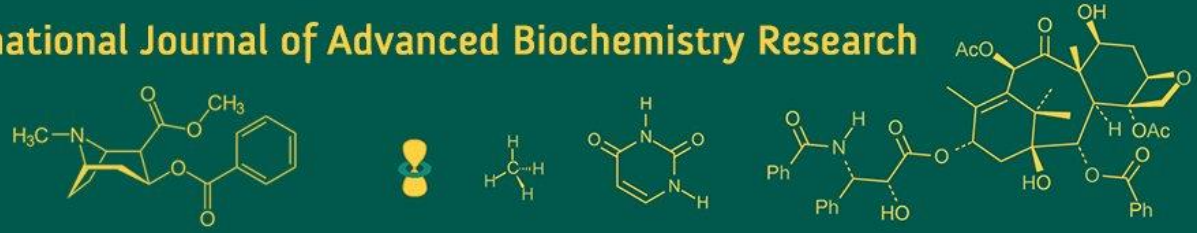
International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(4): 448-451
www.biochemjournal.com
Received: 23-01-2024
Accepted: 28-02-2024

BD Gore
Department of Genetics and Plant Breeding, College of Agriculture, Latur, Maharashtra, India

ST Rathod
Assistant Professor, Department of Genetics and Plant Breeding, College of Agriculture, Ambajogai, Maharashtra, India

GH Naik
Ph.D. Research Scholar Department of Agril. Botany College of Agriculture, Parbhani, Maharashtra, India

PB Sarvade
Department of Horticulture, College of Agriculture, Latur, Maharashtra, India

Corresponding Author:
BD Gore
Department of Genetics and Plant Breeding, College of Agriculture, Latur, Maharashtra, India

Combining ability studies in sesame (*Sesamum indicum* L.) for seed yield and its contributing traits

BD Gore, ST Rathod, GH Naik and PB Sarvade

DOI: https://doi.org/10.33545/26174693.2024.v8.i4f.986

Abstract
The present investigation entitled "Heterosis and combining ability studies in Sesame (*Sesamum indicum* L.)" were undertaken with the objective to study the heterosis and to estimate general and specific combining ability effects. Among the parents, TBS-05 and TBS-10 were found good general combiner for seed yield per plant. Considering both *per se* and GCA effect the parents TBS-05 and TBS-10 were found to be best. The highest SCA effect for seed yield per plant was exhibited by cross R-20 x V-13 along with superior SCA effect for six traits like day to maturity, plant height, number of capsules per plant, seeds per capsule, capsule length and oil content. The character test weight had fixable additive genetic variance which can improve by simple selection. The crosses V-13 x TBS-07 and V-13 x TBS-05 with significant SCA effects for seed yield per plant. Better segregants can be obtained from such hybrid combination for seed yield and yield contributing traits.

Keywords: Sesame, combining ability, GCA, SCA, heterosis

Introduction
There are several common names for Sesame, including *Til* (*Marathi*), *Tili* (*Punjab*), *Nuvulu* (*Telegu*), etc. India is the world's second-largest producer of Sesame, behind Sudan, with 0.78 million tons produced, and an area of 1.56 million hectares with 502 kg/ha of productivity. The family Pedaliaceae and order Tubiflorae include Sesame. A crop that self-pollinates is Sesame. Based on cytogenetically determined groupings, sesamum species have a total of somatic chromosome number. When comparing the chromosome counts of *S. indica* and *S. malabricum* species, the first group has 2n=26. Conversely, the second group, which consists of Sesame *S. laciniatum* and *S. prostratum*, has 2n=32. The last group includes species *S. radiatuma* and *S. occidentale*, with n=64 (Joshi 1961) [8]. It is grown in tropical warm climates. It needs an average temperature of between 25 and 27 degrees Celsius to germinate, grow, and flower quickly. Major states in India that cultivate Sesame include Gujarat, Rajasthan, Uttar Pradesh, Madhya Pradesh, Maharashtra, Andhra Pradesh, Orissa, Tamil Nadu, West Bengal, and Karnataka. Approximately 50% of Sesame seeds are oil, 25% are protein, and 15% are carbohydrates. There is a higher concentration of minerals, iron, calcium, zinc, magnesium, potassium, and vitamins A, E, and B complex. An antioxidant known as sesamol is present in Sesame oil and provides a high level of resistance against oxidative rancidity. Because parents with outstanding phenotypes can produce mediocre or inferior hybrids in subsequent generations, choosing parents only on the basis of their individual performance is not always the best course of action (Banerjee and Kole, 2010). Therefore, it is important to select parent based on *per se* performance and high GCA value for traits to be improved.

