better parent, one cross over the best parent and 16 crosses over the commercial check Arka Anamika and eight crosses over the commercial check MHY-10 showed significantly positive heterosis for number of branches per plant. Maximum positive and significant heterosis was observed in the cross KO1601 x KO1608 over better parent (46.15%), the best parent (18.75%) and the commercial checks Arka Anamika (88.89%) and MHY-10 (58.33%). Similar results have been reported by Koli *et al.* (2020) [6], Sapavadiya *et al.* (2019) [13], Tiwari *et al.* (2015) [17] and Medagam *et al*. (2013) [9] for number of branches per plant.

For number of nodes on the main stem, seven crosses over better parent, three crosses over the best parent and nine crosses over the commercial check Arka Anamika and four crosses over the commercial check MHY-10 showed significantly positive heterosis. Maximum positive and significant heterosis was observed in the cross KO1603 x KO1606 over better parent (55.23%), the best parent (18.51%) and the commercial checks Arka Anamika (38.58%) and MHY-10 (25.04%). Increased number of nodes on the main stem in heterotic hybrids of okra has been observed in the present investigation and confirmed by Gavint *et al*. (2018) [3], Verma and Sood (2015) [18] and Lyngdoh *et al.* (2013) [8].

Farmers prefer to grow early and high yielding hybrids in order to get high profit and to avoid market glut therefore, earliness is an important trait in vegetable crop like okra. Days to first flowering and days to 50 per cent flowering are indicators of earliness and the negative heterosis for these traits was desirable.

For days to first flowering, 18 crosses over better parent, 22 crosses over the best parent and 13 crosses over the commercial check Arka Anamika and five crosses over the commercial check MHY-10 showed significantly negative heterosis for days to first flowering. The cross KO1603 x KO1607 exhibited maximum negative heterosis over better parent (-10.59%) and the commercial checks Arka Anamika (-8.43%) and MHY-10 (-5.00%) for days to first flowering. The results are in agreement with the reports of Rynjah *et al*. (2020) [12] and Chowdhury and Kumar (2019) [2].

Among 28 crosses, nine crosses over better parent, 20 crosses over the best parent and 11 crosses over the commercial check Arka Anamika and four crosses over the commercial check MHY-10 exhibited negative and significant heterosis for days to 50 per cent flowering. For days to 50 per cent flowering, the maximum negative heterobeltiosis was observed in the cross KO1602 x KO1605 (-10.68%) which was higher compare to the reports of Kumar and Reddy, 2016 [7] (-3.64%) and Sawadogo *et al*., 2014 (-1.92%). The cross KO1601 x KO1602 exhibited maximum standard heterosis over the commercial checks Arka Anamika (-14.42%) and MHY-10 (-10.10%) for days to 50 per cent flowering, such magnitude of heterosis also reported by Sidapara *et al*. (2021) [16], Rynjah *et al.* (2020) [12], Gavint *et al*. (2018) [3] and Tiwari *et al.* (2015) [17].

Heterosis for growth parameters is an indication of heterosis for yield as growth and yield parameters are strongly associated. The cross KO1606 x KO1608 exhibited significant positive heterosis over the best parent and the commercial checks Arka Anamika and MHY-10 for plant height. Maximum desirable heterosis was observed in the cross KO1603 x KO1606 for internodal length and number of nodes on the main stem over better parent, the best parent and the commercial checks. The cross KO1601 x KO1608 showed highest heterosis over better parent, the best parent and the commercial checks for number of branches per plant. Maximum negative heterosis for days to first flowering and days to 50 per cent flowering was observed in the crosses KO1603 x KO1607 and KO1601 x KO1602 over the commercial checks Arka Anamika and MHY-10. Therefore, these crosses can be used further for trait specific improvement based on respective traits and or can be used for high yield potential based on the heterobeltiosis for yield.

