



# STUDIES AND HETEROSIS AND COMBINING ABILITY ANALYSIS IN OKRA (*ABELMOSCHUS ESCULENTUS* MOENCH.)

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## Abstract

The combining ability, nature of gene action and heterosis of the parents was estimated by adopting Line  $\times$  Tester analysis suggested by (Kempthorne, 1957) using seven lines and three testers. Four economically important traits viz., Fruit length, Fruit girth, Single Fruit yield and Fruit yield per plant was studied. Among the parents, the lines Trichy Local and Mohanur Local and the testers Arka Anamika were found to be the best for most of the traits studied. In case of hybrids, the crosses Trichy Local  $\times$  Arka Anamika, Mohanur Local  $\times$  Arka Anamika exhibited high *per se* performance for fruit yield per plant. Analysis of Variance showed significant deviation among the parents (lines and testers) for all the traits. The ratio of GCA/SCA also denoted the preponderance of non-additive gene action than additive gene action.

## Introduction

Okra (*Abelmoschus esculentus* L. Moench) is the choicest fruit vegetable grown extensively in the tropical, subtropical and warm areas of the world. It is a powerhouse of variable nutrients which was captured a prominent position among vegetables and commonly known as bhendi or lady's finger in India. The experiment was conducted to assess the combining ability, gene action, heterosis of parents. Selection of suitable parents is an important step for enhancement of any breeding program for crop improvement. The line  $\times$  tester analysis of crossing would be more efficient in studying the combining ability variances and effects of various characters where an attempt was made to evaluate 21 hybrids along with parents to four characters with certain objectives to evaluate the *per se* performance of parents and their hybrids for economically important characters, determine the magnitude of the GCA and SCA variances and their effect of different characters, to understand the nature of gene action for yield and its component characters and also obtain information on the extent of heterosis to ascertain superior hybrid combination for economically important traits.

## Materials and Methods

The experiment was conducted at Plant Breeding

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Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University in two seasons during (June to August, 2018 and January to march, 2019). The parental materials representing geographical and morphological diversity. The genotypes consisted of seven lines and three testers listed in Table 1 The experimental plot was ploughed repeatedly and land was brought to a fine tilth, Ridges and furrows were opened at a distance of 45 cm apart, two to three seeds of each genotype per hill were dibbed at a distance of 30 cm, cultural practices were followed as per the package of practices.

The genotypes for combining ability study comprised of seven lines and three testers. Hand emasculatation and crossing technique was carried out, each of 7 lines crossed with 3 testers resulting in 21 hybrids. During pishanam season (January to March), 21 F<sub>1</sub> hybrids along with parents were sown in experimental plot in randomized block design (RBD). Various observations as Fruit length, Fruit girth, Single Fruit yield, Fruit yield per plant were recorded. The variances and the corresponding standard errors of the mean were computed from the deviations of the individual values (Panse and Sukhatme, 1978). The observed values were subjected to Line  $\times$  Tester analysis and the general combining ability effects of parents and specific combining ability effects of different crosses were worked out. The combining ability was based on the

**Table 1:** List of genotypes.

S. No	Parents	Genotypes
<b>Lines</b>		
1.	L1	Villupuram Local
2.	L2	Chidambaram Local
3.	L3	Trichy Local
4.	L4	Salem Local
5.	L5	Karur Local
6.	L6	Thunder
7.	L7	Mohanur Local
<b>Testers</b>		
8.	T1	Dhanya
9.	T2	Arka Anamika
10.	T3	Varsha Upkar

