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Potential heterosis in bhendi (*Abelmoschus esculentus* (L.) Moench)

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Abstract
The present study was undertaken to identify potential parents and superior cross combinations for yield and its yield attributing traits. Twenty-one hybrids were generated by crossing with seven genotypes, namely AE7- Pudukottai Local (L_1), AE21- Sivagangai Local (L_2), AE13- Dharmapuri Local (L_3), AE6- Karaikudi Local (L_4), AE9- Cuddalore Local (L_5), AE20- Thiruchirappalli Local (L_6) and AE3- Madurai Local (L_7) and three testers Parbhani Kranti (T_1), Arka Anamika (T_2) and Punjab Padmini (T_3) along with parents for studying of heterosis, days to first flowering, plant height, number of branches per plant, fruit length, fruit girth, number of fruits per plant, fruit weight and fruit yield per plant during 2013-2015 at Department of Horticulture, Faculty of Agriculture, Annamalai University, Tamil Nadu, in a Randomized Block Design with three replications. The magnitude of heterosis varied from cross to cross for all characters. The minimum days to first flowering was observed in parent L_4 and cross L_5 x T_1, whereas the highest plant height was found in parent T_3 and cross L_7 x T_3, number of branches per plant in parent L_3 and cross L_7 x T_3, fruit length in parent T_3 and cross L_2 x T_3, fruit girth in parent T_2 and cross L_7 x T_3, number of fruits per plant in L_2 and cross L_2 x T_2, average fruit weight in L_3 and cross L_7 x T_3 and fruit yield per plant in L_3 and cross L_7 x T_3. Thirteen crosses showed significant heterosis for fruit yield per plant, in which maximum heterobeltiosis (36.72 %) and standard heterosis (44.72 %) were found in L_4 x T_2 and relative heterosis (74.24 %) in L_5 x T_2. The highest significant and positive relative heterosis value (38.21 %) and heterobeltiosis value (25.47 %) were expressed by the hybrids L_6 x T_1 and L_7 x T_1, respectively. In contrast, the hybrid L_2 x T_3 showed the highest and positive standard heterosis value (62.86 %) for number of fruits per plant.

Keywords: Bhendi hybrids, heterosis, growth attributes, yield

Introduction
Bhendi (*Abelmoschus esculentus* (L.) Moench), belonging to the family Malvaceous, is an important vegetable crop of the tropics and subtropics. Bhendi is particularly valued for its tender, delectable green fruits, which are cooked, canned, and consumed in various forms throughout the country, and for accounting for approximately 60% of fresh vegetable exports. India is the largest producer of bhendi, covering an area of 3.91 lakh ha with an annual production of 39.7 lakh tones. It has good nutritional value, particularly vitamin C (30 mg/100 g), calcium (90 mg/100 g) and iron (1.5 mg/100 g) in the edible fruit. It is a potential exporter earner accounting for 13% of the export of fresh vegetables. All sorts of plant development activities through breeding envisage an eventual enhancement in genetic capacity for yield. Since yield is polygenically controlled and highly influenced by the environment, selection based on yield alone is ineffective. Hence, the breeder develops into the proposition of selecting for high yield indirectly through yield associated and highly heritable characters after eliminating environmental components of phenotypic variance (Prakash *et al*., 2013) [12].
Hybridization has been the most successful method of enhancing vegetable crops productivity. The selection of genetically superior and suitable genotypes is the most important stage from the standpoint of hybridization of vegetable crops to develop new genotypes with desirable characters. A hybridization-based breeding technique would be preferable for breaking yield restrictions in existing open-pollinated bhendi varieties. Heterosis breeding has been the most successful approach to increasing productivity in cross-pollinated vegetable crops (Medagam *et al*., 2012) [8]. Commercial exploitation of hybrid vigor can be easy in Bhendi because of ease of emasculation, very high per cent fruit set rates and enormous seeds content per fruit. Being an often-cross-pollinated crop, outcrossing to the extent of 5%~9% by insects is reported, which renders considerable genetic diversity (Duggi *et al*., 2013) [3]. Hence, the first step in bhendi improvement should involve the evaluation of the germplasm for genetic variability.

