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Exploitation of hybrid vigour for yield and quality parameters in okra [*Abelmoschus esculentus* (L.) Moench] through half diallel analysis

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Abstract
Eight parental lines of okra and their 28 F_1 hybrids obtained from half diallel were studied to investigate the extent of heterosis for yield and quality parameters. The magnitude of heterosis varied in all the crosses for the characters studied. Maximum positive heterosis for yield per plant and yield per hectare was observed in the cross KO1601 x KO1605 over better parent and the cross KO1606 x KO1608 over the best parent and the commercial checks (Arka Anamika and MHY-10) followed by KO1602 x KO1608 and KO1603 x KO1606. For number of fruits per plant, the crosses KO1601 x KO1604 and KO1607 x KO1608 exhibited maximum heterobeltiosis and standard heterosis respectively. Magnitude of heterosis over the commercial checks was maximum in the cross KO1603 x KO1606 for average fruit weight and the cross KO1601 x KO1606 exhibited maximum positive heterosis over better parent and the commercial checks for number of seeds per fruit. High estimates of heterosis obtain in hybrid combinations revealed considerable genetic divergence among the parental lines.

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. The ease in emasculation, very high per cent of fruit set and large number of seeds per fruit makes commercial exploitation of hybrid vigour easy in okra. Being an often cross-pollinated crop, out crossing to an extent of 5-9% by insects is reported which renders considerable genetic diversity (Duggi *et al*., 2013) [3]. Hybrid vigour in okra has been first reported by Vijayaraghavan and Warier (1946) [11]. Increasing the productivity is the main aim of the plant breeder and it can be achieved by means of hybridisation for the exploitation of heterosis or hybrid vigour. The reproductive biology of the okra offers good scope for exploitation of heterosis. The commercial usefulness of the hybrid would depend on its performance in comparison to the best existing commercial variety or hybrid. Hence, heterosis over better parent, the best parent and the commercial check was worked out in the present investigation for identification of superior hybrids. Keeping in view the above facts, the present investigation was undertaken to study the magnitude and direction of heterosis for yield and quality parameters.

Materials and Methods
The investigation on heterosis studies in okra for yield and quality parameters 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 (KO1601, KO1602, KO1603, KO1604, KO1605, KO1606, KO1607 and KO1608), which were collected from the department itself and their 28 F1 hybrids along with two commercial checks (Arka Anamika and MHY-10). Each of the 8 parents crossed among each other in half diallel fashion 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

In the present investigation, 28 F_1 hybrids derived from eight parents were evaluated using half diallel analysis with two commercial checks (Arka Anamika and Mahyco-10). The variance due to genotypes (crosses and parents) was highly significant (at p=0.01) for all the yield and quality parameters, *viz*., fruit length, fruit diameter, average fruit weight, number of fruits per plant, total yield per plant, yield per plot, yield per hectare, number of ridges on fruit surface and number of seeds per fruit. Parents differed significantly among themselves for all the yield and quality parameters studied except for fruit diameter and average fruit weight. There was highly significant (at p=0.01) difference among the crosses for all the yield and quality parameters studied. Variance due to parents vs crosses was significant for fruit length, average fruit weight, number of fruits per plant and number of ridges on fruit surface and for all other parameters variance due to parents vs crosses was not significant (Table 1). The analysis of variance revealed significant differences among treatments for all the yield and quality traits indicating the presence of appreciable genetic diversity among the parents and cross combinations. Heterosis for yield and quality parameters was presented in Table 2, 3 and 4.

For fruit length, seven crosses over better parent, one cross over the best parent and 12 crosses over the commercial check Arka Anamika and seven crosses over the commercial check MHY-10 exhibited significant and positive heterosis. The cross KO1606 x KO1607 exhibited maximum heterosis over better parent (21.22%), the best parent (3.67%) and the commercial checks Arka Anamika (8.37%) and MHY-10 (6.79%). Similar magnitude of heterosis was also reported by Kumar *et al.,* 2015 [4, 7].

