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HETEROSIS FOR EARLINESS AND FRUIT YIELD COMPONENTS IN BHENDI [*ABELMOSCHUS ESCULENTUS* (L.) MOENCH]

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Abstract

An experiment was conducted to evaluate the extent of heterosis in bhendi for earliness and other yield components in Line x Tester analysis. The hybrids L_2 x T_1, L_3 x T_3, L_3 x T_4 and L_5 x T_3 registered significant standard heterosis for days to first flowering. The hybrids L_2 x T_1, L_6 x T_3 and L_2 x T_2 recorded higher position and significant heterosis for fruit yield per plant.

Key words : Okra, yield components, fruit yield, daily diet.

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] commonly known as bhendi or lady's finger belongs to the family Malvaceae. It originates probably from East Africa and today is widely distributed in the tropics, subtropics and warmer portions of the temperate region. Immature fruits can be used in salads, soups and stews, fresh or dried, fried or boiled (Ndunguru and Rajabu, 2004). High level of dietary fibre, low caloric value and rich source of minerals like Ca, P, K and Mg has made okra an important component of daily diet. Inspite of this importance, no major breakthrough has been made in this crop and the farmers are still growing their own local varieties or open pollinated varieties. Hence an attempt has been made to study the Line x Tester analysis (Kempthrone, 1957) to know the standard heterosis for interested traits in okra (Solankey *et al*., 2013). Hybrid vigour in okra has been first reported by Vijayaraghavan and Wariar (1946). There is very less total area under F_1 hybrids. Yield is a mere universal breeding objective. 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. A clear understanding for heterosis of the traits under consideration will help in deciding the appropriate breeding methods to improve the genetic makeup as well as productivity. Therefore, present investigation was carried out to estimate the magnitude of heterosis for fruit yield and its contributing character in okra.

Materials and Methods

The present investigation was carried out at Experimental Field of Paambanvilai, Asaripallam, Vembanoor Village, Agastheeswaram Thaluk in Kanyakumari District. The experimental material comprised of thirteen parents which involves eight female, five male and their forty F_1 hybrids along with one commercial check (Parbhani Kranti). The above materials (53) were used for the experiment to study heterosis. The parents of F_1's were sown in plots having rows of 10 plants with a spacing of 60 x 45 cms in randomised block design with three replications. Recommended agronomic package of practices were applied to raise a healthy crop. Observations were recorded on days to first flowering, number of fruits per plant, single fruit weight (gm) and fruit yield per plant (gm). The data was subjected to Line x Tester analysis suggested by Kempthrone (1957). The magnitude of heterosis was calculated as per cent deviation of the mean performance of the F_1's from its mid parent (MP), Better parent (BP) and standard parent (SP) (Briggle, 1963 and Hays *et al*., 1965).

Results and Discussion

Percentage of relative heterosis and heterobeltiosis and standard heterosis were estimated and are presented in tables 1 and 2. Among the forty hybrids, twenty one hybrids recorded negative and significant and relative

Table 1 : Mean and heterosis for number of days to first flowering and number of fruits per plant in Bhendi.