As a second step, crosses must be generated using a suitable mating design to determine the extent of heterosis for specific economic traits and inheritance patterns of desirable attributes, which in turn, would help in deciding the breeding strategies as well as identifying potential parents and crosses for further use in breeding programmed (Singh and Singh, 2012) [18].

Material and Methods

The experimental material consisted of 21 F_1's, involving 7 lines *viz.*, AE7- Pudukottai Local (L_1), AE21- Sivagangai Local (L_2), AE13- Dharmapuri Local (L_3), AE6- Karaikudi Local (L_4), AE9- Cuddalore Local (L_5), AE20- Thiruchirappalli Local (L_6) and AE3- Madurai Local (L_7) and 3 testers Parbhani Kranti (T_1), Arka Anamika (T_2) and Punjab Padmini (T_3). The present investigation was carried out at the Department of Horticulture, Faculty of Agriculture, Annamalai University, Tamil Nadu, in a Randomized Block Design with three replications during 2013-2015. All the recommended agronomic practices and plant protection measures were followed during experimentation. A row to row spacing of 60 cm and plant to plant spacing of 30 cm was adopted. Data was recorded on ten randomly selected plants per entry per replication on yield and yield component characters: days to first flowering, plant height, number of branches per plant, fruit length, fruit girth, number of fruits per plant, and average fruit weight and fruit yield per plant. The magnitude of heterosis was calculated as per the standard procedure and the significance of heterosis was tested using the formula suggested by Wynne *et al.* (1970) [23]. Heterobeltiosis was computed as deviation of mean performance of F_1 from that of better parent (BP). The estimates of economic heterosis were computed as deviation of mean performance of F_1 hybrid from that of the check parent T_2 (Arka Anamika). The magnitude of heterosis was calculated and expressed as per cent.

Result and discussion

The mean values of 21 F_1 crosses and 10 parents and heterosis over better parent (BP) and mid parent (MP) and standard parent (SP) are presented in Table 1. The data for days to first flowering showed that the mean of parents ranged from 46.28 cm in L_4 to 56.53 cm in L_6, while in the case of crosses, the ranges varied from 38.48 cm in L_5 x T_1 to 48.59 cm in L_7 x T_1. Negative heterosis is desirable for days to first flowering because this will help the hybrid mature earlier. Twenty hybrids exhibited negative and significant heterobeltiosis, out of which the highest negative heterobeltiosis was found in L_5 x T_1 (-29.04 %) followed by L_5 x T_2 (-25.63 %) and L_3 x T_1 (-24.72 %) for days to first flowering. L_4 x T_3 (-3.61 %) was the only cross that was non-significant heterobeltiosis. Relative heterosis was negative and significant in sixteen crosses and positive in one cross which was significant. The highest relative heterosis (-16.86%) was exhibited by L_5 x T_1. The results of the present investigation are in accordance with the findings of Hosamani *et al.* (2008) [4], Kumar and Sreeparvathy (2010) [16] and Kishor *et al.* (2013) [3], who have also reported heterosis for days to first flowering.

The overall mean value of plant height ranged from 125.36 (L_6) to 175.51 (T_3), and mean values of crosses ranged from 130.84 (L_4 x T_2) to 179.67 (L_7 x T_3). Of all the crosses, nine crosses showed positive and significant relative heterosis, three for heterobeltiosis and nine showed standard heterosis. However, the highest value for plant height for relative heterosis and heterobeltiosis was exhibited by L_6 x T_2 (21. 82%), (12.63%) and standard heterosis by L_7 x T_3 (21.71%). Similar results were recorded by Ahmed *et al.* (1999) [2], Rewale *et al.* (2003) [14], Singh *et al.* (2004) [19], Hosamani *et al.* (2008) [4], Kumar (2011), Kumar and Kumar (2012) [11] and Kishor *et al.* (2013) [3] who have also found similar results for this character.