Among 28 crosses, 11 crosses over better parent, six crosses over the best parent and 21 crosses over the commercial check Arka Anamika and 11 crosses over the commercial check MHY-10 showed significantly positive heterosis for fruit diameter. Maximum heterosis was observed in the cross KO1601 x KO1607 over better parent (9.00%) and the cross KO1606 x KO1608 exhibited significant and positive heterosis over the best parent (5.34%) and the commercial checks Arka Anamika (17.82%) and MHY-10 (8.34%). Such magnitude of standard heterosis was also reported by Verma and Sood (2015) [10].

For average fruit weight, eight crosses over better parent, three crosses over the best parent and 12 crosses over the commercial check Arka Anamika and five crosses over the commercial check MHY-10 showed significantly positive heterosis. Maximum heterosis was observed in the cross KO1601 x KO1605 over better parent (13.82%) and the cross KO1603 x KO1606 exhibited significant and positive heterosis over the best parent (9.21%) and the commercial checks Arka Anamika (24.82%) and MHY-10 (14.50%). These results are in agreement with those previously reported by Verma and Sood (2015) [10], Ashwani *et al*. (2013) [1] and Solankey *et al*. (2013) [9].

Number of fruits per plant is an important trait that determine yield of okra. Among 28 crosses, 10 crosses over better parent, two crosses over the best parent and 22 crosses over the commercial check Arka Anamika and 14 crosses over the commercial check MHY-10 showed significantly positive heterosis for number of fruits per plant. Maximum heterosis was observed in the cross KO1601 x KO1604 over better parent (40.44%) and the cross KO1607 x KO1608 exhibited significant and positive heterosis over the best parent (4.17%) and the commercial checks Arka Anamika (37.93%) and MHY-10 (17.35%). Increased number of fruits per plant in heterotic hybrids of okra has been observed in the present investigation and confirmed by Bhatt *et al*. (2016) [2], Neetu *et al.* (2015) [7] and More *et al.* (2015) [5].

Pod yield is a complex trait. It is the end product of several basic yield components. The standard heterosis is more useful from practical point of view. Among 28 crosses, six crosses over better parent, three crosses over the best parent and 23 crosses over the commercial check Arka Anamika and 10 crosses over the commercial check MHY-10 showed significantly positive heterosis for total yield per plant. Maximum heterosis was observed in the cross KO1601 x KO1605 over better parent (28.64%) and the cross KO1606 x KO1608 exhibited significant and positive heterosis over the best parent (7.33%) and the commercial checks Arka Anamika (59.33%) and MHY-10 (20.35%). Similar magnitude of standard heterosis was also reported by Bhatt *et al.* (2016) [2] and Patel (2015) [4, 8].

Among 28 crosses, four crosses over better parent, two crosses over the best parent and 22 crosses over the commercial check Arka Anamika and seven crosses over the commercial check MHY-10 showed significantly positive heterosis for total yield per hectare. Maximum heterosis was observed in the cross KO1601 x KO1605 over better parent (28.40%) and the cross KO1606 x KO1608 exhibited significant and positive heterosis over the best parent (7.32%) and the commercial checks Arka Anamika (58.98%) and MHY-10 (20.21%). Such magnitude of standard heterosis was also reported by More *et al.* (2015) [5].

For number of ridges negative heterosis is preferred as fruits with fewer ridges are preferred in the market. Among 28 crosses, 20 crosses over better parent, 15 crosses over the commercial check Arka Anamika, nine crosses over the commercial check MHY-10 and all the crosses over the best parent exhibited negative and significant heterosis for number of ridges on fruit surface. Maximum negative and significant heterosis was observed in the cross KO1601 x KO1602 over better parent (-15.25%) and the crosses KO1601 x KO1602, KO1602 x KO1608, KO1603 x KO1607, KO1603 x KO1608, KO1604 x KO1605, KO1605 x KO1607, KO1605 x KO1608, KO1606 x KO1608 and KO1607 x KO1608 exhibited maximum negative heterosis over the best parent (-15.25%) and the commercial checks Arka Anamika (-5.66%) and MHY-10 (-1.96%). Similar magnitude of standard heterosis was also reported by Weerasekara (2006) [12].