S. no.	F_1 hybrids	Number of days to firstflowering				Number of fruits per plant			
		Mean	RH%	HB%	SH%	Mean	RH%	HB%	SH%
1.	TCR852 X Arka Anamika	37.93	-5.79**	-8.37**	-3.72**	32.00	30.61**	26.98**	30.08**
2.	TCR852 X Punjab Padmini	36.87	-2.47**	-5.79**	-6.43**	28.20	23.68**	18.49**	14.63**
3.	TCR852 X Hissar Unnat	36.07	-7.04**	-7.84**	-8.86**	30.40	19.84**	12.87**	23.58**
4.	TCR852 X Parbhani Kranti	42.07	7.13**	6.77**	6.7**	20.50	-15.29**	-16..67**	-16.67**
5.	TCR852 X Varsha Uphar	45.00	10.20**	5.80**	14.21**	24.00	0.98	0.84	-2.44
6.	IC1543 X Arka Anamika	35.27	-16.50**	-18.11**	-10.49**	31.00	29.71**	23.02**	26.02**
7.	IC1543X Punjab Padmini	36.97	-7.04**	-14.16**	-6.18**	31.13	40.24**	37.76**	26.56**
8.	IC1543 X Hissar Unnat	40.13	-1.55	-6.81**	1.86	27.07	9.29**	0.50	10.03**
9.	IC1543 X Parbhani Kranti	36.07	-12.53**	-16.25**	-8.46**	29.07	23.16**	18.16**	18.16**
10.	IC1543 X Varsha Uphar	43.93	2.65**	2.01	11.51**	24.03	3.74**	1.26	-2.30
11.	TCR2086 X Arka Anamika	38.07	-1.89*	-8.05**	-3.38**	28.20	19.83**	11.90**	14.63**
12.	TCR2086 X Punjab Padmini	36.13	-0.55	-0.91	-8.29**	23.10	5.80**	5.64**	-6.10**
13.	TCR2086 X Hissar Unnat	35.27	-5.54**	-8.32**	-10.49**	31.23	28.01**	15.97**	26.96**
14.	TCR2086 X Parbhani Kranti	35.47	-6.17**	-9.98**	-9.98**	29.07	25.11**	18.16**	18.16**
15.	TCR2086 X Varsha Uphar	43.13	9.57**	1.41	9.48**	22.97	0.73	-3.23	-6.64**
16.	EC306722-A3 X Arka Anamika	42.53	-0.62	-3.77**	7.95**	27.07	25.70**	7.41**	10.03**
17.	EC306722-A3 X Punjab Padmini	41.07	1.82*	-7.09**	4.23**	22.07	11.26**	1.22	-10.30**
18.	EC306722-A3 X Hissar Unnat	37.07	-10.32**	-16.14**	-5.92**	33.07	47.62**	22.77**	34.42**
19.	EC306722-A3 X Parbhani Kranti	37.93	-9.25**	-14.18**	-3.72**	28.07	32.18**	14.09**	14.09**
20.	EC306722-A3 X Varsha Uphar	45.27	4.38**	2.41*	14.89**	23.07	10.90**	-2.81	-6.23**
21.	EC306741-A6 X Arka Anamika	37.17	-11.01**	-11.79**	-5.67**	28.00	14.13**	11.11**	13.82**
22.	EC306741-A6 X Punjab Padmini	41.37	5.26**	-1.82	4.99**	24.23	6.13**	1.54	-1.49
23.	EC306741-A6 X Hissar Unnat	35.90	-10.92**	-14.79**	-8.88**	32.13	26.51**	19.31**	30.62**
24.	EC306741-A6 X Parbhani Kranti	36.83	-9.65**	-12.58**	-6.51**	31.37	29.44**	27.41**	27.51**
25.	EC306741-A6 X Varsha Uphar	44.13	4.25**	3.76**	12.01**	22.97	-3.50*	-3.77**	-6.64**
26.	IC7952 X Arka Anamika	47.27	2.75**	-6.59**	19.97**	22.23	0.91	-11.77**	-9.62**
27.	IC7952 X Punjab Padmini	45.50	4.29**	-10.28**	15.23**	24.80	21.97**	13.76**	0.81
28.	IC7952 X Hissar Unnat	39.23	-11.90**	-28.46**	-0.42	32.90	43.67**	22.15**	33.74**
29.	IC7952 X Parbhani Kranti	38.93	-13.48**	-23.06**	-1.18	29.60	36.20**	20.33**	20.33**
30.	IC7952 X Varsha Uphar	46.07	-1.07	-8.09**	16.92**	21.83	2.50	-8.01**	-11.25**
31.	IC 3340 X Arka Anamika	37.17	-9.16**	-10.23**	-5.67**	27.00	-8.43**	7.14**	9.76**
32.	IC 3340 X Punjab Padmini	37.13	-3.42**	-8.16**	-5.75**	30.88	32.76**	25.20**	25.20**
33.	IC 3340 X Hissar Unnat	38.20	-3.17**	-5.52**	-3.05**	31.83	23.54**	18.19**	29.40**
34.	IC 3340 X Parbhani Kranti	35.97	-9.90**	-11.05*	-8.71**	29.03	18.02**	18.02**	18.02**
35.	IC 3340 X Varsha Uphar	47.07	-1.00	-3.45**	4.23**	23.10	-4.41**	-6.10**	-6.10**
36.	EC 305651 X Arka Anamika	41.10	31.8**	-0.72	4.31**	22.53	11.00**	-10.58**	-8.40**
37.	EC 305651 X Punjab Padmini	38.87	4.01**	1.57	-1.35	23.07	24.01**	5.81**	-6.23**
38.	EC 305651 X Hissar Unnat	38.03	-0.87	-1.13	-3.47**	28.93	36.69**	7.43**	17.62**
39.	EC 305651 X Parbhani Kranti	38.10	-1.89*	-3.30**	-3.30**	29.60	48.00**	20.33**	20.33**
40.	EC 305651 X Varsha Uphar	44.00	8.91**	3.45**	11.68**	19.20	-1.87	-19.10**	-21.95**