Materials and Methods
The experimental material was consisting of 7 parents (TBS-10, TBS-05, TBS-07, V-29, R-20, V-13, R-09) and 2 Checks (AKT-101&JLT-408) obtained from Oilseed Research Station, Latur. The experiment was laid out in a randomized block design with two replications at Experimental Farm Department of Agricultural Botany, College of Agriculture, Latur during *Kharif*-2022-23. The data recorded for ten traits on five plants from each treatment in each replication at different growth stages of crop and average value for plant were worked out. Combining ability analysis for seed yield per plant and yield

contributing traits was done by using method given by Kempthorne (1957) [10].

Results and Discussion

The present investigation on ten different traits for various entries were analyzed and subjected to statistical analysis of variance (Table 1) revealed that, treatments, parents and crosses were found highly significant for most of traits indicating presence of considerable amount of variability in the experimental material present in study. Similar results were reported by Hassan and Chaudhari (2015) [7], Priya *et al*. (2016) [11], Vimala *et al*. (2017) [15] and Dela *et al*. (2019) [4].

The estimate of GCA of parents and SCA of crosses presented in Table 2 and Table 3, respectively. An early day to 50 per cent flowering and day to maturity is desirable trait. Parent having negative GCA effects are important in breeding program. In the present evaluation, the parent R-20 (-2.198) recorded significantly negative GCA effect for days to 50 (%) flowering. The parent, R-20 (-3.159), V-29 (-1.325), V-13 (-0.770), recorded significantly negative GCA effect for days to maturity. Among the 21 crosses, the cross V-29 x R-09 (-6.500) and V-29 x TBS-10 (-4.833) expressed significantly desirable negative SCA effects for days to maturity.

The Parent, TBS-07 (3.335) and TBS-10 (3.146) showed positive significant GCA for plant height. Among the 21 crosses, the cross R-20 x V-13 (9.77) expressed significantly desirable positive SCA effects for plant height. For number of branches, parent TBS-07 (0.176) and six F_1s indicated positive and highly significant SCA effects. TBS-10 x V-13 (0.876) was the most significant and positive SCA cross, followed by R-20 x V-13 (0.849), TBS-07 x TBS-05 (0.760), and V-29 x R-20 (0.399).For number of capsules per plant, the TBS-05 (8.386) had the greatest significant positive GCA effect, followed by R-20 (1.158) exhibited highest significant positive GCA effect and the crosses, R-20 x V-13 (23.86) followed by R-20 x TBS-07 (18.77), R-20 x R-09 (16.46) and V-29 x R-20 (15.72) expressed significantly desirable positive SCA effects.

Parent, TBS-05 (0.075) exhibited highest positive significant GCA effect for length of capsule followed by TBS-10 (0.070) and R-20 (-0.085) the cross,R-20 x R-09 (0.297) exhibited maximum significant positive SCA effect for length of capsule followed by R-20 x V-13 (0.079). For number of seeds per capsule, the lines, TBS-05 (3.411) andV-29 (0.30) showed significant positive GCA effect. For 1000 seed weight, study of combining ability effect revealed that the parent, TBS-10 (0.199) and V-29 (0.124) and TBS-07 (0.063) showed significant positive GCA effect and the cross, V-29 x V-13 (0.121) expressed highest significantly desirable positive SCA effects. For oil content, the line, TBS-05 (1.643) showed significant positive GCA effect and cross,V-13 x TBS-07 (5.486) expressed highest significantly desirable positive SCA effects.

Out of seven parent, TBS-05 (1.265) and TBS-10 (0.454) showed significant positive GCA effect for seed yield per plant (g)**.** Among 21 crosses, the cross,R-20 x V-13 (3.379) expressed highest significantly desirable positive SCA effects for seed yield per plant (g).

