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Combining ability studies in sesame (*Sesamum indicum* L.)"

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ABSTRACT: *An attempt was made to study the general and specific combining ability in sesame (*Sesamum indicum *L.) through L x T analysis with five lines and five testers including eleven traits* viz; *days to first flower, days to 50 percent flowering, days to maturity, plant height, number of branches per plant, number of capsules per plant, capsule length, number of seed per capsule, 1000 seed weight, oil content and seed yield per plant were studied. Based on the general combining ability effects of parents OSC-560 was found to be a good general combiner for seed yield and days to maturity. RT-54 was found to be good general combiner for plant height, no. of capsule per plant, no. seed per capsule and oil content. Among male IS-200 was good general combiners for seed yield per plant and no. seed per capsule. The cross combination RT-54 X NIC-16194, OSC-560 X KMR-11, OSC-207 X IS-200, MT-10-13-01 x IS-200, MT-10-13-01 x NIC-8600-A, MT-10-13-01 x SI-982, SSD-01 x NIC-16194 and RT-54 X KMR-11 exhibited positive and significant sca effects. Hence recommended for yield improvement.*

Key words: *general combining ability, specific combining ability, sesame.*

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an important oilseed crop grown all over india. It can be grown either as pure or mixed crop. It has attracted special attention as an important salad dressing and edible oil. The seed contains 45-52% oil, which has excellent stability due to the presence of natural antioxidants such as sesamolin, sesamin and sesamol . The exploitation of heterosis has been a practical proposition in many allogamous crops and a few autogamous crops. In India, sesame is cultivated on an area of 1.94 million hectare with a productivity of 389 kg/ha and 0.755 million tons production. (Anonymous, 2012). Studies on heterosis breeding in sesame are of paramount importance to achieve the goal. In the present investigation, attempts have been made to evaluate ten parents (5 line and 5 testers) and 25 hybrids through Line X Testers analysis to bring out the best parents and cross combinations with good general and specific combining abilities for seed yield and its component characters.

MATERIAL AND METHODS

The present investigation on sesame was conducted at the Oilseed Research Station, College of Agriculture, Latur-413512 during *Rabi-2013.* The present material consisting of five line and five testers were crossed in a line X testers mating design resulting in twenty one hybrids with two standard checks *viz;* Phule Til and JLT-408. Twenty one hybrids and their ten parents were sown in rows with spacing 45 cm between row and 10 cm between plants in row during Octomber 2013. The experiment was conducted in randomized block design with two replications. A fertilizer schedule of 30:60:30 kgs of NPK per hectare was followed a long with the recommended cultural operations and plant protection measures. Observations were recorded on ten biometrical traits viz; days to first flower, days to 50 percent flowering, days to maturity, plant height (cm), number of branches per plant, number of capsule per plant, number of seed per capsule, length of capsule (cm), 1000 seed weight(g), oil content and seed yield per plant(g). The estimation of heterosis was done based on the method developed by Rai,(1979) and The analysis of variance for combining ability was done based on the method developed by Kempthorne (1957) on five randomly selected plants.

RESULT AND DISCUSSION

The estimates of GCA and SCA variances are useful to infer the type of gene action and the relative

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importance of the character in breeding programme. High mean value was the main criterion of selection among the breeders for a long time. The parents with good mean performance would result in good performing off springs.

After comparison of heterotic crosses and their *per se* performance for various characters, it was observed that the crosses showing high heterosis and high *per se* performance involved the parents possessing eleven high x high, high x low and low x low combining ability parents indicating importance of additive and non-additive genetic variance. There was good correspondence between highly heterotic crosses and their respective sca effects for all the character.

Among females OSC-560 was found to be the best general combiner for oil content and had significant gca effects for the characters days to maturity. The female OSC-207 was the best general combiner for oil content and number of capsule per plant.while MT-10-13-01 was best general combiner for seed yield. SSD-01 for length of capsule and 1000 seed weight. While RT-54 was the best general combiner for plant height, no. of capsule per plant and length of capsule.

Among males IS-200 was found to be best general combiner for seed yield per plant and also had significant gca effects for characters number of seed per capsule. A close agreement between gca and *per se* performance of parent was observed for most of the characters studied.