Table 1: Heterosis (%) over better parent, the best parent and the commercial check for plant height and number of leaves in okra

Sl. No.	Hybrids	Plant height				Number of leaves			
		BP	BTP	CC 1	CC 2	BP	BTP	CC 1	CC 2
1	KO1601 x KO1602	5.37	-6.82	5.61	2.17	-15.73**	-15.75**	0.56	-5.78**
2	KO1601 x KO1603	18.14**	6.92	21.19**	17.25**	-20.77**	-31.80**	-18.59**	-23.73**
3	KO1601 x KO1604	-2.35	-13.65**	-2.13	-5.31	8.14**	-12.19**	4.81**	-1.79
4	KO1601 x KO1605	-6.29	-11.57**	0.22	-3.04	1.87	-35.93**	-23.52**	-28.34**
5	KO1601 x KO1606	-2.27	-10.39**	1.57	-1.74	-17.26**	-35.00**	-22.41**	-27.30**
6	KO1601 x KO1607	-1.19	-1.19	12.00**	8.35*	-2.26*	-23.07**	-8.17**	-13.96**
7	KO1601 x KO1608	-14.04**	-17.01**	-5.94	-17.01**	-17.82**	-19.12**	-3.45**	-9.53**
8	KO1602 x KO1603	-0.77	-10.19**	1.79	-1.52	-39.63**	-39.64**	-27.95**	-32.49**
9	KO1602 x KO1604	6.38	-6.03	6.50	3.04	-25.31**	-25.33**	-10.86**	-16.48**
10	KO1602 x KO1605	-15.41**	-20.18**	-9.53*	-12.47**	-34.26**	-34.27**	-21.54**	-26.49**
11	KO1602 x KO1606	-21.04**	-27.60**	-17.94**	-20.61**	-28.44**	-28.45**	-14.60**	-19.98**
12	KO1602 x KO1607	-17.61**	-17.61**	-6.61	-9.65*	-11.73**	-11.75**	5.35**	-1.30
13	KO1602 x KO1608	-5.12	-8.41*	3.81	0.43	-13.41**	-13.44**	3.33**	-3.18**
14	KO1603 x KO1604	-1.64	-10.98**	0.90	-2.39	-18.02**	-29.44**	-15.77**	-21.08**
15	KO1603 x KO1605	6.92	0.89	14.35**	10.63**	-17.09**	-28.63**	-14.81**	-20.18**
16	KO1603 x KO1606	-3.34	-11.37**	0.45	-2.82	24.61**	7.26**	28.03**	19.96**
17	KO1603 x KO1607	-26.71**	-26.71**	-16.93**	-19.63**	-28.53**	-38.48**	-26.57**	-31.20**
18	KO1603 x KO1608	-1.13	-4.55	8.18*	4.66	-21.73**	-22.96**	-8.04**	-13.84**
19	KO1604 x KO1605	-24.63**	-28.88**	-19.39**	-22.02**	-29.54**	-42.79**	-31.71**	-36.01**
20	KO1604 x KO1606	10.57**	1.38	14.91**	11.17**	-6.81**	-24.34**	-9.68**	-15.37**
21	KO1604 x KO1607	-15.13**	-15.13**	-3.81	-6.94	-11.13**	-27.84**	-13.87**	-19.30**
22	KO1604 x KO1608	9.43*	5.64	19.73**	15.84**	9.14**	7.42**	28.23**	20.14**
23	KO1605 x KO1606	3.98	-1.88	11.21**	7.59*	15.87**	-8.97**	8.67**	1.81
24	KO1605 x KO1607	-13.45 **	-13.45 **	-1.91	-5.10	-16.71**	-34.44**	-21.74**	-26.68**
25	KO1605 x KO1608	-3.48	-6.82	5.61	2.17	-9.14**	-10.57**	6.75**	0.02
26	KO1606 x KO1607	-5.44	-5.44	7.17	3.69	11.79**	-12.01**	5.03**	-1.59
27	KO1606 x KO1608	11.58 **	7.72 *	22.09 **	18.11 **	-20.94**	-22.19**	-7.11**	-12.97**
28	KO1607 x KO1608	-6.13	-6.13	6.39	2.93	5.46**	3.80**	23.91**	16.09**
SEm±		2.60	2.60	2.60	2.60	0.68	0.68	0.68	0.68
CD at 5%		7.53	7.53	7.53	7.53	1.96	1.96	1.96	1.96
CD at 1%		9.99	9.99	9.99	9.99	2.63	2.63	2.63	2.63

* and ** indicates significance of value at p= 0.05 and p=0.01, respectively. DAS – Days after sowing, BP: Heterosis over better parent, BTP: Heterosis over best parent, CC 1: Heterosis over commercial check 1 (Arka Anamika) and CC 2: Heterosis over commercial check 2 (Mahyco 10).

