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Studies on the combining ability and heterosis in okra [*Abelmoschus esculentus* (Moench) L.] for bast fibre yield

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ABSTRACT

Combining ability analysis was carried out in a 5 x 5 diallel set of okra for bast fibre and vegetable yield along with their component characters. The parents, Selection 71-14 and KS-3/2 were found to be the best general combiners. Two crosses – KS-3/2 x PBN-57 and PBN-57 x Selection 71-14 were good specific combiners. Considering fibre yield alo the crosses BO-1x PBN-57, and Pusa Selection –7 x Selection 71-14 showed better performance .The analysis of genetic components revealed that fibre yield and dry wood yield were controlled by additive gene effects, plant height is controlled by both additive and dominant effects and the other characters viz., basal circumference, branches / plant, days to first flower including vegetable yield by dominant gene effects. Fibre yield showed high habitability in both senses and genetic advance, but vegetable yield showed low heritability in both the senses and genetic advance. The estimates of heterosis effects for ten hybrids showed the cross of BO-1 x KS-3/2 as the best combination with early fruiting character followed by the crosses of BO-1x Selection 71-14, and PBN-57 x Pusa Selection 7.

Key words: Combining ability, heritability, okra

The global attention to natural fibre like jute and jute like fibres for manufacturing coarse and loosely woven fabrics and for wrapping and packaging materials replacing synthetic ones is slowly getting momentum. Apart from jute (*Corchorus* spp.), mesta (*Hibiscus sabdariffa* L.), etc., okra could be another source of natural fibre. The breeding programme for genetic amelioration of this crop till date is restricted only to vegetable yield and insect-pests and diseases resistance. There has been no work done to explore its potentiality as a possible source of bast fibre. Thus, this experiment is first of its kind on finding out the potentiality of okra as an additional source of bast fibre and heterosis and combining ability for fibre yield. The present investigation aims at identification of superior parents, their cross combinations, and understanding the genetic back ground for both fibre and vegetable yield.

MATERIALS AND METHODS

A half diallel set (excluding reciprocals) was raised involving the lines; BO – 1 KS – 3/2, PBN – 57, Pusa Selection – 7, and Selection 74 –14. The ten hybrids along with their parents were grown in randomized block design in three replications during summer and rainy seasons in 2005 at Instructional Farm of BCKV, Mohanpur, West Bengal. Planting was done at 30cm × 60 cm spacing from plant to plant and from row to row respectively in both the seasons. Fertilizers at the rate of N_{80} P_{40} kg per ha^{-1} were applied where 50% of the nitrogenous fertilizer was top dressed after a month of sowing. Weeding and spraying of insecticide was applied for the management of jassid time to time. Irrigation of summer crop was done whenever needed. Data was recorded for seven quantitative characters *viz.* plant height, basal circumference, number of branches $plant^{-1}$, fiber yield, dry wood yield, vegetable yield and days to first flower. Data were statistically analysed.

Retting was done by immersing the bundles of plants in fresh water, which took ten days for complete retting. Fibre extraction was carried out by single reed extraction method. Model II, Method 2 of (Griffing, 1956) was used for combining ability analysis

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the genotypes studied for plant height, basal circumference, days to first flower, fibre yield, and dry wood yield but total number of branches, and vegetable yield showed insignificant difference. Among the five parents, Selection 71-14 followed by KS-3/2 showed significant positive general combining ability (gca) effect for fibre yield and non significant positive effect for vegetable yield (Table 1). The combination of these two parents may give better hybrid with higher fibre and vegetable yield. The two crosses; BO – 1 ×Selection 71-14, and PBN-57 × Pusa Selection 7 showed significant specific combining ability (sca) with respect to vegetable yield which might be exploited with early fruiting character (Table 1). The crosses of BO-1 × PBN-57, and KS-3/2 × Pusa Selection 7 showed significant positive specific combining ability for fibre yield. However, considering both fibre and vegetable yield, the crosses KS-3/2 × PBN-57 and PBN-57 × Selection 71-14 are good specific combiners although both these crosses showed positively insignificant effects.

The component analysis of gca, sca, additive, and dominant variances indicated the nature of gene action for the expression of the traits (Table 2). The higher magnitude of both gca, and additive component for fibre yield, and day wood yield showed that these traits are controlled by additive genes. On the other hand, for plant height, the estimates of gca variance showed higher magnitude than sca variance, while in genetic components analysis, the dominant variance is higher than additive variance indicating the preponderance of both additive and dominant components. The basal circumference, total number of branches, vegetable yield per plant, and days to first flower showed the preponderance of dominant gene action which is in agreement with earlier findings of Ramu (1976), Kulkarni (1976) and Rao and Sathyarathi (1976). Thus, for the fibre and vegetable yield, direct selection of these traits will bring improvement.