Standard parent –Arka Anamika, RH- Relative Heterosis, HB – Heterobeltiosis, SH- standard Heterosis, HB-heterobeltiosis, SH-Standard Heterosis.
** Significant at 1% level, * significant at 5% level.

Table 2 : Mean and heterosis for single fruit weight and fruit yield per plant in Bhendi.

S. no.	F_1 hybrids	Single fruit weight				Fruits yield per plant			
		Mean(g)	RH%	HB%	SH%	Mean(g)	RH%	HB%	SH%
1.	TCR852 X Arka Anamika	15.43	5.23**	0.87	9.46**	493.79**	37.64**	35.60**	42.43**
2.	TCR852 X Punjab Padmini	16.13	9.13**	5.45**	14.42**	454.98**	34.78**	24.94**	31.23**
3.	TCR852 X Hissar Unnat	17.27	25.58**	12.85**	22.46**	524.84**	51.52**	44.13**	51.38**
4.	TCR852 X Parbhani Kranti	16.40	11.56**	7.19**	16.31**	336.18	-5.41**	-7.68**	-3.03
5.	TCR852 X Varsha Uphar	14.50	2.35*	-5.23**	2.84*	347.97	3.34*	-4.44**	0.37
6.	IC1543 X Arka Anamika	18.50	26.28**	21.18**	31.21**	573.51**	64.25**	62.30**	65.42**
7.	IC1543X Punjab Padmini	17.43	18.06**	14.19**	‘23.64**	542.71**	65.47**	57.32**	56.54**
8.	IC1543 X Hissar Unnat	15.90	15.78**	4.15**	12.77**	430.34	27.78**	24.75**	24.12**
9.	IC1543 X Parbhani Kranti	16.80	14.42**	10.04**	19.15**	488.29	41.49**	40.84**	40.84**
10.	IC1543 X Varsha Uphar	14.77	4.36**	-3.28**	4.73**	354.87	8.48**	2.87	2.36
11.	TCR2086 X Arka Anamika	16.80	23.99**	19.71**	19.15**	473.77**	48.27**	34.07**	36.65**
12.	TCR2086 X Punjab Padmini	13.57	-0.73	-4.91**	--3.78**	313.38	5.04**	0.77	-9.61**
13.	TCR2086 X Hissar Unnat	16.37	29.55**	25.26**	16.08**	511.20**	66.43**	55.56**	47.45
14.	TCR2086 X Parbhani Kranti	17.27	27.12**	22.46**	22.46**	501.93**	58.74**	44.77**	44.77**
15.	TCR2086 X Varsha Uphar	15.43	18.26**	18.11**	9.46**	354.43	19.14**	14.60**	2.23
16.	EC306722-A3 X Arka Anamika	17.30	11.02**	0.96	22.70**	468.29**	42.02**	32.52**	35.07**
17.	EC306722-A3 X Punjab Padmini	14.43	-8.07**	-15.76**	2.36	318.51	3.23	2.42	-8.13**
18.	EC306722-A3 X Hissar Unnat	15.63	6.59**	-8.75**	10.87**	516.98**	62.90**	57.32**	49.11**
19.	EC306722-A3 X Parbhani Kranti	18.53	18.68**	8.17**	31.44**	520.33**	59.41**	50.08**	50.08**
20.	EC306722-A3 X Varsha Uphar	14.37	-4.75**	-16.15**	1.89	331.47	7.73**	7.17**	-4.39*
21.	EC306741-A6 X Arka Anamika	15.40	20.00**	9.74**	9.22**	431.17	36.69**	22.02**	24.36**
22.	EC306741-A6 X Punjab Padmini	14.30	10.42**	0.23	1.42	346.42	17.73**	11.39**	-0.08
23.	EC306741-A6 X Hissar Unnat	16.07	34.83**	31.69**	13.95**	516.25**	70.34**	57.10**	48.90**
24.	EC306741-A6 X Parbhani Kranti	15.70	22.02**	11.35**	11.35**	492.51**	57.80**	42.06**	42.06**
25.	EC306741-A6 X Varsha Uphar	13.00	5.41**	-0.26	-7.80**	298.32	1.68	-3.54	-13.95**
