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Heterosis in *Sesamum indicum* L.

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Abstract: The aim of the present study was to develop superior hybrids for yield and its yield components in *Sesamum incicum* L. A field experiment was undertaken to study heterosis in sesame (*Sesamum indicum* L.) with objective of identifying superior hybrids for yield and yield components. The experiment was layed with five parents and F_1, F_2, F_3 in randomized block design with three replicates at Andhra university agriculture farm, Visakhapatnam. All the ten crosses realised positive, highly significant and relatively high standard heterosis compared to MP and BP heterosis in seed yield and yield components with desirable earliness in maturity. The cross X-79-1 X EC 351887 appeared best with highest heterosis for seed yield, branches, 1000 seed weight over standard parent TC-25. Genetic gain was negative in F_2 for branches, pods/plant, 1000 seed weight and seed yield was positive and highly significant in F_3 for these characters. V_m X X-79-1 is next best and gained desirable earliness and highly significant positive, high heterosis only for seed yield, short stature, pods/plant and primary branches. Heterobeltiosis was highly significant for these characters. Genetic gain was highest and highly significant in F_3 but was negative in F_2 for almost all the characters excepting seeds/pod. Crosses V_m X EC351887, V_m X EZ351881 and V_m X EC359007 also gained highly significant and very high desirable heterosis in seed yields. The realised heterosis and heterobeltiosis for other eight characters was also highly significant and was either moderate or low. Despite high heterosis, genetic gain in seed yields was marginal in F2 and highly significant in F_3 in V_m X EC359007 cross. The cross X-79-1 X EC 351887 showed promising performance with heterosis and highly significant genetic gain in F_2 and F_3 for seed yield and yield components and thus has high potential to utilize in selection programme.

Keywords: Genetic gain, heterosis, *Sesamum indicum* L., yield and yield components

INTRODUCTION

Gingelly is very much valued for its high quality oil as well as protein in the seed. It is used for edible as well as for no edible purposes like bakeries, cosmetics, medicine and various other industries. It is grown throughout the country and around the year with an annual production of about 7.9 lakh tonnes (Directorate of Economics and Statics, 2002).

Development of new stocks with wholesome desirable heterosis is the main aim of the plant breeder to meet with the above said multitude of demands. Knowledge on the genetic architecture of seed yield and various yield components is very important for understanding the feasibility for releasing desirable heterosis.

The vast amount of literature to date from the early of literature to date from 1960s in Sesame is based on diallel and line x tester experiments, indicated although indirectly the operation of additive as well as non-additive factors on seed yield and almost all the yield components (Das and Samanta, 1998; Das and Gupta, 1999; Kamala, 1999; Ragiba and Reddy, 2000; Torpore, 2008).

In self pollinated crops there is great difficulty in producing large quantities of seeds. So there is a urgent need to exploit heterosis in the highly self pollinated crop sesamum for seed yield and other yield components by making all possible crosses involving the available germplasm. Therefore, the present investigation was carried to evaluate five genotypes for heterosis.

MATERIALS AND METHODS

The five *Sesamum indicum* L. lines are V_m, X-79-1 (developed in our research laboratory), EC351887, EC359007, EZ351881 (supplied from NBPGRI, PKV campus, Akola), which were not studied so far were involved as parents for developing ten crosses at Andhra university agriculture farm, Visakhapatnam Andhra Pradesh, India. The five parents, F_1, F_2, F_3 were grown in randomized block design with three replicates during kharif 2004. Seeds were sown in 80×80 feet size

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Table 1: Percent proportion of heterosis and genetic gain for seed yield and seven yield components in ten crosses of *Sesamum indicum* L.