variance due to parents and hybrids for eight characters are presented in Table 2. Anova showed significant differences among lines, for testers and hybrids for all the characters taken for the study. The combining ability variances were studied for five characters ( Table 3). The mean values of seven lines, three testers and twenty-one hybrids for different biometrical traits are studied, Villupuram Local, Trichy Local and Mohanur Local and the tester Arka Anamika registered positive deviation from mean of parents. For fruit length among the hybrids, Mohanur Local × Arka Anamika (21.08cm). The lines Trichy Local and Mohanur Local and the tester Arka Anamika registered positive deviation from mean of parents. The maximum fruit girth was produced by the hybrid Thunder × Varsha Upkar (5.30 cm); The lines Trichy Local and Mohanur Local and the tester Arka Anamika registered positive deviation from mean of parents. The maximum single fruit weight was produced by the hybrid Trichy Local × Arka Anamika (21.77g) followed by Mohanur Local × Arka Anamika (21.64g).. The maximum fruit yield per plant was produced by the hybrid Trichy Local × Arka Anamika (430.00 g) followed by Mohanur Local × Arka Anamika (402.60 g).

**Combining ability effect**

For fruit length, The *gca* effects of testers ranged from -2.45 (Dhanya) to 2.51 (Arka Anamika) of which

**Table 2:** Analysis of variance.

Source	df	MSS			
		Fruit length (cm)	Fruit girth (cm)	Single fruit weight (gm)	Fruit yieldper plant(gm)
Replication	2	0.2641	0.0027	0.0256	240.9782
Hybrid	20	19.4003**	0.2886**	12.6482**	5674.8382**
Line	6	14.5664**	0.1868**	28.5604**	3641.4968**
Tester	2	129.3604**	1.2229**	18.0721**	32795.9012**
L × T	12	3.4906**	0.1837**	3.7881**	2171.3318**
Error	60	0.1763	0.0154	0.2476	49.5539

methods developed by Kempthorne (1957). Proportional contributions of lines, testers and the interactions to total variance was calculated as per the method of Singh and Choudhary (1985).

**Results and Discussion**

Analysis of

**Table 3:** Analysis of variance of combining ability.

Source	Fruit length (cm)	Fruit girth (cm)	Single fruit weight (gm)	Fruit yield per plant (gm)
GCA	0.4143	0.0027	0.2307	91.2371
SCA	1.0949	0.0556	1.1823	706.6997
GCA/SCA	0.3783	0.0485	0.1951	0.1291

**Table 4:** *gca* effects of parents for various traits

	Fruit length (cm)	Fruit girth (cm)	Single fruit weight(gm)	Fruit yieldper plant(gm)
L1	0.72**	0.08**	-0.76	-12.99
L2	-1.47**	-0.29**	-2.87	-34.26
L3	2.06**	0.09**	1.73	31.84
L4	-1.18**	0.04**	-0.85	-15.49
L5	-0.52**	-0.03**	-0.63	-14.19
L6	-0.52**	-0.04	1.22	-2.39
L7	0.91**	0.15**	2.16	47.48
T1	-2.45**	-0.26**	-0.95	-40.08
T2	2.51**	0.22**	0.91	46.01
T3	-0.06	0.04**	0.04	-5.93

\*Significant at 5 per cent level

\*\* significant at 1 per cent level

Arka Anamika registered positive *gca* effects.. For fruit grith, The *gca* effects of testers ranged from -0.26 (Dhanya) to 0.22 (Arka Anamika) of which Arka Anamika and Varsha upkar registered positive *gca* effects. For single fruit yield The *gca* effects of testers ranged from -0.95 (Dhanya) to 0.91 (Arka Anamika) of which Arka Anamika and Varsha Upkar registered positive *gca* effects; For fruit yield per plant, The *gca* effects of testers ranged from -40.08 (Dhanya) to 46.01 (Arka Anamika) of which Arka Anamika registered positive *gca* effects. Trichy Local × Arka Anamika (63.16) showed highest positive *sca* effects (table 5,6). The estimates of heterosis were computed for all the eight characters studied in the twenty-one cross combinations and expressed in percentage over mid parental value (*di*-Relative heterosis), better parent value (*dii*-Heterobeltiosis) and best standard parental value (*diii*-Standard heterosis). The results are presented character

wise. The estimates of additive and dominance variance for each of the characters are studied. The magnitude of dominance variance was greater than additive variance for all the characters. The proportional contribution of lines, testers and hybrids interaction to the total variance are furnished. Fruit girth, Fruit length and Fruit yield contribution of tester was much greater than the tester and their interactions.

