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Research Note

Combining ability studies for assessment of yield and its components in sesame (*Sesamum indicum* L.)

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Abstract
An 8 x 8 diallel cross mating design with parents and F_1s was used to estimate gene action and combining ability for yield and yield characters in sesame (*Sesamum indicum* L.). The experiment was conducted at the AICRP, JNKVV, College of Agriculture Tikamgarh, Madhya Pradesh in *kharif* season. Crosses were attempted between parents in diallel mating design (without reciprocal). The genetic variance of combining ability was separated into general (GCA) and specific (SCA) combining ability variance components. The results indicated significant differences among the parents for general combining ability (gca) and crosses for specific combining ability (sca) for all the characters studied except for capsule length in F_1s. While parent v/s crosses for all the characters had adequate genetic variability. However, the sca component of variance was predominant indicating the predominance of non additive gene effects for the traits studied. Among the parents, ES-230 and SI-1147 were good general combiners for seed yield per plant and its attributing traits. Estimates of gca effects in parents and F_2s indicated that ES-230 and SI-775 were good general combiners for seed yield per plant and its attributing traits. The estimates of specific combining ability revealed that the crosses *viz.* ES-230 x NIC-8401,IS-1162 x NIC-8401,IS-1162 x MT-75,SI-1147 x SI-775, SI775 x DS-10 and SI-775 x MT-75 were the best specific combiners for seed yield per plant. The F_1 hybrids showing high *sca* and parents having good *gca* will be included in breeding programme for further improvement of seed yield in sesame.

Key words
Sesame,Combining ability,Gene effects, seed yield

Sesame (*Sesamum indicum* L.) belongs to the Pedaliaceae family which contains over 30 species but with *Sesamum indicum* as the only cultivated species with chromosomal number (2n=26). It is normally called 'Till' in India and it is a traditional as well as important oilseed crop in India. Sesame seed is a rich source of oil (50%), protein (25%), and minerals; contains about 47% oleic acid and 39% linolenic acid Brar and Ahuja(1979). Sesame is widely used as oriental food for its distinctive quality due to the presence of natural antioxidants such as sesamin and sesamol.

Successful breeding programme depends on the variability available among the different genotypes and in-depth understanding of the underlying gene action and genetic architecture of traits related to yield. Selection of parents based on their performance *per se* alone may not always be a sound procedure, since phenotypically superior genotypes may yield inferior hybrids and/or poor recombinants in the subsequent segregating generations Banerjee and Kole(2009). It is very important to identify parents with high GCA value for the trait to be improved Banerjee and Kole(2009). Griffing (1956) provides an efficient estimation of combining ability and nature of gene action involved. General combining ability is largely due to additive genetic effects and additive x additive epistasis, while specific combining ability is largely a function of non-additive dominance and other types of epistasis.

Knowledge of the nature of the combining ability effects and their resulting variances has a paramount significance in deciding on the selection procedure for exploiting either heterosis or obtaining new recombinants of desirable types in sesame Solanki and Gupta.(2003). Combining ability is helpful to identify desirable parents for producing better recombinants Muhammad and Sedeck(2015). The ability of parents to combine will depend on complex interaction among genes, which cannot be predicted from yield performance and adaptability of the parents Allard (1960). The objectives of the present study were to estimate general and specific combining ability that would help plant breeders to have directional breeding approach for sesame improvement.

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Eight elite genotypes of sesame *viz*. ES-230, IS-1162, SI-1147, SI-775, NIC-8401, NIC-16220, DS-10 and MT-75) were selected on the basis of their diversity. Crosses were attempted between parents in diallel mating design (without reciprocal). The parents, $F_{1'S}$ and $F_{2'S}$ along with one standard check were evaluated in RBD with three replications. The study was conducted at AICRP, JNKVV, College of Agriculture Tikamgarh, Madhya Pradesh. Each F_1 plot consisted of a 6 m long single row while F_2 and checks were planted in four rows plot of 6m length with row to row and plant to plant distance of 30 cm and 10 cm, respectively. Fifteen competitive plants in parents and $F_{1'S}$ whereas 25 plants in $F_{2'S}$ and check were selected randomly for recording observation on eight characters. Observation on days to 50% flowering and days to maturity were recorded on whole plot basis. Analysis of variance was analyzed as per the standard method described by Panse and Sukhatme(1985). Combining ability analysis was done as per the Griffing (1956) method II and model I. The estimates of GCA effect for the parents and SCA effects for the crosses were calculated according to Singh and Chaudhary (1985).

