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Heterosis Studies in Okra (*Abelmoschus esculents* (L.) Moench) For Yield and Yield Contributing Traits

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ABSTRACT

Analysis of variance revealed highly significant differences among genotype and parent and hybrids for all the characters studied indicating substantial amount of genetic variability present in the material. The magnitude of heterosis varied from cross to cross for all characters. Mean squares due to parents vs hybrids were significant for all the traits except fruit breadth and number of fruit/plant indicating that considerable heterosis for those characters. The highest significant Mid Parent heterosis was observed yield/plant Arka anamika × BO-13 (40.44%). The other characters showed considerable amount heterosis were number of fruit/plant for the cross Hissar Naveen×SB-8 (80.77%). The cross Parbhani kranti×BO-2 showed highest heterosis 101.88 and 16.02 for the trait yield q/ha and 1000 seed weight, respectively. The character no. of seed/fruit showed highest heterosis for the cross parbhani kranti x136 thin (36.41) and length of fruit parbhani kranti x kashi pragati (18.27). The significant mid parent heterosis was observed for internodes (-49.60%) for the cross Hissar Naveen x Kashi pragati. The present investigation revealed that Arka anamika x BO-13, Hissar Naveen x Kashi pragati, Hissar Naveen x SB-8, Parbhani kranti x BO-2, Parbhani kranti x 136 thin and Parbhaani kranti x Kashi pragati were found to the best cross combination for fruit yield and yield contributing traits which could be further exploited in future breeding programme.

Key words: *Heterosis, Heterobeltiosis, Line x Tester and Okra.*

INTRODUCTION

Okra *(Abelmoschus esculents* (L.) Moench, 2n=130) is commonly known as lady's finger and Bhendi. It is one of the most important vegetable crop extensively grown throughout the country during summer and rainy season for its green tender fruits. It is the potential source of vitamin A, B and C, Protein and mineral elements. The dried seeds provide oil, protein, vegetable curd and a coffee additive or substitute. Okra dry seeds are reported to contain 18-20 % oil and 20-30 % curd protein. Foliage can be used for biomass and the dried stems serve as a source of pepper pulp or fuel. To limited extent okra is used in canned, dehydrated as frozen forms. It has an average nutritive value of 3.21 which is higher than tomato, egg plant and most cucurbits except bitter gourd.

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In India, okra is cultivated on the area of 532.7 million hectares with production of 6346.4MT. In Maharashtra area under this crop is 0.02Mha with total production of 0.24MT and productivity of 10.5MT/ha (Anonymous, 2013-2014).

Main aim of plant breeder is to evolve genotypes superior in yield and quality attributes than existing one. Varieties developed by selection and other approaches have no better genetic potential for increasing yield and yield contributing traits. Keeping in this view, the present investigation was carried out to know the extent of heterobeltiosis and standard heterosis for fruit yield and its components in okra crosses obtained from 4 lines and 6 testers mating method.

MATERIAL AND METHODS

The present investigation was conducted at Experimental farm of Department of Agricultural Botany, College of Agriculture, VNMKV. Parbhani. The experimental material for this study was taken as four promising female lines i.e, Parbhani Kranti, Arka Anamika, Kashi Satadhari, and Hissar Naveen, six testers i.e, Kashi Pragati, SB-8, BO2, BO-13, VROK-159, 136 thin from different sources and one check i.e, Mahyco hybrid No.64 available in market. All possible 24 cross combinations among four female lines and six testers were made during *kharif* 2015 and sufficient hybrid seeds were sown to see the performance of the different crosses. This material was sown in a Randomized Block Design with three replications. A spacing of 60cm between the rows and 30cm within the plant was adopted. FYM was mixed @ 15t/ha in the soil at the time of field preparation. The fertilizers were applied @ 100kg N, 50kg P, and 50kg per hectare.

The observations for all the traits were recorded on the basis of five randomly selected plants from each parent, F_1 and checks per replication, except days to initiation of flowering, days to 50 per cent flowering which were recorded on the plot basis. The observations were recorded on the characters *viz.* Plant height (cm), Days to initiation of flowering (days), Days to 50 percent flowering (days), Internode length (cm), Fruit length (cm), Breadth of the fruit (mm), Fruit weight (gm), Number of fruits per plant, Number of seeds per fruit, 1000 seed weight (gm), Green fruit yield per plant (gm), Green fruit yield per hectare (kg) and Green fruit yield/plot (kg). The observations were recorded on five randomly selected competitive plants of each parent and F_1 from each replication for thirteen characters (Table 1). The heterotic effects were computed as the percentage increase (+) or decrease (-) of F_1 mean values over better parent (heterobeltiosis) and standard check variety Mahyco hybrid No.64.(Economic heterosis) for all the character and crosses, following the standard formula. The heterosis was carried out by following standard procedure described as relative heterosis (Turner, 1957), Heterobeltiosis (Fonesca and Patterson, 1968) and standard heterosis (Meredith and Bridges, 1972).

