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Hybrid Vigour and Inbreeding Depression for Fruit Yield and its Components in Okra (*Abelmoschus esculentus* (L.) Moench)

D. N. Thaker*, S. B. S. Tikka and K. K. Patel

Gujarat Agricultural University, Navsari Campus, Navsari.

ABSTRACT

Heterosis and inbreeding depression was studied in twentyone intervarietal crosses of okra (*Abelmoschus esculentus* (L.) Moench) in F_1 and F_2 generation respectively. The manifestation of heterobeltiosis was highest for fruit yield per plant (55.74%) followed by fruits per plant (40.46%) and fruit length (20.03%). These characters also exhibited very high inbreeding depression in the F_2 generation. Seven crosses exhibited significant positive heterobeltiosis for fruit yield while four crosses viz., IC 18960 x EC 41292, IC 18960 x IC 18974, Round Selection x IC 7194 and EC 68475 x IC 7194 possessed significant positive heterosis over the top ranking parent.

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INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) is an important vegetable crop of India. Heterosis has been used as one of the important techniques to increase crop productivity. Several workers have demonstrated hybrid vigour for fruit yield and its components in okra (Singh *et al.* 1975; Singh *et al.* 1977; Kulkarni and Virupakshappa, 1977; Singh and Singh, 1979 b). But due to lack of information about suitable hybrids and techniques in production of hybrid seed, the commercial exploitation of heterosis in okra has not been successful. Singh and Singh (1979 b) have suggested the development of synthetic varieties of okra utilising parents manifesting commercially exploitable heterosis in specific cross combinations. The present investigation was, therefore, undertaken to study the extent of heterosis for fruit yield and its components in the F_1 alongwith the degree of inbreeding depression in the F_2 generations.

MATERIAL AND METHODS

Seven varieties of okra (N-5, IC 18960, Round Selection, EC 68475, IC 18974, EC 41292 and IC 7194) were crossed in all possible combinations excluding reciprocals during rainy season of 1978. The F_1s were selfed to obtain F_2 seeds during summer 1979. In the rainy season of 1979, 49 entries comprising 21 F_1s and 21 F_2s and seven parents were sown in a randomised block design with three replications at the Agricultural College Farm, Navsari. Each plot consisted of three rows, spaced

* Associate Professor of Agricultural Botany.

60 cm apart, inter row spacing being 20 cm. Five competitive plants from each parent and F_1 and 15 plants from F_2s were randomly selected from each plot to record observations on days to flower, fruits per plant, fruit length (cm), fruit weight (g) and fruit yield per plant (g).

The plot means were used for analysis of variance (Panse and Sukhatme, 1961). The heterobeltiosis has been expressed as per cent increase or decrease in the mean values over better parent. The standard heterosis expressed as per cent increase or decrease over the best parent (IC 18974) for fruit yield has also been estimated. The inbreeding depression has been expressed as per cent decrease in the mean values of F_2s over F_1s.

RESULTS AND DISCUSSION

The analysis of variance for the design of the experiment revealed significant differences among parents in respect of all the characters under study indicating the diversity in the material for heterosis breeding studies. The group effects were highly significant for all the traits except days to flower indicating the manifestation of mean heterosis.

The heterobeltiosis and standard heterosis are presented in Table 1. The heterobeltiosis for fruit yield ranged from −16.92 to 55.74 per cent including seven crosses exhibiting significant positive heterosis over better parent values. Out of these, only four crosses viz., IC 18960 x EC 41292, IC 18960 X IC 18974,

TABLE 1

Manifestation of heterobeltiosis (BP) and standard heterosis (TP) in crosses of okra.

Cross	*Fruit yield*		*Fruits per plant*	*Fruit length*	*Fruit weight*
	BP	*TP*			
1 x 2	2.93	1.14	− 1.20	− 0.28	7.85
1 x 3	29.54*	− 3.76	12.00	5.53	0.68
1 x 4	− 16.92	−17.44	− 9.25	− 3.26	− 8.22
1 x 5	10.38	10.38	2.61	−10.05*	1.71
1 x 6	0.00	−10.72	16.00	− 0.22	8.74
1 x 7	9.98	−16.11	17.70	− 6.46	0.89
2 x 3	4.78	0.84	22.87**	− 6.18	6.54
2 x 4	24.88**	24.07**	31.20**	1.57	− 1.43
2 x 5	39.40**	39.40**	25.65**	3.06	− 0.13
2 x 6	20.79*	16.02	18,80*	− 1.21	12.00
2 x 7	9.11	4.79	5.28	− 6.18	9.10
3 x 4	3.98	3.31	4.35	− 9.52*	10.23
3 x 5	13.35	13.35	5.52	23.03**	3.97
3 x 6	27.53**	15.18	17.04	0.99	17.14
3 x 7	55.74**	18.78*	37.39**	5.49	8.89
4 x 5	8.60	8.60	15.74	0.91	−1.15
4 x 6	− 0.85	− 1.48	− 1.57	−10.83*	13.41
4 x 7	19.75*	18.98*	40.46**	−11.09*	6.06
5 x 6	14.04	14.04	5.81	9.39*	2.86
5 x 7	14.53	14.53	32.33**	18.90**	− 3.97
6 x 7	− 2.19	−11.67	16.63	4.58	− 5.38