Analysis of variance showed highly significant difference among parents,F_1s and F_2s for all the characters except for capsule length in F_1s. While parent v/s crosses for all the characters had adequate genetic variability. This indicated that both additive and non-additive gene action played a role in determining various characters in sesame. Thus, the importance of these two components of genetic variance cannot be underestimated for improvement of sesame. This suggests that parents selected were quite variable and adequate amount of variability existed among the hybrids for most of the traits studied.

Analysis of variance for combining ability revealed that the variance due to *gca* and *sca* were highly significant for all the characters studied except capsule length in F_1s. This indicates presence of adequate amount of variation in parents and crosses. Also, both kinds of gene effects were important in controlling the inheritance of all the characters studied. The ratio of sca/gca was greater than one for all the characters, thereby, indicating the preponderance of non additive variance in expression of these traits. Significant results of GCA suggest the role of additive genetic effects in the inheritance of these characters. Ravindran and Rathinam (1996) reported predominance of additive gene effects in traits like branches per plant, days to 50% flowering, 1000- seed weight and height to first capsule . Early flowering could be a desirable selection criterion if the reproductive period was long enough to increase productivity or if the shorter time to flowering resulted in a concomitant decrease in time to maturity without decreasing the yield to a significant level or if it helps escape the terminal drought.

The general combining ability estimates revealed that among the parents, ES-230 and SI-1147 were good general combiners for seed yield per plant and its attributing traits. Estimates of *gca* effects in parents and F_2s indicated that ES-230 and SI-775 were good general combiners for seed yield per plant and its attributing traits . Thirugnana *et al* (2006) recorded higher SCA variance than GCA variance for number of branches, number of capsules, number of seeds per capsule, 1000- seed weight and seed yield under normal conditions compared to analysis under floods. They also reported that the magnitude of GCA variance was higher than that of SCA variance for days to 50 per cent flowering and plant height under normal conditions indicating the predominance of additive and additive x additive type of gene action. The SCA is considered to be the best criterion for selection of superior hybrids Aladji-Abatchoua *et al* (2014). Whereas, parents, SI-1162, SI-1147 and SI-775 exhibited good *gca* for number of capsules per plant in F_1s and F_2s. (Table 1-2). In view of the above, breeders may utilize the good general combiners in specific breeding programme for the improvement of seed yield per plant and number of capsules per plant in sesame. ES-230 and SI-775 can be utilized extensively in hybridization programme to accelerate the pace of genetic improvement of seed yield per plant in sesame. Goyal and Kumar(1988) reported the same in relation to general and specific combining ability in sesame. To synthesize a dynamic population with most of the favorable genes accumulated, it will be necessary to make use of these two parents, which are good general combiners for different traits. Apart from conventional breeding methods relying upon additive or additive x additive type of gene action, population improvement appears to be a good alternative.

The estimates of specific combining ability revealed that the crosses *viz.* ES-230 x NIC-8401, IS-1162 x NIC-8401, IS-1162 x MT-75, SI-1147 x SI-775, SI775 x DS-10 and SI-775 x MT-75 were the best specific combiners for seed yield per plant. Specific combing ability effects of F_2s revealed that eleven best F_2s which exhibited highest magnitude of positive *sca* effects for seed yield per plant were ES-230 x NIC-8401, ES-230 x DS-10, IS-1162 x NIC-8401, IS-1162 x MT-75, SI-1147 x SI-775, SI147 x NIC-8401, SI-775 x NIC-16220, SI-775 x DS-10, SI775 x MT-75 NIC-16220 x DS-10 and DS-10 x MT-75. Seven F_2s for number of primary branch per plant, sixteen for number of capsule, for capsule length, fifteen for number of grain per capsule and nine for days to 50% flowering showed significant *sca* effects. It is therefore recommended that new materials should be used in future breeding programme for recombining desirable traits in elite genotypes for producing desirable transgressive segregants in advance generations. Crosses having high specific combining ability effects will be useful if parents involved are also good general combiner especially in often cross pollinated crops.

