International Journal of Environment, Agriculture and Biotechnology
Vol-10, Issue-5; Sep-Oct, 2025
Peer-Reviewed International Journal
Journal Home Page Available: https://ijeab.com/
Journal DOI: 10.22161/ijeab

Half diallel analysis through griffing's approach in sesame (*Sesamum indicum* L.)

M. P. Mungala[1*], M. H. Sapovadiya[2], Divijkumar R. Vaghasiya[3], H. B. Gohil[4] and B. D. Bhatiya[5]

[1,3,4,5]M. Sc. Agri., Department of Genetics and Plant Breeding, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat), India.
[2]Associate Research Scientist, Department of Genetics and Plant Breeding, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat), India.
*Corresponding author

Received: 03 Sep 2025; Received in revised form: 30 Sep 2025; Accepted: 05 Oct 2025; Available online: 12 Oct 2025

***Abstract*— *Ten sesame (Sesamum indicum L.) genotypes were crossed in a half diallel mating fashion to produce 45 hybrids. The analysis of variance for combining ability revealed that mean sum of squares due to GCA and SCA were found highly significant for all the traits. The lower estimates of potence ratio indicated that non-additive gene action was predominant for the inheritance of all the traits except oil contain.The estimates of general combining ability effects revealed that the parents, Keriya 10, U-6-3 and ST-12-25 were good general combiners for seed yield per plant. The genotype Keriya 10 was also good general combiner for plant height (cm), number of braches per plant, number of capsules per plant, number of seeds per capsule, biological yield per plant (g) and 1000-seed weight (g). The cross combinations viz., Keriya 10 × BS-6-1, U-6-3 × Khadkala-1 and U-6-3 × EI-233 were found to be good specific cross combination for seed yield per plant and its attributes. Crosses with high sca effect in seed yield per plant were in combinations of good × poor general combiners.*

***Keywords*— Combining ability, Gene action, Griffing's approach, Half-diallel, Sesame**

I. INTRODUCTION

Sesame is a very ancient oilseed crop grown next to groundnut, mustard and soybean in India. Sesame (*Sesamum indicum* L.) belongs to the order *Tubiflora*e, family *Pedaliaceae* with chromosome number 2n=26. It is basically considered a crop of tropical and sub-tropical regions but, it has also spread to the temperate parts of the world. Africa has been considered to be the primary centre of origin of sesame and it spread early through West Asia to India, China and Japan which they became secondary distribution centers (Weiss, 1983). Sesame is called as the "Queen of Oilseeds" because of its excellent qualities of the seed, oil and meal. Sesame oil contains a high unsaturated essential fatty acids content [linoleic acid (37–47%), oleic acid (35–43%)] and low saturated fatty acid content [palmitic acid (8–11%) and stearic acid (5–10%)], the seeds also contain 14.1–29.5% proteins, 4.3–20.5% carbohydrates, 4.2–6.9% ash and 2.7–6.7% fiber content, along with vitamin E, minerals, lignans (sesamolin and sesamin), and tocopherols. In addition, sesame seed mineral composition includes K (349–851 mg/100g), P (50– 890 mg/100g), Mg (305–79 mg/100g), Ca (80–1263 mg/100g) and Na (123 mg/100g) (Couch *et al*., 2017).In India, sesame is cultivated in an area of 19.01 lakh ha with a production of 8.10 lakh tones annually and productivity of 426 kg/ha (Anon., 2022). In Gujarat, sesame is cultivated in an area of 2.46 lakh ha with a production of 1.16 lakh tones and productivity of 471 kg/ha (Anon., 2022). The choice of parents to be incorporated in hybridization programme is a crucial step for plant breeders, particularly if the aim is improvement of complex quantitative characters, such as yield and its components. The use of parents of known superior genetic worth ensures much better success. It requires extensive and detailed genetic assessment of existing germplasm as well as newly developed promising lines, which could be used in future breeding programme or could be directly released as a cultivar after thorough testing. Combining ability analysis gives useful information regarding the selection of parents in terms of the performance of their hybrids. On the basis of this information, decisions on the selection of the parents can be taken most effectively. Estimates of general combining ability (gca) and specific combining ability (sca) effects are widely used in planning of breeding programs.

