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Diallel analysis to study combining ability effects in okra [*Abelmoschus esculentus* (L.) Moench]

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ABSTRACT

The present investigation was undertaken to study the combining ability analysis using eight genotypes crossed in half diallel fashion in okra *[Abelmoschus esculentus* (L.) Moench] for fruit yield and other important traits. Combining ability analysis showed that general and specific combining ability variances were highly significant for all the characters for the expression of fruit yield (g) and its component traits. The parent JOL-09-7 and Arka Anamika were good general combiners for fruit yield and it's components traits. Out of 28 hybrids, 14 showed significant positive sca effects for fruit yield and it's components traits. The crosses GO-2 x GJO-5, GJO-3 x GJO-5 and GO-2 x HRB-108-2 were identified as promising hybrids for their exploitation in breeding programme.

Key words : General combining ability, specific combining ability, okra

Okra *[Abelmoschus esculentus* (L.) Moench], also called as "Lady's finger" is one of the important vegetable crops grown extensively for its green tender fruits in tropical and sub-tropical regions. An improvement in yield of vegetable crops like okra is effected mainly through selection of genotypes with desirable characters from the variation through recombination followed by selection. Heterosis in F_1 generation is of great importance in vegetable crop. Important steps for exploitation of heterosis in any crop are to study the general combining ability of the parents and specific combining ability of hybrids. Combining ability analysis helps to choose suitable parents for hybridization and provides valuable information regarding F_1 crosses to be exploited commercially. Information on the combining abilities of the genotypes will be helpful in the analysis and interpretation of the genetic basis of important traits. Although, some information on gene effects associated with fruit yield and its attributing traits in okra is available but that is scanty. Therefore. the present investigation was carried out to obtain information regarding general and specific combining ability effects for fruit yield and yield attributing traits in okra following a half diallel mating design.

MATERIALS AND METHODS

A set of 28 hybrids were developed using 8 parents (GO-2, GJO-3, GJO-5, Arka Anamika, VRO-6, JOL-09-7, JOL-04-08 and HRB-108-2) of okra through diallel mating design (excluding reciprocals) during *Kharif-2011*. The trial consisting of 28 hybrids and their 8 parents were raised in randomized block design with three replications at Instructional Farm, Junagadh Agricultural University, Junagadh during *summer*-2012. Each entry was sown in 3.0 m long single row plot at 60 x 30 cm spacing. Observations on five randomly selected plants were recorded for days to 50% flowering, days to first picking, plant height, number of branches per plant, number of nodes per plant, internodal length, number of fruits per plant, fruit length, fruit girth, 10-fruit weight and fruit yield per plant. The data generated were utilized to estimate the combining ability by the method II under model I as suggested by Griffing (1956).

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RESULTS AND DISCUSSION

The analysis of variance for combining ability (Table 1) revealed that general combining ability variances were highly significant for all the characters indicating the involvement of additive type of gene action in the inheritance of all the traits under study. Specific combining ability variances were significant for all the characters indicating the involvement of non-additive gene action in the inheritance of these characters. The significance of variance due to gca and sca for all the characters studied indicated the role of both additive and non-additive gene action. These reflect much scope of improvement in yield through heterosis breeding and recurrent selection.

Consequently it is suggested that these traits could be improved through heterosis breeding rather than selection. Similar results of importance of both additive and non-additive genetic component in the inheritance of various traits were reported by Pal and Sabesan (2009) and Kachhadia *et al.,* (2011) in okra.

The σ^2gca/σ^2sca variance ratio being less than unity (1.0) for all the traits which suggested non additive type of gene action was predominantly involved in the expression of all traits. Thus, it the use of heterosis breeding approach will be fruitful for rapid improvement in the fruit yield governed by non-additive gene action. Role of non additive gene effects was also reported by Bhalekar *et al.,* (2004) and Kumar *et al.,* (2005).

The perusal of data on general combining ability effects of parents (Table 2) revealed that the parents JOL-09-7 and Arka Anamika were the good general combiner for fruit yield, days to 50 % flowering, days to first picking, fruit girth and 10-fruit weight where as, The parent GO-2 was good general combiners for earliness (days to 50 % flowering and days to first picking), number of branches per plant, internodal length and fruit length.For plant height and number of fruits per plant, HR8-108-2 was good general combiner for plant height whereas, GJO-3 was the good general combiner fo fruit girth. On the basis of fruit yield and yield attributing trait JOL-09-7, Arka Anamika, GO-2 and JOL-04-8 appeared desirable parents which could be used in hybridization programme.

Table 1 Analysis of variance for combining ability for various characters in okra

Source of variation	d.f.	Days to 50 % flowering	Days to first picking	Plant height (cm)	No.of branches per plant	No. of nodes per plant	Internodal length (cm)	No. of fruits per plant	Fruit length (cm)	Fruit girth (cm)	10-fruit weight (g)	Fruit yield per plant (g)
GCA	7	28.22**	27.94**	119.28**	0.31**	3.65**	0.23**	3.30**	0.37*	0.39**	162.77**	795.02**
SCA	28	7.87**	8.69**	235.56**	0.33**	5.38**	0.37**	3.77**	0.91**	0.17**	318.27**	1994.63**
Error	70	0.88	2.40	9.90	0.063	0.78	0.03	0.70	0.14	0.03	25.68	175.64
σ^2GCA		2.73	2.55	10.94	0.025	0.29	0.02	0.26	0.02	0.04	13.71	61.94
σ^2SCA		6.99	6.28	225.66	0.27	4.60	0.34	3.07	0.76	0.14	292.58	1818.99
G.P.R. =												
σ^2GCA/ σ^2SCA		0.39	0.40	0.05	0.09	0.06	0.06	*0.08*	*0.03*	*0.26*	*0.05*	*0.03*

*, ** significant at 5% and 1% levels, respectively.