Refrences

Aladji-Abatchoua, M.M.I. Noubissie- Tchiangam, J.B. Njintang-Yanou, N. 2014. Genetic Analysis of Seed Yield Component in Sesame (Sesamum indicum L.) at Mora (Cameroon). Sch. Acad. J. Biosci., **2**(5): 318-325.

Allard, R.W. 1960. Principles of plant breeding. John Wiley and Sons. Inc., New York and London, pp. 24-232.

Brar, G. and Ahuja, R. 1979. Sesame: its culture, genetics, breeding and biochemistry. In Annual review Plant Science Edited by : Malik CP. New Delhi, *Klyani Publishers*: 285-313

Banerjee, P.P. and Kole, P.C. 2009. Combining ability analysis for seed yield and some of its component characters in sesame (Sesamum indicum L.). International Journal of Plant Breeding and Genetics **3**(1):11-21, 2009.

Griffings, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci. **9:** 463-493.

Muhammad, S.H. and Sedeck, FSh. 2015. Combining ability and heterosis estimates in sesame. World Applied Science Journal **33**(5):690-698. DOI:10.5829/idosi.wasj.2015.33.05.14580.

Raja-Ravindran, G. and Amirtha, D.R.A. 1996. Combining ability analysis on sesame. Sesame and Safflower Newsletter, No.11.pp. 70-75.

Solanki, Z.S. and Gupta, D. 2003. Inheritance studies for seed yield in sesame. Sesame and Safflower Newsl. No.18.

Saravanan, S. and Nadarajan, N. 2003. Combining ability studies in sesame. Sesame and Safflower Newsletter No. 18: pp. 2024.

Singh, R.K. and Chaudhary, B.D. 1985. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi,pp;300.

Thirugnana-Kuma, S. Srinivasan, R. Kubenthiran, K. Eswaran, R and Kumar, C.P.S. 2006. Studies on combining ability and heterosis for yield and yield component characters under normal and temporarily flooded conditions in sesame (*Sesamum indicum* L.). Sesame and Safflower Newsl. No.21.

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Table 1. GCA and SCA effects for different characters in parents and hybrids of sesame

