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Combining ability analysis for yield and it's components in sesame (*Sesamum indicum* L.)

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Abstract
An experiment was conducted at Research Farm, RVSKVV, College of Agriculture, Gwalior (M. P.). In *kharif* season 2014 eight parents were grown (received from College of Agriculture, Tikamgarh JNKVV Jabalpur, Madhya Pradesh) for making half diallel crosses [n (n-1)/2] among them and then next year in *kharif* season 2015 eight parents and 28 F_1 hybrids were grown in RBD with 3 replications for evaluation of yield and yield attributing traits. Five plants from each parent and hybrid were selected randomly for collection of data of different yield contributing characters such as days to peak flowering, days to maturity, plant height, number of primary branches per plant, number of capsules on main axis, total number of capsules per plant, number of seeds per capsule, capsule length, 1000 seed weight and seed yield per plant. Analysis of variance for combining ability revealed that the mean sum of squares associated with GCA and SCA were highly significant for all the characters, and it is noticed that additive as well as non-additive genes were operating in the expression of these traits. Parent RT – 367 was the best general combiner for high yield and early maturity along with most of the yield contributing characters. Parent RT – 368 was also identified as good general combiner for seed yield per plant. Three cross combinations RT -367 X RT -368, LT-210 X RT -367 and JLS-302-11 X AT -249 identified as good specific combiner for seed yield and its contributing characters. Cross LT-210 X RT -367 showed highly significant negative SCA effects in desirable direction for early flowering and early maturity traits.

Keywords: General combining ability analysis (GCA), specific combining ability (GCA), *Sesamum indicum* L.

Introduction
Sesame (*Sesamum indicum* L.) is an important oilseed crop belongs to the family Pedaliaceae and it is diploid (2n=26) in nature. It is cultivated in around 60-65 countries of the world, while Asian and African countries are the major producers. Asia is rich in diversity of cultivated types while Africa is prosperous in wild varieties. Due to the presence of diverse wild species "Ethiopia" (Africa) is considered as the primary centre of origin, while India and Japan are considered as the two secondary centres of origin of this crop. Sesame is diploid (2n=26) in nature and is commonly known as Til, Tilli, Gingelly, Ellu, Sim-sim, Benni Seed, Nurvulu, Vellvor Rasi and sesame in different part of the India and often referred as the epithet "the queen of oilseeds". Generally the oil content in sesame ranges from 34 to 63 per cent (Sharma *et al*. 2014) [7].

The superior performance of parents is not always a true indicator of superior combining ability because it depends upon the complex interaction of genes. Combining ability analysis provides precise estimates of nature and magnitude of gene action involved in the inheritance of quantitative characters. It is helpful for identification of good general combiner parents and good specific combiner hybrids. The knowledge on combining ability and type of gene action helps in selecting the most suitable breeding procedure and in turn for the proper planning of a successful breeding programme. Hence, the present investigation was carried out to identify the good general combiner parents and good specific combiners for increasing the seed yield and its components in sesame.

Material and methods
Experiment was conducted at Research Farm, RVSKVV, College of Agriculture, Gwalior (M. P.). In *kharif* season 2014 eight parents were grown (received from College of Agriculture, Tikamgarh JNKVV Jabalpur, Madhya Pradesh) for making half diallel crosses [n (n-1)/2] among them and then next year in *kharif* season 2015 eight parents and 28 F_1 hybrids were grown in RBD with 3 replications for evaluation of yield and yield attributing traits. Five plants from each parent and hybrid were selected randomly for collection of data of different yield contributing characters such as days to peak flowering, days to maturity, plant height,

number of primary branches per plant, number of capsules on main axis, total number of capsules per plant, number of seeds per capsule, capsule length, 1000 seed weight and seed yield per plant. The combining ability analysis was carried out by using the procedure given by Griffing (1956) [3] for method 2 model I,

Results and discussion

Analysis of variance

Analysis of variance for combining ability revealed that the mean sum of squares associated with gca and sca were highly significant for all the characters. Since gca and sca mean squares were found to be significant for all the character revealed that additive as well as non-additive genes were operating in the expression of these traits which is in agreement with Banerjee and Kole 2009 [1]. This could be due to the presence of variability in the experimental material. Besides the significance of variances, it was also noticed that the magnitude of variance due to gca were higher than the magnitude of variance due to sca for all the traits which indicated that preponderance of additive gene action in the expression of these characters. Therefore, pedigree method can be use to over all genetic improvement in sesame. Tripathy *et al.* 2016 [9] also reported the higher magnitude of gca variance than magnitude of sca variance whereas, Karthickeyan *et al.* 2017 [4] reported the greater magnitude of SCA variances than GCA variance for all the characters studied, and suggested preponderance of non-additive gene action play important role.