	Days to maturity					Plant height				
	Heterosis			Genetic gain		Heterosis			Genetic gain	
Crosses	MP	BP	SP	F_2	F_3	MP	BP	SP	F_2	F_3
V_m × EC351887	10.71**	21.56**	-21.50**	-	-	-26.50**	-31.04**	24.67**	17.50	-15.20**
V_m × EZ351881	-14.04**	-7.54*	37.97**	-	-	-33.06**	-34.22**	18.92*	51.50	-27.39**
V_m × X-79-1	-23.74**	-13.11**	-32.91**	-	-	3.50	-18.66**	47.12**	9.10	-25.51**
V_m × EC359007	-8.52**	-3.27	-25.31**	-	-	29.05**	-29.74**	27.02**	3.03	4.48
X-79-1 × EC351887	0.77	27.45**	-17.72**	-	-	26.28**	12.70**	78.46**	-2.12	-20.44**
X-79-1 × EC359007	-23.28**	-17.64**	-29.11**	-	-	-30.71**	-41.05**	4.44	-16.88	46.16**
X-79-1 × EZ351881	-26.72**	-9.43**	-39.24**	-	-	-13.23**	-25.73**	29.63**	-3.63	23.82**
EC359007 × EC351887	-14.28**	0.00	35.44**	-	-	-9.18*	-14.00**	52.35**	25.7	-17.72**
EC359007 × EZ351881	-9.09**	3.77	-30.37**	-	-	-13.01**	-13.78**	52.74**	10.94	-16.17**
EC351887 × EZ351881	-11.53**	-9.80**	-41.77**	-	-	0.87	2.90	67.80**	-39.91	0.00
**Cd at .01	8.28	8.81	8.09	-	-	12.25	11.96	23.82	546.48	13.13
*Cd at .05	5.76	6.12	5.62	-	-	8.52	8.31	16.56	380.76	9.13
	Secondary branches					Pods/plant				
V_m × EC351887	0.00	0.00	0.00	-70.27**	-18.18	-1.03	-6.54	84.76**	-17.82*	-9.62
V_m × EZ351881	-55.10	-77.55**	-70.27**	-100.00**	0.00	-39.61*	-49.71**	49.38**	23.58**	-11.33
V_m × X-79-1	2.60	-48.72**	-45.94**	-20.00	-18.75*	136.50**	13.61	111.54**	-5.81	-28.00**
V_m × EC359007	-28.57	-64.28**	-59.46**	-100.00**	0.00	-7.43	-7.46	83.08**	0.84	35.08**
X-79-1 × EC351887	320.51**	100.25**	121.62**	-70.73**	16.66	48.76**	40.44**	117.84**	-35.22**	-7.09
X-79-1 × EC359007	-40.74	-42.86**	-35.14**	-8.33	68.18**	-7.46	-7.46	83.08**	-31.34**	68.29**
X-79-1 × EZ351881	-100.00**	-100.00**	-100.00**	0.00	-34.78**	-0.28	-40.29**	77.38**	-1.82	-8.48
EC359007 × EC351887	-38.09	-69.04**	-64.86**	30.76*	29.41**	4.56	4.58	106.92**	-11.82	10.87
EC359007 × EZ351881	-36.26	-43.50**	-21.62	20.68	-40.00**	-27.26	39.41**	80.00**	24.02**	-5.51
EC351887 × EZ351881	-100.00**	-100.00**	-100.00**	0.00	-78.37**	-50.28**	-60.44	17.54	65.84**	-36.85**
**Cd at .01	96.29	34.45	39.02	40.65	26.91	42.70	21.67	42.9	20.50	20.67
*Cd at .05	66.96	23.95	27.14	28.27	18.71	31.01	15.07	29.83	13.94	14.37
	1000 seed weight					Seed yield/plant				
V_m × EC351887	17.03	-33.33**	-44.05**	31.25**	5.00**	54.09**	25.40	16.89**	5.70	14.13
V_m × EZ351881	29.41*	-8.33	-22.37**	-9.09	-10.00**	103.60**	65.12**	55.63**	3.76	-3.20
V_m × X-79-1	-37.70*	-41.60**	-51.04**	57.14**	-4.54**	130.86**	109.44**	50.45**	-11.76*	125.97**
V_m × EC359007	23.07	0.00	-16.08*	12.50*	-7.40**	85.92**	62.04**	27.58**	17.38**	43.13**
X-79-1 × EC351887	84.21**	66.66**	22.37**	-14.28*	6.66**	97.91**	75.21**	63.33**	-12.66**	17.48
X-79-1 × EC359007	111.11**	80.95**	32.86**	-7.89	2.85	22.74	17.37	7.58	0.99	7.75
X-79-1 × EZ351881	2.20	45.45**	-39.13**	11.88*	13.33**	-6.25	-1.34	-7.01	3.09	9.71
EC359007 × EC351887	81.25**	70.58**	1.39	6.89	7.40**	14.43	5.54	1.61	38.78**	10.77
EC359007 × EZ351881	57.89**	30.43**	4.89	-6.66	3.57**	19.68	9.75	3.44	-1.60	4.87
EC351887 × EZ351881	15.00	0.00	-19.58**	21.73**	10.71**	-20.49	-20.97	-25.51**	14.96**	37.58*
**Cd at .01	37.01	29.96	16.73	16.57	3.46	46.50	37.31	23.62	11.66	38.18
*Cd at .05	25.74	20.83	11.63	11.52	2.39	33.77	25.94	16.43	8.11	26.55

Table 1: (Continue)