Compared to *per se* performance it is noticed that the combinations having high sca effects also had high *per se* performance for most of the characters indicating close agreement between *per se* performance and sca effects. The combinations which exhibited high sca effects for seed yield per plant also had significant and desirable sca for one or other component characters. The cross RT-54 x NIC-16194 exhibited significantly high sca effects for four characters *viz*., number of capsule, no. of seed per capsule and seed yield per plant.

Likewise, the best crosses identified for various yield contributing characters were SSD-01 x NIC-16194 for character number of branches per plant, number of capsule per plant, number of seed per capsule and seed yield per plant. The cross MT-10-13-01 x SI-982 for number of capsule per plant, number of seed per capsule,1000 seed weight and seed yield per plant. The cross MT-10-13-01 x IS-200 for length of capsule, number of seed per capsule,1000 seed weight and seed yield per plant and The cross MT-10-13-01 x NIC-8600-A for length of capsule,

Analysis of variance for Combining ability for different characters including parents in sesame.

Source	*d.f.*	*Days to first flower*	*Days to 50% flowering*	*Days to maturity*	*Plant height (cm)*	*No. of branches/ plant*	*No. of capsule/ plant*	*No. of seed/ Capsule*	*Length of capsule (cm)*	*1000 Seed weight(g)*	*Oil content (%)*	*Seed yield/ plant(g)*
Replications	1	0.3571	5.1571	3.2142	4.62857	0.1120	9.6571	4.6285	0.00052	0.00252	0.11200	0.15557
Crosses	24	2.8466*	5.4700*	16.996**	13.8450*	0.3544*	189.555**	25.821**	0.01619**	0.13596**	11.4612**	17.7326**
Females	4	0.6500	1.1500	2.3500	10.0000	0.1500	33.400**	37.600**	0.02750**	0.31233**	2.07500**	2.17234**
Males	4	3.9000	1.9000	7.1000	35.4000**	0.3500	91.100**	17.600**	0.01034**	0.06046**	1.41000**	4.18362**
M x F	16	3.2550*	5.3950*	10.317*	14.1700*	0.3503*	180.367**	27.680**	0.01647**	0.10326**	7.35475**	21.7584**
Error	34	1.5336	2.2747	4.9495	6.18739	0.1649	10.363	2.1579	0.00127	0.00765	0.33347	0.79626

*and ** indicated significance at 5 and 1 per cent respectively.

Estimates of General Combining Ability (GCA) of Lines and Testers in sesame.

Parents	*Days to frist flower*	*Days to 50% Flowering*	*Days to maturty*	*Plant height (cm)*	*No. of branches/ plant*	*No. of capsule/ plant*	*No. of seed/ Capsule*	*Length of capsule (cm)*	*1000 Seed Weight (g)*	*Oil content (%)*	*Seed yield/ plant (g)*
Line											
OSC-560	-0.240	0.480	-1.740*	-0.080	-0.016	-5.240**	-1.040*	-0.038**	0.013	0.670**	-1.613**
OSC-207	0.060	-0.420	-0.540	0.120	0.0184	4.860**	-0.940	-0.070**	0.030	2.430**	0.406
MT-10-13-01	0.060	-0.220	-0.040	-0.480	-0.016	-3.240	-0.540	0.012	-0.251**	-0.810**	1.459**
SSD-01	-0.040	0.080	1.960*	-1.880*	-0.316	-4.340**	0.260	0.047**	0.220**	0.130	-0.693*
RT-54	0.160	0.080	0.360	2.320**	0.164	7.960**	2.260**	0.051**	-0.014	-2.420**	-0.440
Tester											
NIC-16194	-0.040	0.080	0.060	0.120	0.184	3.860**	0.460	0.029 *	-0.072	-0.690**	0.873
KMR-11	-0.0140	-0.120	0.660	-0.180	0.184	-0.640	0.360	-0.013	-0.095	-0.760**	-0.354
IS-200	0.560	0.780	1.260	0.720	-0.036	-0.040	1.960**	-0.009	0.000	1.300***	0.452
NIC-8600-A	-0.940*	-1.620**	-3.540**	0.220	-0.216	-0.540	-0.340	-0.010	0.184	0.300	-1.039 **
SI-982	0.560	0.880	1.560 *	-0.880	-0.116	-2.640 *	-2.440**	0.005	-0.019	-0.150	0.067

*and ** indicated significance at 5 and 1 per cent level respectively.

