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Research Paper

Evaluation of Hybrids for Heterosis Breeding in Sesame (*Sesamum indicum*)

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ABSTRACT

Heterosis for sesame yield and its important component characters was studied in a set of line x tester crosses. 14 diverse sesame genotypes were used as parents. Among these, 10 were used as female parents and highly adopted 4 local varieties were used as female parents 40 hybrids were produced and were evaluated along with parents and check variety during summer season in Randomized Block Design at Plant Breeding Farm, Faculty of Agriculture, Annamalai University, Tamil Nadu. The data was recorded for eight biometrical traits viz., Days 60, 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. In the present study highly significant difference were recorded among the hybrids for all the eight traits studied in sesame. Further, four hybrids IVIS-25-06/CO1, AVTS-3/06/TMV3, IVTS-15-07/CO1 and IVTS-25-06/TMV3 had recorded highest standard heterosis for most of the traits. The hybrid IVTS-24-06/TMV3 and IVTS-25-06/CO1 recorded statistically significant superior seed yield per plant 13.56g and 12.23g respectively. Keeping above points view, these hybrids were ranked as best hybrid and can be utilized for hybrid breeding programe.

Key words: Sesame, Heterosis, Heterobeltiosis, Standard heterosis

Sesame (*Sasamum indicum* L.) is an important oil seed crop in the tropical and subtropical region. It is called as the "Queen of oilseed" because of its excellent quality of the seed, oil and meal. It belongs to the family pedaliaceae and order Tubiflorae, containing 60 species organized into 16 genera [1] (Azhri, 1998). The genes Sesamum comprises of 36 species of which Sesamum indicum is the one of the oldest oil seed and most commonly cultivated species highly cultivating in India. Sesame is an erect herbaceous annual crop that has two growth characteristics indeterminate and determinate growth, with the plants reaching height of up to two meters. Most of the varieties show an indeterminate growth habit, which is shown as a continuous production of new leaves, flowers and capsules as long as the environment remains suitable for growth [2]. Sesame is highly drought tolerant, and it can adopt and produce seed well under fairly high temperatures [3] and it can thrive well on drained soil with a moderate fertility and a pH between 5.5 and 7.0.

Sesame is highly nutritive (oil 50%, protein 25%) and its oil contains an antioxidant called sesamol which imparts a high degree of resistance against oxidative rancidity. Sesame cake is nutritions feed for dairy cattle and it can also be used as fertilizer [4]. Brown 'or' black seeded are value more for oil extraction and medicinal purpose, where as white seeded are rich in iron. Sesame seeds are digestive, rejuvenate, anti-aging and rich in Vit-E, A and B complex and minerals like calcium, phosphoral, Magnesium Zinc and potassium. This Unique composition coupled with high level of unsaturated fatty acids like linolenic and tocopherol make the same nearly perfect food [5].

Hybrid vigour of even a small magnitude for individual component may have an additive effect on the end produce [6]. Thus, extent of heterotic response of F_1 hybrids largely depends on the breeding value and genetic diversity of the parents involved in the crosses [7]. Heterosis over better parent (heterobeltiosis) is relatively more important than relative heterosis for commercial exploitation of hybrids. Heterobeltiosis for seed yield and yield component in sesame has been reported by many workers [8-9]. However, success of hybridization depends on the extent of heterosis for seed yield and its important component characters. Therefore, the present study was undertaken to study the extent of heterosis for quantitative traits in sesame.