	Primary branches					Seeds/pod				
	Heterosis			Genetic gain		Heterosis			Genetic gain	
Crosses	MP	BP	SP	F_2	F_3	MP	BP	SP	F_2	F_3
V_m × EC351887	18.64	-10.26	59.09*	-28.57	8.57	-45.39**	-49.72**	-	44.50**	1.82
V_m × EZ351881	-30.43	-58.97**	-27.27	87.50**	10.00	-35.29**	-45.97**	-	47.72**	0.00
V_m × X-79-1	96.20**	20.00	118.18	2.00	-22.44**	29.25**	0.49	-	-12.42	22.38
V_m × EC359007	6.97	-2.13	52.17	-30.43	37.50	-19.18**	-38.09**	-	2.92	5.67
X-79-1 × EC351887	133.33**	75.00**	218.20**	-47.14*	-5.40	-25.43**	-45.30**	-	4.04	-6.79
X-79-1 × EC359007	45.00**	2.13	118.18**	-29.16	32.35**	32.02**	29.28**	-	-8.92	-11.55
X-79-1 × EZ351881	6.50	2.50	86.40**	-21.95	12.50	10.86**	1.35	-	-11.00	-0.54
EC359007 × EC351887	-25.73	-46.80*	13.64	220.00**	-53.75**	-20.23**	-42.27**	-	52.15**	-35.80**
EC359007 × EZ351881	-26.19	-34.04*	40.90	77.41**	-16.36*	-27.26**	-39.41**	-	76.60**	25.28**
EC351887 × EZ351881	-22.80	-150.00**	0.00	68.18**	-59.45**	-32.51**	-47.24**	-	-10.21	0.29
**Cd at .01	44.44	47.64	64.12	63.66	19.79	9.88	18.82	-	26.55	12.93
*Cd at .05	29.51	33.13	44.58	44.27	13.76	6.87	13.08	-	18.46	8.99

plot, in individual lines with 15×30 cm. spacing with not less than 50 plants/line. Ten plants in each replication at the middle of the row were selected at random in each genotype and observations were recorded on yield and yield related characters. The extent of heterosis over Mid-Parent (MP), Better Parent (BP) and Standard Parent (TC-25) (SP) were estimated. Heterosis over MP, BP and SP were calculated following Singh and Chaudhary (1979).

RESULTS AND DISCUSSION

The amount of heterosis actually realized was calculated for the eight characters (i.e., days to maturity, plant height, primary branches, secondary branches, pods/plant, seeds/pod, 1000 seed weight and seed yield/plant) as the percent proportion of enhancement of the F1 over the MP, BP and SP (National check TC-25). Excellence of any cross combination in F_1 if follows in F_2 & F_3 as well indicates the real improvement achieved in newly developed stocks fulfilling the objectives of the experiment.

Data relating to number of crosses showing negative and positive heterosis (MP), heterobeltiosis (BP), standard heterosis (SP) together with genetic gain in F_2 and F_3 for eight characters are presented in Table 1.

All the ten crosses realized positive, highly significant and relatively high standard heterosis compared to MP and BP heterosis in seed yield and yield components with desirable earliness in maturity.

Of the ten crosses, the cross X-79-1 X EC351887 appeared best and top ranking by scoring highly significant desirable high positive component heterosis in seed yield and three yield components, branches (primary and secondary), 1000 seed weight and moderate heterosis in pods/plant with significant earliness in maturity over standard parent TC-25. Heterosis in height is low although significant and negative, highly significant for seeds/pod. The genetic gain in F_2 although negative for branches, pods/plant, 1000 seed weight and seed yield/plant was positive and highly significant in F_3 for these characters excepting pods/plant and seeds/pod.

Cross V_m X X-79-1 is next best and gained desirable earliness and highly significant positive, high heterosis only for seed yield, short stature, pods/plant and primary branches. Heterobeltiosis was highly significant for these characters. Genetic gain was highest and highly significant in F_3 but was negative in F_2 for almost all the characters excepting seeds/pod.

The three crosses V_m X EC351887, V_m X EZ351881 and V_m X EC359007 also gained highly significant and very high desirable heterosis in seed yields. The realized heterosis and heterobeltiosis for other eight characters was also highly significant and was either moderate or low. Despite high heterosis, genetic gain in seed yields was marginal in F2 and highly significant in F_3 in third cross.

The rest of the crosses did not appear promising in view of moderate or low heterosis being negative non significant even where marginally positive.

Differences observed in high heterotic levels variation may be due to differences in the genotypes used in experiments but also owing to the agro climatic conditions of the experiment with particular reference to soil type, plant spacing and the epistatic gene action in the hybrids which can be either increase or decrease the expression of heterosis (Hayman, 1958).

A similar logic can be extended to the differences observed in magnitude and direction of heterosis either MP, BP, SP and genetic gain in the individual experiments of the several earlier reports (Navavidya *et al*., 1995; Fatteh *et al*., 1995; Kumar, 1996; Gamechu and Bulchawoyessa, 1997; Padmavathi, 1998; Alam *et al*., 1999; Kumar *et al*., 2002; Singh *et al*., 2005; Yadav *et al*., 2005; Torpore, 2008) and of the present experiment.

CONCLUSION

A perusal of the results discussed so far pointed out that out of ten cross the cross X-79-1 X EC351887 showed promising performance with heterosis and positive and highly significant genetic gain in F_2 and F_3 for seed yield and yield components.

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