II. MATERIALS AND METHODS

The experimental material comprised of 10 parents, one standard check (G.Til 7) and 45 F_1's derived by crossing 10 different genotypes of sesame in a half-diallel fashion at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, during summer-2023. A total 56 genotypes, including 10 parents, 45 F_1's and one standard check (G.Til 7) were grown in a randomized complete block design with three replications during *kharif*-2023 at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. Each entry was accommodated in a single row plot of 3 meter length with row to row and plant to plant distances of 45 cm and 10 cm, respectively. All the recommended cultural practices and plant protection measures were followed uniformly to grow healthy crop. The observations were recorded both as plot basis (days to 50% flowering, days to maturity, 1000-seed weight (g) and oil content (%))and measurement on five randomly selected plants(plant height (cm), number of branches per plant, number of capsules per plant, length of capsule (cm), number of seeds per capsule, seed yield per plant (g), biological yield per plant (g) and harvest index (%)). The replication wise mean values of each entry for the twelve traits were analyzed using randomized block design (RBD) as suggested by Panse and Sukhatme (1995). The combining ability analysis was carried out according to Model-I (Fixed effect), Method-2 (Parents and one set of F_1's without reciprocals) of Griffing (1956). The replicated mean data were analyzed statistically using the software INDOSTAT version 8.1.

III. RESULTS AND DISCUSSION

The analysis of variance for combining ability for different characters has been presented in Table 1. The results revealed that mean squares due to general combining ability (GCA) and specific combining ability (SCA) were highly significant for all the characters. This indicated that both additive and non-additive type of gene effects imparting a vital role in the inheritance of all these traits. The results, in general, are in accordance with the findings of Reddy *et al*. (2015), Rajput *et al*.(2017), Ram *et al*. (2018), Jeeva *et al*. (2020), Kumar *et al*. (2021), Sikarwar *et al*. (2021), Rathod *et al*. (2022) and Gadhiya *et al*. (2023). The magnitude of GCA and SCA variances revealed that the SCA variances were higher than their respective GCA variances for all the characters except oil content where GCA variance is equal to SCA. The σ^2_{GCA}/ σ^2_{SCA} ratio less than unity confirmed the preponderance of non-additive gene action for all the traits except oil content where σ^2_{GCA}/ σ^2_{SCA} ratio equal to unity confirmed the preponderance of both additive and non-additivegene action. The predominance of non-additive gene action for seed yield and its component traits were also reported by Reddy *et al*. (2015), Ram *et al*. (2018), Kumar *et al*. (2021), Sapara *et al*. (2022) and Gadhiya *et al*. (2023).

Table 1: Analysis of variance (mean squares) for combining ability of different characters in sesame

Source of variation	**Df**	**Days to 50% flowering**	**Days to maturity**	**Plant height (cm)**	**Number of branches per plant**	**Number of capsules per plant**	**Length of capsule (cm)**
GCA	9	4.99**	29.95**	271.69**	1.25**	109.86**	0.10**
SCA	45	1.67**	14.45**	102.38**	0.37**	96.31**	0.03**
Error	108	0.46	1.23	17.36	0.01	10.82	0.01
σ^2_{GCA}		0.28	1.29	14.11	0.07	1.13	0.01
σ^2_{SCA}		1.23	13.22	85.02	0.36	85.49	0.02
σ^2_{GCA}/ σ^2_{SCA}		0.22	0.10	0.16	0.21	0.01	0.33

Source of variation	**Df**	**Number of seeds per capsule**	**Seed yield per plant (g)**	**Biological yield per plant (g)**	**1000-seed weight (g)**	**Harvest index (%)**	**Oil content (%)**

GCA	9	22.78**	6.91**	213.91**	0.10**	5.81**	2.87**
SCA	45	20.76**	3.69**	130.54**	0.05**	2.47**	0.35**
Error	108	3.54	0.36	12.00	0.01	1.27	0.14
σ^2_{GCA}		0.17	0.27	6.95	0.004	0.28	0.21
σ^2_{SCA}		17.22	3.34	118.54	0.04	1.20	0.21
σ^2_{GCA}/ σ^2_{SCA}		0.01	0.08	0.06	0.11	0.23	1.01

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

The general combining ability effects of the parents (Table 2) revealed that none of the parents was found to be good general combiner for all the characters. An overall appraisal of gca effect revealed that parents, Keriya 10, U-6-3 and ST-12-25 was good general combiners for seed yield per plant. The parent Keriya 10 was also found good gca effect for plant height, number of branches per plant, number of capsules per plant, number of seeds per capsule, biological yield per plant and 1000-seed weight. The parent G. Til 6 had good gca effect for days to 50% flowering, days to maturity, length of capsule and harvest index. For oil content B-14-1, ST-12-25 and EI-233 were found good general combiner.It is suggested that population involving these parents in a multiple crossing programme may be developed for isolating desirable recombinants. Further, the varieties or lines showing good general combining ability for particular component may also be utilized in component breeding programme for effective improvement in particular components, ultimately seeking improvement in seed yield itself.