MATERIALS AND METHODS

The present investigation was carried out at college Plant Breeding Farm, Faculty of Agriculture, Annamalai University, Tamil Nadu. Ten diverse lines viz., L_1 (IVTS-1-06), L_2 (IVTS-20-06), L_3 (IVTS-15-07), L_4 (AVTS-3-06), L_5 (IVTS-17-07), L_6 (IVTS-14-07), L_7 (AVTS-20-06), L_8 (IVTS-8-07), L_9 (IVTS-24-06) and L_{10} (IVTS-25-06) and four testers viz., T_1 (TMV3), T_2 (TMV4), T_3 (Co1), T_4 (VRI-1) were

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crossed in a line × tester mating design to produce 40 hybrids. The resulting 40 hybrids along with 14 parents and a check variety, Co1 were evaluated during summer in a randomized block design with three replications. Each plot with a spacing of 45 × 30 cm. Observations were recorded on randomly selected ten plants in each entry for 8 quantitative 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 for each replication.

RESULTS AND DISCUSSION

Analysis of variance was performed to test the difference among parents and hybrids for all the eight characters studied and are presented in (Table 1). The result revealed that the mean squares due to genotypes were highly significant for six 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 plant. This indicated that sufficient amount of genetic variability was present in the experimental material for all the characters under study significant difference between lines was observed for all the characters except capsule length and seed yield per plant. Significant difference among testers was observed for plant height, 1000 seed weight and seed yield per plant. The interaction effect (L × T) was significant for all the characters. This indicated the existence of considerable genetic variability among the hybrids for all characters. Similar results were reported by [10-11].

Table 1 Analysis of variance for combining ability

Source	df	Days to 50% flowering	Plant height	No. of branches plant^{-1}	No. of capsules plant^{-1}	Capsule length	No. of seeds per capsule	1000 seed weight	Seed yield plant^{-1}
Replication	2	2.90	141.86	1.85	102.90	0.02	12.07	0.56	0.67
Genotypes	53	1067**	826.58**	21.81**	1392.08**	0.07**	487.98**	0.41**	30.65**
L × T	27	1.77*	359.56**	12.42**	633.22**	0.10**	319.06**	0.05	13.85**
Parent	13	0.79	200.14**	31.76**	852.48**	0.02*	147.21**	0.00	31.94**
Line (P)	9	0.92	72.81*	12.25**	842.01**	0.3*	187.68**	0.00	13.92**
Tester (P)	3	0.52	46.75	26.08**	198.97**	0.00	61.63*	0.00	19.54**
Cross V_s parent	1	231.62**	4632.34**	20.99**	151.25**	0.00	1191.81**	1.49**	0.23
Error	106	0.97	32	1.56	11.92	0.01	26.72	0.12	0.35

*Significant at 5 per cent level
**Significant at 1 per cent level

Table 2 Range of relative heterosis, heterobeltiosis and standard heterosis for all the eight traits in sesame

