J. Soils and Crops 27 (2) 61-66, Dec. 2017

ISSN 0971-2836
NAAS Rating - 4.46
Scientific Journal Impact Factor - 4.338

COMBINING ABILITY STUDIES IN SESAME (*Sesamum indicum* L.) GENOTYPES

P.R.Manapure[1], N.H.Sable[2], A.D.Banginwar[3], V.K.Biradar[4] and D. Y. Upadhyay[5]

ABSTRACT

Combining ability studies were made in sesame using line x tester analysis with three testers and fifteen lines. The 45 hybrids were evaluated along with their parents in a randomized block design with three replications at Agriculture Botany Farm, Dr. PDKV, Akola during *kharif* 2011-12. Important yield traits *viz.,* days to 50 % flowering, days to maturity, plant height (cm), number of branches plant^{-1}, number of capsules plant^{-1}, number of seeds capsule^{-1}, seed yield plant^{-1}(g), 1000 seed weight, oil content were studied. The combining ability analysis was carried out on 45 crosses following the methodology of Kempthorne (1957) with fixed effect model (model 1) of Eisenheart (1947). The analysis of variance for combining ability indicated substantial genetic variation for general and specific combining ability for all the characters under study except 1000 seed weight and oil content. The lines SI-11, JCSC-8, SP-1102-B, NIC-16207, Tarun, RT-46, Hima, SI-7-2 and testers JLT-7 and AKT-64 were good general combiners for seed yield and economic related traits. Cross combinations *viz.,* Phule Til-1 x NIC-16207, AKT-64 x NIC-16207, JLT-7 x RT-46 and JLT-7 x GT-L showed high mean values with involvement of either parent with significant general combining ability (GCA) effects and high positive significant specific combining ability (SCA). These crosses may serve as a better source population for deriving superior segregates. The magnitude of GCA *vs* SCA ranged from 0.74 to 0.95 indicating the progeny performance can be predicted on the basis of GCA alone for most of the traits.

(Key words: GCA, SCA, Line x Tester analysis, hybrids, sesame)

INTRODUCTION

Sesame, a member of pedaliaceae family is the oldest oilseed used by human beings. In India, sesame is grown by marginal and sub marginal farmers in a wide range of environments, extending from the semi-arid tropics to temperate regions. Consequently, the crop has a large diversity in cultivars and cultured systems. Sesame was cultivated on an area of 17.78 lakh hectares with production of 8.11 lakh tones and productivity of 456 kg^{-1} ha during 2014-15 in the country (Anonymous, 2016). The oil extracted from sesame is of high quality, resistant to oxidation and rancidity even when stored at ambient air temperature. About 78 per cent of sesame produced in India is used for oil extraction, 20 per cent for domestic use including preparation of sweets, candies as condiments, culinary purpose, confectionary and about 2 to 3 per cent is defined for next sowing. Considerable progress has been made in development of high yielding, short duration varieties for different niches. However, tremendous scope is available for both horizontal and vertical expansion of sesame.

Various biometrical methods have been successfully employed to assess the genetic makeup of different genotypes for developing suitable breeding methodology. One such method is the line x tester analysis which provides valid information on combining ability effect of genotypes. Accordingly, the present study was undertaken to estimate the combining ability effects for yield and its component characters in sesame.

MATERIALS AND METHODS

Fifteen genetically diverse sesame genotypes were crossed with three testers in line x tester mating fashion to obtain 45 hybrids. The lines *viz.*, SI-7-2, SI-11, ICSC-8, SP-1162-B, NIC-16207, NIC-16205, IC-14329, T-13, Tarun, Shekhar, RT-46, Hima, Swetha Til, GT-1 and TKG-21 and testers *viz.*, AKT-64, JLT-7 and Phule Til-1 identified as donor for high yield with high oil content were involved as parents in this study. The 45 hybrids were evaluated along their parents in a randomized block design with three replications at Agriculture Botany Farm, Dr. PDKV, Akola during *kharif* 2011-12 with 45 cm between rows and 15 cm within row between plants. The recommended package of practices was followed throughout the growth period. Biometrical observations were recorded on days to 50 per cent flowering,

1. Principal Scientist & Linseed Breeder, AICRP on Oilseeds, College of Agriculture, Nagpur
2. Sr. Res. Assistant, AICRP on Oilseeds, College of Agriculture, Nagpur
3. Jr. Sesame Breeder, AICRP on Oilseeds, College of Agriculture, Nagpur
4. Jr. Linseed Entomologist, AICRP on Oilseeds, College of Agriculture, Nagpur
5. P.G. Student, Botany Section, College of Agriculture, Nagpur

days to maturity, plant height (cm), number of branches plant^{-1}, number of capsules plant^{-1}, number of seeds capsule^{-1}, seed yield plant^{-1} (g), 1000 seed weight (g), oil content (%) and fatty acid profile (%).