An important milestone in the development of productive and successful breeding techniques for a variety of crop plants is the idea of combining ability. Guidelines for an early evaluation of the relative breeding value of the parental material are provided by the analysis of combining ability. The GCA attributes hereditary effects that are cumulative and reversible. Conversely, SCA ascribed to non-additive gene action may result from higher order gene interaction, additive x dominance, dominance, or dominance and cannot be fixed. A hybrid development program is primarily justified by the existence of non-additive genotypic diversity. Depending on the type of gene activity, the parental material can be exploited to create hybrids or accumulate advantageous fixable genes. The selection of parents for combining ability was justified since the results of the study of variances of combining ability for ten distinct traits in half diallel analysis (Table-1) showed that variance owing to parents was extremely significant for all traits. It was evident from the high GCA effects in the desired direction for seed yield and its constituents that these lines would mix well with other lines to give superior offspring. In the present investigation, among the parent, TBS-05 was the best general combiner for seed yield per plant and recorded positive significant GCA effect for the traits *viz.*, number of capsules per plant (8.386), plant height (cm) (3.335), Number of branches per plant (0.301) and 1000 seed weight (0.199). The other line, TBS-05 (1.265) also exhibited desirable and significant GCA for seed yield per plant and expressed positive significant GCA effects for the traits *viz.*, number of capsules per plant (8.386).These observations clearly indicate that there appeared to be close relationship between GCA and *per se* performance of most of the traits expressed by the parents. In turns it will help as criteria to select the parents for breeding program. Since, high GCA effect attributed to additive gene action, the parent having highly significant and positive GCA effect could be used in breeding program for yield improvement through pedigree breeding. Similar result registered by Vidhyavati *et al*. (2005) [14], Virani *et al.* (2018) [17], Karthikeyan *et al*. (2019) [9], Sirohi *et al*. (2020) [12] and Ghule *et al*. (2022) [6].

The results on specific combining ability effects of crosses for different traits under study are presented in Table 3. V-29 x R-09 andV-29 x TBS-10 cross combination showed significantly desirable negative SCA effects for days to flowering. Earliness is desirable in crop plants, hence the cross combinations with negative SCA effects are great value as they would result into early segregates. In the present investigation for days to maturity the hybrid combination V-29 x R-09 (-6.500) showed maximum negatively SCA effects for days to maturity. Similar result registered by Vidhyavati *et al*. (2005) [14], Deshmukh *et al.* (2019) [5], Sonwane *et al.* (2019) [13], Dela *et al.* (2019) [4], Sirohi *et al*. (2020) [12] and Ghule *et al*. (2022) [6].

In case of plant height (cm), number of branches per plant, length of capsule, number of seeds per capsule, 1000 seed weight (g), seed yield per plant (g) and oil content (%) positive SCA were desirable. In this investigation, out of 21 crosses evaluated, significant and positive SCA effect for 10 traits were found in different crosses discussed above. When SCA significantly positive for these traits were using heterosis breeding method is desirable. This trait can be improved by biparental mating and reciprocal recurrent selection and exploitation of heterosis. Similar results reported by Visat *et al.* (2016) [18], Vimala *et al*. (2017) [15], Virani *et al.* (2018) [17], Karthikeyan *et al*. (2019) [9], Sirohi *et al*. (2020) [12], Bhattacharjee *et al.* (2021) [2] and Ghule *et al*. (2022) [6].

Table 1: Analysis of variance of combining ability for ten different traits including parents in Sesame (*Sesamum indicum* L.).

Source of Variation	d.f.	Days to 50 percent flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of capsule per plant	Length of capsule (cm)	No. of Seeds per capsule	1000 Seed weight (g)	Seed yield per plant (g)	Oil Content (%)
Treatments	27	8.516 **	25.175 **	158.339**	0.500 **	359.39**	0.044 *	35.255 **	0.146 **	27.598 **	5.483 **
Parents	6	9.786 **	11.333 **	141.519 *	0.318 **	8.809	0.019	81.498 **	0.296 **	11.779 **	0.671
Crosses	20	6.931 **	30.581 **	108.845 **	0.528 **	379.029 **	0.052 **	22.959 *	0.107 **	26.836 **	6.684 **
P x C	1	32.595 **	0.095	1249.1 **	1.021 **	207.26**	0.025	3.720	0.024 *	137.75 **	10.351**
Error	27	0.421	1.884	41.226	0.043	8.680	0.018	9.829	0.004	0.288	0.330

*and ** indicated significance at 5and 1 percent level, respectively.

Table 2: General combining ability effects of parents for ten traits in 7 x7 half diallel set of Sesame.

