

Heterosis Studies in Okra (*Abelmoschus esculentus* (L.) Moench)

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ABSTRACT

Heterosis in Okra was studied in set of 10 x 1 diallel cross excluding reciprocals. Analysis of variance indicated highly significant differences for all the characters, suggesting the presence of considerable genetic diversity among the materials studied. The magnitude of heterosis varied from cross to cross for all the characters. Degree of heterosis was higher for number of branches per plant, yield per plant, number of pods per plant and plant height; moderate for first fruiting node, pod girth, pod length and number of nodes per plant; while days to 50 per cent flowering and days to first picking exhibited low heterosis.

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INTRODUCTION

Okra (*Abelmoschus esculentus* (L.)) is one of the most important vegetables grown in the country. It is grown almost throughout the country. With the ease in fruit set and good number of seeds per fruit, okra, a commercially grown vegetable crop, can be well exploited for hybrid seed production. The extent of heterosis in okra in relation to yield and its components have earlier been reported by Kumbhani *et al.* (1993), Singh and Mandal (1993), Dhankhar *et al.* (1996) and Wankhede *et al.* (1997).

MATERIALS AND METHODS

Ten promising lines of okra namely, Kheda-11, Vadodara-4, Vadodara-7, Vadodara-1, Bhavnagar-8, Pusa Sawani, DL-1-87-5, HRB-55, JO-5 and Chhodavadi were selected for study. These were crossed in all possible combinations excluding reciprocals during *kharif*, 1997. The 55 entries, comprising of ten parents and their 45 F₁s, were planted in a randomised block design with three replications at the Vegetable Research Station, Junagadh during summer 1998. Each entry was represented by a single row of 10

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plants, spaced at 22.5 x 60 cm. The normal agronomic and plant protection practices were followed. The observation on five randomly selected plants in a row, excluding border ones, were recorded for eleven characters viz., days to 50 per cent flowering days to first picking, first fruiting node, pod girth, pod length, number of pods per plant, number of nodes per plant, internodal length, plant height, number of branches per plant and yield per plant. The results pertaining to heterosis over mid-parent and better parent for all the crosses were calculated as per cent deviation from the mid-parent and better parent values, respectively.

RESULTS AND DISCUSSION

Significant differences among parents and hybrids were observed for all the characters studied (Table 1). Significant parental differences were also observed for all the characters except days to 50 per cent flowering and days to first picking. Parents Vs hybrids variances were significant for first fruiting node, pod length, pod girth and internodal length. Heterosis in percentage over mid parent (MP) and better parent (BP) for various characters of heterotic crosses are presented in (Table 2). Those characters and crosses having desirable significant heterosis

TABLE 1

Analysis of variance for experimental design for different characters in okra.

Character	Replications	Genotypes	Parents	Hybrids	Parents Vs Hybrids	Error
	2	54	9	44	1	108
Days to 50% flowering	5.922	22.936**	25.111	23.011**	0.031	13.051
Days to first picking	9.422	23.182**	26.163	23.085	0.625	13.548
First fruiting node	0.105	1.863**	1.615**	1.947**	0.382**	0.027
Pod length	0.017	1.392**	1.438**	1.411**	0.121**	0.016
Pod girth	0.029	0.190**	0.241**	0.180**	0.208**	0.024
No. of pods per plant	3.445	4.934**	6.083**	4.690**	5.363	1.428
No. of nodes per plant	0.015	9.377**	9.562**	9.552**	0.008	3.580
Internodal length	0.007	0.347**	0.337**	0.350**	0.305**	0.016
Plant height	51.063	359.194**	555.512**	327.195**	0.385	18.810
No. of branches per plant	0.041	0.463**	0.287*	0.509**	0.012	0.144
Yield per plant	4360.250**	1993.870**	1910.583**	2056.137**	3.500	323.380

*, ** indicates significance at 5 and 1 per cent, respectively.

TABLE 2

Heterosis in percentage over mid parent (MP) and better parent (BP) for various characters in okra.