Genotype	Plant height (cm)	Number of primary branches per plant	Number of capsules per plant	Capsule length (cm)	Number of grains per capsule	Days to 50% flowering	Days to maturity	Seed yield per plant
P1 (ES-230)	1.15**	-0.55**	-7.55**	0.04	-0.78*	1.70**	1.90**	0.89**
P2(IS-1162)	-2.18**	0.13*	5.58**	-0.06	-1.28**	0.50*	0.18	0.14
P3(SI-1147)	-0.30	0.33**	4.88**	0.07	0.12	-0.05	-1.43**	0.71**
P4(SI-775)	-2.35**	0.05	6.38**	0.09	-1.16**	0.98**	0.88**	0.14
P5 (NIC-8401)	1.05**	-0.18	-3.55**	-0.03	2.22**	0.00	1.85**	-0.41*
P6 (NIC-16220)	2.05**	-0.48**	-1.75**	0.02	0.94**	-0.90*	-2.03**	-0.26
P7(DS-10)	1.95**	0.375**	-1.70**	-0.06	0.02	-0.98*	0.45*	-0.14
P8(MT-75)	0.73**	0.33**	-2.28**	-0.08	-0.08	-1.25**	-1.8**	-1.06**
P1 x P2	-3.67**	0.90**	7.84**	0.31*	4.50**	-4.06**	-9.99**	-1.19**
P1 x P3	14.96**	0.20	0.79*	-0.31*	1.35**	0.24	0.86**	-2.41**
P1 x P4	5.7**6	-0.53**	-20.21**	-0.09	1.37**	0.71**	7.56**	-0.50*
P1 x P5	5.71**	-0.55**	-8.04**	0.04	0.75*	0.94**	-2.92**	18.55**
P1 x P6	-1.89**	0.75**	6.16**	0.49**	0.28	2.59**	5.71**	-0.48*
P1 x P7	-0.79	-0.10	2.86**	0.06	-3.30**	-0.34	7.23**	1.29**
P1 x P8	-7.57**	-0.30**	3.67**	-0.41**	-2.45**	-2.56**	-7.02**	-0.68**
P2 x P3	4.28**	0.77**	10.16**	0.29	-2.15**	2.94**	-3.92**	-1.43**
P2 x P4	0.08	0.05	3.91**	0.26	-10.63**	-1.84**	-6.22**	-0.04
P2 x P5	7.03**	-0.48**	-7.16**	-0.36	0.00	-0.86**	4.56**	5.33**
P2 x P6	-2.57**	-0.18	5.54**	0.34*	-2.48**	0.04	2.68**	-0.29
P2 x P7	-0.72	-0.03	11.74**	-0.09	1.20**	0.86**	2.71**	-5.59**
P2 x P8	2.26**	0.02	8.56**	-0.06	1.55**	4.14**	7.21**	3.05**
P3 x P4	6.21**	0.60**	-4.39**	0.14	-0.03	-1.04**	1.88**	1.44**
P3 x P5	6.16**	2.82**	13.79**	-0.24	-2.15**	-0.81**	2.91**	0.05
P3 x P6	2.94**	-1.13**	-6.76**	-0.04	2.13**	0.09	1.18**	-1.40**
P3 x P7	-5.09**	-0.73**	1.69**	0.29	-2.20**	1.41**	2.81**	-1.30**
P3 x P8	-8.87**	-0.68**	2.51**	0.06	0.65*	-2.81**	-6.19**	-0.63**
P4 x P5	-0.79***	0.10	12.29**	0.49**	2.38**	2.41**	3.11**	-6.12**
P4 x P6	-6.14**	0.65**	-3.51**	-0.31*	3.40**	0.81**	-1.52**	0.66*
P4 x P7	0.96*	-1.45**	-8.06**	-0.24	2.58**	-0.11	-3.24**	2.40**
P4 x P8	1.93**	-0.65**	-12.24**	-0.46*	-2.08**	3.16**	2.26**	2.30**
P5 x P6	-4.94**	-0.13*	-13.59**	-0.19	-1.23**	3.79**	1.51**	-1.92**
P5 x P7	-6.09**	-1.23**	-14.89**	-0.11	-2.55**	-2.39**	-2.48**	-5.16**
P5 x P8	1.13**	-0.68**	-11.31**	-0.34*	0.80**	-2.36**	0.03	-1.45**
P6 x P7	-2.44**	-0.43**	-1.44**	0.09	0.46*	-1.99**	-8.84**	0.74
P6 x P8	1.03**	0.62**	8.89	0.11	-0.68**	-1.71**	-5.09**	0.65
P7 x P8	11.38**	2.52**	15.09	0.19	1.50**	0.86**	-7.07**	0.61

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

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Table 2. GCA and SCA effects for different characters in parents and F_2s of sesame