Lines and Testers	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Length of capsule (cm)	Number of seeds per capsule	1000 seed weight (g)	Seed yield per plant (g)	Oil content %
V-29	-0.532 **	-1.325**	-4.632 **	-0.299 **	-6.56**	-0.003	1.300	0.124 **	1.083 **	-0.874 **
TBS-10	0.302 *	0.730 *	3.146 *	-0.005	-2.58**	0.070 *	-0.789	0.199 **	-1.283 **	0.454 **
R-20	-2.198 **	-3.159**	-6.182**	-0.055	1.158	-0.085 **	-0.694	-0.114 **	-2.242 **	-0.074
V-13	-0.310 *	-0.770 *	1.290	-0.116 *	-0.709	-0.053	-1.517 *	-0.322 **	0.301 *	-0.357 **
TBS-07	0.246	0.230	3.335 *	0.173 **	0.319	0.027	-2.061 **	0.063 **	0.414 **	-0.107
TBS-05	0.968 **	1.619 **	1.052	0.301 **	8.386 **	0.075 *	3.411 **	0.015	1.643 **	1.265 **
R-09	1.524 **	2.675 **	1.990	0.001	-0.009	-0.030	0.350	0.034 *	0.083	-0.307 *
S.E. (gi) ±	0.141	0.299	1.401	0.045	0.642	0.029	0.684	0.014	0.117	0.125
C.D. at 5%	0.290	0.614	2.874	0.092	1.319	0.059	1,403	0.029	0.240	0.257

*and ** indicated significance at 5 and 1 percent level, respectively.

Table 3: Estimates of specific combining Ability (SCA) for ten traits in Sesame (*Sesamum indicum* L.)

Sr. No.	Crosses	Days to 50 percent flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Length of capsule (cm)	Number of seeds per capsule	1000 seed weight (g)	Seed yield per plant (g)	Oil content %
1	V-29 x TBS-10	-1.806**	-4.833**	-10.0**	-0.151	-7.590*	-0.117	0.864	-0.081*	3.43**	-1.082**
2	V-29 x R-20	0.194	0.056	7.29	0.399**	15.72**	0.078	1.019	0.187**	1.92**	1.846**
3	V-29 x V-13	1.361**	2.000*	4.81	-0.496**	-10.71**	0.004	0.558	0.121**	3.42**	-1.082**
4	V-29 x TBS-07	0.806*	2.667**	5.81	0.160	-2.212	-0.144	-3.258	0.210**	-1.28**	-0.971**
5	V-29 x TBS-05	-0.528	0.111	-0.26	0.215	13.95**	0.133	2.681	0.044	-5.17**	1.201**
6	V-29 x R-09	-2.028**	-6.500**	-7.43	-0.185	1.266	-0.232**	1.286	0.067	-0.86*	0.529
7	TBS-10 x R-20	-1.250**	-0.833	5.07	-0.529**	5.01**	-0.019	4.036*	-0.105	2.19**	0.129
8	TBS-10 x V-13	0.917*	2.611**	6.99	0.876**	-5.27**	0.002	-3.975*	0.089*	0.001	0.051
9	TBS-10 x TBS07	-1.083**	-2.000*	5.72	-0.324*	1.538	0.007	-2.969	-0.083*	-0.010	-0.421
10	TBS-10 x TBS05	-0.472	1.111	8.75*	0.037	3.255	0.001	3.853	-0.145**	2.507**	1.462**
11	TBS-10 x R-09	0.028	2.778**	-1.74	-0.457**	-15.25**	-0.032	-4.136	-0.047	1.275**	-1.393**
12	R-20 x V-13	-0.306	1.722*	9.77*	0.849**	23.86**	0.079	-1.247	-0.038	4.421**	3.379**
13	R-20 x TBS-07	-1.306**	-1.389	9.05*	0.299*	18.77**	0.089	2.958	0.105	-1.724	2.257**
14	R-20 x TBS-05	-0.194	1.722*	4.73	-0.240*	-10.51**	-0.142	-3.319	-0.12**	2.597**	-1.110**
15	R-20 x R-09	-0.750	-1.278	4.69	0.271*	16.46**	0.297**	4.475*	0.043	1.475**	1.440**
16	V-13 x TBS 07	-1.028**	-0.278	0.71	-0.107	1.538	0.063	-1.075	-0.031	5.486**	1.179**
17	V-13 x TBS 05	0.639	1.167	-2.66	0.199	-3.94*	-0.041	1.014	-0.12**	5.252**	-0.249
18	V-13 x R-09	-0.861*	0.056	-1.13	0.099	-1.084	0.014	3.619	-0.24**	1.771**	-0.521
19	TBS-07 x TBS05	-1.750	-1.333	5.59	0.760**	15.28	0.093	1.342	-0.026	3.068**	-0.238
20	TBS-07 x R-09	-0.306	1.167	0.15	0.171	0.855	-0.118	-2.014	-0.12**	-1.975**	-1.087**
21	TBS-05 x R-09	0.472	0.778	1.33	-0.207	12.78**	-0.271**	-8.836**	0.047	-1.934**	0.890**
	S.E (+)	0.411	0.871	4.07	0.131	1.869	0.084	1.989	0.041	0.340	0.364