Crosses	Days to 50% flowering		Days to first picking		First fruiting node		Pod length	
	MP	BP	MP	BP	MP	BP	MP	BP
Kheda -11 x Pusa Sawani	-1.41	5.26	0.65	7.59	-1.87	12.89**	-0.06	-0.66
Vadodara-4 x Bhavnagar-8	-6.67	-3.45	-4.91	-1.90	2.46	4.20*	-3.60**	-4.67**
Vadodara-4 x Pusa Sawani	-2.88	1.50	7.59	12.41**	7.46**	11.31**	8.28**	3.91**
Vadodara-4 x JO-5	3.18	5.80	6.49	9.33	1.50	8.20**	-0.48	-5.73**
Vadodara-7 x Pusa Sawani	0.01	3.01	-0.98	4.14	5.58**	18.44**	4.34**	1.82**
Vadodara-7 x HRB-55	-2.94	0.76	-3.56	0.01	2.73	12.23**	1.87*	-3.03**
Vadodara-7 x Chhodavadi	6.31	13.48**	4.45	10.00	-1.35	2.81	-1.37	-2.37**
Vadodara-1 x DL-1-87-5	3.23	5.88	-2.93	-1.97	-10.23**	-2.37	-0.55	-4.07**
Bhavnagar-8 x DL-1-87-5	3.09	10.29	5.00	10.53	-16.48**	-13.27**	-4.37**	10.89**
Bhavnagar-8 x JO-5	2.39	8.70	3.14	9.33	5.14**	14.11**	-1.54**	-7.71**
Pusa Sawani x HRB-55	-3.03	-2.29	-2.04	-0.69	3.56*	5.24	7.88**	5.17**
HRB-55 x JO-5	-4.09	-1.53	-1.67	-1.34	-4.26**	0.08	0.69	-0.52
S. E. (d) ±	2.55	2.95	2.60	3.01	0.12	0.13	0.09	0.10

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

Table-2 (contd.)

Crosses	Pod girth		No. of pods per plant		No. of nodes per plant		Internodal length	
	MP	BP	MP	BP	MP	BP	MP	BP
Kheda -11 x Pusa Sawani	6.11**	1.69	28.66**	10.99	4.81	-6.11	1.82	6.27**
Vadodara-4 x Bhavnagar-8	-2.37	-2.98	0.31	-1.83	-0.90	-4.87	1.30	3.25*
Vadodara-4 x Pusa Sawani	0.80	-5.73**	17.34*	11.54	8.89	7.22	-6.77**	-4.33**

1.	2.	3.	4.	5.	6.	7.	8.	9.
Vadodara-4 x JO-5	1.69	-3.33	2.44	-7.80	-5.97	-7.45	0.82	1.76
Vadodara-7 x Pusa Sawani	4.17	1.50	-1.22	-10.99	-2.42	-10.28	2.02	2.82
Vadodara-7 x HRB-55	0.13	-3.75**	1.56	-6.86	5.68	0.90	-2.68	-0.33
Vadodara-7 x Chhodavadi	-0.42	-3.30	16.81*	2.59	7.21	6.17	1.33	3.87*
Vadodara-1 x DL-1-87-5	1.19	-4.83*	-0.59	-10.58	-1.49	-4.49	-3.48*	-0.34
Bhavnagar-8 x DL-1-87-5	5.73**	-3.48	4.05	-4.76	4.27	2.80	2.03	4.82**
Bhavnagar-8 x JO-5	2.73	-1.74	-8.29	-19.02**	6.22	3.55	1.93	4.88**
Pusa Sawani x HRB-55	0.87	-0.53	22.69**	20.33*	8.96	4.72	-3.98**	-0.88
HRB-55 x JO-5	-0.52	-3.56	6.32	-1.46	11.34	10.36	-8.76**	-2.30
S. E. (d) =	0.11	0.13	0.85	0.98	1.34	1.55	0.09	0.10

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

Table-2 (contd.)

Crosses	Plant height		No. of branches per plant		Yield per plant	
	MP	BP	MP	BP	MP	BP
Kheda -11 x Pusa Sawani	10.27**	-8.12*	12.12	5.71	41.43**	35.42**
Vadodara-4 x Bhavnagar-8	-8.26*	-12.86**	-5.8	-15.15	14.89	5.37
Vadodara-4 x Pusa Sawani	5.08	2.84	18.03	2.86	22.81**	19.19*
Vadodara-4 x JO-5	-13.31**	-17.89**	43.40**	40.74**	25.28**	18.29*
Vadodara-7 x Pusa Sawani	-8.27*	-19.28**	6.49	-2.38	16.21*	8.49
Vadodara-7 x HRB-55	-10.66**	-18.01**	-6.33	-11.90	14.84*	5.53
Vadodara-7 x Chhodavadi	10.01*	5.84	8.05	4.44	25.76**	13.31
Vadodara-1 x DL-1-87-5	-1.48	-7.33	-4.35	-15.38	26.88**	6.88
Bhavnagar-8 x DL-1-87-5	0.37	-4.63	-5.56	-12.82	22.02**	12.06
Bhavnagar-8 x JO-5	-4.24	-13.59**	0.01	-9.09	18.03*	12.89
Pusa Sawani x HRB-55	2.83	-1.83	19.44	16.22	29.83**	27.63**
HRB-55 x JO-5	4.92	-2.97	6.25	-8.11	22.82**	21.43**
S. E. (d) =	3.07	3.54	0.24	0.28	12.72	14.68