The parental mean value of the number of branches per plant ranged from -0.75 (T_2) to 1.17 (T_3), and mean values of crosses ranged from -1.81 in L_2 x T_3 to 1.29 in L_7 x T_3. Out of 21 crosses, six crosses showed significant heterobeltiosis. They have a greater number of branches per plant than their respective parent. Among 21 hybrids, ten crosses showed positive and significant heterosis, whereas nine crosses for significant standard heterosis. The highest value for relative heterosis (120.26 %), heterobeltiosis (99.29 %) as well as standard heterosis (90.80 %) was exhibited by L_7 x T_3. These findings are in agreement with those of Pawar *et al.* (1999) [10], Saha and Kabir (2001) [15], Rewale *et al.* (2003) [14], Ahlawat (2004) [1], Hosamani *et al.* (2008) [4], Kumar (2011), Kumar and Kumar (2012) [11] and Kishor *et al.* (2013) [3] for this character.

The data for fruit length showed that the mean of parents ranged from 10.32 cm in L_2 to 20.43 cm in T_3, while in crosses, the ranges varied from 16.26 cm in L_3 x T_2 to 23.51 cm in L_2 x T_3. Among all the crosses fourteen crosses showed significant relative heterosis, ten crosses for significant heterobeltiosis and eighteen crosses for significant standard heterosis. However, in crosses, L_2 x T_2 showed the highest positive significant relative heterosios (59.94 %), L_5 x T_2 for significant heterobeltiosis (31.48%) and L_2 x T_3 for significant standard heterosis (44.58%), respectively. Similar types of result have also been reported by Singh *et al.* (1996), Ahmed *et al.* (1999) [2], Saha and Kabir (2001) [15], Shobha (2002) [17], Rewale *et al.* (2003) [14], Murugan (2004) [9], Hosamani *et al.* (2008) [4], Kumar and Sreeparvathy (2010) [16], Kumar and Kumar (2012) [11] and Kishor *et al.* (2013) [3] in bhendi who have reported significant standard heterosis for fruit length.

The overall mean value of fruit girth for parents ranged from 4.50 cm (L_2) to 6.40 cm (T_2), and mean value of crosses was ranging from 4.70 cm (L_3 x T_2) to 6.83 cm (L_7 x T_3). Only four hybrids showed significant heterosis, which was negative values. Out of 21 hybrids, five hybrids showed significant relative heterosis, nine crosses for significant heterobeltiosis and thirteen hybrids for significant standard heterosis. Among all the hybrids, L_7 x T_3 was the only hybrid that exhibited positive and significant relative heterosis (20.88 %). A similar result was given by Saha and Kabir (2001) [15], Rewale *et al.* (2003) [14], Singh *et al.* (2004) [19], Hosamani *et al.* (2008) [4] and Kishor *et al.* (2013) [3].

The parental mean value of number of fruits per plant ranged from 12.43 in L_6 to 21.41 in L_2, while mean value of hybrids varied from 19.38 (L_6 x T_3) to 31.58 (L_2 x T_3), respectively. Out of 21 crosses, eight crosses exhibited significant heterobeltiosis, eleven for significant relative heterosis and twelve hybrids for standard heterosis. The highest significant relative heterosis, heterobeltiosis and standard heterosis were found in L_6 x T_1 (38.21 %), L_7 x T_1 (25.47 %) and L_2 x T_3 (62.86 %), respectively. This type of heterosis also has been reported for this trait by Lal *et al.* (1975) [7] and Singh and Singh (1979) [21]. In contrast, negative as well as positive heterotic effects were also reported for this trait by Pawar *et*

al. (1999 [10] Rewale *et al*. (2003) [14], Ahlawat (2004) [1], Hosamani *et al*. (2008) [4], Kumar (2011), Kumar and Kumar (2012) [11] and Kishor *et al*. (2013) [3].