General Combining Ability (GCA) effects

The results revealed that RT -367 and RT-368 was the good general combiner for seed yield per plant along with majority of the traits. RT -367 showed highly significant positive gca effects for number of primary branches per plant, number of capsules on main axis, total number of capsules per plant, number of seeds per capsule, capsule length, 1000 seed weight and seed yield per plant whereas, highly significant negative gca effects in desirable direction for days to peak flowering and days to maturity. RT-368 exhibited highly significant positive gca effects for plant height, number of capsules on main axis, total number of capsules per plant, number of seeds per capsule and seed yield per plant. TKG-22 was identified as good general combiner for earliness in flowering and maturity along with yield contributing characters *viz*. plant height, number of capsules on main axis, total number of capsules per plant and number of seeds per capsules. Sikarwar 2002 [8] reported parent JLT- 3 was good general combiner for plant height, number of branches per plant, number of capsules on main axis, total number of capsules per plant, number of seeds per capsules and seed yield per plant. Banerjee and Kole 2009 [1] reported OS-Sel-2 was the good general combiner parent for days to peak flowering and oil yield per plant and parent B 67 was good general combiner for days to peak flowering, duration from peak flowering to maturity and oil yield per plant. Vavdiya *et al.* 2014 [10] suggested line IC-81564 was good general combiner for days to 50 % flowering, days to maturity, plant height, number of branches per plant, capsule length, 1000 seed weight and seed yield per plant and tester G Til- 10 for plant height, number of branches per plant, number of capsules per plant and seed yield per plant. Raikwar 2018 [5] reported parent ES-230 showed highly significant and positive gca effects for plant height and seed yield per plant and parent SI-1147 was good general combiner for number of primary branches per plant, number of capsules per plant, days to maturity and seed yield per plant.

Specific Combining Ability (SCA) effects

Five crosses *viz.* RT -367 X RT -368 (high x high), LT-210 X RT -367 (low x high), JLS-302-11 X AT -249 (low x low), JLS-302-11 X RT -368 (low x high) and AT -282 X JLS -120 (low x low) identified as good specific combiner for seed yield per plant along with majority of characters. RT -367 X RT -368 showed highly significant positive sca effects for number of capsules on main axis, total number of capsules per plant, number of seeds per capsule, capsule length, 1000 seed weight and seed yield per plant. LT-210 X RT -367 showed significant positive sca effects for number of primary branches per plant, total number of capsules per plant, number of seeds per capsule, 1000 seed weight and seed yield per plant whereas, significant negative sca effects for days to peak flowering and days to maturity. JLS-302-11 X AT -249 exhibited highly significant positive sca effects for number of seeds per capsule, capsule length, 1000 seed weight and seed yield per plant. Highly significant positive estimates of sca of the cross JLS-302-11 X RT -368 recorded for plant height, total number of capsules per plant and seed yield per plant. Cross AT -282 X JLS -120 showed highly significant positive sca effects for number of capsules on main axis, total number of capsules per plant and seed yield per plant along with highly significant and negative sca effects for days to peak flowering and days to maturity in desirable direction. Sikarwar 2002 [8] suggested cross RT- 46 X TKG- 21 was the best specific combiner for seed yield per plant along with majority of the traits such as plant height, number of branches per plant, number of capsules on main axis, total number of capsules per plant, number of seeds per capsule and 1000 seed weight. Banerjee and Kole 2009 [1] suggested MT 34 9 AAUDT9304-14-4 was the good specific combiner for days to peak flowering, duration from peak flowering to maturity and oil yield per plant. Rajaram and Kumar 2011 [6] reported cross IVTS -17-07 X TMV 4 [Line 5 X Tester 2] was good specific combiner for days to 50 per cent flowering, number of branches per plant, number of seeds per capsule and seed yield per plant. Raikwar 2018 [5] suggested cross ES-230 X NIC-8401 was good specific combiner for plant height, number of seeds per capsule, days to maturity and seed yield per plant. And combination IS - 1162 X NIC -16220 was promising for number of capsules per plant and capsule length. Chaudhari *et al.* 2016 [2] reported G.Til-2 X JLS-116 was good specific combiner for plant height, branches per plant, capsules per plant, capsule length, days to maturity, number of seeds per capsule, 1000 seed weight and seed yield per plant.

