Vegetable Science (2011) 38(2) : 212-214

Short communication

Combining ability analysis for yield and yield contributing characters in Okra [*Ablelmoschus esculentus* (L.) Moench]

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Received : May 2010 / Accepted : March 2011

Okra [*Abelmoschus esculentus* (L.) Moench] is an extensively cultivated vegetable crop throughout the country, in plains and hills both. It has high nutritive value as wel as export potential. To improve the yield and other characters in okra, thte genetic information is must. However, the explotation of genetic information in okra has not been fully demonstrated as compared to other vegetable crops. Further advancement in yield requires information regarding the nature of combining abilities in a wide array of genetic materials to be used as parents in the hybridization programme, as well as, the nature of gene action involved in the expression of quantitative traits of economic importance. It is proven that general and specific combining ability are effective genetic prarameter in deciding the next phase of breeding programme. Combining ability is most helpful in determining the appropriate parents of a cross. Therefore, the present study was planned and conducted.

Eight genotypes of okra *viz;* Arka Abhay, Badshah, Parbhani Kranti, Pusa Sawani, Punjab Padmini, KS 373, KS 383 and KS 393 were crossed in al possible combinations excluding reciprocals to get 28 F_1 which were advanced to get F_2 seed during summer season. During rainy season, final experiment comprising 8 parents, 28 F_1s and 28 F_2s were grown in a frandomized block design with three replications, at the research farm, of the Department of Horticulture, Allahabad Agriculture Insiitute – Deemed University, Allahabad. The parents and F_1s were grown in single row and F_2s in three rows, each row was three meter long, accommodating 10 plants. Five competitive plants of the parents and ten plants in each F_2 families were selected randomly for recording observations on ten characters, namely days to first flower, first fruiting node length, plant height (cm) number of branches per plant, number of nodes per plant, length of the fruits (cm), width of the fruit (cm) tapering length (cm), number of fruits per plant, fruit yield per plant (g). The combining ability variances and effects were estimated following Method II, Model I of Griffing (1956).

Analysis of variance for combining ability ravealed that the variances due to general combining ability (gca) and specific combining ability (sca) were highly significant for all the traits studied. Thus, both kinds of gene effects were important in controlling the inheritance of all the characters studied. However, the gca: sca ratio mostly favoured sca in all the traits, indicating the preponderance of non-additive gene effects in the genetic control of the traits. The present findings, therefore, supported by the report of Srivastava (1971), which clearly indicated that non- additive genetic variance was the main component of genetic variance of various economic traits in Okra.

The estimate of gca effects (Table 1) revealed that neither the parents nor the combinations studied were good for all the characters. The parents Arka Abhay and Badshah were good general combiner for early flowering and first fruiting node length. These parents were good cominers for yield and also found good general combiner for number of branches per plant, length and width of the fruit, tapering lenth and number of fruits per plant. The parent Parbhani Kranti was a good general combiner for yield and also for fruit thickness and number of fruits per plant. Pusa Sawani was found good for transmitting

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Table 1: Estimates of general combining ability effects of eight parents for ten characters in okra (F1 & F2)

Parents	Generations	Days to first flower	First fruiting node length	Plant height	Number of nodes per plant	Number of branches per plant	Length of the fruit	Width of the fruit	Tapering length of the fruit	Number of fruits per plant	Fruit yield per plant
Arka Abhay	F1	-2.22**	-4.64**	-1.4	.14	-13*	1.30**	.05**	.30**	.91**	16.08*
	F2	-2.30**	-4.95**	-3.13**	-2.05**	.13*	1.34**	.06**	.57**	.51**	20.48*
Badshah	F1	-62*	-2.75**	12.44**	.33	.17**	1.20**	.02*	.54**	1.22**	51.75**
	F2	-2.30**	-2.00**	9.77**	-.35	.38**	.92**	-.03**	.41**	.40	47.05**
Parbhani Kranti	F1	.57	2.45**	-0.02	.34	.01	.39**	.04**	-.23**	.64**	16.58*
	F2	1.67**	2.29*	.69	.43	.25	.09	.07**	-06	.87**	15.97*
Pusa Sawani	F1	-0.36	4.36**	5.00**	1.32**	-.29**	-.44*	-.03**	-.01	.61**	-17.41
	F2	1.87**	2.55**	3.92**	1.67**	-.08	-.22	.02*	-.20**	-.54*	-21.02
Punjab Padmini	F1	1.21**	1.72**	-9.35**	-1.70**	.01	-.22	.03**	-.17*	-.10	-6.08
	F2	1.27**	2.15**	-.27	-.21	-.13	-.42	-.01	-.19**	-.50*	-16.85*
KS 373	F1	0.97**	-2.14**	-5.28**	-.17	.23**	-.50	-.02*	.09	-.64**	-13.75
	F2	1.03**	.53	-6.35**	.17	-.13*	-.60**	-.03**	.08	-.06	-11.68
KS 383	F1	.61	.13	-.60	-.18	.01	-.88*	-.07**	-.26**	-.10	-19.42
	F2	-.53	-.75	-4.06**	.44	-.22**	-.75**	-.07**	-.30**	-.33	-6.20
KS 393	F1	-.16	.86	-.72	-.90	-.002	-.05	-.01	-.25**	.05	3.42
	F2	-.70	.14	-.30	.40	-.19**	-.18	-.03*	-.31**	-.36	-6.68
SE (gi)	F1	.30	.45	1.00	.28	.06	.20	.006	.07	.23	8.14
	F2	.30	.45	1.00	.28	.06	.20	.006	.07	.23	8.14
SE(gi-gi)	F1	.45	.69	1.52	.44	.10	.30	.009	.10	.34	12.31
	F2	.45	.69	1.52	.44	.10	.30	.009	.10	.34	12.31

the character plant height and number of nodes per plant, while KS 373 for lower fruiting node.