RESULTS AND DISCUSSION

The analysis off variance revealed highly significant differences among the genotypes for all the thirteen characters studied indicating sufficient variability in the experimental material (table 1). The experimental revealed that the magnitude of heterosis over mid parent, better parent and standard check varied from cross to cross and character to character. This depicted the existence of potential of heterosis in okra (Table 2).

For the trait plant height, out of 24 crosses, ten and three crosses exhibited significantly positive heterosis over mid parent and better parent, respectively. The highest desirable heterosis was recorded in the cross Hissar Naveen x136 thin (41.54) followed by Arka Anamika x Kashi Pragati (29.91) and Parbhani kranti x VROK-159 (24.47). Out od 24 crosses none of the crosses exhibited significantly Positive heterosis over check, i.e. Mahyco hybrid No. 64. Plant height is an important parameter in obtaining the yield potential of okra. Tall plant with shorter internodes plays an important role in increasing the yield as fruiting takes place at each node, sillar findings in okra have been reported by Joshi *et al.*[8], Sing and Sing[20] and Pathak *at al.*[17].

An examination of performance of hybrids for fruit length revealed that the 13 and 6 crosses were recorded significant positive relative heterosis over mid parent and better parent, respectively. The highest positive heterosis was displayed for the cross Parbhani kranti x Kashi Pragati (22.95) followed by Parbhani Kranti x BO-13 (10.87). Only one cross i.e. Parbhani kranti x Kashi Pragati (11.28) exhibited significant and positive heterosis over standard check for this trait. Six crosses over mid parent and five crosses over better parent exhibited significant and positive heterosis for the trait fruit breadth (mm), the cross Parbhani kranti x Kashi Pragati had recorded highest significant and positive heterosis over better parent (15.53), whereas none of the crosses significantly positive heterosis over standard check Mahyco hybrid No. 64. The consumers do not prefer thicker fruits however fruit breadth and fruit length directly contribute towards the total yield and hence the positive value increases the total yield. Heterosis for fruit length and fruit breadth also reported by Sing and Shyamal[19], Shoba Mariappan[18] and Patel *et al.*[17].

Regarding number of fruit/plant, 11 and 10 crosses exhibited significant and positive heterosis over better parent and standard check, respectively. The cross combination Parbhani kranti x BO-2 (61.76) followed by Hissar Naveen x SB-8 (56.67) and Kashi sattadhari x VROK-159 (53.13) expressed maximum degree of heterobeltiosis, whereas the cross combination Hissar Naveen x SB-8 (80.77) showed highest magnitude of economic heterosis for number of fruit/ plant. With respect to green fruit yield/plant 13 crosses have been recorded significantly positive heterobeltiosis and significantly positive heterosis over standard check. The highest positive heterobeltiosis was recorded in the cross Parbhani kranti x 136 thin (50.05) followed by Parbhani kranti x SB-8 (42.88) and Arka anamika x BO-13 (32.03). In case of internodal length, 18 and 14 crosses showed significantly and positive heterosis over mid parent and better parent, respectively. The highest significant positive heterosis was observed in the cross Arka anmika x Kashi Pragati (143.27) followed by Arka anamika x VROK-159 (86.51) and Arka anamika x BO-13 (75.24). 14 crosses exhibited significant positive heterosis over standard check. The number of fruit/ plant is directly related to the presence of number of internodes and height of pant. The hybrid showing number of fruits will ultimately give good yield. These findings are in conformity with those of Panda and Sing[13], Dhake *et al.*[4], and Hossamani *et al.*[7].

For days to initiation of flowering (days) among the crosses, only three crosses revealed significantly negative heterosis over mid parent and these hybrids can be used in early hybrid development program. Each six crosses exhibited significant negative over better parent and standard check. Among the crosses four and six crosses displayed significant negative over (desired) heterosis over mid parent and better parent for the character Days to 50% flowering, Whereas four crosses were found significantly earlier over standard check. Hissar Naveen x SB-08 (-7.03) cross is found earliest to standard check. From above finding it is observed that there is no much variation recorded for days to initiation of flowering for all parental lines and testersand also for all hybrids. There was no much variation was recorded for days to 50% flowering. Numerous worker indicating Sing and Shyamal observed heterosis for earliness and Pratap *et al.*[16], observed heterosis for lateness.