For number of seeds per fruit, five crosses over better parent, two crosses over the best parent and two crosses over the commercial check Arka Anamika and 13 crosses over the commercial check MHY-10 exhibited positive and significant heterosis. Maximum heterosis was observed in the cross KO1601 x KO1606 over better parent (25.88%), the best parent (13.01%) and the commercial checks Arka Anamika (10.75%) and MHY-10 (40.09%). Similar magnitude of standard heterosis was also reported by Nagesh *et al*. (2014) [6].

Comprehensive assessment of crosses by considering standard heterosis values of 20 characters revealed that, out of 28 crosses, 15 crosses were highly heterotic, five were average heterotic and eight were low heterotic.

Table 1: Analysis of variance (mean sum of squares) of diallel analysis for various characters in okra

Sl. No.	Character	Replications	Genotypes	Parents	Crosses	Parents vs Crosses	Error
	Degrees of freedom	**1**	**35**	**7**	**27**	**1**	**35**
a.	**Yield parameters**						
1.	Fruit length (cm)	0.80	2.94**	3.23**	2.83**	3.76*	0.89
2.	Fruit diameter (mm)	0.75	2.17**	1.53NS	2.36**	1.69NS	0.75
3.	Average fruit weight (g)	1.85	5.31**	1.31NS	6.36**	4.98*	1.03
4.	Number of fruits per plant	5.58	4.44**	6.77**	3.65**	9.43**	0.64
5.	Total yield per plant (kg)	0.001	0.003**	0.002**	0.003**	0.00NS	0.001
6.	Yield per plot (kg)	0.40	0.87**	0.73**	0.94**	0.07NS	0.16
7.	Yield per hectare (t)	3.14	6.73**	5.62**	7.25**	0.55NS	1.26
b.	**Quality parameters**						
8.	Number of ridges on fruit surface	0.03	0.08**	0.17**	0.06**	0.05*	0.01
9.	Number of seeds per fruit	7.74	82.12**	53.63**	92.46**	2.03NS	8.42

*and** indicate significance of values at p= 0.05 and p= 0.01, respectively. NS: Non significant, DAS: Days after sowing.

Table 2: Heterosis (%) over better parent, the best parent and the commercial check for fruit length, fruit diameter and average fruit weight in okra