26.	IC7952 X Arka Anamika	15.17	0.78	-5.60**	7.57**	337.17	2.72	-4.58**	-2.75
27.	IC7952 X Punjab Padmini	15.20	0.22	-5.39**	7.80**	376.89	22.74**	21.19**	8.71**
28.	IC7952 X Hissar Unnat	17.23	21.93**	7.26**	22.22**	566.87**	79.46**	72.50**	63.50**
29.	IC7952 X Parbhani Kranti	18.33	21.55**	14.11**	30.02**	542.57**	66.79**	56.50**	56.50**
30.	IC7952 X Varsha Uphar	13.00	-10.65**	-19.09**	-7.80**	283.87	-7.30**	-8.21**	-18.12**
31.	IC 3340 X Arka Anamika	15.70	13.77**	11.88**	11.35**	423.83	23.30**	19.94**	22.25**
32.	IC 3340 X Punjab Padmini	13.50	-2.99**	-5.37**	-4.26**	415.72	28.94**	24.53**	19.91**
33.	IC 3340 X Hissar Unnat	14.80	14.88**	9.09**	4.96**	471.14**	42.24**	41.13**	35.89**
34.	IC 3340 X Parbhani Kranti	16.13	16.63**	14.42**	14.42**	468.40**	37.66**	35.10**	35.10**
35.	IC 3340 X Varsha Uphar	16.23	22.06**	19.66**	15.13**	375.08	16.65**	12.36**	8019**
36.	EC 305651 X Arka Anamika	16.07	0.73	-10.07**	13.95**	362.07	15.22**	2.46	4.43*
37.	EC 305651 X Punjab Padmini	14.20	-11.62**	-20.52**	0.71	327.59	11.78**	5.34*	-5.51**
38.	EC 305651 X Hissar Unnat	17.10	13.75**	-4.29**	21.28**	494.81**	63.91**	50.57**	42.72**
39.	EC 305651 X Parbhani Kranti	16.20	1.36	-9.33**	14.89**	479.57**	54.24**	38.32**	38.32**
40.	EC 305651 X Varsha Uphar	14.27	-7.66**	-20.15**	1.18	273.76	-6.32**	-11.48**	-21.04**

Standard parent –Arka Anamika, RH- Relative Heterosis, HB – Heterobeltiosis, SH- standard Heterosis, HB-heterobeltiosis, SH-Standard Heterosis
** Significant at 1% level, * significant at 5% level.

heterosis for days to first flowering. It varied from -16.50 per cent to 10.20 per cent. It was higher with L_2 x T_1 followed by L_6 x T_4 and L_2 x T_4. Similar researches were early reported by Amutha *et al*. (2007). Heterobeltiosis was negative and significant in twenty eight hybrids. It varied from -23.06 per cent to 6.77 per cent. It was higher with L_6 x T_4 followed by L_6 x T_3 and L_2 x T_1. Negative heterosis is desirable for days to first flowering because this will help the hybrid to mature earlier. Standard heterosis was negative and significant in twenty one hybrids. It ranged from -10.49 per cent to 19.97 per cent. It was higher with L_2 x T_1, L_3 x T_3 followed by L_3 x T_4 and L_5 x T_3. The observed direction and magnitude of standard heterosis for this character added a scope for inclusion of this trait in heterosis breeding programme of bhendi. Higher standard heterosis for this character was earlier reported by Amudha *et al.* (2007), Dabhi *et al.* (2009), Senthilkumar and Sree Parvathy (2010).