**Table 5:** *gca* effects of parents for various traits

Line × tester	Fruit length (cm)	Fruit girth (cm)	Single fruit weight(gm)	Fruit yieldper plant
L1 × T1	1.31**	0.21**	-0.86**	15.88**
L1 × T2	-0.90**	-0.04	0.16	-8.61*
L1 × T3	-0.41	-0.17*	0.70*	-7.27
L2 × T1	-0.25	-0.17*	0.65*	17.74**
L2 × T2	0.45	0.13**	0.33	-15.64**
L2 × T3	-0.20	-0.30**	-0.98**	-2.10
L3 × T1	-0.40	-0.02	-0.46	-28.46**
L3 × T2	1.43**	0.03**	0.99**	63.16**
L3 × T3	1.31**	0.00	-0.53	-34.70**
L4 × T1	-0.44	0.15*	0.16	12.18**
L4 × T2	1.39**	-0.12	-1.60**	-18.71**
L4 × T3	-0.95**	-0.03	1.44**	6.53
L5 × T1	-0.66*	-0.17*	0.23	6.88
L5 × T2	0.19	0.01	-0.86**	-23.41**
L5 × T3	0.47	0.16*	0.63*	16.53**
L6 × T1	-0.91**	-0.48**	-0.85**	21.78**
L6 × T2	-0.72**	0.10**	0.54	-16.91**
L6 × T3	-0.71**	0.38**	0.31	-4.87
L7 × T1	-0.99**	0.15*	1.15**	-45.99**
L7 × T2	0.51	-0.08	0.43	20.12**
L7 × T3	0.48	-0.07	-1.58**	25.87**

\*, \*\* Significant at 5 and 1 percent respectively

### Conclusion

The general combining ability, specific combining ability and heterosis were estimated for these characters and their results are, The analysis of variance for all the traits was studied highly significant which revealed a wide range of variability between the genotypes studied. The SCA variances were higher than the GCA variance for all the eight characters studied. The ratio of GCA/SCA was less than unity indicated that the predominance of non-additive gene action. The magnitude of dominance variance was much pronounced for all the eight characters investigated, both when  $F=0$  and  $F=1$ . Selection of hybrids based on *per se* performance, *sca* effects and standard heterosis will be more effective. It

may be concluded that based on all the three criteria, the following two hybrids  $L_3 \times T_2$  (Trichy Local  $\times$  Arka Anamika) and  $L_7 \times T_2$  (Mohanur Local  $\times$  Arka Anamika) was adjudged as the best hybrid since it possessed desirable performance for all the traits. Based on the overall combining ability effects the cross combination Trichy Local  $\times$  Arka Anamika ( $L_3 \times T_2$ ) and Villupuram Local  $\times$  Varsha Upkar ( $L_1 \times T_3$ ) were adjudged as good specific combiners. The hybrid Trichy Local  $\times$  Arka Anamika ( $L_3 \times T_2$ ) was the best hybrid based on *sca* effect, since it had desirable performance for fruit yield per plant and its component traits, which indicated the dominance of non-additive gene action. Based on standard heterosis, the hybrids Trichy Local  $\times$  Arka Anamika ( $L_3 \times T_2$ ) and Mohanur Local  $\times$  Arka Anamika ( $L_7 \times T_2$ ) recorded significantly high standard heterosis for fruit yield per plant and its component traits. The hybrid Trichy Local  $\times$  Arka Anamika ( $L_3 \times T_2$ ) was identified as the best hybrid since it had significant standard heterosis for all the traits.

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