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Table 1: Estimates of gca and sca effects of parents and hybrids for seven characters in okra

Parents and hybrids	Plant height	Basal circumference	Total number of branches	Fibre yield	Dry wood yield	Vegetable yield	Days to first flower
BO-1	-2.95	-0.21	0.05	-1.11	-4.11	0.28	1.12**
KS 3/2	9.36*	0.54	-0.09	1.60*	9.27*	0.48	-0.32
PBN – 57	-7.53	-0.32	0.07	-1.73	-5.38	-0.40	0.58
Pusa Selection - 7	-9.92*	-0.56	0.28	-0.43	-5.39	-0.39	0.67
Selection 71-14	10.46*	0.55*	-0.31	1.66*	5.61	0.04	0.20
SEm(±)	**4.02**	**0.27**	**0.18**	**0.68**	**2.76**	**0.66**	**0.34**
BO-1 x KS 3/2	23.22	-0.79*	-0.51*	-0.81	-11.29**	-1.19	1.93**
BO-1 x PBN - 57	-10.96*	2.25**	-0.44	1.81*	9.50*	1.40	-0.12
BO-1 x Pusa Selection–7	15.69**	0.25	0.10	-1.34	4.51	1.03	-4.30**
BO-1 x Selection 71 - 14	-5.33	-1.10**	-0.11	-3.10	-13.29**	2.70**	0.36
KS 3/2 x PBN – 57	31.06**	0.50	1.44**	0.05	-2.25	1.24	-1.48**
KS 3/2 x Pusa Selection–7	-14.03*	2.45**	-0.48*	2.10	-1.91	-2.05*	-0.29
KS 3/2 x Selection 71 - 14	15.72**	0.46	-0.13	-4.58**	-13.91**	-3.50**	-2.34**
PBN – 57 x Pusa Selection-7	17.16**	-1.43**	0.62*	-0.60	-2.16	2.34*	-1.68
PBN – 57 x Selection 71 - 14	4.57	0.69	0.99**	1.74	-0.78	0.91	-0.03
Pusa Selection – 7 x Selection 71 - 14	2.76	1.67**	0.23	0.97	1.82	-1.83*	-0.05
SEm(±)	**5.19**	**343.00**	**0.23**	**0.97**	**3.56**	**0.85**	**0.44**

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

Table 2: Estimates of variance components and genetic components and heritability for seven characters in okra

Components	Plant height	Basal circumference	Total number of branches	Fibre yield	Dry wood yield	Vegetable yield	Days to first flower
σ^2 g	345.11	1.54	0.22	5.04	103.34	0.11	3.57
σ^2 s	279.41	1.66	0.28	1.88	36.60	1.25	3.88
σ^2 e	141.37	0.62	0.28	4.06	66.48	3.80	1.02
σ^2 A	65.70	-0.12	-0.07	3.17	66.74	-1.13	-0.31
σ^2 D	279.41	1.66	0.28	1.88	36.60	1.25	3.88
σ^2 P	486.48	2.16	0.49	9.11	69.82	3.91	4.59
σ^2 D/ σ^2 A	4.25	-13413.00	-4.22	0.59	0.55	-1.10	-12.48
h^2 (ns)	13.51	-5.76	-13.75	34.77	39.30	26.98	-6.59
h^2 (bs)	70.94	71.26	43.57	55.38	60.85	2.90	77.77
Genetic Advance	3.86	-109.00	-145.00	1.49	7.04	-1.02	-0.18

Table 3: Expression of heterosis (%) over better parents for fibre yield and pod yield and their component characters

Hybrids	Plant height	Basal circumference	Total number of branches	Fibre yield	Dry weight of wood	Vegetable yield	Days to 1st flower
BO-1 × KS 3/2	73.37**	-24.29**	-28.57**	-36.72**	-63.95**	-20.84**	0.86**
BO-1 × PBN - 57	-6.55**	30.38	-10.71**	-5.38	93.62	-9.28**	-7.74**
BO-1 × Pusa Selection–7	31.00**	-4.51**	-16.96**	-27.15**	-7.72*	9.16**	-19.89**
BO-1 × Selection 71 - 14	-10.52**	-11.21**	-18.12**	-55.68**	-68.11**	18.76	-4.57**
KS 3/2 × PBN – 57	56.40**	-13.55**	-2.22**	-34.96**	-51.32**	-12.03**	-9.00**
KS 3/2 × Pusa Selection–7	52.61**	-42.58**	68.60	-11.03**	-50.77**	-28.50**	-9.56**
KS 3/2 × Selection 71 - 14	25.61**	-5.98**	-18.60**	-47.46**	-43.49**	-33.64**	-8.96**
PBN – 57 × Pusa Selection-7	59.20	-25.21**	8.78	17.16**	-6.02	13.19	-10.60**
PBN – 57 × Selection 71 - 14	-4.86**	7.38*	13.97	-27.55**	-43.42**	-2.22**	-4.61**
Pusa Selection – 7 × Selection 71 - 14	-9.34**	15.65	47.06	-24.06**	-41.43**	-18.19**	-7.94**
SEm(±)	**16.82**	**1.11**	**0.75**	**2.85**	**11.53**	**2.76**	**1.43**
LSD(0.05)	**34.44**	**2.28**	**1.53**	**5.84**	**23.61**	**5.64**	**2.93**

*, ** *Significant at 5% and 1% level, respectively.*

The high heritability in broad sense [h_2 (bs)] than narrow sense [h_2(ns)] for all characters suggest that these characters are not influenced by environment for their expression. But selection of such traits may not be useful because broad sense heritability is based on total genetic variance, which includes both fixable and nonfixable (dominance and epistatic) variances (Singh, P. and Narayanan, S. S 1993). Further, genetic advance for all the characters is very low. For such traits, heterosis breeding will be rewarding. The low genetic advance for vegetable yield indicates the high environmental influence and non-additive gene action which is not in agreement with earlier findings of Rao (1972) and Lal and Shrivastava (1977).

The estimation of heterosis for better parents in ten hybrids showed the cross BO-1 x Pusa Selection 7 was the best combination which registered significant heterosis for vegetable yield per plant, days to first flower and plant height (Table 3). Interestingly, none of the crosses showed significant positive heterosis for fibre weight and all the crosses except BO-1 x KS-3/2 showed significant negative heterosis for days to flower (in this case, negative values are desired as such combinations will fruit early).

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