The parental mean value of average fruit weight ranged from 16.65 g in T_1 to 24.53 g in L_3, and mean value crosses ranged from 15.16 g in L_1 x T_3 to 24.41 g in L_7 x T_3. Six crosses

Table 1: Performance of parents crosses for different characters of bhendi and heterosis

S No.	Parent/ Crosses	Days to first flowering				Plant height (cm)				Number of branches per plant				Fruit length (cm)			
		Mean	MP	BP	SP	Mean	MP	BP	SP	Mean	MP	BP	SP	Mean	MP	BP	SP
1	L_1	56.23				134.61				3.18				20.19			
2	L_2	53.26				145.63				4.97				10.32			
3	L_3	51.34				131.66				7.16				16.39			
4	L4	46.28				137.41				3.39				18.52			
5	L_5	54.23				147.69				4.03				15.20			
6	L_6	56.53				125.36				5.36				13.34			
7	L_7	54.61				160.74				3.75				20.40			
8	T_1	38.34				152.26				3.32				18.35			
9	T_2	40.28				147.63				3.91				16.26			
10	T_3	44.62				175.51				3.03				20.43			
Mean of parent		49.57				145.85				4.21				16.94			
1	L_1 X T_1	45.85	-7.26 **	-22.01 **	8.87 **	156.65	9.21 **	2.88 **	6.11 **	3.91	20.31 **	17.77 *	-0.09	18.37	-4.70	9.05 *	12.93 *
2	L_1 X T_2	43.09	-10.70 **	-23.37 **	6.98 **	140.28	-0.59	-4.98 **	-4.98 **	3.01	-15.13 **	-23.08 **	-23.08 **	20.35	11.62 **	0.76	25.11 **
3	L_1 X T_3	45.63	-9.51 **	-18.85 **	13.28 **	160.94	3.79 **	-8.30 **	9.02 **	5.12	64.81 **	61.01 **	30.83 **	20.39	0.39	-0.20	25.37 **
4	L_2 X T_1	40.36	-11.87 **	-24.21 **	0.22	148.61	-0.22	-2.40 *	0.67	4.94	19.15 **	-0.60	26.15 **	19.60	36.72 **	6.79	20.50 **
5	L_2 X T_2	41.55	-11.16 **	-21.99 **	3.15	140.36	-4.28 **	-4.92 **	-4.92 **	5.32	19.82 **	7.11	35.95 **	21.26	59.94 **	30.70 **	30.70 **
6	L_2 X T_3	44.65	-8.76 **	-16.16 **	10.87 **	169.68	5.67 **	-3.33 **	14.94 **	4.16	4.00	-16.24 **	6.30	23.51	52.95 **	15.09 **	44.58 **
7	L_3 X T_1	38.65	-13.81 **	-24.72 **	-4.04	142.82	0.61	-6.20 **	-3.26 **	5.11	-2.42	-28.58 **	30.66 **	18.55	6.80	1.11	14.08 **