Hybrids	Days to 50% flowering			Plant height			Number of branches plant^{-1}			Number of capsules plant^{-1}		
	RH	HB	SH	RH	HB	SH	RH	HB	SH	RH	HB	SH
L_1/T_1	14.89**	14.89**	12.50**	-8.66	-19.07**	-19.07**	5.66	-28.57**	-24.24**	-16.57**	-33.18**	-29.50**
L_1/T_2	18.09**	18.09**	15.63**	-12.14*	-23.08**	-20.93**	-28.81**	-48.78**	-36.36**	-14.89**	-35.74**	-20.00**
L_1/T_3	10.53**	9.38**	9.38**	-4.46	-15.35*	-15.35*	1.96	-21.21*	-21.21*	5.20	-14.00**	-14.00**
L_1/T_4	15.51**	14.89**	12.50**	12.78*	4.64	-5.58	42.11**	35.00*	-18.18	52.80**	26.15**	23.00**
L_2/T_1	9.09**	8.51**	6.25*	-37.79**	-43.72**	-43.72**	-16.00	-40.00**	-36.36**	43.79**	4.27	10.00*
L_2/T_2	14.44**	13.83**	11.46**	-34.18**	-41.18**	-39.53**	-35.71**	-56.10**	-45.45**	-12.79**	-39.76**	-25.00**
L_2/T_3	13.23**	11.46**	11.46**	-34.19**	-40.47**	-40.47**	25.00**	-9.09	-9.09	22.03**	-10.00*	-10.00*
L_2/T_4	10.75**	10.75**	7.29**	11.41*	5.67	-4.65	42.86**	25.00	-24.24**	-1.38	-26.67**	-23.50**
L_3/T_1	6.81**	5.15*	6.25*	49.61*	35.35**	35.35**	-43.85**	-62.86**	-60.61**	-53.55**	-65.88**	-64.00**
L_3/T_2	3.66	2.06	3.13	-5.82	-15.84*	-13.49*	-53.85**	-70.73**	-63.64**	-17.24**	-42.17**	-28.00**
L_3/T_3	5.70**	5.15*	6.25*	43.44**	29.77**	29.77**	0.00	-33.33**	-33.33**	-6.35	-30.00**	-30.00**
L_3/T_4	11.58**	9.28**	10.42**	40.22**	32.99**	20.00**	61.29**	25.00	-24.24**	-30.61**	-47.69**	-49.00**
L_4/T_1	4.21*	3.13	3.13	-9.29	-22.79**	-22.79**	57.14**	-5.71	0.00	64.59**	18.96**	25.50**
L_4/T_2	1.05	0.00	0.00	-5.38	-20.36**	-18.14**	12.50	-34.15**	-18.18	-7.87*	-36.55**	-21.00**
L_4/T_3	3.13	3.13	3.13	-16.39**	-28.84**	-28.84**	0.00	-39.39**	-39.39**	-33.33**	-51.00**	-51.00**
L_4/T_4	4.76*	3.13	3.13	33.33**	18.56**	6.98	18.52	-20.00	-51.52**	-38.41**	-54.36**	-55.50**
L_5/T_1	1.59	1.05	0.00	-10.24	-20.47**	-20.47**	-10.64	-40.00**	-36.36**	-60.61**	-63.03**	-61.00**
L_5/T_2	-1.59	-2.11	-3.13	-9.04	-20.36**	-18.14**	20.75*	-21.95**	-3.03	-67.28**	-71.49**	-64.50**
L_5/T_3	3.66	3.13	3.13	29.66**	14.88**	14.88**	11.11	-24.24**	-24.24**	-48.05**	-50.00**	-50.00**
L_5/T_4	5.32**	4.21	3.13	60.00**	48.45**	33.95**	43.75**	15.00	-30.30**	-17.89**	-20.00**	-22.00**
L_6/T_1	1.57	0.00	1.04	16.48**	-4.65	-4.65	-26.92**	-45.71**	-42.42**	47.64**	33.65**	41.00**
L_6/T_2	2.62	1.03	2.08	22.35**	-0.90	1.86	-58.62**	-70.73**	63.64**	35.24**	14.06**	42.00**
L_6/T_3	-3.63	-4.12	-3.13	23.86**	1.40	1.40	-8.00	-30.30	-30.30**	64.96**	53.00**	53.00**
L_6/T_4	1.03	-1.03	0.00	38.97**	18.56**	6.98	-40.54**	-45.00**	-66.67**	72.68**	62.05**	58.00**
L_7/T_1	14.89**	14.89**	12.50**	52.97**	37.67**	37.67**	57.69**	17.14	24.24**	22.73**	15.17**	21.50**
L_7/T_2	17.02**	17.02**	14.58**	49.62**	33.03**	36.74**	-13.79	-39.02**	-24.24**	17.97**	2.81	28.00**
L_7/T_3	14.74*	13.54**	13.54**	31.27**	18.14**	18.14**	24.00**	-6.06	-6.06	-23.12**	-26.00**	26.00**
L_7/T_4	21.93**	21.28**	18.75**	15.85**	9.28	-1.40	67.57**	55.00**	-6.06	-30.53**	-32.31**	-34.00**
L_8/T_1	10.05**	9.47**	8.33**	22.83**	8.84	8.84	-47.43**	-57.14**	-54.55**	-35.82**	-38.86**	-35.50**