Estimates of specific combining ability (SCA) for 10 characters in sesame

Sr. No	*Crosses*	*Days to first flower*	*Days to 50% flowering*	*Days to maturity*	*Plant height (cm)*	*No. of branches/ plant*	*No. of capsule/ plant*	*No. of seed/ capsule*	*Length of capsule (cm)*	*1000 Seed Weight (g)*	*Oil content (%)*	*Seed yield/ plant (g)*
1)	*2)*	*3)*	*4)*	*5)*	*6)*	*7)*	*8)*	*9)*	*10)*	*11)*	*12)*	*13)*
1	OSC-560 X NIC-16194	-0.160	-0.180	-1.360	1.080	-0.184	-7.060**	-5.760**	0.006	0.018	0.130	-1.966**
2	OSC-560 X KMR-11	-0.560	1.020	2.040	1.880	0.316	-2.060	0.340	0.098**	-0.029	-0.050	1.656*
3	OSC-560 X IS-200	0.740	-0.380	-0.060	-0.520	0.036	8.840**	0.740	0.014	0.011	1.290**	0.985
4	OSC-560 X NIC-8600-A	0.240	0.520	1.240	-0.520	0.216	0.340	-0.960	-0.160**	-0.003	-1.610**	0.556
5	OSC-560 X SI-982	-0.260	-0.980	-1.860	-1.920	-0.384	-0.060	5.640**	0.040	0.005	0.240	-1.230
6	OSC-207 X NIC-16194	-0.960	-0.280	-2.560	-2.120	-0.884 **	-9.160 **	0.140	0.008	0.116	1.470 **	-2.260**
7	OSC-207 X KMR-11	1.140	0.420	-1.660	-3.820 *	-0.384	3.340	-2.260 *	-0.150**	-0.106	1.240 **	0.357
8	OSC-207 X IS-200	0.940	1.520	3.240	3.280	0.336	-0.260	1.140	-0.074 **	-0.196**	-1.070 *	1.306*
9	OSC-207 X NIC-8600-A	0.440	-0.080	0.040	1.780	0.516	10.740 **	-2.060	0.107 **	0.430**	-0.170	-0.128
10	OSC-207 X SI-982	-1.560	-1.580	0.940	0.880	0.416	-4.660	3.040 **	0.107 **	-0.242**	-1.470 **	0.726
11	MT-10-13-01 X NIC-16194	0.040	-0.980	-0.560	3.480	0.316	-11.060**	-2.260*	-0.114**	-0.163*	1.460**	-5.673 **
12	MT-10-13-01 X KMR-11	2.140 *	2.720 *	2.340	2.780	-0.184	0.440	0.840	-0.012	0.215**	0.830	-3.241 **
13	MT-10-13-01 X IS-200	-1.560	-1.180	-2.260	-2.120	0.036	2.840	4.240**	0.094**	0.210**	-1.180**	2.663**
14	MT-10-13-01 X NIC-8600-A	-1.060	-1.280	0.040	-3.620	-0.284	-1.660	2.540*	0.055*	-0.494**	1.170**	2.854**
15	MT-10-13-01 X SI-982	0.440	0.720	0.440	-0.520	0.116	9.440**	-5.360**	-0.025	0.234**	-2.280**	3.398**
16	SSD-01 X NIC-16194	-0.360	-0.780	1.940	-1.120	0.616 *	15.540**	4.940 **	0.051	-0.049	0.120	5.319**
17	SSD-01 X KMR-11	-1.260	-1.080	0.340	-2.820	0.116	-4.960*	1.040	0.033	-0.201**	0.790	-1.574*
18	SSD-01 X IS-200	-0.460	-0.480	-3.260 *	-0.720	-0.164	4.940*	-1.560	0.009	0.079	0.330	-0.740
19	SSD-01 X NIC-8600-A	0.040	-0.080	-0.460	3.780	-0.484	-6.560**	-0.260	-0.030	0.115	-1.620 **	-1.359*
20	SSD-01 X SI-982	2.040 *	2.420*	1.440	0.880	-0.084	-8.960**	-4.160 **	-0.065*	0.058	0.380	-1.645*
21	RT-54 X NIC-16194	1.440	2.220 *	2.540	-1.320	0.136	11.740 **	2.940 **	0.047	0.080	-3.180 **	4.581**
22	RT-54 X KMR-11	-1.460	-3.080 **	-3.060	1.980	0.136	3.240	0.040	0.029	0.123	-2.810 **	2.803**
23	RT-54 X IS-200	0.340	0.520	2.340	0.080	-0.244	-16.360 **	-4.560 **	-0.045	-0.102	0.630	-4.213**
24	RT-54 X NIC-8600-A	0.340	0.920	-0.860	-1.420	0.036	-2.860	0.740	0.026	-0.046	2.230 **	-1.922**
25	RT-54 X SI-982	-0.660	-0.580	-0.960	0.680	-0.064	4.240	0.840	-0.059 *	-0.053	3.130 **	-1.248
	SE (±)	1.2115	1.5050	2.1976	2.509	0.3949	3.2602	1.4847	0.0347	0.0859	0.5987	0.9146