8	L_3 X T_2	42.66	-6.88 **	-16.91 **	5.91 *	136.67	-2.13 *	-7.42 **	-7.42 **	3.63	-34.44 **	-49.30 **	-7.24	16.26	-0.40	-0.79	-0.00
9	L3 X T_3	43.26	-9.84 **	-15.74 **	7.40 **	153.94	0.23	-12.29 **	4.27 **	4.79	-6.08	-33.15 **	22.32 **	21.36	16.00 **	4.54	31.32 **
10	L4 X T1	42.75	1.02	-7.64 **	6.13 *	149.25	3.05 **	-1.98	1.10	3.76	12.13 *	11.02	-3.92	19.28	4.57	4.09	18.53 **
11	L4 X T2	43.73	1.05	-5.51 *	8.58 **	130.84	-8.19 **	-11.37 **	-11.37 **	3.36	-7.95	-14.14 *	-14.14 *	20.33	16.88 **	9.76 *	24.98 **
12	L4 X T3	44.61	-1.84	-3.61	10.77 **	150.28	-3.95 **	-14.37 **	1.80	6.48	101.87 **	91.34 **	65.59 **	23.37	19.98 **	14.37 **	43.68 **
13	L5 X T1	38.48	-16.86 **	-29.04 **	-4.45	142.76	-4.81 **	-6.24 **	-3.29 **	4.22	14.83 **	4.71	7.84	20.33	21.19 **	10.79 *	25.01 **
14	L5 X T2	40.33	-14.65 **	-25.63 **	0.13	136.35	-7.66 **	-7.67 **	-7.64 **	3.57	-10.20 *	-11.50	-8.86	21.38	35.93 **	31.48 **	31.48 **
15	L5 X T3	43.84	-11.30 **	-19.16 **	8.85 **	169.93	5.16 **	-3.18 **	15.11 **	6.33	79.33 **	57.15 **	61.84 **	23.24	30.45 **	-5.82	42.90 **
16	L6 X T1	46.58	-1.80	-17.60 **	15.66 **	144.53	4.12 **	-5.07 **	-2.10	3.68	-15.25 **	-31.36 **	-6.05	20.28	28.01 **	10.54 *	24.72 **
17	L6 X T2	46.67	-3.59 *	-17.45 **	15.87 **	166.27	21.82 **	12.63 **	12.63 **	4.37	-5.72	-18.42 **	11.67	17.23	16.41 **	5.94	5.94
18	L6 X T3	44.25	-12.52 **	-21.73 **	9.86 **	156.83	4.25 **	-10.65 **	6.23 **	6.13	46.21 **	14.50 **	56.73 **	20.32	20.32 **	-0.55	24.92 **
19	L7 X T1	48.59	4.54 **	-11.03 **	20.63 **	150.92	-3.57 **	-6.11 **	2.23 *	3.75	6.13	0.09	-4.17	19.37	-0.02	-5.03	19.10 **
20	L7 X T2	41.40	-12.73 **	-24.18 **	2.80	145.61	-5.56 **	-9.41 **	-1.37	3.82	-0.26	-2.39	-2.39	17.30	-5.64	-15.20**	6.35
21	L7 X T3	46.17	-6.94 **	-15.46 **	14.63 **	179.67	6.87 **	2.37 *	21.71 **	7.47	120.26 **	99.29 **	90.80 **	22.45	9.98 **	9.98 **	38.04 **
Mean of crosses		43.39				151.10				4.62				20.21			