The combining ability analysis was carried out by following methodology of Kempthorne (1957) with fixed effects model (model I) of Eisenhart (1947).

RESULTS AND DISCUSSION

The analysis of variance for combining ability for different characters are presented in table 1. The mean squares due to testers were significant for all the characters except seed yield plant^{-1}, 1000 seed weight, oil content, oleic acid content and linoleic acid content indicating importance of gca for characters under study. The mean squares due to lines were significant for all the characters except 1000 seed weight, oil content, oleic acid content and linoleic acid content. Hasan and Sedeck (2015) was also observed that general combining ability (gca) and specific combining ability (sca) mean squares were highly significant for all the studied traits. The line x tester interactions were significant for all the characters except days to maturity, 1000 seed weight, oil content, oleic acid content and linoleic acid content indicating genetic variability for specific combing ability. The significant general combining ability and specific combing ability variation was also reported by Bangar *et al.* (2010) in sesame. Sapkal *et al.* (2016) also obtained similar results of significant mean squares of line x tester for all traits in mustard.

The gca effects and sca effects were estimated for selection of parents and crosses for different characters and data are presented in table 2 and 3 respectively. The gca effects of parents for 1000 seed weight, oil content, oleic acid content and linoleic acid content and sca effects of crosses for 1000 seed weight, days to maturity, oil content, oleic acid content and linoleic acid content were not calculated as the mean squares were non significant.

The combining ability analysis was useful in deciding relative ability of lines and testers to produce desirable hybrid combinations. This can also provide information regarding the usefulness of lines and testers for hybridization to generate segregating population which is expected to give prodigious selections. Tripathi *et al.*(2016) reported that the magnitude of gca effects were invariably higher than sca effects for all characters including seed yield and oil content indicating preponderance of additive gene action for inheritance of the traits. The crosses showing high mean performance, high gca effects of the parents involved in the cross and low and negative sca effects may serve as better source population for deriving superior segregates.

In the present study gca effects were estimated for selection of parents indicated that the testers JLT-7 was good general combiner and may be selected for improvement of number of capsules plant^{-1}. AKT-64 also was good general combiner for improvement of days to maturity. Among lines, SI-11 was good general combiner for days to 50 % flowering, days to maturity. JCSC-8 was good general combiner for improvement of number of capsules plant^{-1} and number of seeds capsule^{-1}. SP-1162-B was good general combiner for days to 50 % flowering and days to maturity. NIC-16207 was good general combiner and may be selected for improvement of seed yield plant^{-1}.Tarun was selected as good combiner for improvement of days to 50 % flowering and number of seeds capsule^{-1}. RT-46 was good general combiner for days to 50 % flowering; number of capsules plant^{-1} and seed yield plant^{-1}. Hima is good general combiner for number of branches plant^{-1}. SI-7-2 was also good general combiner and may be selected for improvement of days to maturity. The genotypes JLT-7, AKT-64, JCSC-8, NIC-16207, Tarun and RT-46 would be useful as desirable parents for enhancing the yield potential through assembling the favourable genes for desirable yield components.

The crosses showing high mean performance, high gca effects of the parents involved in the cross and low sca effects may serve as better source population for deriving superior segregates. The same was also reported by Parimala and Thangvel (2011). The cross AKT-64 x RT-46 showed negative significant sca effects for days to 50 per cent flowering, number of capsules plant^{-1} and seed yield plant^{-1} The cross JLT-7 x SI-7-2 exhibited negative significant sca effects for number of branches plant^{-1}, number of seeds capsule^{-1} and seed yield plant^{-1}. The cross JLT-7 x IC-14329 showed negative significant sca effects for number of capsules plant^{-1} and the cross Phule Til-1 x GT-1 exhibited negative significant sca effects for plant height, number of capsules plant^{-1}, number of seeds capsule^{-1} and seed yield plant^{-1}.

These crosses may serve as a better source population for deriving superior segregates. However, for exploiting the potential of these crosses the conventional breeding methodology needs some modifications. Instead of continuous selfing for a number of generations prior to selection, alternate intermating and selfing may be adopted to increase frequency of desirable segregates and to increase the span of selection.