L_8/T_2	11.11**	10.53**	9.38**	21.96**	6.79	9.77	35.48**	-51.22**	-39.39**	-44.55**	-51.00**	-39.00**
L_8/T_3	2.62	2.08	2.08	19.69**	6.05	6.05	3.70	-15.15	-15.15	-25.32**	-27.00**	-27.00**
L_8/T_4	9.57**	8.42**	7.29**	51.11**	40.21**	26.51**	31.71**	28.57	-18.18	-32.64**	-33.33**	-35.00**
L_9/T_1	11.58**	10.42**	10.42**	-22.81**	-28.37**	-28.37**	-38.98**	-48.57**	-45.45**	11.79**	11.27**	18.50**
L_9/T_2	10.53**	9.38**	9.38**	-16.05**	-23.08**	-20.93**	-20.00**	-36.59**	-21.21*	-9.09**	-15.66**	5.00
L_9/T_3	8.33**	8.33**	8.33**	-30.83**	-35.81**	-35.81**	-36.84**	-45.45**	-45.45**	21.55**	17.84**	25.50**
L_9/T_4	13.23**	11.46**	11.46**	24.87**	21.65**	9.77	-50.00**	-54.17**	-66.67**	26.47**	21.13**	29.00**
L_{10}/T_1	12.90**	11.70**	9.38**	41.29**	32.09**	32.09**	35.45**	20.00*	27.27**	27.52**	23.56**	39.00**
L_{10}/T_2	11.83**	10.64**	8.33**	43.14**	32.13**	35.81**	-5.55	-21.95**	-3.03	-16.46**	-20.48**	-1.00
L_{10}/T_3	10.64**	8.33**	8.33**	44.28**	34.88**	34.88**	-13.33	-21.21*	-21.21*	10.12**	4.00	17.00**
L_{10}/T_4	14.59**	13.98*	10.42**	43.83**	41.24**	27.44**	36.17**	18.52	-3.03	-2.38	-8.89*	2.50

