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Research Article

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 ten lines and four testers. Eight characters *viz.,* days to 50 per cent flowering, plant height, number of branches per plant, number of capsules per plant, capsule length, number of seeds per capsule, 1000 seed weight and seed yield per plant were studied. Based on the general combining ability effects of parents IVTS-14-07 [L_6] was found to be a good general combiner for days to 50 per cent flowering and number of capsules per plant, IVTS-215-06 [L_{10}] was found to be good general combiner for plant height, number of branches per plant and 1000 seed weight. IVTS-24-06 [L_9] was found to be good general combiner for number of seeds per capsule and seed yield per plant. The cross combination IVTS -17-07 X TMV 4 [L_5 X T_2] showed negative ,significant *sca* for days to 50 per cent flowering. AVTS-3-06 X TMV 3 [L_4 X T_1] exhibited positive and significant *sca* for number of capsules per plant and seed yield per plant and hence recommended for yield improvement.

Key words:
Sesame, General combining ability, Specific combining ability

Introduction

Sesame (*Sesamum indicum* L.) is an important oilseed crop grown all over India. It can be grown either as a pure or mixed crop. It has attracted special attention as an important salad dressing and edible oil . India ranks first in the world in sesame cultivation in terms of (1.75 m ha) area and production(0.60m tones) (Naina Mohammed, 2001). In Tamil Nadu this crop occupies an area of 1.21 lakh ha with an average productivity of 298 kg ha^{-1} (GOI, 1990). This is far below the recorded high yield of 3000 kg (Weiss, 1983) and 2000 kg in Yugoslavia (FAO, 1980). A further increase in sesame productivity per unit area and unit time needs intensive research in genetics and plant breeding. Studies on combining ability is of paramount importance to select suitable parents for hybridization. In the present investigation attempts have been made to evaluate fourteen parents (ten lines, four testers) and 40 hybrids through Line × Tester 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 Plant Breeding Farm, Faculty of Agriculture, Annamalai University during May 2008 – January 2009. The experimental material for this study consisted of ten lines and four testers, viz., L_1 – IVTS -1- 06, L_2 – IVTS-20-06 , L_3 – IVTS-15-07, L_4 – AVTS -3-06, L5- IVTS-17-07, L6- IVTS-14-07, L7- AVTS-20-06, L_8-IVTS-8-07, L_9-IVTS-24-06, L_{10}-IVTS-25-06, T_1- TMV3, T_2-TMV-4,T_3-CO1,and T_4-VRI 1. The seeds were obtained from Regional Research Station, Virudhachalam, Tamil Nadu Agricultural University, Tamil Nadu. The ten lines and four testers were crossed in a line × tester manner resulting in forty hybrids.

The forty hybrids and their fourteen parents were raised in a randomized block design with two replications during January-April 2008. A spacing of 30 cm between rows and 20 cm between plants was given and 20 plants were maintained in each cross. Border rows were grown all around the experimental block. A fertilizer schedule of 40:25:25 kgs of NPK per hectare was followed along with the recommended cultural operations and plant protection measures. Observations were recorded on eight biometrical traits viz., days to 50 per cent flowering, plant height, number of branches per plant, number of capsules per plant, capsule length, number of seeds per capsule, 1000 seed weight and seed yield per plant. The combining ability variance analysis was done based on the method developed by Kempthorne (1957).

Results and Discussion

The analysis of variance showed significant differences among the genotypes, for all eight traits *viz.*, days to 50 per cent flowering, plant height, number of branches per plant, number of capsule per plant, capsule length, number of seeds per capsule, 1000 seed weight and seed yield per plant (Table 1.). Among the lines significant differences were observed for all the characters except capsule length while among testers significant difference was observed for plant height. The interaction effect L × T was significant for days to 50 per cent of flowering, number of branches per plant, number of capsule per plant, capsule length, number of seeds per capsule and seed yield per plant.

Dhillon (1975) reported that combining ability of parents gives useful information on the choice of parents in terms of expected performance of the hybrids and their progenies. Singh and Nanda (1976) opined that it was logical to select at least one parent with high *gca* effects. Among the parents studied IVTS -24-06 (L_9) is a good combiner for yield contributing characters *viz.,* number of seeds per capsule and seed yield per plant. IVTS-14-07 (L_6) recorded negative *gca* effect for days to 50 per cent flowering which indicated that this parent is suitable for earliness breeding (Table 2.) It also recorded desirable *gca* for yield contributing character, number of capsules per plant. Another line IVTS-25-06 (L_{10}) is a good combiner for yield contributing characters *viz.,* number of branches per plant, plant height and1000 seed weight. Considering the gca effect of parents IVTS -24-06 (L_9), IVTS-25-06 (L_{10}) and IVTS-14-07 (L_6) were adjudged as superior parents.