Table 2: Estimates of general combining ability (gca) effects of parents for different characters in sesame

Parents	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Length of capsule (cm)
Keriya 10	0.16	**2.03****	4.89**	0.38**	4.18**	0.01
KMR 102	-0.68**	1.64**	**6.98****	0.34**	-0.38	0.04
BS-6-1	-0.23	1.17**	-4.53**	-0.13**	**-3.35****	0.04
U-6-3	**0.93****	0.95**	-0.34	**0.46****	**4.49****	-0.08**
B-14-1	-0.09	-0.74*	3.02**	0.03	-0.51	-0.04
ST-12-25	0.91**	-0.58	3.30**	0.09**	3.72**	0.005
EI-233	-0.32	**-2.58****	-5.28**	**-0.44****	-2.47**	**-0.14****
Khadkala-1	-0.18	-1.41**	**-7.81****	-0.08*	-3.06**	-0.10**
AT 482	0.54**	1.12**	0.77	-0.21**	-1.74	0.10**
G.Til 6	**-1.04****	-1.61**	-0.99	**-0.44****	-0.88	**0.16****
SE(g_i)	**0.18**	**0.30**	**1.14**	**0.03**	**0.90**	**0.02**
SE(g_i-g_j)	**0.28**	**0.43**	**1.70**	**0.04**	**1.34**	**0.03**

Parents	Number of seeds per capsule	Seed yield per plant (g)	Biological yield per plant (g)	1000-seed weight (g)	Harvest index (%)	Oil content (%)
Keriya 10	**2.11****	**1.21****	**5.72****	0.09**	0.25	**-1.08****
KMR 102	0.52	0.07	-0.93	0.04*	0.46	0.15
BS-6-1	1.09*	-0.58**	-3.35**	-0.09**	0.08	-0.61**
U-6-3	1.67**	0.89**	4.24**	-0.001	0.18	0.04

B-14-1	-1.69**	-0.43*	-1.41	-0.11**	-0.48	**0.50****
ST-12-25	0.48	0.76**	5.50**	-0.05*	-0.56	0.44**
EI-233	**-1.72****	-0.56**	-1.80	0.08**	-0.48	0.36**
Khadkala-1	-1.27*	**-1.21****	**-6.37****	**-0.12****	-0.10	0.04
AT 482	-0.69	0.02	2.40*	**0.15****	**-0.90****	0.14
G.Til 6	-0.49	-0.16	-3.99**	-0.01	**1.56****	-0.01
SE(g_i)	**0.52**	**0.16**	**0.95**	**0.02**	**0.31**	**0.10**
SE(g_i-g_j)	**0.77**	**0.24**	**1.41**	**0.03**	**0.46**	**0.15**

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

For days to 50% flowering out of 45 hybrids significant sca effects in the desirable (negative) direction were exhibited by five hybrids. The range of sca effects varied from -2.67 (Keriya 10 × KMR 102) to 2.52 (KMR 102 × G.Til 6 (Table 3). The hybrid Keriya 10 × KMR 102 (-2.67) depicted highest significant sca effects in desirable direction followed by B-14-1 × AT 482 (-2.31), Keriya 10 × ST-12-25 (-2.26), BS-6-1 × G.Til 6 (-1.92) and KMR 102 × BS-6-1 (-1.62) indicating that they may be promising hybrids for exploiting earliness in flowering.

The ranged of sca effects for days to maturity in hybrids varied from -6.77 (BS-6-1 × AT 482) to 6.18 (B-14-1 × ST-12-25) (Table 3). Out of 45 crosses, six crosses exhibited significant and negative sca effects for early maturity. The highest significant and negative sca effect was observed in cross BS-6-1 × AT 482 (-6.77) followed by EI-233 × AT 482 (-3.68), Khadkala-1 × AT 482 (-3.18), BS-6-1 × EI-233 (-3.07), ST-12-25 × G.Til 6 (-2.96) and ST-12-25 × Khadkala-1 (-2.82) indicating that they may be promising hybrids for exploiting earliness.