Table 1 Continues …………

Hybrids	Capsule length (cm)			Number of seeds per capsule			1000 seed weight			Seed yield plant^{-1}		
	RH	HB	SH	RH	HB	SH	RH	HB	SH	RH	HB	SH
L_1/T_1	4.76	2.67	2.67	9.36	-8.18	-12.57	4.00	4.00	-4.88	23.10**	-13.38**	5.50
L_1/T_2	-1.39	-1.39	-5.33	11.52	-6.83	-10.18	28.77	25.33	14.63	-28.64**	-52.33**	-29.67**
L_1/T_3	2.04	0.00	0.00	26.55**	4.19	4.19	47.77	41.46	41.46	-48.17**	-61.23**	-61.23**
L_1/T_4	10.20**	8.00*	8.00*	30.33**	16.91	-4.79	17.57	16.00	6.10	-12.70*	-32.30**	-39.07**
L_2/T_1	16.67**	-20.00*	-20.00**	54.19**	50.31**	43.11**	35.90	30.86	29.27	-44.37**	-61.30**	-52.87**
L_2/T_2	-3.55	-5.56	-9.33**	26.92**	22.98**	18.56**	7.89	1.23	-0.00	-36.07**	-57.70**	-37.60**
L_2/T_3	12.50**	8.00*	8.00*	66.04**	58.08**	58.08**	46.01	45.12	45.12	-48.26**	-61.80**	-61.80**
L_2/T_4	9.72**	5.33	5.33	26.83**	20.53**	8.98	62.34	54.32	52.44	6.54	-18.52**	-26.67**
L_3/T_1	4.58	2.56	6.67	-10.62	-11.18	-14.37	-10.34	-21.22	-4.88	-66.25**	-77.64**	-72.77**
L_3/T_2	0.00	-3.85	0.00	54.04**	54.04**	48.50**	-3.53	-17.17	-0.00	-52.16**	-69.66**	-55.23**
L_3/T_3	-5.88*	-7.69*	-4.00	48.78**	46.11**	46.11**	31.49	20.20	45.12	-43.17**	-60.33**	-60.33**
L_3/T_4	-8.50**	-10.26**	6.67	58.25**	45.96**	40.72**	13.95	-1.01	19.51	-56.64**	-68.78**	-71.90**
L_4/T_1	8.72**	8.00*	8.00*	2.58	0.00	-4.72	17.51	-28.43	-10.98	44.28**	-1.01	20.57**
L_4/T_2	1.37	0.00	-1.33	-17.31**	-19.88*	-22.75**	24.86	-36.27	-20.73	-50.54**	-67.67**	-52.30**
L_4/T_3	-0.67	-1.33	-1.33	-10.06	-14.37	-14.37	-26.09	-33.33	-17.07	-49.95**	-63.63**	-63.63**
L_4/T_4	-4.70	-5.33	-5.33	-6.62	-11.26	-19.76**	2.86	-11.76	9.76	62.46**	22.15**	9.93*
L_5/T_1	1.94	-1.25	5.33	4.79	3.14	-1.80	72.57	51.00	84.15	-49.47**	-59.22**	-50.73**
L_5/T_2	-1.32	-6.25	0.00	32.70**	29.81**	25.15**	70.76	46.00	78.05	-34.99**	-51.02**	-27.73**
L_5/T_3	4.52	1.25	8.00*	5.92	1.80	1.80	-14.29	-22.00	-4.88	-66.13**	-70.40**	-70.40**
L_5/T_4	-4.52	-7.50*	-1.33	14.48*	7.79	-0.60	-7.51	-20.00	-2.44	-55.22**	-59.00**	-63.10**
L_6/T_1	-5.41*	-6.67	-6.67	13.50*	10.78	10.78	37.80	26.97	37.80	-9.20*	-30.82**	-15.73**
L_6/T_2	-20.07	-2.74	-5.33	40.85**	38.32**	38.32**	12.50	1.12	9.76	-35.52**	-53.82**	-31.87**
L_6/T_3	4.05	2.67	2.67	-7.78	-7.78	-7.78	12.28	7.87	17.07	25.07**	2.43	2.43
L_6/T_4	1.35	0.00	0.00	-19.47**	-26.95**	-26.95**	18.52	7.87	17.07	-3.51	-17.56**	-25.80**
L_7/T_1	-1.33	-1.33	-1.33	-8.14	-14.59*	-5.39	21.79	17.28	15.85	12.17**	-18.50**	-0.73
L_7/T_2	6.12*	4.00	4.00	12.72*	5.41	16.71*	42.11	33.33	31.71	6.31	-26.95**	7.77
L_7/T_3	5.33*	5.33	5.33	14.77**	9.19	20.96**	69.33	68.29	68.29	53.05**	18.77**	18.77**
L_7/T_4	1.33	1.33	1.33	-7.17	-19.46**	-10.78	98.70	88.89	86.59	40.82**	13.59*	2.23
L_8/T_1	4.00	4.00	4.00	-14.29*	-18.64**	-13.77	15.23	14.47	6.10	7.96	-21.70**	-4.63
L_8/T_2	14.29**	12.00**	12.00**	-32.54**	-35.59**	-31.74**	231.97**	221.05*	197.56	-3.62	-33.89**	-2.47
L_8/T_3	-1.33	-1.33	-1.33	-23.26**	-25.42**	-20.96**	97.47	90.24	90.24	39.26**	7.83	7.83
L_8/T_4	-6.67*	-6.67	-6.67	2.24	-9.60	-4.19	85.23	81.58	68.29	-3.36	-22.22**	-30.00**
L_9/T_1	5.33*	5.33	5.33	38.29**	26.70**	44.91**	70.89	62.65	64.63	8.07*	-4.21	16.67**
L_9/T_2	6.12*	4.00	4.00	44.89**	33.51**	52.69**	2.60	-4.82	-3.66	-4.54	-21.83**	15.33**
L_9/T_3	-2.67	-2.67	-2.67	24.02**	16.23*	32.93**	-1.82	-2.41	-1.22	3.45	0.40	0.40
L_9/T_4	-20.00**	-20.00**	-20.00**	2.75	-12.04	0.60	189.74*	172.29	175.61	47.31**	44.10**	35.60**
L_{10}/T_1	-11.26**	-11.84*	-10.67**	-18.45**	-22.60**	-17.96*	422.67**	422.67*	378.05**	-27.33**	-32.68**	-18.00**
L_{10}/T_2	0.00	-2.63	-1.33	6.51	1.69	7.78	631.51**	612.00**	551.22**	-17.82**	-29.98**	3.30
L_{10}/T_3	0.66	0.00	1.33	26.16**	22.60**	29.94**	552.23**	524.39**	524.39**	20.05**	17.81**	22.37**
L_{10}/T_4	-0.66	-1.32	0.00	-14.38*	-24.29**	-19.76**	637.84**	628.00**	565.85**	4.06	-2.89	0.87