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

over mid parent but non-significant over better parent are omitted from the discussion for brevity purpose. For days to 50 per cent flowering and days to first picking none of the crosses produced the desired significant negative heterobeltiosis. The cross combination Vadodara-4 x Bhavnagar-8 exhibited highest negative and non-significant heterobeltiosis for days to 5 per cent flowering (-3.45 per cent) and for days to first picking, cross Vadodara-1 x DL-1-87-5 (-1.97 per cent) was highest. Similar results were obtained by Singh *et al.* (1975) and Pratap *et al.* (1981).

The early flowering at a lower internodal level is helpful in increasing the number of fruits per plant and therefore, the hybrids exhibiting negative heterosis are considered favourable for the first fruiting node. Out of 12 crosses, 5 exhibited desired heterosis over mid parent. One cross, Bhavnagar-8 x DL-1-87-5 (-13.27 per cent) exhibited negative desired heterobeltiosis. These results are in close agreement with those of Singh *et al.* (1975) and Poshia and Shukla (1986). For pod length, four hybrids exhibited positive significant heterosis over mid parent of which two viz., Pusa Sawani x HRB-55 (5.17 per cent) and Vadodara-4 x Pusa Sawani (3.91 per cent) showed significant heterobeltiosis. Two crosses, Kheda-11 x Pusa Sawani (6.11 per cent) and Bhavnagar-8 x DL-1-87-5 (5.75 per cent) exhibited significant positive heterosis over mid parent for pod girth. The consumers do not prefer thicker pods. However, pod girth and pod length directly contributes towards the total yield and hence the positive value increases the total yield. These results are in close agreement with those of Singh *et al.*, (1975) and Poshia and Shukla (1986). In case of number of pods per plant, only one cross Pusa Sawani x HRB-55 (20.23 per cent) exhibited positive significant heterobeltiosis.

Number of pods per plant is a single major factor governing the yield. Similar results for pod number have been reported by Poshia and Shukla (1986) and Wankhede *et al.* (1997). None of the crosses exhibited significant positive heterobeltiosis for number of nodes per plant. The cross combination Vadodara-4 x Pusa Sawani (-4.33 per cent) exhibited highest negative heterobeltiosis for internodal length. More number of fruiting nodes on main stem with shorter distance and more height will be helpful in increasing the number of pods per plant which in turn gives more yield per plant. Singh *et al.* (1975) and Poshia and Shukla (1986) reported heterosis in desirable direction for these characters. Two cross combinations Kheda-11 x Pusa Sawani (10.27 per cent) and Vadodara-7 x Chhodavadi (10.01 per cent) exhibited positive significant heterosis over mid parent for plant height. Poshia and Shukla (1986) reported heterosis for plant height in Okra. One cross Vadodara-4 x JO-5 (40.74 per cent) exhibited positive significant heterobeltiosis for number of branches per plant. Positive heterosis for this character was reported by Singh and Mandal (1993) and Dhankhar *et al.* (1996).

Out of the 45 hybrids, 26 expressed positive heterosis over mid-parental values, of which 12 exhibited significant heterosis for yield per plant. Five crosses exhibited positive significant heterobeltiosis for this character. The cross combination Kheda-11 x Pusa Sawani showed the highest heterosis (41.43 per cent) for yield per plant. Manifestation of heterosis by this particular cross combination was realised for days to 50 per cent flowering, first fruiting node, pod girth, number of pod per plant, number of nodes per plant, plant height and number of branches per plant. It was found that heterosis for yield per plant is mainly due to increased pod number per plant. Pratap *et al.* (1981).

Poshiya and Shukla (1986), Kumbhani *et al.* (1993), Dhankhar *et al.* (1996) and Wankhede *et al.* (1997) drew similar results.

The crosses with high heterosis should be exploited for commercial cultivation after necessary testing and should also be used for further breeding programmes.

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