High gca effects are mostly due to additive gene effects or additive x additive interaction effects , as earlier reported by Griffing (1956). In view of this, breeders may utilize the good general combiners in specific breeding program for amelioration of fruit yield in okra.

Normally, the sca effects do not contribute tangibly in the improvement of self fertilizing crops,except where commercial exploitation of herosis is feasible . The sca represents thte dominance and epistatic interactions that can be related to heterosis. The estimate of sca showed that out of 28 crosses, 6 crosses in F_1s and 5 in F_2s each were found to be good specific combiner for fruit yield. It is note worthy that 3 crosses showed positive and significant sca effects for fruit yield in both the F_1 and F_2. The positive significant sca effects for fruit yield was exhibited by the crosses Arka Abhay x Parbhani Kranti, Badshah x Parbhaani Kranti and Parbhani Kranti x KS 383 in both the generations where as , the crosses Badshah x Junjab Padmini, Pusa Sawani x KS 383 and KS 373 x KS 383 in F1 and Arka Abhay x Punjab Padmini and Badshah x KS 393 in F2 only. The crosses Arka Abhay x Parbhani Kranti and Badshah x Parbhani Kranti had the high values for yield and most of the its contributing characters.

A limited number of crosses showed significant and positive sca effects for different characters studied except days to first flower fro which none of the crosses showed desired sca values. (Table 1) The data indicated that for characters like first fruiting node length, Arka Abhay x KS 393 was found to be the best specific combiner, fro plant height Arka Abhay x Prabhani Kranti, for number of nodes per plant, Badshah x KS 383 , for number of branches per plant , Badshah x Punjab Padmini, for length of the fruit, KS 373 x KS 383 , for fruit thickness, Arka Abhay x Punjab Padmini, for tapering length, KS 373 x KS 383 and for the number of fruits per plant , Arka Abhay x Parbhani Kranti were, found to be best specific combiners. Thus, Among these desirable crosses, emphasis might be given to most promising crosses Arka Abhay x Parbhani Kranti, Arka Abhay x Punjab Padmini, Badshah x Parbhani Kranti, Badshah x Punjab Padmini and Pusa Sawani x KS 383 for further improvement of fruit yield.

Table 2: Estamites of significant specific combining ability effects for different traits in okra.

Characters	Significant crosses in both the generations	S C A	
		F_1	F_2
Days to first	Nil	--	--
First fruiting node length	Arka Abhay x Punjab Padmini	-2.82*	-3.29*
	Arka Abhay x KS 393	-8.50*	-7.81**
	Badshah x Parbhani Kranti	-4.57**	-4.62**
	Badshah x Pusa Sawani	-4.18**	-3.15*
Plant height	Arka Abhay x Parbhani Kranti	30.82**	29.92**
	Arka Abhay x Punjab Padmini	21.29**	12.02**
	Badshah x KS 383	34.31**	16.71**
	Pusa Sawani x KS 383	26.02**	9.79**
	KS 373 x KS 383	7.54*	13.94**
Number of nodes per plant	Arka Abhay x Parbhani Kranti	2.55**	2.23*
	Arka Abhay x Punjab Padmini	3.60**	1.86*
	Badshah x KS 383	3.88**	3.25**
	Pusa Sawani x KS 383	2.16*	3.70**
Number of branches per plant	Badshah x Parbhani Kranti	0.49**	0.53**
	Badshah x Punjab Padmini	0.60*	1.08**
Length of the fruit	Arka Abhay x Parbhani Kranti	2.85**	2.57**
	Arka Abhay x Punjab Padmini	1.83**	2.04**
	Badshah x Punjab Padmini	2.80**	1.50*
	Badshah x KS 383	2.03**	1.60**
	KS 373 x KS 383	3.28**	2.18**
	KS 373 x KS 393	1.88**	2.28**
Width of the fruit	Arka Abhay x Parbhani Kranti	0.11**	0.08**
	Arka Abhay x Punjab Padmini	0.12**	0.17**
	Arka Abhay x KS 393	0.11**	0.06**
	Badshah x Punjab Padmini	0.12**	0.19**
	Parbhani Kranti x KS 393	0.04*	0.12**
	Pusa Sawani x KS 383	0.09**	0.04*
	Punjab Padmini x KS 383	0.10**	0.08**
	KS 373 x KS 383	0.11**	0.20**
Tapering length	Arka Abhay x Parbhani Kranti	0.60**	0.46*
	Badshah x Punjab Padmini	0.42*	0.50*
	KS 373 x KS 383	0.91*	0.50*
No. of fruits per plant	Arka Abhay x Badshah	2.19**	1.52*
	Arka Abhay x Parbhani Kranti	1.68*	2.90**
Fruit yield per plant	Arka Abhay x Parbhani Kranti	62.30*	56.55*
	Badshah x Parbhani Kranti	85.30**	49.65*
	Parbhani Kranti x KS 383	50.20*	49.00*

*,** Significant at 5 and 1 percent level

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