* Significant at 5% level, ** Significant at 1 % level

S No.	Parent/ crosses	Fruit girth (cm)				Number of fruits per plant				Average fruit weight (g)				Fruit yield per plant (g)			
		Mean	MP	BP	SP	Mean	MP	BP	SP	Mean	MP	BP	SP	Mean	MP	BP	SP
1	L_1	6.16				27.28				18.73				391.25			
2	L_2	4.50				29.41				18.83				502.39			
3	L_3	5.37				31.50				24.53				322.36			
4	L4	5.07				27.54				19.57				437.55			
5	L_5	5.77				18.34				18.51				232.34			
6	L_6	5.45				12.43				22.92				192.73			
7	L_7	5.27				23.43				18.33				439.32			
8	T_1	6.00				24.14				16.65				328.08			
9	T_2	6.40				19.39				21.14				413.37			
10	T_3	6.03				22.48				18.47				340.60			
Mean of parent		5.60				23.59				19.77				19.77			
1	L_1 X T_1	5.20	-14.47 **	-15.58 *	-18.71 **	24.27	-5.58	-11.02	25.16 **	15.65	-11.55 *	-16.48 *	-25.97 **	470.25	30.75 **	20.19 **	13.76 **
2	L_1 X T_2	5.11	-18.61 **	-20.11 **	-20.11 **	22.30	-4.46	-18.27 **	14.97	17.14	-14.02 **	-18.91 **	-18.91 **	490.42	21.90 **	18.64 **	18.64 **
3	L_1 X T_3	5.27	-13.54 **	-14.45 *	-17.61 **	26.54	6.67	-2.72	36.83 **	15.16	-18.50 **	-19.07 **	-28.28 **	506.50	38.42 **	29.46 **	22.53 **
4	L_2 X T_1	5.60	6.67	-6.67	-12.45	26.42	-1.32	-10.17	36.23 **	16.91	-4.66	-10.18	-20.00 **	446.45	7.52 **	-11.14 **	8.00 **
5	L_2 X T_2	5.03	-7.74	-21.42 **	-21.42 **	24.48	0.32	-16.76 *	26.23 **	19.34	-3.21	-8.50	-8.50	510.36	11.46 **	1.59 **	23.47 **
6	L_2 X T_3	5.10	-3.13	-15.42 *	-20.27 **	31.58	21.74 **	7.39	62.86 **	18.28	-1.98	-2.90	-13.52 *	587.61	39.41 **	16.96 **	42.15 **
7	L_3 X T_1	5.30	-6.77	-11.67	-17.14 **	24.33	29.28 **	0.78	25.47 **	18.19	-11.64 *	-25.84 **	-13.94 *	431.11	32.56 **	31.40 **	4.29 **
8	L_3 X T_2	4.70	-20.11 **	-26.52 **	-26.52 **	20.51	24.75 **	5.77	5.76	16.24	-28.89 **	-33.80 **	-23.18 **	442.39	20.26 **	7.02 **	7.02 **
9	L_3 X T_3	5.10	-10.53	-15.42 *	-20.27 **	21.36	-18.73 **	-4.98	10.14	19.13	-11.00 *	-21.99 **	-9.48	396.48	19.61 **	16.41 **	-4.09 **
10	L_4 X T_1	5.27	-4.79	-12.17	-17.61 **	25.54	-1.16	-7.26	31.68 **	18.27	0.90	-6.63	-13.56 *	412.29	7.70 **	-5.77 **	-0.26
11	L_4 X T_2	5.79	1.05	-9.43	-9.43	29.36	25.12 **	6.62	51.39 **	21.28	4.56	0.68	0.68	598.24	40.61 **	36.72 **	44.72 **
12	L_4 X T_3	5.62	1.26	-6.80	-12.14	20.29	-18.85 **	-26.30 **	4.64	22.23	16.89 **	13.61 *	5.17	381.39	-1.98 **	-12.84 **	-7.74 **
13	L_5 X T_1	5.83	-0.93	-2.83	-8.86	24.34	14.60 *	0.84	25.51 **	19.33	9.98	4.45	-8.55	400.34	42.87 **	22.02 **	-3.15 **
14	L_5 X T_2	6.00	-1.37	-6.20	-6.20	24.24	28.49 **	25.01 *	25.01 **	18.58	-6.26	-12.10 *	-12.10 *	562.54	74.24 **	36.09 **	36.09 **
15	L_5 X T_3	5.77	-2.20	-4.31	-9.80	22.39	9.70	-0.39	15.45	21.96	18.76 **	18.64 **	3.88	441.24	54.03 **	29.55 **	6.74 **
16	L_6 X T_1	5.42	-5.33	-9.67	-15.27 *	25.27	38.21 **	4.70	30.30 **	18.83	-4.79	-17.82 **	-10.90	447.40	71.81 **	36.37 **	8.23 **
17	L_6 X T_2	6.12	3.32	-4.33	-4.33	20.37	28.02 **	5.04	5.04	19.87	-9.81 *	-13.31 *	-6.01	456.40	50.60 **	10.41 **	10.41 **
18	L_6 X T_3	5.13	-10.63	-14.93 *	-19.80 **	19.38	11.02	-13.79	-0.09	23.43	13.21 **	2.23	10.83	353.43	32.54 **	3.77 **	-14.50 **
19	L_7 X T_1	5.37	-4.70	-10.50	-16.05 *	30.28	27.33 **	25.47 **	56.15 **	20.50	17.23 **	11.86	-3.01	500.18	30.36 **	13.85 **	21.00 **
20	L_7 X T_2	5.33	-8.63	-16.68 *	-16.68 *	20.25	-5.44	-13.59	4.40	18.56	-5.94	-12.19 *	-12.19 *	410.33	-3.76 **	-6.60 **	-0.74
21	L_7 X T_3	6.83	20.88 **	13.27	6.77	21.25	-7.41	-9.29	9.59	24.42	32.73 **	32.21 **	15.53 *	386.35	-0.93 *	-12.06 **	-6.53 **
Mean of crosses		5.47				24.04				19.20				19.20			