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

Source of variation	Degree of freedom	Days to Peak Flowering	Days to Maturity	Plant Height (cm)	Number of Primary Branches Per Plant	Number of Capsules On Main Axis
GCA	7.00	14.33***	25.93***	178.39***	0.86***	42.28***
SCA	28.00	5.52***	9.16***	25.55***	0.08***	7.51***
Error	70.00	0.35	0.46	0.41	0.02	0.38
GCA/SCA Ratio	---	0.27	0.29	0.71	1.27	0.59

Source of variation	Degree of freedom	Total Number of Capsules per Plant	Number of Seeds Per Capsule	Capsule Length (cm)	1000 Seed Weight (g)	Seed Yield Per Plant (g)
GCA	7.00	665.57***	173.87***	0.07***	0.50***	47.68***
SCA	28.00	50.53***	44.01***	0.09***	0.18***	5.12***
Error	70.00	2.00	0.47	0.004	0.01	0.19
	---	1.27	0.40	0.08	0.29	0.96

Significance Levels * = <.05, ** = <.01 & *** = <.001

Table 2: Estimates of GCA effects of parents for yield and its components in sesame

Parents	Days to Peak Flowering	Days to Maturity	Plant Height (cm)	Number of Primary Branches Per Plant	Number of Capsules on Main Axis
LT-210	0.39*	1.41***	-4.90***	0.20***	-1.58***
JLS-302-11	0.29	-0.03	3.58***	-0.21***	-2.05***
RT -367	-1.01***	-1.02***	-5.13***	0.35***	2.96***
AT -282	0.66***	0.28	-3.03***	-0.41***	0.71***
AT -249	0.16	-1.99***	0.46*	-0.33***	-1.47***
RT -368	0.66***	0.31	7.06***	0.03	2.55***
TKG -22	-2.47***	-1.76***	0.48*	0.04	0.93***
JLS -120	1.33***	2.81***	1.49***	0.34***	-2.04***
CD Gi (5%)	0.41***	0.47***	0.45***	0.09***	0.43***
CD Gi (1%)	0.61***	0.70***	0.67***	0.14***	0.64***
CD Gi - Gj (5%)	0.62***	0.72***	0.68***	0.14***	0.66***
CD Gi - Gj (1%)	0.92***	1.06***	1.01***	0.21***	0.97***

Parents	Total Number of Capsules per Plant	Number of Seeds Per Capsule	Capsule Length (cm)	1000 Seed Weight (g)	Seed Yield Per Plant (g)
LT-210	-4.88***	-8.29***	-0.06**	-0.10**	-2.16***
JLS-302-11	-8.31***	0.29	0.00	0.01	-1.40***
RT -367	15.66***	0.90***	0.18***	0.46***	4.84***
AT -282	-6.50***	3.44***	-0.06**	-0.07*	-0.85***
AT -249	-5.79***	-3.61***	-0.07**	0.20***	-1.13***
RT -368	6.85***	4.93***	0.01	-0.21***	1.12***
TKG -22	0.94*	0.92***	-0.06**	-0.11***	-0.22
JLS -120	2.02***	1.42***	0.06**	-0.17***	-0.20
CD Gi (5%)	0.99***	0.48***	0.05***	0.07***	0.31***
CD Gi (1%)	1.46***	0.71***	0.07***	0.11***	0.46***
CD Gi - Gj (5%)	1.49***	0.72***	0.07***	0.11***	0.47***
CD Gi - Gj (1%)	2.21***	1.07***	0.10***	0.16***	0.69***

Significance Levels * = <.05, ** = <.01 & *** = <.001

Table 3: Estimates of sca effects of 28 hybrids for yield and its components in sesame.