Sl. No.	Hybrids	Fruit length				Fruit diameter				Average fruit weight			
		BP	**BTP**	**CC 1**	**CC 2**	**BP**	**BTP**	**CC 1**	**CC 2**	**BP**	**BTP**	**CC 1**	**CC 2**
1	KO1601 x KO1602	-7.32**	-10.00**	-5.92**	-7.29**	-4.31**	-10.32**	0.30	-7.77**	-30.43**	-37.51**	-28.58**	-34.48**
2	KO1601 x KO1603	-4.39**	-4.39**	-0.06	-1.52	3.67**	0.09	11.94**	2.94**	-3.21**	-13.63**	-1.29	-9.45**
3	KO1601 x KO1604	-9.79**	-12.40**	-8.43**	-9.76**	-4.31**	-4.31**	7.03**	-1.58	-26.57**	-26.57**	-16.08**	-23.01**
4	KO1601 x KO1605	-18.66**	-21.01**	-17.43**	-18.63**	-4.12**	-7.35**	3.63**	-4.70**	13.82**	2.96**	17.67**	7.95**
5	KO1601 x KO1606	-3.09**	-5.89**	-1.63	-3.07**	5.82**	-0.83	10.92**	2.00*	-29.74**	-30.06**	-20.07**	-26.67**
6	KO1601 x KO1607	-10.77**	-13.35**	-9.42**	-10.74**	9.00**	2.15*	14.25**	5.07**	1.28	-10.28**	2.55*	-5.93**
7	KO1601 x KO1608	-2.08*	-4.91**	-0.60	-2.05*	-0.50	-1.09	10.62**	1.73	-5.41**	-16.20**	-4.22**	-12.13**
8	KO1602 x KO1603	-1.76	-1.76	2.69**	1.19	-17.20**	-20.06**	-10.59**	-17.78**	-9.52**	-18.72**	-7.11**	-14.78**
9	KO1602 x KO1604	-11.57**	-18.49**	-14.80**	-16.04**	-10.27**	-10.27**	0.36	-7.71**	-10.87**	-10.87**	1.86	-6.56**
10	KO1602 x KO1605	6.14**	-2.17*	2.27*	0.77	2.69**	-0.77	10.99**	2.06*	3.42**	-6.45**	6.92**	-1.92
11	KO1602 x KO1606	-14.48**	-21.18**	-17.61**	-18.81**	-0.53	-11.83**	-1.39	-9.31**	-11.29**	-11.71**	0.91	-7.43**
12	KO1602 x KO1607	7.74**	-0.69	3.81**	2.29*	8.62**	-4.51**	6.80**	-1.79*	-24.32**	-32.03**	-22.31**	-28.73**
13	KO1602 x KO1608	-1.59	-8.67**	-4.53**	-5.92**	-13.59**	-14.10**	-3.93**	-11.65**	-2.78**	-12.67**	-0.19	-8.44**
14	KO1603 x KO1604	-9.25**	-9.25**	-5.13**	-6.52**	1.12	1.12	13.10**	4.00**	-8.41**	-8.41**	4.68**	-3.97**
15	KO1603 x KO1605	1.30	1.30	5.89**	4.35**	1.34	-2.06*	9.53**	0.73	2.87**	-6.95**	6.35**	-2.44*
16	KO1603 x KO1606	-1.33	-1.33	3.14**	1.64	5.93**	2.27*	14.38**	5.19**	9.72**	9.21**	24.82**	14.50**
17	KO1603 x KO1607	-2.31*	-2.31*	2.11*	0.63	-4.16**	-7.46**	3.50**	-4.82**	12.86**	0.70	15.09**	5.58**
18	KO1603 x KO1608	-0.46	-0.46	4.05**	2.53*	3.20**	2.60**	14.75**	5.52**	5.37**	-5.99**	7.45**	-1.43
19	KO1604 x KO1605	8.48**	-0.95	3.53**	2.02*	-2.27*	-2.27*	9.30**	0.52	-29.93**	-29.93**	-19.92**	-26.53**
20	KO1604 x KO1606	1.27	-14.97**	-11.11**	-12.41**	-10.80**	-10.80**	-0.23	-8.25**	6.68**	6.68**	21.93**	11.85**
21	KO1604 x KO1607	16.05**	-0.75	3.75**	2.23*	-5.16**	-5.16**	6.07**	-2.46**	-18.72**	-18.72**	-7.11**	-14.78**
22	KO1604 x KO1608	1.90	-5.43**	-1.15	-2.59**	4.84**	4.84**	17.26**	7.83**	-13.87**	-13.87**	-1.56	-9.69**
23	KO1605 x KO1606	0.00	-8.70**	-4.56**	-5.95**	-2.05*	-5.34**	5.87**	-2.64**	-27.23**	-27.57**	-17.22**	-24.06**
24	KO1605 x KO1607	-5.25**	-13.49**	-9.57**	-10.89**	-9.62**	-12.65**	-2.31*	-10.16**	7.39**	-2.86**	11.02**	1.85
25	KO1605 x KO1608	-3.74**	-10.66**	-6.61**	-7.98**	5.61**	4.99**	17.42**	7.98**	-5.74**	-14.73**	-2.55*	-10.60**
26	KO1606 x KO1607	21.22**	3.67**	8.37**	6.79**	7.12**	-5.04**	6.20**	-2.34*	-0.77	-1.23	12.88**	3.56**
27	KO1606 x KO1608	5.51**	-2.08*	2.36*	0.86	5.96**	5.34**	17.82**	8.34**	-5.28**	-5.72**	7.75**	-1.15
28	KO1607 x KO1608	8.34**	0.55	5.10**	3.57**	0.47	-0.12	11.71**	2.73**	-3.64**	-14.63**	-2.43*	-10.50**
	SEm±	0.67	0.67	0.67	0.67	0.61	0.61	0.61	0.61	0.72	0.72	0.72	0.72
	CD at 5 %	1.93	1.93	1.93	1.93	1.78	1.78	1.78	1.78	2.08	2.08	2.08	2.08
	CD at 1 %	2.57	2.57	2.57	2.57	2.36	2.36	2.36	2.36	2.77	2.77	2.77	2.77