* Significant at 5% level, ** Significant at 1 % level

Showed significant heterosis for average fruit weight, out of which maximum relative heterosis (32.73 %), heterobeltiosis (32.21 %) and standard heterosis (15.53 %) was reported in L_7 x T_3. Similar results were reported by Singh *et al.* (2004) [19], Hosamani *et al*. (2008) [4], Kumar and Sreeparvathy (2010) [16], Kumar (2011), Kumar and Kumar (2012) [11] and Kishor *et al.* (2013) [3] for average fruit weight.

The overall mean value of fruit yield per plant ranged from 192.73 g (L_6) to 502.39 g (L_2), while in the case of crosses mean value of hybrids for fruit yield per plant was varied from L_6 x T_3 (353.43 g) to L_4 x T_2 (598.24 g). Nineteen hybrids showed significant heterosis for fruit yield per plant, out of which maximum relative heterosis (74.24 %) was found in L_5 x T_2. Similarly, the maximum heterobeltiosis (36.72 %) and standard heterosis (44.72 %) were exhibited by L_4 x T_2. Similar types of results were reported by Rewale *et al*. (2003) [14], Singh *et al*. (2004) [19], Hosamani *et al.* (2008) [4], Kumar and Sreeparvathy (2010) [16], Kumar (2011), p Kumar and Kumar (2012) [11] and Kishor *et al.* (2013) [3] for fruit yield per plant (g). Overall, the results discussed above are quite indicative of the fact that hybrids of bhendi have great potential for maximizing fruit yield.

Table 2: Performance of top parents and hybrids based on mean value

Characters	Parents position			Crosses position (F_1)		
	I	II	III	I	II	III
Days to first flowering	T_1	T_2	T_3	L_5 X T_1	L_3 X T_1	L_5 X T_2
Plant height	T_3	L_7	T_1	L_7 X T_3	L_5 X T_3	L_6 X T_2
Number of branches per plant	L_3	L_6	L_2	L_7 X T_3	L_4 X T_3	L_5 X T_3
Fruit length	T_3	L_7	L_1	L_2 X T_3	L_4 X T_3	L_5 X T_3
Fruit girth	T_2	L_1	T_3	L_7 X T_3	L_6 X T_2	L_5 X T_2
Number of fruits per plant	L_2	L_4	L_1	L_2 X T_3	L_7 X T_1	L_4 X T_2
Average fruit weight	L_3	L_6	T_2	L_7 X T_3	L_6 X T_3	L_4 X T_3
Fruit yield per plant	L_2	L_7	L_4	L_4 X T_2	L_2 X T_3	L_5 X T_2

Based on the overall performance of all parents and hybrids it may be concluded that among the parents L_2 (Sivagangai Local), L_7 (Madurai Local) and T_2 (Arka Anamika) were found better for fruit yield and among the crosses L_4 x T_2 (Karaikudi Local x Arka Anamika) and L_2 x T_3 (Sivagangai Local x Punjab Padmini) were found better for fruit yield per plant (Table 2). The above parents and hybrids may be utilized to develop the F_1 hybrids for commercial production and may be recommended for commercial cultivation.

Conflict of Interest

The authors declare that they have no conflict of interest

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