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Research Article

Studies on general and specific combining ability in sesame (*Sesamum indicum* L.)

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Abstract:
A Line × Tester analysis in sesame (*Sesamum indicum* L.) was carried out with seven lines and four testers to estimate the combining ability effects, nature of gene action and heterosis for 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. Based on the general combining ability effects, IVTS 7 among lines and TMV 6 among testers were found to be good general combiners for seed yield per plant. The cross combination IVTS 7 X TMV 6 exhibited the maximum positive and significant *sca* for seed yield per plant and hence recommended for heterosis breeding, whereas the hybrid IVTS-13 × TMV 6 exhibited high test weight and hence it is recommended for breeding bold seeded type. Similarly the hybrid IVTS 8 × TMV 3 recorded desirable *sca* for earliness.

Key words:
General combining ability, specific combining ability, sesame

Introduction

Sesame (*Sesamum indicum* L.), thought to have been originated in Africa, and considered to be the oldest oil seed crop known to man and now grown in many parts of the world including the U.S. The seed contains 50-60% oil which has excellent stability due to the presence of natural antioxidants such as sesamolin, sesamin and sesamol (Brar and Ahuja, 1979). In India sesame is being raised in an area of 24.33 lakh ha with an average productivity of 274 kg ha^{-1} (GOI, 1990a). In Tamil Nadu, this crop occupies an area of 1.21 lakh ha with an average productivity of 298 kg ha^{-1} (GOI, 1990b). This is far below the recorded high yield of 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 heterosis breeding in sesame are of paramount importance to achieve the goal. In the present investigation, attempts have been made to evaluate eleven parents (seven lines, four testers) and 28 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 materials for this study consisted of seven lines and four testers *viz.,* L_1 – IVTS 5, L_2 – IVTS 7, L_3 – IVTS 8, L_4 – IVTS 9, L_5- IVTS-11, L_6- IVTS-13, L_7- IVTS-14, T_1- CO 1, T_2- TMV 3, T_3-TMV 6 and T_4-VRI 1. The seeds were obtained from Regional Research Station, Tamil Nadu Agricultural University, Virudhachalam, Tamil Nadu. The seven lines and four testers were crossed in a line × tester mating design resulting in twenty eight hybrids.

Twenty eight hybrids and their eleven parents were sown in rows with spacing of 30 cm between rows and 20 cm between plants in a row during January-April 2009. In each cross, 20 plants were maintained. The experiment was conducted in randomized block design with two replications. 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 analysis of variance for combining ability 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, seed yield per plant (Table 1.). Significant differences between lines and among testers were observed for all the characters. The L x T interaction effect was significant for days to 50 per cent of 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.

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 lines studied, IVTS 8 (L_3) is a good combiner for yield contributing characters *viz.,* number of capsule per plant, capsule length, number of seeds per capsule. It also recorded negative *gca* effects for days to 50 per cent flowering which indicated that this parent is suitable for earliness breeding (Table 2.). Another line IVTS 11 (L_5) is a good combiner for yield contributing characters *viz.,* number of branches per plant, number of capsules per plant and line IVTS 14 (L_7) is a good combiner for plant height, 1000 seed weight, and IVTS 7 (L_2) is a good combiner for seed yield per plant.

Among the testers TMV 6 (T_3) recorded high *gca* for days to 50 per cent of 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. VRI 1 (T_4) performed better for five traits viz., days to 50% flowering, plant height, number of branches per plant, number of capsules per plant and seed yield. Considering the *gca* effects of parents, IVTS 8 (L_3), IVTS 11 (L_5) and IVTS 14 (L_7), IVTS 7 (L_2) among lines and TMV 6 (T_3) and VRI 1 (T_4) among testers were adjudged as good 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 IVTS 14 / TMV 3 ($L_7 \times T_2$) showed positive and significant *sca* effect for the traits number of branches per plant, number of capsules per plant, number of seed per capsule, 1000 seed weight and seed yield. IVTS 5 / VRI 1 ($L_1 \times T_4$) showed maximum positive and significant *sca* effects for the traits capsule length and number of seeds per capsule.

Another hybrid IVTS 11 / CO 1 ($L_5 \times T_1$) showed positive and significant *sca* effects for the traits plant height, number of capsule per plant, number of seeds per capsule and 1000 seed weight. For the trait days to 50 per cent flowering, IVTS 8 / TMV 3 ($L_3 \times T_2$) showed desirable effects for earliness. Based on *sca* effects, the hybrids IVTS 11 / Co 1 ($L_5 \times T_1$) and IVTS 8 / TMV 3 ($L_3 \times T_2$), IVTS 14 / TMV 3 ($L_7 \times T_2$) IVTS 5 / VRI 1 ($L_1 \times T_4$), were adjudged as better hybrids.