*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 fruit and yield parameters in okra

Sl. No.	Hybrids	Number of fruits per plant				Total yield per plant				Yield per hectare			
		BP	**BTP**	**CC 1**	**CC 2**	**BP**	**BTP**	**CC 1**	**CC 2**	**BP**	**BTP**	**CC 1**	**CC 2**
1	KO1601 x KO1602	0.82	0.82	33.50**	13.58**	-30.12**	-31.59**	1.55**	-23.29**	-30.01**	-31.46**	1.53	-23.23**
2	KO1601 x KO1603	5.82**	-25.60**	-1.48	-16.18**	-11.03**	-33.86**	-1.81**	-25.83**	-11.17**	-33.86**	-2.03	-25.92**
3	KO1601 x KO1604	40.44**	-4.39**	26.60**	7.71**	-21.83**	-41.88**	-13.73**	-34.83**	-22.00**	-41.92**	-13.96**	-34.95**
4	KO1601 x KO1605	14.22**	-10.34**	18.72**	1.01	28.64**	-4.36**	41.97**	7.24**	28.40**	-4.40**	41.62**	7.08**
5	KO1601 x KO1606	-11.86**	-17.04**	9.85**	-6.54**	-26.35**	-26.35**	9.33**	-17.42**	-26.17**	-26.17**	9.36**	-17.31**
6	KO1601 x KO1607	-0.91	-19.27**	6.90**	-9.05**	-8.53**	-25.13**	11.14**	-16.05**	-8.67**	-25.25**	10.73**	-16.27**
7	KO1601 x KO1608	5.00**	3.05**	36.45**	16.09**	-2.84**	-10.30**	33.16**	0.59**	-2.84*	-10.24**	32.97**	0.54
8	KO1602 x KO1603	-24.11**	-24.11**	0.49	-14.50**	-35.29**	-36.65**	-5.96**	-28.96**	-35.22**	-36.56**	-6.02**	-28.94**
9	KO1602 x KO1604	-17.41**	-17.41**	9.36**	-6.96**	-22.10**	-23.73**	13.21**	-14.48**	-22.23**	-23.84**	12.81**	-14.70**