The magnitude of sca effects in hybrids varied from -12.79 (EI-233 × Khadkala-1) to 17.96 (BS-6-1 × U-6-3) for plant height (Table 3). Out of 45 hybrids, 12 hybrids exhibited significant and desirable (positive) sca effects for this trait. The highest significant and negative sca effect was observed in cross BS-6-1 × U-6-3 (17.96) followed by Keriya 10 × G.Til 6 (17.29) and B-14-1 × AT 482 (16.56), seven hybrids showed significant and negative sca effects, thus they were poor combinations.

The results of sca effect revealed that 11 hybrids recorded significant positive sca effects for number of capsules per plant. The significant positive sca effects ranged from -11.47 (B-14-1 × EI-233) to 29.28 (Keriya 10 × BS-6-1) (Table 3). The crosses, Keriya 10 × BS-6-1 (29.28) followed by U-6-3 × Khadkala-1 (22.56) and U-6-3 × EI-233 (18.87) had maximum sca effects for number of capsules per plant. These superior crosses involved one good and one poor combiner parents. Eleven crosses exhibited sca effects in negative direction.

Out of 45 crosses, eight crosses exhibited significant and positive sca effects which was ranged from -0.26 (Keriya 10 × BS-6-1) to 0.28 (Khadkala-1 × AT 482) for length of capsule (Table 3). The highest significant and positive sca effect was reported in cross Khadkala-1 × AT 482 (0.28) followed by B-14-1 × G.Til 6 (0.27), U-6-3 × G.Til 6 (0.26), Keriya 10 × AT 482 (0.21) and EI-233 × G.Til 6 (0.20). Six crosses exert significant and negative sca effects for this trait, thus they were poor combinations.

The spectrum of variation for sca effects in hybrids ranged from -8.27 (Keriya 10 × BS-6-1) to 9.79 (B-14-1 × G.Til 6) for number of seeds per capsule (Table 4). Out of 45 crosses, 10 hybrids exhibited significant and positive sca effects, therefore, they were considered as good specific combinations for number of seeds per capsule. Some of the good specific combinations were B-14-1 × G.Til 6 (9.79) followed by KMR 102 × B-14-1 (8.14), KMR 102 × EI-233 (7.20), Khadkala-1 × AT 482 (6.96) and BS-6-1 × U-6-3 (4.70). The seven crosses noted as poor specific cross combinations as they noted significant and negative sca effects. Some of the poor specific combinations were Keriya 10 × BS-6-1(-8.27), B-14-1 × Khadkala-1 (-7.60) and BS-6-1 × B-14-1 (-5.20).

Significant sca effects for seed yield per plant was exhibited by 20 hybrids, of which, 12 hybrids possessed positive sca effects, hence they were good specific combinations for higher seed yield per plant (Table 4). Eight crosses showing negative sca effects were registered as poor specific combinations. The hybrids U-6-3 × Khadkala-1 (4.20) followed by Keriya 10 × BS-6-1 (4.17), U-6-3 × EI-233 (3.16) and B-14-1 × AT 482 (3.07) for seed yield per plant. The range of sca effect for seed yield per plant varied from 4.20 (U-6-3 × Khadkala-1) to -2.08 (B-14-1 × EI-233).

The magnitude of sca effects ranged from -14.47 (Keriya 10 × U-6-3) to 24.33 (U-6-3 × Khadkala-1) for biological yield per plant (Table 4). The results revealed that 18 hybrids recorded significant positive sca effects in desirable direction. The highest significant and positive sca effect was observed in cross U-6-3 × Khadkala-1 (24.33) followed by U-6-3 × EI-233 (20.54), Keriya 10 × BS-6-1 (18.09), ST-12-25 × EI-233 (15.93) and BS-6-1 × EI-233 (15.27). Eleven crosses had found significant and negative sca effects for this trait. Some of the poor specific combinations for biological yield per plant were Keriya 10 × U-6-3 (-14.47), EI-233 × Khadkala-1 (-12.46) and EI-233 × AT 482 (-12.31).