The specific combining ability is the deviation from the performance predicted on the basis of general combining ability (Allard, 1960). The *sca* effect is an important criterion for the evaluation of hybrids (Table 3). Among the hybrids AVTS-3-06 X TMV3 (L_4XT_1) showed positive and significant *sca* effect for the traits, number of capsules per plant and seed yield per plant. Similar results were reported by Senthilkumar and Ganesan (2001). IVTS-24-06 X TMV4 ($L_9 \times T_2$) showed maximum positive and significant *sca* effects for the trait number of branches per plant. IVTS-17-07 X TMV 4 (L_5 X T_4) recorded negative and significant *sca* for days to 50 per cent flowering.

Another hybrid IVTS -20-06 X VRI1 ($L_2 \times T_4$) showed positive and significant *sca* effects for the trait capsules length. For the trait plant height IVTS-15-07XTMV3 ($L_3 \times T_1$) showed desirable *sca* effects. Based on *sca* effects the hybrids IVTS 24-06 X TMV 4 ($L_9 \times T_2$), IVTS 17-07 X TMV 4 ($L_5 \times T_2$) and AVTS-3-06 X TMV 3 (L_4XT_1) were adjudged as better hybrids.

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Table 1. Analysis of variance for eight characters in sesame

		Days to 50 per cent flowering	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)
Replication	2	2.90	141.86	1.85	102.90	0.02	12.07	0.56	1.88
Hybrids	53	8.30**	937.80**	18.52**	1603.77**	0.08**	583.52**	0.51**	84.15**
Lines	9	29.81**	2650.52**	41.20**	4975.18**	0.04	1313.37**	2.05**	6.33**
Testers	3	2.55	883.85**	5.43	224.44	0.05	774.14	0.06	0.32
Lines × Testers	27	1.77**	359.56	12.42**	633.22**	0.10**	319.06**	0.05	38.62**
Error	106	0.9766	32.24	1.56	11.92	0.01	26.72	0.12	0.64

* Significant at 5% level ** Significant at 1% level

Table 2. General Combining Ability of Parents

Parents	Days to 50 per cent flowering	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)
L_1	1.70**	-11.50**	0.33	-0.38	0.04	-7.23**	-0.18	-0.97**
L_2	0.62*	-23.58**	-0.08	-2.55**	-0.09**	13.94**	-0.14	-2.23**
L_3	-0.22	12.25**	-1.92**	-22.13**	-0.01	12.86**	-0.18	-4.37**
L_4	-1.55**	-11.83**	0.08	-10.63**	0.01	-12.56**	-0.25*	0.00
L_5	-2.05**	1.25	0.50	-26.55**	0.09**	-0.56	-0.12	-3.15**
L6	-2.30**	0.42	-2.50**	38.70**	-0.05	-1.98	-0.17	0.37*
L7	2.45**	15.75**	2.75**	4.62**	0.07*	-0.98	-0.08	2.84**
L_8	-0.13	8.58**	-0.42	-16.38	0.06	-13.81**	0.02	1.41**
L_9	0.87**	-14.08**	-1.83**	19.37**	-0.07*	14.28**	-0.06	3.84**
L_{10}	0.62*	22.75**	3.08**	15.95**	-0.05	-3.98*	1.16**	2.35**
T_1	-0.07	-2.38**	0.35	4.07**	-0.01	-2.41**	-0.06	0.42**
T_2	-0.03	-3.95**	-0.42	-1.87**	0.01	3.99**	0.01	0.04
T_3	-0.30	-1.68*	0.38	-1.13*	0.05*	4.43**	0.00	-0.52**
T4	0.40*	8.02**	-0.32	-1.07	-0.05*	-6.01**	0.05	0.06