10	KO1602 x KO1605	-6.62**	-6.62**	23.65**	5.20**	-7.49**	-9.42**	34.46**	1.57**	-7.51**	-9.43**	34.17**	1.45
11	KO1602 x KO1606	-4.76**	-4.76**	26.11**	7.29**	-9.42**	-9.42**	34.46**	1.57**	-9.28**	-9.28**	34.39**	1.61
12	KO1602 x KO1607	-1.79*	-1.79*	30.05**	10.65**	-29.23**	-30.72**	2.85**	-22.31**	-29.22**	-30.68**	2.68*	-22.36**
13	KO1602 x KO1608	-3.35**	-3.35**	27.98**	8.89**	4.46**	2.27**	51.81**	14.68**	4.42**	2.30*	51.48**	14.53**
14	KO1603 x KO1604	7.41**	-24.48**	0.00	-14.92**	-2.62**	-28.62**	5.96**	-19.96**	-2.47*	-28.54**	5.86**	-19.96**
15	KO1603 x KO1605	3.79**	-18.53**	7.88**	-8.21**	8.17**	-21.47**	16.58**	-11.94**	8.15**	-21.48**	16.32**	-12.05**
16	KO1603 x KO1606	6.21**	-0.04	32.36**	12.62**	1.05**	1.05**	50.00**	13.31**	1.11	1.11	49.78**	13.25**
17	KO1603 x KO1607	-4.57**	-22.25**	2.96**	-12.41**	-1.28**	-19.20**	19.95**	-9.39**	-1.22	-19.15**	19.77**	-9.44**
18	KO1603 x KO1608	-1.44	-3.27**	28.08**	8.97**	2.27**	-5.58**	40.16**	5.87**	2.20	-5.58**	39.87**	5.76**
19	KO1604 x KO1605	-6.16**	-26.34**	-2.46**	-17.02**	-27.38**	-46.77**	-20.98**	-40.31**	-27.35**	-46.77**	-21.14**	-40.37**
20	KO1604 x KO1606	-14.23**	-19.27**	6.90**	-9.05**	-10.99**	-10.99**	32.12**	-0.20**	-10.94**	-10.94**	31.93**	-0.25
21	KO1604 x KO1607	-6.85**	-24.11**	0.49	-14.50**	-21.11**	-35.43**	-4.15**	-27.59**	-21.23**	-35.53**	-4.49**	-27.78**
22	KO1604 x KO1608	-8.26**	-9.97**	19.21**	1.42	-13.04**	-19.72**	19.17**	-9.98**	-13.05**	-19.67**	19.00**	-10.02**
23	KO1605 x KO1606	2.21**	-3.79**	27.39**	8.38**	-20.42**	-20.42**	18.13**	-10.76**	-20.30**	-20.30**	18.07**	-10.72**
24	KO1605 x KO1607	-7.76**	-24.85**	-0.49	-15.34**	-7.68**	-24.43**	12.18**	-15.26**	-7.54**	-24.33**	12.10**	-15.24**
25	KO1605 x KO1608	-0.83	-2.68**	28.87**	9.64**	-7.94**	-15.01**	26.17**	-4.70**	-7.80**	-14.82**	26.18**	-4.60**
26	KO1606 x KO1607	17.81**	-4.02**	27.09**	8.13**	-1.57**	-1.57**	46.11**	10.37**	-1.55	-1.55	45.84**	10.27**
27	KO1606 x KO1608	-6.37**	-8.11**	21.67**	3.52**	7.33**	7.33**	59.33**	20.35**	7.32**	7.32**	58.98**	20.21**
28	KO1607 x KO1608	6.14**	4.17**	37.93**	17.35**	0.00	-7.68**	37.05**	3.52**	-0.04	-7.65**	36.80**	3.44**
SEm±		0.56	0.56	0.56	0.56	0.02	0.02	0.02	0.02	0.79	0.79	0.79	0.79
CD at 5 %		1.62	1.62	1.62	1.62	0.05	0.05	0.05	0.05	2.30	2.30	2.30	2.30
CD at 1 %		2.18	2.18	2.18	2.18	0.06	0.06	0.06	0.06	3.05	3.05	3.05	3.05

* 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 4: Heterosis (%) over better parent, the best parent and the commercial check for number of ridges on fruit surface and number of seeds per fruit in okra