Yield is the attribute of economic importance, for which considerable magnitude of heterosis was registered in number of crosses. In the present investigation, as regards to the number of seeds/fruit only five crosses over mid parent and two crosses over heterobeltiosis. The highest significant positive heterobeltiosis was observed in the cross combination Parbhani kranti x 136 thin (34.03) followed by Parbhani kranti x SB-8 (19.21), whereas among the croses only one cross combination Parbhani kranti x 136 thin showed significant positive heterosis over standard check Mahyco hybrid No. 64. There was no much variation among the crosses for this trait and this character may not be effective in okra breeding program. Similar results reported for this trait by Panda and Sing[13] and Pathak *et al.*[17].

As regards to the fruit weight, 14 crosses showed significant positive heterosis over mid parent and only 4 crosses showd significant positive heterobeltiosis. The

highest significant positive heterobeltiosis was recorded in the cross Hissar Naveen x BO-13 (39.32) followed by Parbhani Kranti x BO-13 (35.09) and Hissar Naveen x Kashi Pragati (31.08), where as eight crosses combination exhibited significant heterosis over standard check. For 1000 seed weight, five crosses exhibited significant positive heterosis and none of the hybrid observed positive and significant over heterobeltiosis and over standard check, however this trait may not consider as desirable for consumption purpose. An Examination of performance of hybrids for fruit yield/plant revealed that, among the 24 crosses eleven and five cross combination recorded significant and positive for mid parent and heterobeltiosis, respectively. The highest significant heterobeltiosis was recorded in cross Arka anamika x BO-13 (27.13) followed by Parbhani kranti x 136 thin (19.88)and Parbhani kranti x Kashi pragati (17.66), while none of the cross combination recorded significant positive over standard check Mahyco hybrid No. 64. These hybrids performed for thes traits and for heterosis for green fruit yield/plant was also reported by Sing and Sing (1979), Patel *et al.*[15] and Narendra kumar *et al.*[12].

In this investigation regarding fruit yield/ha, 14 and 11 crosses were found significant and positive heterosis over mid parent and better parent and cross combination Parbhani krani x BO-2 (53.56) followed by Parbhani kranti x 136 thin (44.13) and Parbhani kranti x Kashi pragati (43.13) expressed maximum degree of heterobeltiosis, whereas among these 24 crosses 14 crosses showed significant positive heterosis over check Mahyco hbrid No. 64. It was found that heterosis for green fruit yield/ha was mainly due to fruit yield/plant, no. of fruit/plant. Heterosis for this character was also reported by Ahmad *et al.*[2], Pathak *et al.*[17], Borgaonkar *et al.*[3], Patel *et al.*[15] and Narendra kumar *et al.*[12].

Findings of the present investigation revealed that Arka anamika x BO-13, Hissar Naveen x Kashi pragati, Hissar Naveen x SB-8, Parbhani kranti x BO-2, Parbhani kranti x 136 thin and Parbhani kranti x Kashi pragati were found to the best cross combination for fruit yield and yield contributing traits on the basis of per se performance and heterosis over standard check. Therefore these hybrids may be advanced and can be exploited in future breeding program for improving yield and its components in okra.

Table 1. ANOVA for line x tester analysis for yield and yield contributing traits in okra