RH – Relative Heterosis
HB – Heterobeltiosis
SH – Strandard Heterosis

*Significant at 5 per cent level
**Significant at 1 per cent level

The main aim of estimation of heterosis in the present study was to find out the superior combinations of parents giving the high degree of useful heterosis for yield and its contributing characters and for its future use in breeding programme. The magnitude of heterosis was measured as per cent increase or decrease of F_1 value over better parent (heterobeltiosis) and over standard checks, Co1 for all eight characters. The character wise results of heterosis over better parent (BP) and over standard check are presented in (Table 2). The results revealed that the majority of hybrids for most of the traits viz., seed yield per plant, number of branches per plant, number of capsules per plant, and plant height and exhibited positive significant relative heterosis, thereby indicating that for these traits the genes with positive effects were dominant. Similar heterotic effects for different traits in sesame have been reported by [12-14].

The testing of performance of hybrids over better parent revealed that one hybrids manifested significant positive heterobeltiosis for seed yield per plant IVTS-24-06 x VRI-1 (44.10%). The hybrid IVTS-24-06 x VRI -1, IVTS-20-06 x TMV-4 and IVTS-20-06 x CO1 depicted high heterobeltiosis for 1000 seed weight, while hybrids IVTS-20-06 x CO1 (58.08%) and IVTS -20-06 x TMV-3 (50.31%) for the numbers of seeds per capsule [15-17]. In case of standard heterosis, seven hybrids manifested significant and desirable heterosis for seed yield per plant over the check variety.

The hybrid, IVTS-25-06/Co1 exhibited desirable standard heterosis for the five characters *viz*., plant height, number of capsules per plant, number of seeds per capsule and seed yield per plant. The hybrid AVTS-3-06/TMV3 exhibited desirable standard heterosis for three characters *viz*., number of capsules per plant, capsule length, seed yield per plant and IVTS-15-07/CO1 for days to 50 per cent flowering, plant height, number of seed per capsules. Whereas the hybrid IVTS-25-06/TMV3 exhibited desirable standard heterosis for plant height, number of branches per plant, number of capsules per plant and 1000 seed weight.

CONCLUSIONS

From the above discussion, it can be concluded that three crosses, AVTS-3.06/TMV3, IVTS-15-07/CO1, IVTS-25-06/CO1 and IVTS-25-01TMV3 found to be most promising crosses for seed yield and other desirable traits, hence these hybrids could be evaluated further to exploit the heterosis after identifying suitable hybrid seed production technology and in future breeding programme by utilizing biparental mating or recurrent selection breeding approaches to obtain desirable segregants for development of further superior genotypes for seed yield and its component traits.

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