Sl. No.	Hybrids	Number of ridges on fruit surface				Number of seeds per fruit			
		BP	**BTP**	**CC 1**	**CC 2**	**BP**	**BTP**	**CC 1**	**CC 2**
1	KO1601 x KO1602	-15.25**	-15.25**	-5.66**	-1.96**	-24.84**	-32.53**	-33.88**	-16.36**
2	KO1601 x KO1603	-10.17**	-10.17**	0.00	3.92**	-15.80**	-15.80**	-17.49**	4.38
3	KO1601 x KO1604	-8.47**	-8.47**	1.89**	5.88**	0.62	-9.67**	-11.48**	11.98**
4	KO1601 x KO1605	-10.17**	-10.17**	0.00	3.92**	-10.77**	-13.75**	-15.48**	6.91*
5	KO1601 x KO1606	-8.47**	-8.47**	1.89**	5.88**	25.88**	13.01**	10.75**	40.09**
6	KO1601 x KO1607	-13.56**	-13.56**	-3.77**	0.00	-20.50**	-28.62**	-30.05**	-11.52**
7	KO1601 x KO1608	-5.08**	-5.08**	5.66**	9.80**	-10.35**	-19.52**	-21.13**	-0.23
8	KO1602 x KO1603	-3.70**	-11.86**	-1.89**	1.96**	0.74	0.74	-1.28	24.88**
9	KO1602 x KO1604	-1.85**	-10.17**	0.00	3.92**	-5.17	-28.44**	-29.87**	-11.29**
10	KO1602 x KO1605	-1.85**	-10.17**	0.00	3.92**	-21.54**	-24.16**	-25.68**	-5.99*
11	KO1602 x KO1606	0.00	-8.47**	1.89**	5.88**	-3.12	-19.14**	-20.77**	0.23
12	KO1602 x KO1607	1.85**	-6.78**	3.77**	7.84**	19.17**	-4.09	-6.01*	18.89**
13	KO1602 x KO1608	-7.41**	-15.25**	-5.66**	-1.96**	-7.05*	-21.56**	-23.13**	-2.76
14	KO1603 x KO1604	-3.70**	-11.86**	-1.89**	1.96**	-12.83**	-12.83**	-14.57**	8.06**
15	KO1603 x KO1605	-1.85**	-10.17**	0.00	3.92**	4.65	4.65	2.55	29.72**
16	KO1603 x KO1606	-5.56**	-13.56**	-3.77**	0.00	-32.34**	-32.34**	-33.70**	-16.13**
17	KO1603 x KO1607	-7.41**	-15.25**	-5.66**	-1.96**	9.11**	9.11**	6.92*	35.25**
18	KO1603 x KO1608	-7.41 **	-15.25**	-5.66**	-1.96**	-10.59**	-10.59**	-12.39**	10.83**
19	KO1604 x KO1605	-3.85**	-15.25**	-5.66**	-1.96**	-15.19**	-18.03**	-19.67**	1.61
20	KO1604 x KO1606	3.85**	-8.47**	1.89**	5.88**	-10.47**	-25.28**	-26.78**	-7.37*
21	KO1604 x KO1607	3.85**	-8.47**	1.89**	5.88**	-4.85	-23.42**	-24.95**	-5.07
22	KO1604 x KO1608	0.00	-11.86**	-1.89**	1.96**	-11.89**	-25.65**	-27.14**	-7.83*
23	KO1605 x KO1606	0.00	-11.86**	-1.89**	1.96**	-10.38**	-13.38**	-15.12**	7.37*
24	KO1605 x KO1607	-3.85**	-15.25**	-5.66**	-1.96**	-27.12**	-29.55**	-30.97**	-12.67**
25	KO1605 x KO1608	-3.85**	-15.25**	-5.66**	-1.96**	2.12	-1.30	-3.28	22.35**
26	KO1606 x KO1607	3.92**	-10.17**	0.00	3.92**	10.02**	-8.18**	-10.02**	13.82**
27	KO1606 x KO1608	-1.96**	-15.25**	-5.66**	-1.96**	6.39*	-10.22**	-12.02**	11.29**
28	KO1607 x KO1608	0.00	-15.25**	-5.66**	-1.96**	-17.40**	-30.30**	-31.69**	-13.59**
SEm±		0.07	0.07	0.07	0.07	2.05	2.05	2.05	2.05
CD at 5 %		0.21	0.21	0.21	0.21	5.95	5.95	5.95	5.95
CD at 1 %		0.27	0.27	0.27	0.27	7.90	7.90	7.90	7.90

*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).

Conclusion

The cross KO1606 x KO1608 was the best hybrid selected for yield per hectare and also exhibited significant standard heterosis over the commercial checks Arka Anamika and MHY-10 in the desirable direction for fruit diameter, number of fruits per plant, total yield per plant, yield per plot and yield per hectare. The cross KO1602 x KO1608 was the second best hybrid selected for yield per hectare and also exhibited significant standard heterosis (Arka Anamika and MHY-10) in the desirable direction for number of fruits per plant, total yield per plant, yield per plot and yield per hectare. The third best hybrid was KO1603 x KO1606 and also exhibited significant standard heterosis (Arka Anamika and MHY-10) in the desirable direction for average fruit weight, number of fruits per plant, total yield per plant, yield per plot and yield per hectare. These crosses can be further assessed for its yield stability to confirm its potentiality and also its adaptability to different agro-climatic conditions before exploiting it on commercial scale.

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