Sr. No.	Source of variation	D. F.	Plant height (cm)	Green fruit yield/plot	Internode length (cm)	Days to initiation of flowering	Days to 50 % flowering	Fruit length (cm)	Breadth of Fruits (mm)	Green fruit yield/ plant (g)	No. of Fruits/ plant	No. of seeds/ fruits	1000 Seed weight (gm)	Fruit weight (gm)	Green fruit yield/ ha (kg)
1	Replication	2	1.92	0.90	0.13	2.12	2.21	0.44	0.06	1940.0	0.24	9.63	5.67	11.85*	1308664.6
2	Genotypes	33	1049.60***	21.63***	7.35***	11.60***	6.49***	4.75***	2.86***	3329777.7***	28.18***	282.11***	114.54***	389.85***	95788954.***
3	Parents	9	549.05***	15.21***	1.93***	9.39***	2.99***	3.52***	2.20***	9728002..2***	12.96***	154.90***	102.97***	421.50***	64168695.1***
4	Parent vs crosses	1	537.78***	104.7***	43.05***	0.13	0.36	5.26***	0.11	1443299.3***	44.35***	859.35***	57.26***	392.36***	3115477381.1***
5	Crosses	23	1267.7***	20.53***	7.92***	12.97***	8.12***	5.20***	3.24***	908145.5***	33.43***	306.80***	121.55***	377.35***	98781282.6***
6	Lines	3	698.24***	11.80***	1.76***	21.55***	4.75***	5.92***	1.04*	166328.7***	24.97***	143.97***	188.77***	170.81***	16619947.4***
7	Tester	5	530.57***	2.77**	0 .57***	0.48	1.95*	2.36***	3.28***	17247148.2***	4.48***	192.42***	49.68***	248.90***	30886114.7***
8	Lines x tester	1	193.91*	87.65***	9.24***	17.42***	2.93*	2.11**	0.26	817292.4***	19.33***	0.10	112.02***	2036.5***	373227840.2***
9	Error	66	32.19	0.80	0.09	0.75	0.69	0.20	0.33	17675.41	0.52	3.58	6.30	179.35***	619949.77
Variance for general and specific combining ability															
1	σ^2gca (F)		69.25	1.15	0.51	1.94*	0.69	0.77*	0.06	85238.29	3.76	9.27	21.46	0.13	13214603.21
2	σ^2gca(M)		214.87*	2.22	0.59	0.89	0.63	0.31	0.23	96910.25	0.82	34.68	6.66	66.74	4166165.10
3	σ^2gca(Av)		127.50**	1.58*	0.54	1.52	0.66*	0.59**	0.13	89907.07*	2.59	19.43	15.54**	26.77	9595227.97*
4	σ^2sca		261.87***	5.73***	2.58***	2.71***	2.12***	1.20***	1.10***	223629.53***	11.19***	97.59***	24.26	102.32***	28758937.22***
5	σ^2gca/ σ^2sca		0.48	0.27	0.20	0.56	0.31	0.49	0.11	0.40	0.23	0.19	0.64	0.26	0.33

***, **,* = significant at 0.1, 1 and 5 per cent, respectively

Table 2. Estimation of Relative heterosis, heterobeltosis and heterosis over standard checks for yield and yield contributing traits in okra

Sr. No.	Name of genotypes	Plant height (cm)			Green fruit yield / plot (kg)		
		MP	BP	Standard check	MP	BP	Standard check
1	Parbhani Kranti x Kashi Pragati	-4.90	-13.69**	-40.16**	29.75**	27.12**	9.35
2	Parbhani Kranti x SB-8	13.04**	8.06	-25.09**	51.67**	42.88**	17.92**
3	Parbhani Kranti x BO2	13.77**	-4.06	-33.49**	10.61	0.43	-17.11**
4	Parbhani Kranti x BO-13	-26.94**	-34.97**	-54.91**	45.89**	31.77**	8.76
5	Parbhani kranti x VROK-159	26.25**	24.47**	-13.7**	40.83**	29.58**	6.95
6	Parbhani Kranti x 136 thin	8.85*	-7.97	-36.20**	68.14**	50.05**	23.84**
7	Arka Anamika x Kashi Pragati	38.89**	29.91**	-26.57**	9.55	7.64	-4.06
8	Arka Anamika x SB-8	12.89**	0.38	-36.54**	10.21	0.21	-10.68
9	Arka Anamika x BO2	-31.85**	-32.97**	-67.02**	-11.54	-22.35**	-30.79**
10	Arka Anamika x BO-13	-6.36	-10.59*	-51.64**	51.24**	32.09**	17.73**
11	Arka Anamika x VROK-159	3.48	-10.47*	-39.68**	25.76**	11.80	-0.35
12	Arka Anamika x 136 thin	-9.96	-11.16	-56.28**	-16.00*	-27.48**	-35.36**
13	Kashi Satadhari x Kashi Pragati	6.74	0.28	-35.52**	18.07**	3.00	18.98**
14	Kashi Satadhari x SB-8	7.31	6.41	-31.58**	12.79*	-7.98	6.30
15	Kashi Satadhari x BO2	-19.63**	-30.07**	-55.04**	33.18**	5.41	21.76**
16	Kashi Satadhari x BO-13	-9.10*	-16.32**	-46.19**	-16.35**	-34.07**	-23.84**
17	Kashi Satadhari x VROK-159	0.90	-1.40	-33.57**	57.85**	26.30**	45.90**
18	Kashi Satadhari x 136 thin	18.77**	3.63	-33.37**	-18.73**	-36.58**	-26.74**
19	Hissar Naveen x Kashi Pragati	12.20**	9.85	-37.91**	-4.12	-14.80**	-5.70
20	Hissar Naveen x SB-8	-10.29*	-16.72**	-47.36**	-0.81	-17.71**	-8.92
21	Hissar Naveen x BO2	-2.05	-7.98	-50.17**	-22.28**	-37.49**	-30.82**
22	Hissar Naveen x BO-13	0.72	0.67	-45.49**	35.39**	8.40	19.98**
23	Hissar Naveen x VROK-159	16.21**	4.80	-29.3**	34.83**	9.65	21.36**
24	Hissar Naveen x 136 thin	50.21**	41.54**	-23.36**	0.37	-20.44**	-11.95