Crosses	Days to Peak Flowering	Days to Maturity	Plant Height (cm)	Number of Primary Branches Per Plant	Number of Capsules On Main Axis
LT 210 X JLS 302-11	-1.58**	-1.41*	-1.59*	-0.01	0.07
LT 210 X RT 367	-4.28***	-4.41***	-1.75**	0.70***	-1.22*
LT 210 X AT 282	-1.95**	-0.71	-2.67***	0.11	1.64**
LT 210 X AT 249	-0.45	-3.44***	-2.16***	0.08	-1.45*
LT 210 X RT 368	1.05	-0.74	-0.20	-0.27*	0.83
LT 210 X TKG 22	-1.81**	6.32***	9.68***	-0.24	4.06***
LT 210 X JLS 120	2.39***	2.09**	1.37*	0.47***	0.64
JLS 302-11 X RT 367	-0.18	3.02***	3.90***	-0.23	-1.23*
JLS 302-11 X AT 282	1.15*	0.72	-5.16***	-0.02	0.02
JLS 302-11 x AT 249	-0.35	-0.01	-4.05***	0.06	-0.60
JLS 302-11 X RT 368	0.15	0.69	4.98***	0.21	0.94
JLS 302-11 X TKG 22	1.29*	-1.24	-4.17***	0.24	-2.54***
JLS 302-11 X JLS 120	0.49	-1.81**	3.78***	-0.03	0.54
RT 367 X AT 282	4.45***	4.39***	-0.85	0.18	3.21***
RT 367 X AT 249	-1.05	-2.01**	0.53	0.01	-2.91***
RT 367 X RT 368	3.45***	1.69*	-8.08***	-0.35**	3.06***
RT 367 X TKG 22	-0.41	-1.91**	-1.13	-0.11	4.41***
RT 367 X JLS 120	3.79***	5.19***	8.62***	-0.03	-0.53
AT 282 X AT 249	-2.05***	-2.31***	3.83***	-0.38**	-2.86***

AT 282 X RT 368	-1.21*	1.39*	7.86***	0.28*	1.22*
AT 282 X TKG 22	1.92**	3.79***	8.35***	-0.24	-4.16***
AT 282 X JLS 120	-1.88**	-2.11**	-2.94***	0.03	1.88**
AT 249 X RT 368	0.29	3.66***	1.54*	-0.14	-0.64
AT 249 X TKG 22	4.42***	-0.28	4.16***	-0.02	1.25*
AT 249 X JLS 120	-0.38	4.49***	1.54*	-0.05	1.95**
RT 368 X TKG 22	-2.08***	-2.58***	4.39***	0.63***	5.31***
RT 368 X JLS 120	-0.55	-2.81***	-4.16***	-0.42**	-0.98
TKG 22 X JLS 120	-3.41***	-3.74***	-4.61***	0.11	-3.83***
CD Sij (5%)	1.10	1.26	1.20***	0.25	1.15
CD Sij (1%)	1.48	1.70	1.62	0.34	1.56
CD Sij-Sik (5%)	1.62	1.87	1.77	0.37	1.71
CD Sij-Sik (1%)	2.19	2.52	2.39	0.50	2.30