Table 3: Estimates of specific combining ability effects of hybrids for days to 50% flowering, days to maturity, plant height, number of branches per plant in sesame

Sr. No.	Crosses	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Length of capsule (cm)
1.	Keriya 10 × KMR 102	**-2.67****	2.51*	-10.79**	0.69**	9.67**	-0.05
2.	Keriya 10 × BS-6-1	-0.12	2.65*	1.86	0.75**	**29.28****	**-0.26****
3.	Keriya 10 × U-6-3	0.05	0.54	-9.03*	0.05	-1.19	-0.03
4.	Keriya 10 × B-14-1	0.41	1.23	-3.06	0.90**	4.84	-0.09
5.	Keriya 10 × ST-12-25	-2.26**	-0.60	2.19	0.02	-4.75	-0.17*
6.	Keriya 10 × EI-233	-0.37	1.07	0.41	-0.51**	-9.36**	-0.10
7.	Keriya 10 × Khadkala-1	2.49**	2.57*	0.57	0.59**	1.83	0.003
8.	Keriya 10 × AT 482	1.11	2.37*	12.42**	-0.23*	-0.69	0.21**
9.	Keriya 10 × G.Til 6	0.36	3.43**	17.29**	**-0.86****	-8.85**	-0.15*
10.	KMR 102 × BS-6-1	-1.62*	-0.30	-2.44	-0.36**	-3.03	0.05
11.	KMR 102 × U-6-3	0.22	-0.07	1.41	0.74**	-7.33*	-0.10
12.	KMR 102 × B-14-1	-0.42	-0.05	6.35	0.39**	2.90	0.16*
13.	KMR 102 × ST-12-25	-0.42	0.79	-6.37	0.29**	-2.13	0.14
14.	KMR 102 × EI-233	-0.53	-1.55	2.88	0.66**	2.73	0.14
15.	KMR 102 × Khadkala-1	0.33	1.29	10.17**	0.28**	-0.78	-0.11
16.	KMR 102 × AT 482	0.94	0.09	-5.48	0.26*	-5.67	-0.07
17.	KMR 102 × G.Til 6	**2.52****	5.48**	8.76*	0.19	5.50	-0.05
18.	BS-6-1 × U-6-3	-0.23	1.40	**17.96****	-0.37**	3.97	0.01
19.	BS-6-1 × B-14-1	1.80**	0.43	-3.87	0.10	-7.76*	-0.10
20.	BS-6-1 × ST-12-25	1.13	5.26**	8.81*	0.93**	-0.59	-0.003
21.	BS-6-1 × EI-233	0.69	-3.07**	14.26**	-0.21*	8.94**	-0.002
22.	BS-6-1 × Khadkala-1	0.22	6.09**	-8.45*	-0.11	-4.57	0.08
23.	BS-6-1 × AT 482	-1.17	**-6.77****	-9.23*	-0.49**	-7.10*	-0.18*
24.	BS-6-1 × G.Til 6	-1.92**	3.29**	-10.53**	-0.13	-2.16	-0.08
25.	U-6-3 × B-14-1	0.97	-0.35	0.64	-0.40**	-7.30*	0.12

Table 3: contd…..

Sr. No.	Crosses	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Length of capsule (cm)
26.	U-6-3 × ST-12-25	-0.03	2.82**	4.96	0.01	7.24*	0.14
27.	U-6-3 × EI-233	1.19	1.48	4.94	0.24*	18.87**	0.14
28.	U-6-3 × Khadkala-1	0.72	-1.68	6.90	-0.09	22.56**	-0.02
29.	U-6-3 × AT 482	1.33*	4.12**	-11.11**	0.91**	15.20**	-0.09
30.	U-6-3 × G.Til 6	-0.09	4.51**	5.19	0.83**	-7.09*	0.26**
31.	B-14-1 × ST-12-25	0.66	**6.18****	-0.97	0.21*	3.14	0.04
32.	B-14-1 × EI-233	-1.12	0.84	10.12**	-0.43**	**-11.47****	-0.11
33.	B-14-1 × Khadkala-1	0.08	2.01	-5.43	-0.01	10.22**	-0.25**
34.	B-14-1 × AT 482	-2.31**	-0.52	16.56**	0.29**	8.66**	0.16*
35.	B-14-1 × G.Til 6	-0.06	-1.13	8.16*	**1.12****	0.67	0.27**
36.	ST-12-25 × EI-233	-0.12	3.01**	16.30**	-0.16	10.97**	0.16*
37.	ST-12-25 × Khadkala-1	0.08	-2.82**	5.52	0.09	-8.44**	0.01
38.	ST-12-25 × AT 482	1.02	2.32*	10.61**	-0.77**	-4.16	-0.10
39.	ST-12-25 × G.Til 6	1.94**	-2.96**	-3.56	0.30**	-5.62	0.02
40.	EI-233 × Khadkala-1	0.30	3.84**	**-12.79****	-0.57**	-9.65**	-0.02
41.	EI-233 × AT 482	-0.76	-3.68**	0.99	0.48**	-6.37*	-0.14
42.	EI-233× G.Til 6	1.16	0.70	2.06	0.09	1.17	0.20**
43.	Khadkala-1 × AT 482	-0.23	-3.18**	3.18	0.21*	2.02	**0.28****
44.	Khadkala-1 × G.Til 6	-0.98	-1.46	-4.28	-0.36**	-1.14	0.09
45.	AT 482 × G.Til 6	1.30*	2.01	2.87	-0.25*	6.84*	-0.21**
	SE (S_{ij})	**0.62**	**1.02**	**3.84**	**0.10**	**3.03**	**0.07**
	SE ($S_{ij} – S_{ik}$)	**0.91**	**1.50**	**5.64**	**0.15**	**4.45**	**0.11**
	SE ($S_{ij} – S_{kl}$)	**0.87**	**1.43**	**5.38**	**0.14**	**2.43**	**0.11**
	Range	**-2.67 to 2.52**	**-6.77 to 6.18**	**-12.79 to 17.96**	**-0.86 to 1.12**	**-11.47 to 29.28**	**-0.26 to 0.28**
	Number of significant and desirable crosses	**5**	**6**	**12**	**20**	**11**	**8**