***, **,* = significant at 0.1, 1 and 5 per cent, respectively.

Sr. No.	Name of genotypes	Internode length (cm)			Days to initiation of flowering (Days)		
		MP	BP	Standard check	MP	BP	Standard check
1	Parbhani Kranti x Kashi Pragati	16.67**	-0.68	10.53	-0.41	-0.83	-083
2	Parbhani Kranti x SB-8	34.15**	11.49*	24.06**	-0.41	-1.63	0.00
3	Parbhani Kranti x BO2	30.00**	5.41	17.29**	1.24	0.83	0.83
4	Parbhani Kranti x BO-13	-13.08*	-30.41**	-22.56**	6.67**	6.67**	5.79**
5	Parbhani kranti x VROK-159	42.34**	31.76**	46.62**	-0.83	-1.64	-0.83
6	Parbhani Kranti x 136 thin	58.87**	33.11**	48.12**	1.23	0.00	1.65
7	Arka Anamika x Kashi Pragati	146.83**	143.27**	90.23**	0.00	0.00	0.00
8	Arka Anamika x SB-8	47.74**	45.54**	10.53	3.28*	2.44	4.13*
9	Arka Anamika x BO2	40.93**	34.65**	2.26	2.48	2.48	2.48
10	Arka Anamika x BO-13	86.32**	75.25**	33.08**	1.24	0.83	0.83
11	Arka Anamika x VROK-159	107.05**	86.51**	76.69**	2.88	2.46	3.31
12	Arka Anamika x 136 thin	2.49	1.98	-22.56**	4.10**	3.25	4.96**
13	Kashi Satadhari x Kashi Pragati	31.47**	12.24*	24.06**	2.88	2.46	3.31
14	Kashi Satadhari x SB-8	45.31**	21.09**	33.83**	-11.84**	-12.20**	-10.74**
15	Kashi Satadhari x BO2	78.24**	44.90**	60.15**	-7.00**	-7.38**	-6.61**
16	Kashi Satadhari x BO-13	49.15**	19.73**	32.33**	-0.83	-1.64	-0.83
17	Kashi Satadhari x VROK-159	51.65**	40.82**	55.64**	0.00	0.00	0.83
18	Kashi Satadhari x 136 thin	-38.46**	-48.30**	-42.86**	3.67*	3.25	4.96**
19	Hissar Naveen x Kashi Pragati	-49.60**	-56.85**	-52.63**	-2.65	-9.09**	-9.09**
20	Hissar Naveen x SB-8	-26.23**	-38.36**	-32.33**	-2.63	-9.76**	-8.26**
21	Hissar Naveen x BO2	1.68	-17.12**	-9.02	7.96**	0.83	0.83
22	Hissar Naveen x BO-13	64.26**	32.19**	45.11**	2.22	-4.17*	-4.96**
23	Hissar Naveen x VROK-159	15.44**	7.53	18.05**	-6.61**	-13.11**	-12.40**
24	Hissar Naveen x 136 thin	10.57*	-6.85	2.26	7.89**	0.00	1.65

***, **,* = significant at 0.1, 1 and 5 per cent, respectively.

Table 2. Contd….