Table 2: Heterosis (%) over better parent, the best parent and the commercial check for internodal length, number of branches and number of nodes on main stem in okra

Sl. No.	Hybrids	Intermodal length				Number of branches per plant				Number of nodes on main stem			
		BP	BTP	CC 1	CC 2	BP	BTP	CC 1	CC 2	BP	BTP	CC 1	CC 2
1	KO1601 x KO1602	52.85**	52.85**	65.42**	51.28**	-12.50**	-12.50**	55.56**	16.67**	-21.02**	-29.27**	-17.30**	-25.38**
2	KO1601 x KO1603	26.09**	50.26**	62.62**	48.72**	-38.46**	-50.00**	-11.11**	-33.33**	-1.32	-23.02**	-9.99**	-18.78**
3	KO1601 x KO1604	-18.05**	-14.51**	-7.48**	-15.38**	-8.33**	-31.25**	22.22**	-8.33**	24.23**	7.91**	26.18**	13.86**
4	KO1601 x KO1605	18.32**	21.59**	31.59**	20.34**	-33.33**	-50.00**	-11.11**	-33.33**	-20.30**	-24.53**	-11.75**	-20.37**
5	KO1601 x KO1606	22.49**	58.03**	71.03**	56.41**	-8.33**	-31.25**	22.22**	-8.33**	-16.84**	-35.13**	-24.14**	-31.55**
6	KO1601 x KO1607	1.95*	35.58**	46.73**	34.19**	-25.00**	-43.75**	0.00	-25.00**	-5.07**	-25.95**	-13.41**	-21.87**
7	KO1601 x KO1608	34.75**	37.31**	48.60**	35.90**	46.15**	18.75**	88.89**	58.33**	-27.61**	-27.61**	-15.36**	-23.62**
8	KO1602 x KO1603	41.62**	41.62**	53.27**	40.17**	-50.00**	-50.00**	-11.11**	-33.33**	-26.06**	-33.78**	-22.57**	-30.13**
9	KO1602 x KO1604	26.94**	26.94**	37.38**	25.64**	-43.75**	-43.75**	0.00	-25.00**	-9.63**	-19.07**	-5.37**	-14.61**
10	KO1602 x KO1605	38.51**	38.51**	49.91**	37.09**	-25.00**	-25.00**	33.33**	0.00	-23.48**	-27.53**	-15.26**	-23.54**
11	KO1602 x KO1606	50.26**	50.26**	62.62**	48.72**	-12.50**	-12.50**	55.56**	16.67**	-31.89**	-39.00**	-28.68**	-35.64**
12	KO1602 x KO1607	-10.71**	-10.71**	-3.36**	-11.62**	-31.25**	-31.25**	22.22**	-8.33**	7.24**	-3.96**	12.30**	1.34
13	KO1602 x KO1608	34.72**	34.72**	45.79**	33.33**	-18.75**	-18.75**	44.44**	8.33**	-27.45**	-27.45**	-15.17**	-23.46**
14	KO1603 x KO1604	-3.15**	1.04*	9.35**	0.00	-38.46**	-50.00**	-11.11**	-33.33**	6.38**	-7.59**	8.05**	-2.50**
15	KO1603 x KO1605	39.66**	43.52**	55.33**	42.05**	-53.85**	-62.50**	-33.33**	-50.00**	-20.05**	-24.29**	-11.47**	-20.12**
16	KO1603 x KO1606	-35.65**	-23.32**	-17.01**	-24.10**	0.00	-18.75**	44.44**	8.33**	55.23**	18.51**	38.58**	25.04**

* and ** indicates significance of value at p= 0.05 and p=0.01, respectively.

BP: Heterosis over better parent

BTP: Heterosis over best parent

CC 1: Heterosis over commercial check 1 (Arka Anamika) and **CC 2:** Heterosis over commercial check 2 (Mahyco 10)

Table 2: contd…..