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

The estimates of sca effects in hybrids ranged from -0.77 (B-14-1 × G.Til 6) to 0.34 (KMR 102 × ST-12-25) (Table 4). Among 45 crosses, 14 crosses were identified as good specific combinations by exhibiting significant and positive sca effects for 1000-seed weight. The most superior cross combinations with respect to sca effect were KMR 102 × ST-12-25 (0.34), KMR 102 × G.Til 6 (0.31) and AT 482 × G.Til 6 (0.26). The superiority of these three crosses was confirmed by their highly significant positive sca effects. While seven hybrids were poor specific combinations as they possessed significant and negative sca effects.

Only one hybrids Keriya 10 × U-6-3 exhibited significant positive sca effects for harvest index (Table 4). The magnitude of sca effects among hybrids varied -3.19 (BS-6-1 × B-14-1) to 4.04 (Keriya 10 × U-6-3). Three hybrids BS-6-1 × B-14-1 (-3.19), U-6-3 × G.Til 6 (-2.87) and KMR 102 × G.Til 6 (-2.50) showed significant and negative sca effects, thus they were poor combinations.

The range of sca effects for oil content among hybrids varied from -1.81 (Keriya 10 × G.Til 6) to 1.04 (Keriya 10 × Khadkala-1) (Table 4). The results revealed that three hybrids recorded significant positive sca effects in desirable direction. The highest significant and positive sca effect was observed in cross Keriya 10 × Khadkala-1 (1.04) followed by KMR 102 × U-6-3 (1.01) and ST-12-25 × EI-233 (0.85). Five crosses had found significant and negative sca effects for this trait. Some of the poor specific combinations for oil content were Keriya 10 × G.Til 6 (-1.81), KMR 102 × Khadkala-1 (-1.23) and Keriya 10 × AT 482 (-1.14).

IV. CONCLUSION

From this study, it was concluded that both additive and non-additive gene actions were observed in expression of the traits studied. Among the parents Keriya 10, U-6-3 and ST-12-25 was found to be good general combiner for seed yield per plant. The best combiners Keriya 10, G.Til 6 and ST-12-25 could be utilized in future breeding programmes. The crosses Keriya 10 × BS-6-1, U-6-3 × Khadkala-1 and U-6-3 × EI-233 showed highly significant sca effect with high *per se* for seed yield. Since heterosis breeding is not feasible in sesame on commercial scale at present, above three crosses could be exploited to isolate transgressive segregants in segregating generation to develop high yielding pureline in sesame.

Table 4: Estimates of specific combining ability effects of hybrids for biological yield per plant, 1000-seed weight, harvest index and oil content in sesame