Sr. No.	Name of genotypes	Days to 50 % flowering (Days)			Length of fruits (cm)		
		MP	BP	Standard check	MP	BP	Standard check
1	Parbhani Kranti x Kashi Pragati	0.39	-0.78	0.00	27.33**	22.95**	11.28**
2	Parbhani Kranti x SB-8	0.00	-1.54	0.00	13.09**	9.51*	-7.72*
3	Parbhani Kranti x BO2	5.14**	4.72**	3.91*	23.86**	19.72**	0.89
4	Parbhani Kranti x BO-13	6.77**	6.35**	4.69**	17.82**	10.87**	5.93
5	Parbhani kranti x VROK-159	0.39	-0.78	0.00	-3.17	-7.94*	-13.95**
6	Parbhani Kranti x 136 thin	-2.33	-4.55**	-1.56	-8.10*	-13.40**	-17.51**
7	Arka Anamika x Kashi Pragati	-1.15	-2.27	0.78	8.29*	-3.61	-12.76**
8	Arka Anamika x SB-8	0.00	-0.76	2.34	21.43**	15.04**	-9.20**
9	Arka Anamika x BO2	4.25**	2.27	5.47**	18.09**	12.08**	-11.87**
10	Arka Anamika x BO-13	-2.72	-5.30**	-2.34	12.86**	-1.86	-6.23
11	Arka Anamika x VROK-159	-1.15	-2.27	0.78	18.63**	4.13	-2.67
12	Arka Anamika x 136 thin	4.55**	4.55**	7.81**	5.90	-7.79*	-12.17**
13	Kashi Satadhari x Kashi Pragati	1.18	0.00	0.78	3.65	-2.30	-11.57**
14	Kashi Satadhari x SB-8	-1.56	-3.08	-1.56	-15.3**	-15.93**	-32.64**
15	Kashi Satadhari x BO2	-5.14**	-5.51**	-6.25**	26.36**	-27.04**	-41.54**
16	Kashi Satadhari x BO-13	1.20	0.79	-0.78	10.14**	1.24	-3.26
17	Kashi Satadhari x VROK-159	1.18	0.00	0.78	-4.96	-11.75**	-17.51**
18	Kashi Satadhari x 136 thin	2.33	0.00	3.13	0.17	-7.79*	-12.17**
19	Hissar Naveen x Kashi Pragati	-3.17*	-5.43**	-4.69**	12.11**	-16.52**	-16.02**
20	Hissar Naveen x SB-8	-5.93**	-8.46**	-7.03**	6.45	-5.01	-4.45
21	Hissar Naveen x BO2	5.60**	3.94*	3.13	10.93**	-1.18	-0.59
22	Hissar Naveen x BO-13	0.81	0.00	-2.34	6.51*	3.83	4.45
23	Hissar Naveen x VROK-159	-4.76**	-6.98**	-6.25**	6.42*	2.65	3.26
24	Hissar Naveen x 136 thin	5.10**	1.52	4.69**	-0.30	-2.95	-2.37

**,* = significant at 1 and 5 per cent, respectively.

Sr. No.	Name of genotypes	Breadth of fruits (mm)			Green fruit yield per plant (g)		
		MP	BP	Standard check	MP	BP	Standard check
1	Parbhani Kranti x Kashi Pragati	18.27**	15.53**	2.08	33.72**	17.76**	-59.77**
2	Parbhani Kranti x SB-8	7.12*	7.08	-5.38	30.95**	9.60*	-62.56**
3	Parbhani Kranti x BO2	1.69	-4.44	-3.97	24.16**	0.85	-65.55**
4	Parbhani Kranti x BO-13	-16.34**	-21.57**	-20.79**	21.37**	1.59	-65.30**
5	Parbhani kranti x VROK-159	6.68	6.09	-6.25	-49.01**	-66.01**	-65.15**
6	Parbhani Kranti x 136 thin	12.16**	9.46*	-3.28	29.46**	19.88**	-59.05**
7	Arka Anamika x Kashi Pragati	-2.06	-7.08	-12.75**	15.01**	10.31*	-68.76**
8	Arka Anamika x SB-8	-10.79**	-13.45**	-18.73**	8.02	-2.09	-72.27**
9	Arka Anamika x BO2	-21.34**	-23.93**	-23.55**	-29.70**	-38.37**	-82.55**
10	Arka Anamika x BO-13	-13.62**	-16.66**	-15.83**	40.44**	27.31**	-63.95**
11	Arka Anamika x VROK-159	15.93**	11.92**	5.09	-49.85**	-68.00**	-67.19**
12	Arka Anamika x 136 thin	16.34**	10.28**	3.55	-25.91**	-26.91**	-78.73**
13	Kashi Satadhari x Kashi Pragati	-1.15	-1.38	-16.90**	21.55**	6.11	-63.00**
14	Kashi Satadhari x SB-8	2.68	0.11	-11.61**	6.18	-11.85**	-69.27**
15	Kashi Satadhari x BO2	-4.50	-12.40**	-11.96**	22.55**	-1.24	-65.56**
16	Kashi Satadhari x BO-13	5.23	-3.69	-2.73	-6.76	-22.60**	-73.01**
17	Kashi Satadhari x VROK-159	4.72	2.61	-10.32**	-32.66**	-54.88**	-53.74**
18	Kashi Satadhari x 136 thin	4.64	4.48	-12.11**	-28.34**	-34.26**	-77.08**
19	Hissar Naveen x Kashi Pragati	-4.94	-8.88*	-16.28**	-8.12	-19.62**	-72.12**
20	Hissar Naveen x SB-8	-5.50	-7.35	-14.86**	-2.63	-19.00**	-71.91**
21	Hissar Naveen x BO2	-2.08	-6.27	-5.81	-36.7**	-48.91**	-82.28**
22	Hissar Naveen x BO-13	-1.04	-5.50	-4.57	23.44**	2.69	-64.38**
23	Hissar Naveen x VROK-159	10.75**	8.05*	-0.72	-41.57**	-60.90**	-59.92**
24	Hissar Naveen x 136 thin	1.73	-2.57	-10.4**	14.28**	5.09	-63.55**