Crosses	Total Number of Capsules per Plant	Number of Seeds Per Capsule	Capsule Length (cm)	1000 Seed Weight (g)	Seed Yield Per Plant (g)
LT 210 X JLS 302-11	-2.95*	-0.92	-0.32***	-0.28**	-1.16**
LT 210 X RT 367	20.13***	1.45*	0.07	0.47***	5.06***
LT 210 X AT 282	-2.50	-2.84***	0.01	0.25*	-0.16
LT 210 X AT 249	0.63	12.83***	0.18**	-0.84***	-0.69
LT 210 X RT 368	5.95***	-4.61***	-0.06	0.15	0.14
LT 210 X TKG 22	-5.06***	-3.48***	0.44***	0.14	-0.93*
LT 210 X JLS 120	1.87	-5.39***	-0.15*	0.22*	-0.03
JLS 302-11 X RT 367	-7.32***	-6.79***	-0.02	0.21*	-2.12***
JLS 302-11 X AT 282	1.80	-4.48***	0.31***	0.02	-0.20
JLS 302-11 x AT 249	-3.81**	3.41***	0.22***	0.82***	2.22***
JLS 302-11 X RT 368	9.47***	-3.49***	0.11	0.16	1.65***
JLS 302-11 X TKG 22	-0.44	7.76***	-0.28***	-0.20*	0.43
JLS 302-11 X JLS 120	-0.55	-2.33***	-0.01	0.06	-0.04
RT 367 X AT 282	-10.08***	8.55***	0.00	0.40***	1.41**
RT 367 X AT 249	-13.80***	2.67***	-0.09	0.05	-1.97***
RT 367 X RT 368	8.62***	6.87***	0.24***	0.39***	6.58***
RT 367 X TKG 22	7.44***	3.31***	0.44***	-0.23*	1.09*
RT 367 X JLS 120	0.32	-2.27**	-0.18**	-0.56***	-3.05***
AT 282 X AT 249	3.28*	-11.86***	-0.15*	0.48***	0.27
AT 282 X RT 368	-3.29*	4.78***	-0.49***	0.18	0.78
AT 282 X TKG 22	-2.39	3.00***	-0.39***	0.30**	1.15**
AT 282 X JLS 120	8.66***	-1.19	0.09	0.06	1.55***
AT 249 X RT 368	-0.98	9.41***	-0.02	-0.73***	-1.56***
AT 249 X TKG 22	3.81**	-8.28***	-0.35***	0.07	-0.21
AT 249 X JLS 120	1.15	0.92	0.03	-0.02	0.64
RT 368 X TKG 22	1.29	-14.93***	-0.42***	0.39***	-0.99*
RT 368 X JLS 120	-4.81***	1.87**	0.69***	0.29**	0.70
TKG 22 X JLS 120	-0.15	6.25***	-0.28***	-0.07	0.71
CD Sij (5%)	2.63	1.27	0.12	0.19	0.82
CD Sij (1%)	3.55	1.72	0.17	0.26	1.11
CD Sij-Sik (5%)	3.89	1.88	0.18	0.28	1.21
CD Sij-Sik (1%)	5.25	2.54	0.24	0.38	1.64

Significance Levels * = <.05, ** = <.01 & *** = <.001

Conclussion

From this experiment it can be concluded that, parent RT – 367 was the best general combiner for high yield and early maturity along with most of the yield contributing characters. Parent RT – 368 was also identified as good general combiner for seed yield per plant. Cross RT -367 X RT -368, LT-210 X RT -367 and JLS-302-11 X AT -249 identified as good specific combiner for seed yield and its contributing characters. Among these three crosses cross LT-210 X RT - 367 showed highly significant negative sca effects in desirable direction for early flowering and early maturity traits.

References

1. Banerjee PP, Kole PC. Analysis of genetic architecture for some physiological characters in sesame (*Sesamum indicum* L.). Euphytica. 2009; 168(1):11-22.
2. Chaudhari GB, Anarase SA, Ban YG. Combining ability and gene action over environments in Sesame (S*esamum indicum* L.). Electronic Journal of Plant Breeding. 2016; 7(1):71-77.
3. Griffing B. Concept of general and specific combining ability in relation to diallel crossing system. Aust. J Bio. Sci. 1956b; 9:463-493.
4. Karthickeyan S, Anitha Vasline Y, Saravanan K. Yield response of sesame genotypes for gene action under normal condition. Plant Archives. 2017; 17(2):1237-1241.
5. Raikwar RS. Combining ability studies for assessment of yield and its components in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2018; 9(2):777-781.
6. Ranjith Rajaram S, Senthil Kumar P. Combining ability studies in Sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2011; 2(2):224- 227.
7. Sharma, Ekta Shah, Tajamul Islam, Khan Fatima. A review enlightening genetic divergence in *Sesamum indicum* based on morphological and molecular studies.

International Journal of Agriculture and Crop Sciences. 2014; 7(1):1-9.
8. Sikarwar RS. Genetic study in sesame (*Sesamum indicum* L.). Ph. D. (Plant Breeding & Genetics) Thesis, Dr. B. R. Ambedkar University, Agra, (U. P.). 2002.
9. Tripathy Swapan K, Mishra DR, Dash GB, Senapati N, Mishra D, Nayak PK *et al*. Combining Ability Analysis in Sesame (*Sesamum indicum* L.) International Journal of Biosciences. 2016; 9(3):114-121.
10. Vavdiya PA, Dobariya KL, Babariya CA. Combining ability and gene action studies for seed yield and its components in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2014; 5(4):688-694.