Sr. No.	Crosses	Number of seeds per capsule	Seed yield per plant (g)	Biological yield per plant (g)	1000-seed weight (g)	Harvest index (%)	Oil content (%)
1.	Keriya 10 × KMR 102	-3.76*	0.78	10.07**	0.22**	-1.94	0.47
2.	Keriya 10 × BS-6-1	**-8.27****	4.17**	18.09**	0.07	0.96	0.53
3.	Keriya 10 × U-6-3	-4.04*	-0.74	**-14.47****	-0.21**	**4.04****	-0.16
4.	Keriya 10 × B-14-1	1.32	1.06	6.43*	0.07	-0.27	-0.23
5.	Keriya 10 × ST-12-25	-2.32	-1.92**	-10.67**	0.04	0.15	0.05
6.	Keriya 10 × EI-233	-2.65	-0.96	-2.59	0.09	-0.22	0.45
7.	Keriya 10 × Khadkala-1	3.16	0.98	2.78	0.15*	0.88	**1.04****
8.	Keriya 10 × AT 482	-2.21	-0.60	-0.11	-0.09	-1.09	-1.14**
9.	Keriya 10 × G.Til 6	3.32	-0.27	-2.06	0.13*	-0.34	**-1.81****
10.	KMR 102 × BS-6-1	1.45	-0.34	-5.65	-0.28**	1.94	0.67
11.	KMR 102 × U-6-3	-0.39	-0.59	-7.26*	0.01	1.62	1.01**
12.	KMR 102 × B-14-1	8.14**	1.64**	6.45*	0.13*	0.79	0.31
13.	KMR 102 × ST-12-25	-1.00	-0.03	-4.15	**0.34****	1.32	0.39
14.	KMR 102 × EI-233	7.20**	0.06	-1.08	-0.51**	0.48	-0.54
15.	KMR 102 × Khadkala-1	0.15	-0.96	-6.62*	-0.41**	0.93	-1.23**
16.	KMR 102 × AT 482	-0.22	-0.87	-6.49*	0.03	0.63	-1.02**

17.	KMR 102 × G.Til 6	-2.56	1.56**	13.61**	0.31**	-2.50*	0.33
18.	BS-6-1 × U-6-3	4.70**	2.16**	13.67**	0.06	-0.80	-0.06
19.	BS-6-1 × B-14-1	-5.20**	-1.42*	0.03	0.16*	**-3.19****	-0.12
20.	BS-6-1 × ST-12-25	0.43	-0.01	-0.35	0.01	0.24	0.04
21.	BS-6-1 × EI-233	1.79	2.64**	15.27**	0.10	-0.55	-0.73*
22.	BS-6-1 × Khadkala-1	1.08	-0.75	-5.50	0.08	0.77	-0.26
23.	BS-6-1 × AT 482	0.53	-1.90**	-11.95**	-0.06	0.72	0.08
24.	BS-6-1 × G.Til 6	-0.27	-0.73	-3.71	-0.01	-0.17	0.02
25.	U-6-3 × B-14-1	2.16	-0.36	-5.07	0.04	1.24	0.05

Table 4: contd…..

Sr. No.	Crosses	Number of seeds per capsule	Seed yield per plant (g)	Biological yield per plant (g)	1000-seed weight (g)	Harvest index (%)	Oil content (%)
26.	U-6-3 × ST-12-25	-1.62	0.99	7.59*	-0.08	-0.85	-0.17
27.	U-6-3 × EI-233	4.45*	3.16**	20.54**	0.19**	-1.29	0.50
28.	U-6-3 × Khadkala-1	3.53*	**4.20****	**24.33****	0.13*	-0.73	0.22
29.	U-6-3 × AT 482	-1.24	2.19**	13.15**	0.21**	-0.36	-0.05
30.	U-6-3 × G.Til 6	3.75*	-1.13*	-0.17	-0.05	-2.87**	0.13
31.	B-14-1 × ST-12-25	3.82*	1.54**	7.47*	0.06	0.32	-0.10
32.	B-14-1 × EI-233	-1.99	**-2.08****	-11.34**	0.11	-0.09	-0.27
33.	B-14-1 × Khadkala-1	-7.60**	0.64	6.73*	0.08	-1.34	0.23
34.	B-14-1 × AT 482	4.06*	3.07**	15.03**	0.10	0.73	0.34
35.	B-14-1 × G.Til 6	**9.79****	-0.87	-3.94	**-0.77****	-0.52	0.44
36.	ST-12-25 × EI-233	2.04	2.61**	15.93**	0.14*	-0.44	0.85*
37.	ST-12-25 × Khadkala-1	2.53	-1.88**	-11.14**	-0.17*	0.19	0.32
38.	ST-12-25 × AT 482	1.28	-0.70	-8.66**	-0.16*	1.67	-0.10
39.	ST-12-25 × G.Til 6	-0.92	-0.93	-3.88	0.12	-0.95	-0.22
40.	EI-233 × Khadkala-1	-4.01*	-2.07**	-12.46**	0.04	0.44	-0.35
41.	EI-233 × AT 482	-0.55	-1.39*	-12.31**	0.09	1.83	0.27
42.	EI-233× G.Til 6	2.71	1.08	8.63**	0.14*	-1.66	0.25
43.	Khadkala-1 × AT 482	6.96**	1.07	10.40**	-0.04	-1.62	-0.21
44.	Khadkala-1 × G.Til 6	2.26	0.90	0.70	0.13*	1.78	-0.03
45.	AT 482 × G.Til 6	-4.18*	1.81**	11.88**	0.26**	-1.38	0.63
	SE (S_{ij})	**1.73**	**0.55**	**3.19**	**0.06**	**1.04**	**0.34**
	SE ($S_{ij} - S_{ik}$)	**2.55**	**0.80**	**4.69**	**0.09**	**1.53**	**0.50**
	SE ($S_{ij} - S_{kl}$)	**5.38**	**0.76**	**4.47**	**0.09**	**1.46**	**0.48**
	Range	**-8.27 to 9.79**	**-2.08 to 4.20**	**-14.47 to 24.33**	**-0.77 to 0.34**	**-3.19 to 4.04**	**-1.81 to 1.04**
	Number of significant and desirable crosses	**10**	**12**	**18**	**14**	**1**	**3**