**,* = significant at 1 and 5 per cent, respectively.

Sr. No.	Name of genotypes	Number of fruits per plant			Number of seeds per fruit		
		MP	BP	Standard check	MP	BP	Standard check
1	Parbhani Kranti x Kashi Pragati	9.86*	0.00	0.00	-13.77**	-21.27**	-23.71**
2	Parbhani Kranti x SB-8	45.16**	40.63**	15.38**	30.06**	19.21**	-4.57
3	Parbhani Kranti x BO2	66.67**	61.76**	41.03**	-30.14**	-31.64**	-45.28**
4	Parbhani Kranti x BO-13	-18.31**	-25.64**	-25.64**	-27.76**	-28.37**	-41.68**
5	Parbhani kranti x VROK-159	21.88**	21.88**	0.00	-14.46**	-22.53**	-23.55**
6	Parbhani Kranti x 136 thin	0.00	-2.94	-15.38**	36.41**	34.03**	11.17**
7	Arka Anamika x Kashi Pragati	-25.00**	-26.83**	-23.08**	-17.09**	-20.95**	-23.40**
8	Arka Anamika x SB-8	-32.39**	-41.46**	-38.46**	6.60*	-6.24*	-17.61**
9	Arka Anamika x BO2	-17.33**	-24.39**	-20.51**	-29.75**	-34.26**	-42.23**
10	Arka Anamika x BO-13	12.50**	9.76*	15.38**	-21.26**	-24.15**	-33.35**
11	Arka Anamika x VROK-159	-20.55**	-29.27**	-25.64**	-31.37**	-35.13**	-35.99**
12	Arka Anamika x 136 thin	-12.00**	-19.51**	-15.38**	-26.18**	-28.25**	-36.95**
13	Kashi Satadhari x Kashi Pragati	61.90**	30.77**	30.77**	-5.82**	-6.39*	-9.29**
14	Kashi Satadhari x SB-8	-14.81*	-23.33**	-41.03**	13.19**	-3.98	-8.07**
15	Kashi Satadhari x BO2	-24.14**	-35.29**	-43.59**	-38.56**	-44.70**	-47.06**

16	Kashi Satadhari x BO-13	-26.98**	-41.03**	-41.03**	-1.49	-8.85**	-12.74**
17	Kashi Satadhari x VROK-159	75.00**	53.13**	25.64**	-7.36**	-8.74**	-9.95**
18	Kashi Satadhari x 136 thin	-10.34	-23.53**	-33.33**	-44.83**	-48.52**	-50.71**
19	Hissar Naveen x Kashi Pragati	54.10**	20.51**	20.51**	-9.12**	-21.22**	-23.65**
20	Hissar Naveen x SB-8	80.77**	56.67**	20.51**	-0.77	-3.85	-31.62**
21	Hissar Naveen x BO2	42.86**	17.65**	2.56	-10.10**	-13.32**	-33.60**
22	Hissar Naveen x BO-13	47.54**	15.38**	15.38**	7.75**	0.94	-17.82**
23	Hissar Naveen x VROK-159	40.74**	18.75**	-2.56	-25.38**	-35.80**	-36.65**
24	Hissar Naveen x 136 thin	64.29**	35.29	17.95**	-0.36	-7.47*	-23.25**