Genotype	Plant height (cm)	Number of primary branches per plant	Number of capsules per plant	Capsule length (cm)	Number of grains per capsule	Days to 50% flowering	Days to maturity	Seed yield per plant (g)
P1 (ES-230)	0.95**	-1.31**	-2.08**	3.25**	-0.06	0.45*	0.23	1.35**
P2(IS-1162)	-1.08**	1.13**	3.25**	-1.05**	-2.12**	0.43*	0.32	0.09
P3(SI-1147)	-1.36**	2.33**	4.26**	0.05	2.13**	-0.08	-1.89**	0.12
P4(SI-775)	-1.05**	1.09**	4.32**	0.15	-2.15**	0.45*	0.78**	0.89**
P5 (NIC-8401)	2.06**	-2.16**	-2.13**	-1.02**	1.02**	0.03	1.23**	-0.56**
P6 (NIC-16220)	3.05**	-6.08**	-1.65**	1.06**	0.62*	-0.65*	-2.13**	-1.36**
P7(DS-10)	2.05**	1.56**	-0.98**	-1.02**	0.08	-0.65*	0.36	-0.26
P8(MT-75)	1.73**	1..39**	-1.45**	-1.02**	-1.07**	-1.09**	-1.12**	-1.76**
							**	
P1 x P2	-2.68**	7.98**	10.67**	3.09**	2.56**	-2.36**	-7.89**	-2.08**
P1 x P3	11.36**	8.27**	1.39**	-0.01	0.89*	0.36	2.36**	-1.08**
P1 x P4	6.36**	-7.56**	-13.01**	-0.05	3.27**	0.32	5.32**	-1.35**
P1 x P5	4.51**	-3.54**	-5.05**	0.05	1.05**	0.45*	-3.32**	12.23**
P1 x P6	-2.82**	1.05**	4.12**	0.0 9	1.25**	1.23**	3.65**	-1.23**
P1 x P7	-1.76**	-1.16**	5.89**	0.05	-2.32**	-1.32**	5.13**	0.89**
P1 x P8	-3.07**	-1.35**	4.07**	-0.05	-1.12**	-1.06**	-5.03**	-1.61**
P2 x P3	6.08**	0.45	15.17**	0.08	-1.01**	1.95**	-5.95**	-0.23
P2 x P4	2.09**	0.09	6.05**	0.25	-9.53**	-0.89*	-5.29**	-1.24**
P2 x P5	8.03**	-0.23	-4.26**	-1.46**	0.56*	-1.01**	6.42**	2.56**
P2 x P6	-4.32**	-0.10	6.52**	3.24**	-1.22**	0.08	1.65**	-1.30**
P2 x P7	-1.43**	-0.93**	15.08**	-0.89*	0.98*	0.12	4.76**	-8.23**
P2 x P8	1.06**	0.04	5.58**	-1.02**	2.54**	5.12*	3.56**	6.12**
P3 x P4	7.01**	0.66*	-5.33**	2.12**	-1.09**	-2.05**	5.45**	2.45**
P3 x P5	8.13**	2.50**	12.75**	-1.32**	-1.05**	-0.21	1.23**	1.08**
P3 x P6	3.04**	-1.08**	-4.06**	-2.02**	3.18**	0.48*	0.15	-2.44**
P3 x P7	-4.09**	-0.65*	4.69**	2.21**	-3.28**	1.56**	1.09**	-2.35**
P3 x P8	-7.07**	-0.45*	3.41**	1.08**	0.39	-1.23**	-1.08**	-2.23**
P4 x P5	-1.09**	0.09	14.08**	2.42**	4.39**	3.53**	2.01**	-2.08**
P4 x P6	-5.12**	0.42*	-2.58**	-2.32**	4.47**	0.31	-0.89**	2.35**
P4 x P7	2.35**	-1.36**	-7.07**	-1.04**	1.49**	-0.41*	-2.09**	1.45**
P4 x P8	2.12**	-0.23	-15.22**	-1.21**	-1.09**	2.45**	1.09**	1.09**
P5 x P6	-3.57**	-0.10	-10.29**	-1.13**	-3.12**	5.45**	8.06**	-2.32**
P5 x P7	-7.08**	-1.08**	-10.71**	-1.05**	-1.56**	-3.24**	-1.23**	-2.23**
P5 x P8	3.14**	-0.23	-9.12**	-2.34**	2.65**	-1.46**	2.08**	-3.08**
P6 x P7	-3.54**	-0.36*	-2.56**	2.01**	2.35**	-3.75**	-2.82**	3.23**
P6 x P8	5.03**	0.42*	5.89**	2.11**	-1.08**	-3.23**	-3.14**	2.56**
P7 x P8	13.21**	1.12**	13.04**	3.11**	0.89**	1.02**	-5.06**	-2.65**

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