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

REFERENCES

[1] Anonymous, (2022). Directorate of Economics and Statistics, Department of Agriculture, Co-operation and Farmer Welfare, New Delhi. Available at

https://eands.dacnet.nic.in (accessed on May 24, 2023).

[2] Couch, A.; Gloaguen, R. M.; Langham, D. R.; Hochmuth, G. J.; Bennett, J.M. and Rowland, D. L. (2017). Non-dehiscent sesame (*Sesamum indicum* L.): Its unique production potential and expansion into the southeastern USA. *Journal of Crops Improvement*, **31**(2): 101-172

[3] Gadhiya, C. J.; Patil, S. S.; Kalaria, R. K.; Parsaniya, T. A.; Baria, K. G.; Bhoya, B. J. and Pandya, H. D. (2023). Genetic studies on yield and yield attributing traits in sesame (*Sesamum indicum* L.). *Electronic Journal of Plant Breeding*, **14**(1): 209-216.

[4] Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crossing system. *Australian Journal of Biological Sciences*, **9**(1): 463-493.

[5] Jeeva, G.; Saravanan, K. and Sowmiya, C. A. (2020). Assessment of combining ability and standard heterosis through diallel analysis in sesame (*Sesamum indicum* L.). *Electronic Journal of Plant Breeding*, **11**(2): 386-391.

[6] Kumar, R.; Patel, J. A.; Rahevar, P. M. and Patel, R. M. (2021). Deciphering combining ability and gene action study in elite genotypes of sesame (*Sesamum indicum* L.) using diallel mating design. *Emergent Life Sciences Research*,**7**(1): 1-6.

[7] Panse, V. G. and Sukhatme, P. V. (1995). *Statistical Methods for Agricultural Workers,* (*Fourth edition*), ICAR, New Delhi. pp. 359.

[8] Rajput, S. D.; Harer, P. N. and Kute, N. S. (2017). Combining ability analysis for yield and its component traits in sesame (*Sesamum indicum L). Electronic Journal of Plant Breeding*, **8**(4): 1307-1309.

[9] Ram, B. B.; Sastry, E. V. D. and Solanki, Z .S. (2018). Combining ability and heterosis studies in sesame (*Sesamum indicum* L). *International Journal of Human Genetics,***10**(5): 415-419.

[10] Rathod, S. T.; Dhuppe, M. V. and Borgaokar, S. B. (2022). Studies on reciprocal effects and gene actions in sesame (*Sesamum indicum* L.). *Advances in Agricultural and Horticultural Sciences*, pp 51-56.

[11] Reddy, A.; Vishnuvardhan, K.; Parimala, and P. V. R. Rao (2015). Exploitation of hybrid vigour in sesame (*Sesamum indicum* L.). *Electronic Journal of Plant Breeding*, **6**(1): 125-129.

[12] Sapara, G. K.; Parmar, R. S.; Barad, H. R. and Patel, J. B. (2022). Combining ability studies in F_2 generation of sesame (*Sesamum indicum* L.) over environments. *Frontiers in Crop Improvement*, **10**(2): 134-140.

[13] Sikarwar, R. S.; Kundan, M.; Kushwah, M. K. and Jaya, R. (2021). Combining ability studies in sesame (*Sesamum indicum* L.). *Journal of Pharmacognosy and Phytochemistry,* **10**(1): 1979-1981.

[14] Weiss, E. A. (1983). Oilseed Crops. *Longman, New York*, pp. 660.