Sl. No.	Hybrids	Intermodal length				Number of branches per plant				Number of nodes on main stem			
		BP	BTP	CC 1	CC 2	BP	BTP	CC 1	CC 2	BP	BTP	CC 1	CC 2
17	KO1603 x KO1607	30.00**	54.92**	67.66**	53.33**	-38.46**	-50.00**	-11.11**	-33.33**	-26.94**	-44.22**	-34.78**	-41.15**

18	KO1603 x KO1608	54.41**	57.34**	70.28**	55.73**	-7.69**	-25.00**	33.33**	0.00	-27.37**	-27.37**	-15.08**	-23.37**
19	KO1604 x KO1605	4.54**	7.43**	16.26**	6.32**	-54.55**	-68.75**	-44.44**	-58.33**	-25.98**	-29.91**	-18.04**	-26.04**
20	KO1604 x KO1606	44.21**	50.43**	62.80**	48.89**	-41.67**	-56.25**	-22.22**	-41.67**	-16.85**	-27.77**	-15.54**	-23.79**
21	KO1604 x KO1607	-3.15**	1.04*	9.35**	0.00	-18.18**	-43.75**	0.00	-25.00**	9.02**	-5.30**	10.73**	-0.08
22	KO1604 x KO1608	16.61**	18.83**	28.60**	17.61**	0.00	-18.75**	44.44**	8.33**	-6.49**	-6.49**	9.34**	-1.34
23	KO1605 x KO1606	-3.53**	-0.86	7.29**	-1.88*	-16.67**	-37.50**	11.11**	-16.67**	5.10**	-0.47	16.37**	5.01**
24	KO1605 x KO1607	24.54**	27.98**	38.50**	26.67**	0.00	-50.00**	-11.11**	-33.33**	-23.89**	-27.93**	-15.73**	-23.96**
25	KO1605 x KO1608	-5.93**	-4.15**	3.74**	-5.13**	-23.08**	-37.50**	11.11**	-16.67**	4.98**	4.98**	22.76**	10.77**
26	KO1606 x KO1607	8.43**	39.90**	51.40**	38.46**	16.67**	-12.50**	55.56**	16.67**	-4.77**	-28.96**	-16.93**	-25.04**
27	KO1606 x KO1608	47.46**	50.26**	62.62**	48.72**	-15.38**	-31.25**	22.22**	-8.33**	-23.10**	-23.10**	-10.08**	-18.86**
28	KO1607 x KO1608	16.27**	18.48**	28.22**	17.26**	15.38**	-6.25**	66.67**	25.00**	-10.52**	-10.52**	4.63**	-5.59**
S.Em±		0.64	0.64	0.64	0.64	0.17	0.17	0.17	0.17	0.54	0.54	0.54	0.54
CD at 5%		1.86	1.86	1.86	1.86	0.48	0.48	0.48	0.48	1.55	1.55	1.55	1.55
CD at 1%		2.47	2.47	2.47	2.47	0.65	0.65	0.65	0.65	2.09	2.09	2.09	2.09

* and ** indicates significance of value at p= 0.05 and p=0.01, respectively.
BP: Heterosis over better parent
BTP: Heterosis over best parent
CC 1: Heterosis over commercial check 1 (Arka Anamika)
CC 2: Heterosis over commercial check 2 (Mahyco 10)

Table 3: Heterosis (%) over better parent, the best parent and the commercial check for earliness parameters in okra