* Significant at 5% level ** Significant at 1% level

Table 3. Specific Combining Ability of Hybrids

Hybrids	Days to 50 per cent flowering	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)
L_1/T_1	0.07	-0.37	-0.27	-16.98**	0.04	-1.34	0.01	3.24**
L_1/T_2	1.03	-0.13	-0.83	-4.72*	-0.17**	-6.41*	-0.01	0.11
L_1/T_3	-0.70	1.60	0.03	-1.45	-0.08	1.16	0.08	-2.50**
L_1/T4	-0.40	-1.10	1.07	23.15**	0.22**	6.59*	-0.07	-0.86*
L_2/T_1	-0.85	-5.95	-1.18	11.52**	-0.39**	-11.58**	0.05	-1.23*
L_2/T_2	0.78	-1.38	-1.42*	-5.88**	-0.14*	9.99**	-0.10	0.68
L_2/T_3	1.05	-4.32	1.78*	3.38	0.25**	-6.91*	0.04	-1.19**
L_2/T4	-0.98	11.65**	0.82	-9.02**	0.28**	22.43**	0.01	1.74**
L_3/T_1	-0.02	14.88**	-2.02**	-18.23**	0.20**	6.17*	0.01	-1.19**
L_3/T_2	-1.05	-18.55**	-1.58*	11.70**	0.02	4.41	-0.05	0.95**
L_3/T_3	0.22	10.18**	0.95	9.63**	-0.13*	11.84**	0.08	0.99**
L_3/T_4	0.85	-6.52*	2.65**	-3.10	-0.09	8.33**	-0.04	-0.75*
L_4/T_1	0.32	-2.70	2.65**	29.93**	0.20**	8.33**	0.06	3.78**
L_4/T_2	-0.72	2.20	1.42*	4.87*	-0.04	-8.08**	-0.04	-3.13**
L_4/T_3	0.55	-7.73*	-1.72*	-15.87**	-0.08	-3.84	-0.02	-3.71**
L_4/T_4	-0.15	8.23*	-2.35**	-18.93**	-0.08	3.59	0.00	3.07**
L_5/T_1	-0.18	-14.12**	-1.77*	-11.82**	0.06	-2.01	0.18	-0.16
L_5/T_2	-1.22*	-10.88**	2.67**	-8.22**	-0.08	6.59*	0.10	2.48**
L_5/T_3	1.05	10.52**	-0.47	0.72	0.07	-6.84*	-0.12	-1.24**
L_5/T_4	0.35	14.48**	0.43	19.32**	-0.08	2.26	-0.16	-1.08**
L_6/T_1	0.40	-1.95	0.57	-9.07**	-0.10	6.41*	0.11	-0.22
L_6/T_2	0.70	4.28	-1.00	-2.47	-0.08	15.34**	-0.04	-1.45**
L_6/T_3	-0.70	1.68	1.87**	4.13*	0.07	10.76**	-0.01	2.53**
L_6/T_4	-0.40	-4.02	-1.43*	7.40**	0.11	10.99**	-0.06	-0.87*
L_7/T_1	-0.68	13.05**	2.65**	12.02**	-0.09	-3.59	-0.03	-1.19**
L_7/T_2	-0.05	13.95**	-1.92**	22.28**	0.4	2.34	-0.06	0.04
L_7/T_3	-0.12	-1.65	-0.72	-14.45**	0.02	4.24	0.05	1.69**
L_7/T_4	0.85	-25.35**	-0.02	-19.85**	0.03	-2.99	0.05	-0.54
L_8/T_1	0.57	-0.45	-2.85**	-4.98**	0.05	4.58	-0.17	-0.15
L_8/T_2	0.81	1.78	-0.42	-1.38	0.25**	-11.83**	0.28	0.45
L_8/T_3	-1.20*	-3.15	1.45*	5.88**	-0.13*	-6.26*	0.00	2.03**
L_8/T4	-0.23	1.82	1.82*	0.48	-0.17**	13.51**	-0.11	-2.33**
L_9/T_1	0.23	-4.45	-0.43	-4.73*	0.22**	9.16**	0.08	-0.45
L_9/T_2	-0.13	2.45	3.00**	-7.80**	0.18**	7.09*	-0.18	-0.20
L_9/T_3	-0.20	-10.48**	-0.47	5.13*	-0.03	-4.34	-0.16	-1.14**
L_9/T4	0.10	12.48**	-2.10**	7.40**	-0.37**	-11.91**	0.27	1.80**
L_{10}/T_1	0.15	2.05	2.65**	12.35**	-0.19**	-7.59*	-0.29	-2.43**
L_{10}/T_2	-0.22	6.28	0.08	-8.38**	0.03	0.34	0.11	0.08
L_{10}/T_3	0.05	3.35	-2.72**	2.88	0.05	12.24**	0.06	2.54**
L_{10}/T_4	0.02	-11.68**	-0.02	-6.85**	0.12	-4.99	0.12	-0.19

* Significant at 5% level ** Significant at 1% level