Table 2 Estimates of general combining ability effects of parents for different characters in okra

Parents	Days to 50 % flowering	Days to first picking	Plant height (cm)	No.of branches per plant	No. of nodes per plant	Internodal length (cm)	No.of fruits per plant	Fruit length (cm)	Fruit girth (cm)	10-fruit weight (g)	Fruit yield per plant (g)
GO-2	-1.00**	-1.20*	-1.74	0.25**	-0.48	-0.11*	-0.60*	0.31**	-0.28**	-0.91	-7.65
GJO-3	0.37	0.20	-3.66**	0.004	-0.77**	-0.19**	-0.54*	0.20	0.11*	2.46	-3.28
GJO-5	-0.20	0.13	-2.34*	-0.14	-0.35	-0.08	-0.58*	-0.16	0.02	-2.36	-10.69**
Arka Anamika	-2.47**	-2.50**	-0.11	-0.01	-0.06	-0.02	0.34	-0.16	0.30**	5.68**	12.15**
VRO-6	2.64**	2.67**	-2.14*	0.17*	-0.10	-0.05	-0.11	-0.13	-0.07	-0.22	-2.48
JOL-09-7	-1.60**	-1.47**	-0.15	-0.07	0.07	0.01	0.32	-0.05	0.20**	4.87**	12.77**
JOL-04-8	0.67*	0.77	3.39**	0.11	0.60*	0.19**	1.03 **	-0.17	-0.19**	-4.49**	4.86
HRB-108-2	1.60**	1.40	6.74**	-0.31**	1.11**	0.26**	0.14	0.16	-0.09	-5.03**	-5.69
SE(gi)	0.28	0.46	0.93	0.07	0.26	0.05	0.25	0.11	0.04	1.49	3.92
SE(gi-gj)	0.33	0.70	1.41	0.11	0.39	0.08	0.37	0.17	0.07	2.27	5.93

*, ** significant at 5% and 1% levels, respectively.

In the present study, the parents exhibiting high mean performance also had high general combining ability effects. A close relationship between the mean performance and general combining ability effects was noted by Kumar *et al.*, (2005). Such parallel behavior indicated that selection for good combiners for different characters could also be made on the basis of mean performance.

The estimates of sca effects revealed that 14 out of 36 hybrids showed significant positive sca effects for fruit yield per plant. Ten best specific combiners with mean performance, gca status and their significant response of sca effects to other traits are presented in Table 3. Eight crosses showed significant positive response to ten fruits weight, four crosses for fruit girth and fruit length indicating its direct effect for increasing fruit yield. However, five crosses showed significant response to plant height and number of nodes per plant, six crosses for number of branches per plant and three crosses for internodal length. This may be because of very complex nature of fruit yield and its dependence on its components. Out of ten crosses showing high mean and significant positive sca effects for fruit yield, three *crosses (*GO-2 x GJO-5, GJO-3 x JOL-04-8 *and* GJO-3 x GJO-5*) involved average x poor gca parents, two crosses (*GO-2 x HRB-108-2 and GO-2 x JOL-09-7) with average x good, *two crosses (*JOL-04-8 x HRB-108-2 and GJO-5 x HRB-108-2 *) with poor x* good, one cross (JOL-09-7 x JOL-04-8) with good x poor, one cross (Arka Anamika x JOL-09-7) with good x good, one cross (Arka Anamika x VRO-6) good x average gca parents. Better performance of hybrids involving poor x poor or average x poor general combiners indicated dominance x dominance (epitasis) type of gene action (Jinks, 1955). The crosses showing high sca effects involving one good general combiner indicated additive x dominance type of gene interaction which could produce desirable transgressive segregants in subsequent generations. In a situation where predominance of additive and non-additive gene effect has been observed for most of the traits, it is better to advocate the biparental mating and diallel selective mating to exploit both additive and non-additive type of gene effects.

Table 3 Ten best specific combiners for fruit yield/plant and their performance for other traits in okra

Sr. No	Hybrids	Fruit yield/ plant (g)	Mean fruit yield/ plant (g)	GCA status	Significant response in other traits for SCA effects
1	GO-2 x GJO-5	62.01	234.27	(A x P)	DF, NBP, NFP, FL, TFW
2	GJO-3 x GJO-5	61.42	238.06	(A x P)	PH, NBP, NNP, NFP, FL,FG, TFW
3	GO-2 x HRB-108-2	51.52	228.77	(A x G)	PH, NNP.NFP,FL, FG, TFW
4	JOL-04-8 x HRB-108-2	50.61	240.38	(P x G)	DF, NFP, TFW
5	GO-2 x JOL-09-7	49.62	245.34	(A x G)	PH, NNP, IL, TFW
6	JOL-09-7 x JOL-04-8	43.21	251.44	(G x P)	NFP, FG, TFW,DF, DFP, PH, NNP, IL
7	Arka Anamika x JOL-09-7	38.67	254.19	(G x G)	NFP,NBP
8	Arka Anamika x VRO-6	37.34	237.62	(G x A)	NBP,NFP
9	GJO-5 x HRB-108-2	36.78	211.00	(P x G)	TFW,FG,NNP,NFP,IL, PH, NBP
10	GJO-3 x JOL-04-8	33.19	225.37	(A x P)	TFW, FL, NBP

G = Good; A = Average; P = Poor general combining ability, respectively.

Figure in the parenthesis indicates per se performance for fruit yield per plant

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

DF = Days to 50 % flowering
PH = Plant height
TFW = Ten fruit weight
NBP = Number of branches per plant
FL = fruit length
NNP = Number of nodes per plant
IL = Internodl length
NFP = Number of fruits per plant
DFP = Days to first picking
FG = fruit girth

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