*and ** indicated significance at 5 and 1 percent level, respectively

Conclusion

The crosses V-13 x TBS-07 and V-13 x TBS-05 with significant SCA effects for seed yield per plant. Better segregants can be obtained from such hybrid combination for seed yield and yield contributing traits.

References

1. Banerjee PP, Kole PC. Combining ability analysis for seed yield and some of its component traits in Sesame (*Sesamum indicum* L.). International Journal of Plant Breeding and Genetics. 2010;3(1):11-21.
2. Bhattacharjee M, Kundagrami S, Dasgupta T. Combining ability for quantitative traits in Sesame through line x tester analysis. An International Quarterly Journal of Life Sciences. 2021;16(1):239-246.
3. Chaudhari GB, Naik MR, Anarase SA, Ban YG. Heterosis studies for quantitative traits in Sesame

(*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2015;6(1):218-224
4. Dela GJ, Sharma LK, Delvadiya IR. Combining ability analysis for seed yield per plant and its components in Sesame (*Sesamum indicum* L.). Journal of Pharmacognosy and Phytochemistry. 2019;8(4):1339-1344.
5. Deshmukh AS, Misal AM, Tavadare PL, Dasari R. Combining ability analysis in Sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2019;10(3):1283-1291.
6. Ghule VB, Misal AM, Durge SM, Ghodake MK. Studies on general and specific combining ability in Sesame (*Sesamum indicum* L.). The Pharma Innovation Journal. 2022;11(1):514-517.
7. Hassan MS, Sedeck FS. Combining ability and heterosis estimates in Sesame. World Applied Sciences Journal. 2015;33(5):690-698.
8. Joshi AB. Sesamum - a monograph. Hyderabad, India: Indian Central Oilseed Committee; c1961.
9. Karthikeyan P, Eswaran R, Saravanan KR, Thangavel P. Combining ability studies through line x tester analysis in Sesame (*Sesamum indicum* L.). Journal of Pharmacognosy and Phytochemistry. 2019;8(2S):311-314.
10. Kempthorne. Introduction to Genetic statistics. New York, NY: John Wiley and Sons Inc.; London: Chapman and Hall; c1957.
11. Priya R, Thiyagarajan K, PechiappanBharathi S, Krishnasamy V. Combining ability studies through Line x Tester analysis in Sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2016;7(4):883-887.
12. Sirohi S, Kumhar S, Kumari B. Heterosis and combining ability studies in Sesame (*Sesamum indicum* L.). The Indian Society of Oilseeds Research. 2020;37(1):16-20.
13. Sonawane SJ, Wadikar PB, Magar MR, Dhare SL. Combining ability and gene action in Sesame (*Sesamum indicum* L.) elite genotypes by half diallel mating design. International Journal of Current Microbiology Applied Science. 2019;8(9):2747-2754.
14. Vidhyavathi R, Manivannan N, Muralidharan V. Line x tester analysis in Sesame (*Sesamum indicum* L.). Indian Journal of Agricultural Research. 2005;39(3):225-228.
15. Vimala G, Parameshwarappa SG. Combining ability analysis for yield and yield attributing traits in Sesame (*Sesamum indicum* L.). Journal of Farm Sciences. 2017;30(3):418-420.
16. Virani MB, Vachhani JH, Kachhadia VH, Chavadhari RM, Mungala RM. Heterosis studies in Sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2017;8(3):1006-1012.
17. Virani MB, Vachhani JH, Kachhadia VH, Chavadhari RM, Sharma S. Combining ability for seed yield and its components in Sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2018;9(1):107-115.
18. Visat M, Patel M, Balat J, Patel S. Combining ability analysis for yield and yield components in Sesame (*Sesamum indicum* L.). Advances in Life Sciences. 2016;5(18):7726-7729.