**,* = significant at 1and 5 per cent, respectively.

**,* = significant at 1and 5 per cent, respectively.

Sr. No.	Name of genotypes	1000 seed weight (g)			Fruit weight (g)		
		MP	BP	Standard check	MP	BP	Standard check
1	Parbhani Kranti x Kashi Pragati	-6.27	-21.98**	-26.04**	-5.47	-21.99**	-19.72**
2	Parbhani Kranti x SB-8	12.24**	-4.62	-14.06**	10.80**	-8.85**	-6.21*
3	Parbhani Kranti x BO2	16.06**	3.92	-17.19**	-30.52**	-53.73**	-52.38**
4	Parbhani Kranti x BO-13	-7.69*	-20.00**	-31.25**	44.75**	35.09**	39.02**
5	Parbhani kranti x VROK-159	-29.20**	-36.60**	-49.48**	22.23**	2.17	5.14
6	Parbhani Kranti x 136 thin	-8.36*	-18.18**	-34.38**	8.17**	0.56	3.48
7	Arka Anamika x Kashi Pragati	-12.91**	-20.33**	-24.48**	17.22**	-8.82**	9.84**
8	Arka Anamika x SB-8	3.09	-3.47	-13.02**	-46.49**	-58.50**	-50.01**
9	Arka Anamika x BO2	-1.97	-2.61	-22.40**	-28.63**	-54.20**	-44.83**
10	Arka Anamika x BO-13	-0.63	-4.85	-18.23**	15.80**	0.76	21.38**
11	Arka Anamika x VROK-159	-1.32	-1.96	-21.88**	30.50**	2.70	23.71**
12	Arka Anamika x 136 thin	-8.85*	-9.74*	-27.60**	-4.46	-17.17**	-0.22
13	Kashi Satadhari x Kashi Pragati	-2.49	-3.30	-8.33*	-21.49**	-38.28**	-27.81**
14	Kashi Satadhari x SB-8	-8.52**	-10.06**	-16.15**	26.50**	-0.84	15.98**
15	Kashi Satadhari x BO2	10.24**	2.23	-4.69	22.58**	-20.81**	-7.38*
16	Kashi Satadhari x BO-13	8.72**	4.47	-2.60	4.71	-7.73**	7.92*
17	Kashi Satadhari x VROK-159	-4.22	-11.17**	-17.19**	-15.07**	-32.44**	-20.98**
18	Kashi Satadhari x 136 thin	-4.50	-11.17**	-17.19**	-11.90**	-22.65**	-9.53**
19	Hissar Naveen x Kashi Pragati	-11.57**	-18.13**	-22.40**	45.81**	31.08**	9.97**
20	Hissar Naveen x SB-8	-2.44	-7.51*	-16.67**	24.26**	11.30**	-6.63*
21	Hissar Naveen x BO2	-9.74**	-10.32*	-27.60**	28.86**	-9.34*	-23.94**
22	Hissar Naveen x BO-13	1.88	-1.21	-15.10**	43.67**	39.42**	24.33**
23	Hissar Naveen x VROK-159	8.44*	7.74	-13.02**	15.97**	5.77	-11.26**
24	Hissar Naveen x 136 thin	1.62	1.29	-18.23**	-30.59**	-32.37**	-40.20**

Sr. No.	Name of genotypes	Green fruit yield per ha (kg)		
		MP	BP	Standard check
1	Parbhani Kranti x Kashi Pragati	47.11**	43.13**	43.09**
2	Parbhani Kranti x SB-8	42.43**	34.58**	34.55**
3	Parbhani Kranti x BO2	101.88**	53.56**	53.53**
4	Parbhani Kranti x BO-13	52.66**	34.34**	34.31**
5	Parbhani kranti x VROK-159	35.17**	21.91**	21.89**
6	Parbhani Kranti x 136 thin	50.66**	44.13**	44.09**
7	Arka Anamika x Kashi Pragati	-11.19**	-20.66**	-4.64
8	Arka Anamika x SB-8	-3.70	-16.21**	0.71
9	Arka Anamika x BO2	-13.88**	-38.27**	-25.80**
10	Arka Anamika x BO-13	33.69**	9.09**	31.13**

11	Arka Anamika x VROK-159	10.92**	-7.46**	11.24**
12	Arka Anamika x 136 thin	-26.84**	-35.63**	-22.63**
13	Kashi Satadhari x Kashi Pragati	17.25**	2.34	29.77**
14	Kashi Satadhari x SB-8	0.54	-14.46**	8.47**
15	Kashi Satadhari x BO2	25.54**	-11.43**	12.31**
16	Kashi Satadhari x BO-13	-31.86**	-45.52**	-30.91**
17	Kashi Satadhari x VROK-159	56.17**	27.57**	61.77**
18	Kashi Satadhari x 136 thin	-26.24**	-36.57**	-19.56**
19	Hissar Naveen x Kashi Pragati	-13.26**	-20.95**	-9.14**
20	Hissar Naveen x SB-8	-10.88**	-20.95**	-9.14**
21	Hissar Naveen x BO2	-22.88**	-43.95**	-35.58**
22	Hissar Naveen x BO-13	34.02**	11.30**	27.93**
23	Hissar Naveen x VROK-159	29.84**	10.31**	26.79**
24	Hissar Naveen x 136 thin	27.00**	13.94**	30.97

**,* = significant at 1and 5 per cent, respectively.

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