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Table 1. Analysis of variance for eight characters in sesame

Source	df	Mean sum of squares							
		Days to 50 per cent flowering	Plant height (cm)	Number branches per plant	Number capsule per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)
Replication	1	4.7296	22.4103	3.6184	8.2732	0.0018	3.4263	0.0210	0.0240
Hybrids	27	34.5903**	400.7434**	3.8538**	161.6883**	0.0376**	19.1091**	0.5498**	2.2874**
Lines	6	35.8934**	1383.8607**	8.4264**	116.7197**	0.0439**	30.9746**	0.1378**	3.6212**
Testers	3	18.4301**	149.9018**	7.7493**	286.1868**	0.0135**	11.2504**	0.8397**	0.7347**
Lines × Testers	18	36.8494**	114.8446**	1.6804**	155.9281**	0.0394**	16.4638**	0.6389**	2.1016**
Error	38	0.1870	5.1261	0.0164	1.3004	0.0024	0.0244	0.0001	0.0003

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

Table 2. General Combining Ability of Parents

Parents	Days to 50 per cent flowering	Plant height (cm)	Number branches per plant	Number capsule per plant	Capsule length (cm)	Number of seeds per capsule	1000-seed weight (g)	Seed yield per plant (g)
L_1	-2.99**	-15.89**	0.94**	-0.28	-0.01	0.83**	0.17**	-0.07**
L_2	0.69**	-13.14**	0.21**	-7.08**	0.02	0.95**	-0.13**	1.20**
L_3	-0.89**	-9.37**	-1.49**	2.67**	0.13**	2.78**	-0.07**	-0.94**
L_4	1.06**	1.73	-1.01**	2.37**	0.01	-3.15**	-0.14**	-0.12**
L_5	3.04**	12.88**	1.46**	3.89**	0.01	-0.15**	0.01**	0.45**
L_6	1.26**	5.86**	-0.14**	-2.81**	-0.06**	0.63**	-0.02**	-0.12**
L_7	-2.19**	17.93**	0.01	1.24*	-0.11**	-1.90**	0.18**	-0.39**
T_1	1.71**	-4.21**	-0.09**	-6.71**	-0.02	-0.55**	-0.03**	-0.03**
T_2	-0.46**	-0.81	-1.02**	2.37**	-0.03	-0.56**	-0.15**	-0.31**
T_3	-0.50**	3.26**	0.51**	2.94**	0.04*	1.32**	0.36**	0.19**
T_4	-0.75**	1.76*	0.60**	1.40**	0.01	-0.21**	-0.17**	0.15**

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

Table 3. Specific Combining Ability of Hybrids

Hybrids	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	Seed yield per plant
L_1/T_1	-4.89**	0.94	-0.11	-1.36	-0.06	-1.00**	-0.67**	-0.68**
L_1/T_2	0.09	-7.66**	0.02	-12.55**	-0.04	-3.49**	0.19**	1.18**
L_1/T_3	1.73**	2.86	0.89**	5.68**	-0.09*	1.33**	-0.01	-0.27
L_1/T_4	3.07**	3.86*	-0.80**	8.22**	0.19**	3.16**	0.49**	-0.23
L_2/T_1	-1.86**	-3.41*	-0.79**	9.44**	0.14**	4.98**	0.74**	-0.56**
L_2/T_2	9.71**	-6.21**	-0.36**	2.05*	0.14**	-0.61**	0.17**	-1.04**
L_2/T_3	-3.45**	3.81*	0.21*	-6.82**	-0.12**	-0.80**	-0.62**	0.96**
L_2/T_4	-4.40**	5.81**	0.93**	-4.67**	-0.16**	-2.57**	-0.30**	0.64**
L_3/T_1	2.71**	2.91	1.31**	-3.31**	0.04	-5.05**	-0.38**	-1.04**
L_3/T_2	-6.51**	10.71**	0.44**	-16.70**	0.03	1.76**	0.40**	0.78**
L_3/T_3	1.93**	-6.96**	-0.99**	9.73**	0.09**	0.68**	-0.27**	0.43**
L_3/T_4	1.87**	-6.66**	-0.77**	10.28**	-0.17**	2.61**	0.24**	-0.17**
L_4/T_1	2.86**	-13.89**	0.84**	-8.01**	-0.12**	-0.53**	0.49**	0.86**
L_4/T_2	-1.76**	8.61**	0.07	9.30**	0.01	0.59**	-0.23**	-1.32**
L_4/T_3	-1.32**	1.64	-0.66**	1.33	0.22**	-1.90**	-0.40**	0.17**
L_4/T_4	0.22	3.64*	-0.25**	-2.62**	-0.12**	1.83**	0.13**	0.29**
L_5/T_1	3.89**	6.26**	-0.64**	1.66*	-0.10**	1.98**	0.60**	1.39**
L_5/T_2	-5.84**	-11.34**	-0.71**	-1.22	-0.10**	-1.71**	-0.46**	0.59**
L_5/T_3	0.60	1.09	0.36**	-0.79	0.11**	1.60**	-0.33**	-1.11**
L_5/T_4	1.35**	3.99*	0.98**	0.35	0.10**	-1.87**	0.19**	-0.87**
L_6/T_1	-1.74**	5.59**	-0.74**	4.16**	0.01	-0.10	-0.17**	0.97**
L_6/T_2	-0.76**	5.09**	-0.81**	9.08**	-0.02	3.21**	-0.44**	-1.15**
L_6/T_3	1.38**	-0.49	0.96**	-4.99**	-0.15**	1.13**	0.93*	-0.61**
L_6/T_4	1.12**	-10.19**	0.58**	-8.25**	0.17**	-4.24**	-0.32**	0.79**
L_7/T_1	-0.99**	1.61	0.11	-2.59**	0.09*	-0.27*	-0.62**	-0.94**
L_7/T_2	5.09**	0.81	1.34**	10.03**	-0.02	0.24*	0.36**	0.96**
L_7/T_3	-0.87**	-1.96	-0.79**	-4.14**	-0.06	-1.05**	0.69**	0.44**
L_7/T_4	-3.23**	-0.46	-0.67**	-3.30**	0.01	1.08**	-0.43**	-0.45**

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