*and ** Significant at P = 0.05 and P = 0.01 respectively, BP = Better parent. TP = Top Top parent, Parents 1 = N-5, 2 = IC 18960, 3 = Round Selection, 4 = EC 68475, 5 = IC 18974, 6 = EC 41292 and 7 = IC 7194.

Round Selection X IC 7194 and EC 68475 x IC 7194 possessed significant positive heterosis over the top ranking parent IC 18974. The parents involved in these four crosses viz., IC 18960, EC 41292, IC 18974, Round Selection, IC 7194 and EC 68475 can be utilized in developing synthetic varieties as suggested by Singh and Singh (1979b).

For fruits per plant, the heterobeltiosis ranged from -9.25 to 40.46 per cent with seven crosses exceeding superior parental values. Only three crosses exhibited significant positive heterobeltiosis for fruit length which ranged from 9.39 to 20.03 per cent. None of the crosses possessed significant heterobeltiosis for fruit weight. These results are in confirmity with the earlier findings of Singh *et al.* (1975) and Singh and Singh (1979 b).

Grafius (1959) suggested that there may not be any gene *per se* for yield, but the yield is an end product of multiplicative interactions between yield components. In okra fruits per plant, fruit length and fruit weight have been reported to be important components of yield (Majmudar *et al.* 1974; Singh and Singh, 1979a). This implied that heterosis in fruit yield should reflect through heterosis in the individual yield component. In the present study, out of seven crosses which showed positive significant heterobeltiosis, fruits per plant in five crosses, significantly contributed towards heterosis in fruit yield. Singh and Singh (1979b) also concluded that the heterosis in fruit yield was the result of heterosis in individual yield components particularly fruit number and fruit length.

The extent of inbreeding depression in F_2 generation for fruit yield and its components is given in Table 2. All the twentyone crosses exhibited significant inbreeding depression for fruits per plant which ranged from 21.55 to 51.88 per cent. For fruit yield, eighteen crosses

TABLE 2

Inbreeding depression for fruit yield and some other characters in okra.

Cross	*Fruit yield*	*Fruits/ plant*	*Fruit length*	*Fruit weight*
1 x 2	23.50*	21.55*	5.20	13.59
1 x 3	31.66**	33.03**	7.28	8.32
1 x 4	6.58	21.73*	8.50	2.05
1 x 5	34.00**	26.41**	2.71	21.43*
1 x 6	25.94*	36.46**	3.09	16.08
1 x 7	4.12	32.62**	- 2.07	- 2.07
2 x 3	27.10**	41.32**	- 6.29	- 5.80
2 x 4	42.11**	45.45**	12.20**	- 0.16
2 x 5	43.51**	44.95**	3.45	12.58
2 x 6	39.79**	42.87**	4.32	4.08
2 x 7	32.68**	34.04*$	- 1.29	8.48
3 x 4	28.85**	40.81**	6.06	- 0.96
3 x 5	43.00**	33.94**	8.90*	24.25**
3 x 6	40.47**	36.36**	4.23	12.20
3 x 7	4.28	27.75**	- 1.06	20.64*
4 x 5	34.91**	42.16**	9.95*	13.23
4 x 6	31.10**	34.81**	- 4.39	6.68
4 x 7	39.46**	51.88**	- 3.23	-- 7.64
5 x 6	33.37**	29.28**	5.09	18.03*
5 x 7	30.64**	40.75**	15.61**	6.41
6 x 7	21.26	32.37**	2.70	3.70

* and ** Significant at P = 0.05 and P = 0.01 respectively.
Parents 1 to 7 : as per Table 2.

possessed significant inbreeding depression which ranged from 21.26 to 43.51 per cent. The inbreeding depression was moderate for fruit length with only four crosses being significantly inferior over F_1. For fruit weight, inbreeding depression ranged from 18.03 to 24.25 per cent with four crosses being significantly inferior.

Mean heterosis and inbreeding depression over crosses revealed that the F_1 means were higher than those of parents for all the traits. The degree of heterosis was the highest for fruit yield per plant (24.38%) followed by fruits per plant (22.55%), fruit weight (10.92%) and fruit length (5.00%). Mean inbreeding depression was the highest for fruits per plant (36.47%) followed by fruit yield (32.43%), fruit weight (9.03%) and fruit length (3.91%).

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