Table 1. The analysis of variance for combining ability

Sr.No.	Source of variance	d.f.	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches plant^{-1}	Number of capsules plant^{-1}	Number of seeds capsule^{-1}	Seed yield plant^{-1}	1000 seed weight (g)	Oil content (%)	Oleic acid content (%)	Linoleic acid content (%)
1.	Replications	2	1.43	12.94	33.54	0.04	156.97	28.12	0.20	0.11	7.16	2.72	0.01
2.	Crosses	44	9.44**	45.63**	634.51**	0.41**	117.80**	91.32**	4.30**	0.10	3.18	13.63	6.55
3.	Testers	2	5.34*	82.01**	756.50**	0.52**	410.87**	212.27**	0.12	0.07	5.87	35.92	22.34
4.	Lines	14	21.84**	100.32**	849.46**	0.62**	73.24**	44.87**	5.90**	0.14	4.22	12.66	8.89
5.	Line x tester	28	3.53**	15.69	518.33**	0.29**	119.15**	105.91**	3.80*	0.09	2.47	12.52	4.25
6.	Error	88	1.40	11.38	25.78	0.04	24.17	6.18	2.00	0.08	6.43	11.81	8.01
7	GCA vs SCA		0.93	0.95	0.83	0.86	0.82	0.74	0.76	-	-	-	-

Table 2. General combining ability effects of parents for different characters

Sr. No.	Genotypes	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches $plant^{-1}$	Number of capsules $plant^{-1}$	Number of seeds $capsule^{-1}$	Seed yield $plant^{-1}$ (g)
	Testers							
1	AKT-64	-0.34	-1.41**	-4.48	-0.07 *	-3.42	-2.47	--
2	JLT-7	-0.01	1.27 **	3.56	-0.06 *	2.30 **	1.59	--
3	Phule Til-1	0.35	0.14	0.92	0.12	1.12	0.88	--
	SE (g_i) ± I	**0.189**	**0.467**	**0.662**	**0.028**	**0.787**	**0.452**	--
	Lines							
4	SI-7-2	-0.41	-3.01 **	-9.68	0.01	-2.39	1.04	0.56
5	SI-11	-1.07 *	-3.35 **	-6.13	-0.25	-3.64 *	-1.63	-0.61
6	JCSC-8	0.59	-1.01	13.76	0.35	4.78 **	3.26 **	-0.73
7	SP-1162-B	-1.07 *	-3.24 **	-7.46	-0.19 **	-1.62	-1.85	0.65
8	NIC-16207	0.26	-1.24	6.87	0.45	2.12	-4.41	0.84 *
9	NIC-16205	0.26	0.65	3.87 *	0.01	0.56	-0.19	0.15
10	IC-14329	-0.19	1.32	2.10	-0.06	1.05	-1.19	0.77
11	T-13	-0.07	-0.01	-8.68	0.05	-2.28	1.70	0.16
12	Tarun	-1.19 **	-0.24	-6.46	-0.01	1.58	2.04 *	0.70
13	Shekhar	-0.74	-1.13	-5.68	-0.09	1.76	0.26	0.45
14	RT-46	-0.85 *	-1.68	-2.01	-0.16 *	3.78 *	1.04	1.06 *
15	Hima	3.81	7.87	8.54	0.14 *	-3.66 *	0.48	-1.27 **
16	Swetha Til	3.15	7.21	23.43	0.45	3.26	3.59	-0.86 *
17	GT-1	-1.85	-0.79	-9.79	-0.49	-2.99	-1.30	-0.53
18	TKG-21	-0.63	-1.35	-2.68	-0.19 **	-2.33	-2.85 **	-1.32 **
	SE (g_j) ±	**0.423**	**1.046**	**1.480**	**0.063**	**1.760**	**1.012**	**0.418**