* and ** indicated the significance at 5 and 1 per cent respectively.

Information on best 5 crosses based on *per se* performance in sesame.

Sr. No.	*Cross*	*Per se performance Seed yield/ plant (g/pl.)*	*Heterosis*				*GCA effects*		***SCA effects***	***Significant heterosis in desired direction for other traits***	***Significant SCA in desired direction for other traits***
			M.P (%)	*B.P (%)*	*SC-1 JLT-408 (%)*	*SC-2 PHULE TIL (%)*	*Parent I (Female)*	*Parent II (Male)*			
1	RT-54 X NIC-16194	16.69	158.04**	123.79**	146.60**	116.54**	+0.440	0.873	4.581**	Plant height, No. of capsule / plant, No. of seed/ capsule, Length of capsule.	No. of capsule per plant, No. of seed/ capsule, Seed yield / plant.
2	SSD-01 X NIC-16194	16.30	109.11**	100.49**	140.77**	111.41**	-0.693*	0.873	5.319**	Days to maturity, Length of capsule, 1000 seed weight, No. of capsule/ plant.	No. of branches per plant, No. of capsule per plant, No. of seed/ capsule, Seed yield / plant.
3	MT-10-13-01 X SI-982	15.72	136.56**	133.83**	132.27**	103.96**	1.459**	0.067	3.398**	Days to maturity, Seed yield / plant.	No. of capsule per plant, , No. of seed/ capsule,1000 seed weight, Seed yield / plant.
4	MT-10-13-01 X IS-200	15.37	84.96**	52.91**	127.10**	99.42**	1.459**	0.452	2.663**	No. of seed per capsule, Oil content, Seed yield / plant.	Length of capsule, No. of seed per capsule, 1000 seed weight, Seed yield / plant.
5	MT-10-13-01 X NIC-8600-A	14.07	71.96**	43.62**	107.90**	82.56**	1.459*	-1.039*	2.854**	Days to first flowering, Days to 50 % flowering, Days to maturity, Seed yield / plant.	Length of capsule, No. of seed per capsule, 1000 seed weight, Seed yield / plant, Oil content

number of seed per capsule,1000 seed weight, seed yield per plant and for oil content on the basis of sca effects indicating suitability for exploitation of respective characters similar result were also obtained by Suresh Kumar *et al* (2004), Thiyagau *et al* (2007b), Kumar and Kannan (2010) and Praveen Kumar *et al* (2012).

Thus, while selecting the potential crosses for future use in breeding programme *per se* performance of parents and hybrids for various attributes must be taken in to consideration in addition to per cent heterosis. Non-additive gene action was found to be important for eight characters except the traits days to maturity and oil content. The ratio of δ^2 gca / δ^2 sca was less than unity for the characters indicating predominance of sca variance and their by non additive gene action (dominance and epistasis). The character days to maturity and oil content showed additive type gene action. The best 5 crosses *viz* RT-54 x NIC-16194, SSD-01 x NIC-16194, MT-10-13-01 x SI-982, MT-10-13-01 x IS-200 and MT-10-13-01 x NIC-8600-A produced significant and desirable sca effects for most of the traits studied. Among the 5 best hybrid combinations crosses showed the higher magnitude of standard heterosis indicating good potential for their exploitation of hybrid vigour commercially.

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