Sl. No.	Hybrids	Days to first flowering				Days to 50 per cent flowering			
		BP	BTP	CC 1	CC 2	BP	BTP	CC 1	CC 2
1	KO1601 x KO1602	-2.47*	-7.06**	-4.82**	-1.25	-10.10**	-16.82**	-14.42**	-10.10**
2	KO1601 x KO1603	-3.53**	-3.53**	-1.20	2.50*	0.98	-3.74*	-0.96	4.04*
3	KO1601 x KO1604	4.88**	1.18	3.61**	7.50**	10.10**	1.87	4.81**	10.10**
4	KO1601 x KO1605	-3.61**	-5.88**	-3.61**	0.00	-0.97	-4.67*	-1.92	3.03
5	KO1601 x KO1606	4.94**	0.00	2.41*	6.25**	7.00**	0.00	2.88	8.08**
6	KO1601 x KO1607	-2.38*	-3.53**	-1.20	2.50*	-3.74*	-3.74*	-0.96	4.04*
7	KO1601 x KO1608	2.47*	-2.35*	0.00	3.75**	-1.01	-8.41**	-5.77**	-1.01
8	KO1602 x KO1603	-3.53**	-3.53**	-1.20	2.50*	0.98	-3.74*	-0.96	4.04*
9	KO1602 x KO1604	-1.22	-4.71**	-2.41*	1.25	1.01	-6.54**	-3.85*	1.01
10	KO1602 x KO1605	-7.23 **	-9.41**	-7.23**	-3.75**	-10.68**	-14.02**	-11.54**	-7.07**
11	KO1602 x KO1606	4.94**	0.00	2.41*	6.25**	2.00	-4.67*	-1.92	3.03
12	KO1602 x KO1607	-7.14 **	-8.24**	-6.02**	-2.50*	-10.28**	-10.28**	-7.69**	-3.03
13	KO1602 x KO1608	-5.00**	-10.59**	-8.43**	-5.00**	-3.09	-12.15**	-9.62**	-5.05**
14	KO1603 x KO1604	-3.53**	-3.53**	-1.20	2.50*	3.92*	-0.93	1.92	7.07**
15	KO1603 x KO1605	-1.18	-1.18	1.20	5.00**	2.91	-0.93	1.92	7.07**
16	KO1603 x KO1606	-2.35*	-2.35*	0.00	3.75**	2.94	-1.87	0.96	6.06**

* and ** indicates significance of value at p= 0.05 and p=0.01, respectively.
BP: Heterosis over better parent
BTP: Heterosis over best parent
CC 1: Heterosis over commercial check 1 (Arka Anamika)
CC 2: Heterosis over commercial check 2 (Mahyco 10)

Table 3: contd…..

Sl. No.	Hybrids	Days to first flowering				Days to 50 per cent flowering			
		BP	BTP	CC 1	CC 2	BP	BTP	CC 1	CC 2
17	KO1603 x KO1607	-10.59**	-10.59**	-8.43**	-5.00**	-7.48**	-7.48**	-4.81**	0.00
18	KO1603 x KO1608	-4.71**	-4.71**	-2.41*	1.25	-8.82**	-13.08**	-10.58**	-6.06**
19	KO1604 x KO1605	1.20	-1.18	1.20	5.00**	8.74**	4.67*	7.69**	13.13**
20	KO1604 x KO1606	-1.22	-4.71**	-2.41*	1.25	3.00	-3.74*	-0.96	4.04*
21	KO1604 x KO1607	-7.14**	-8.24**	-6.02**	-2.50*	-6.54**	-6.54**	-3.85*	1.01
22	KO1604 x KO1608	3.66**	0.00	2.41*	6.25**	7.07**	-0.93	1.92	7.07**
23	KO1605 x KO1606	0.00	-2.35*	0.00	3.75**	0.00	-3.74*	-0.96	4.04*
24	KO1605 x KO1607	-5.95 *	-7.06 **	-4.82**	-1.25	-7.48**	-7.48**	-4.81**	0.00
25	KO1605 x KO1608	-2.41*	-4.71**	-2.41*	1.25	2.91	-0.93	1.92	7.07**
26	KO1606 x KO1607	-2.38*	-3.53**	-1.20	2.50*	-2.80	-2.80	0.00	5.05**
27	KO1606 x KO1608	-2.47*	-7.06 **	-4.82**	-1.25	-1.00	-7.48**	-4.81**	0.00
28	KO1607 x KO1608	-2.38*	-3.53**	-1.20	2.50*	-4.67*	-4.67*	-1.92	3.03
S.Em±		0.73	0.73	0.73	0.73	1.21	1.21	1.21	1.21
CD at 5%		2.13	2.13	2.13	2.13	3.53	3.53	3.53	3.53
CD at 1%		2.83	2.83	2.83	2.83	4.68	4.68	4.68	4.68

* and ** indicates significance of value at p= 0.05 and p=0.01, respectively.
BP: Heterosis over better parent
BTP: Heterosis over best parent
CC 1: Heterosis over commercial check 1 (Arka Anamika)
CC 2: Heterosis over commercial check 2 (Mahyco 10)

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