*, ** significant at 5% and 1% level respectively

Table 3. Specific combining ability effects of crosses for different characters

Sr. No.	Crosses	Days to 50% flowering	Plant height (cm)	Number of branches $plant^{-1}$	Number of capsules $plant^{-1}$	Number of seeds $capsule^{-1}$	Seed yield $plant^{-1}$ (g)
1	AKT-64 x SI-7-2	0.67	6.82**	-0.06	-1.60	-1.86	0.76
2	AKT-64 x SI-11	1.34	-5.41*	0.20	-5.56	-1.53	0.16
3	AKT-64 x JCSC-8	0.67	6.04*	0.30**	1.02	2.25	0.45
4	AKT-64 x SP-1162-B	0.34	-8.41**	-0.09	-0.11	0.36	1.11
5	AKT-64 x NIC-16207	-0.99	19.59	0.30**	9.42**	3.92*	0.82
6	AKT-64 x NIC-16205	1.01	11.26	-0.06	-1.69	-0.97	-1.09
7	AKT-64 x IC-14329	0.12	3.70	0.01	7.82*	9.36	0.79
8	AKT-64 x T-13	-0.66	-10.85	-0.13	0.69	-2.86	0.06
9	AKT-64 x Tarun	0.12	-11.07	0.12	-0.38	3.14	-0.61
10	AKT-64 x Shekhar	-0.66	-9.19	-0.26*	-4.36	-6.41	-1.16
11	AKT-64 x RT-46	-1.88*	-3.85	0.21	-9.71**	5.47**	-2.00**
12	AKT-64 x Hima	0.12	13.93	-0.09	-1.87	-4.64**	0.16
13	AKT-64 x Swetha Til	1.79*	-10.63	-0.50	-9.09**	-4.41*	-0.31
14	AKT-64 x GT-1	-1.88*	-2.41	0.08	9.27**	-3.86*	0.12
15	AKT-64 x TKG-21	-0.10	0.48	-0.02	6.13*	2.03	0.74
16	JLT-7 x SI-7-2	0.34	-4.23	-0.26*	-7.46*	-4.93**	-1.28
17	JLT-7 x SI-11	-0.99	-1.12	-0.04	5.99	-0.26	0.02
18	JLT-7 x JCSC-8	0.34	-13.67	-0.41	-3.03	0.85	-0.36
19	JLT-7 x SP-1162-B	-0.99	-9.45	0.14	1.97	-6.04	-1.04
20	JLT-7 x NIC-16207	0.67	-10.79	-0.44	-6.77*	-5.81**	-1.19
21	JLT-7 x NIC-16205	-0.33	-11.45	0.30**	2.59	8.30	1.39
22	JLT-7 x IC-14329	0.12	-8.34**	0.17	-8.30**	-8.04	-0.93
23	JLT-7 x T-13	0.01	3.10	0.06	-3.90	-3.26	-0.35
24	JLT-7 x Tarun	0.12	1.88	0.01	1.10	-5.93**	-0.09
25	JLT-7 x Shekhar	-0.33	-0.90	0.40	1.92	8.52	-0.07

Table 3: Continued…….

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Sr. No.	Crosses	Days to 50% flowering	Plant height (cm)	Number of branches plant^{-1}	Number of capsule plant^{-1}	Number of seeds capsule^{-1}	Seed yield plant^{-1} (g)
26	JLT-7 x RT-46	0.79	-3.23	0.07	6.17*	1.74	0.68
27	JLT-7 x Hima	1.12	10.55	0.44	5.48	3.96*	0.42
28	JLT-7 x Swetha Til	-1.55*	18.33	-0.24*	6.09*	1.52	1.57*
29	JLT-7 x GT-1	0.45	10.21	-0.13	-0.59	8.07	1.87*
30	JLT-7 x TKG-21	0.23	19.10	-0.06	-1.26	1.30	-0.64
31	Phule Til-1 x SI-7-2	-1.01	-2.59	0.32**	9.06**	6.79	0.52
32	Phule Til-1 x SI-11	-0.35	6.53*	-0.16	-0.43	1.79	-0.18
33	Phule Til-1 x JCSC-8	-1.01	7.64**	0.11	2.01	-3.10	-0.09
34	Phule Til-1 x SP-1162-B	0.65	17.86	-0.05	-1.86	5.67**	-0.07
35	Phule Til-1 x NIC-16207	0.32	-8.81	0.14	-2.66	1.90	0.37
36	Phule Til-1 x NIC-16205	-0.68	0.19	-0.25*	-0.90	-7.33	-0.30
37	Phule Til-1 x IC-14329	-0.24	4.64	-0.18	0.48	-1.33	0.14
38	Phule Til-1 x T-13	0.65	7.75**	0.08	3.21	6.12	0.29
39	Phule Til-1 x Tarun	-0.24	9.19	-0.13	-0.72	2.79	0.71
40	Phule Til-1 x Shekhar	0.99	10.08	-0.15	2.43	-2.10	1.23
41	Phule Til-1 x RT-46	1.10	7.08**	-0.28*	3.54	-7.21	1.32
42	Phule Til-1 x Hima	-1.24	-24.47	-0.35**	-3.61	0.67	-0.58
43	Phule Til-1 x Swetha Til	-0.24	-7.70**	0.74	3.00	2.90	-1.26
44	Phule Til-1 x GT-1	1.43	-7.81**	0.05	-8.68**	-4.21*	-1.99**
45	Phule Til-1 x TKG-21	-0.13	-19.59	0.09	-4.88	-3.33	-0.10
	SE (S_{ij}) ±	**0.733**	**2.564**	**0.109**	**3.049**	**1.753**	**0.725**

*, ** significant at 5% and 1% level respectively

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Rec. on 03.01.2017 & Acc. on 25.01.2017