Positive heterosis for number of fruits per plant is a desirable character, which is the major yield contributing trait in bhendi. Thirty two hybrids showed positive significant relative heterosis for this trait. It ranges from -15.29 per cent to 48.00 per cent. It was maximum with L_8 x T_4 and L_4 x T_3 and L_6 x T_3. Heterobeltiosis was significant and positive in twenty six hybrids. It ranges from -19.10 per cent to 37.76 per cent. It was maximum with L_2 x T_2 followed by L_5 x T_4 and L_1 x T_1. Standard heterosis for this character ranged from -21.95 per cent to 34.42 percent. It was maximum with L_2 x T_2 followed by L_5 x T_4 and L_1 x T_1. Standard heterosis for this character ranged from -21.95 per cent to 34.42 per cent. Twenty four hybrids portrait positive significant standard heterosis for this character. It was maximum with L_4 x T_3 followed by L_6 x T_3 and L_5 x T_3. There exists a scope for inclusion of this trait in heterosis breeding programme of bhendi. Similar results were reported earlier by Sonia Sood and Pritham Kalia (2001), Senthil Kumar *et al.* (2007), Senthil Kumar and Sreeparvathy (2010), Anitha Vasline (2013).

Among the forty hybrids, twenty nine hybrids registered significant positive relative heterosis for the character single fruit weight. It varied from -11.62 per cent to 34.83 per cent. It was maximum with L_5 x T_3 followed by L_3 x T_3 and L_3 x T_4. Twenty one hybrids recorded positive significant heterobeltiosis for this character. It ranged from -20.52 per cent to 31.69 per cent. It was maximum with L_5 x T_3 and L_3 x T_3 and L_3 x T_4. Standard heterosis for this character was positive and significant for thirty one hybrids. It ranged from -7.80 per cent to 31.44 per cent. It was maximum with L_4 x T_4 followed by L_2 x T_1 and L_6 x T_4. The result is in agreement with the findings of Seema Pandey *et al.* (2008), Senthil Kumar and Sreeparvathy (2010), Anitha Vasline (2013).

Fruit yield is a complex trait. It is the end product of several basic yield components. The standard heterosis of yield is more useful from the practical point of view. A total of thirty four hybrids exhibited positive significant relative heterosis for this character. It ranges from -7.30 per cent to 79.46 per cent. It was maximum with L_6 x T_3 followed by L_5 x T_3 and L_6 x T_4. A total of thirty hybrids demonstrated significant positive heterobeltiosis for this character. It ranged from -11.48 per cent to 72.50 per cent. It was maximum with L_6 x T_3 followed by L_2 x T_1, L_2 x T_2 and L_4 x T_3. A total of twenty seven hybrids recorded positive significant standars heterosis for this character. It ranged from -21.04 per cent to 65.42 per cent. It was maximum with L_2 x T_1 followed by L_6 x T_3 and L_2 x T_2. High amount of heterosis indicates the possibility of exploiting hybrids by utilizing these lines. The hybrids need to be tested on large scale for their commercial values and can be released for commercial cultivation. High heterosis for this trait was reported by Singh *et al.* (2009), Senthilkumar and Sreeparvathy (2010).

From this study, it could be concluded that the hybrids L_2 x T_1, L_3 x T_3, L_3 x T_4 and L_5 x T_3 registered negative significant standard heterosis for days to first flowering and the hybrids namely L_2 x T_1, L_6 x T_3 and L_2 x T_2 recorded higher, positive and significant commercial heterosis for fruit yield per plant and so the above hybrids may be recommended for commercial utilization.

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