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HETEROSIS IN RELATION TO COMBINING ABILITY IN SESAME

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ABSTRACT

The performance of 36 hybrids of *Sesamum indicum* L. involving cultivars of diverse origin was studied to estimate heterosis for seed yield and other component characters. The midparental (MP) and better parent (BP) heterosis for seed yield ranged from –91.9 to 76.3% and –47.1 to 72.5%, respectively. Out of 36, 19 hybrids showed significant positive heterosis over the corresponding BP for seed yield. Significant heterosis for all the other components (except for plant height and per cent oil), the highest magnitudes being from seed yield on secondaries, seed yield on primaries and seed yield on main stem was also observed, indicating their contribution towards seed yield heterosis. Crosses, R 84-4-2 x VS 16 and RT 54 x VS 16, involving high general combining parents, manifested very high and significant heterosis and sca effects for seed yield, and are useful for exploiting hybrid vigour.

Key words : Sesame, heterosis, general combiners, sca effect.

Plant breeders have extensively explored and utilized heterosis in enhancing the yield in a number of crops. Heterosis of varying degree for seed yield and other traits in sesame has been reported [1–9]. Further exploitable heterosis also depends on general combining ability (gca) and specific combining ability (sca) and the breeding procedure adopted. The importance of nonadditive gene action for seed yield and seed components was also reported earlier [10–14]. In the present study, heterosis for seed yield and its component traits in relation to gca and sca are discussed.

MATERIALS AND METHODS

Nine varieties of sesame viz., Madhavi, Rauss 17-4, X-198, RT 54, Gouri, B 9, R 84-4-2, VS 16 and R 84-360-3 were crossed in a 9 x 9 diallel mating design (excluding reciprocals) during kharif, 1988. The 36 resulting hybrids along with parents were grown in a

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randomized block design with three replications during Rabi, 1989 with a spacing of 40 x 15 cm in a single row of 4.05 cm length. Observations were recorded on ten competitive plants from each entry in each replication for nine quantitative traits. Heterosis over midparent (MP) and better parent (BP) was estimated as per usual procedure and its significance was tested as per Wynne et al. [15] and combining ability analysis was done as per Griffing Model 1, Method 2 [16].

RESULTS AND DISCUSSION

Significant differences existing among treatments for all the characters studied. Higher magnitude of significant and desirable BP heterosis (> 45%) was observed for all characters except for plant height (14.7%) and oil content (3.8%), the highest being for seed yield on secondaries (125.8%), followed by seed yield on primaries (106.0%). For seed yield/plant, maximum BP heterosis observed was 62.5% (RT 54 x VS 16). Swaminathan et al. [17] reported that heterosis of 20-50% over BP for seed yield could offset the cost of hybrid seed. High heterosis for all the characters except for 1000-seed weight, the highest being for capsules/plant closely followed by seed yield/plant has been reported [3, 9]. In the present study, number of hybrids with significant economic heterosis over BP were more for seed yield/plant, seed yield on primaries and 1000- seed weight, while less for plant height, number of primaries, capsules/plant and per cent oil. Mean BP heterosis was positive and maximum for seed yield on primaries (10.0%), followed by seed yield/plant (5.7%), seed yield on secondaries (4.0%) and plant height (1.9%), while it was negative for rest of the traits studied.

The performance of the crosses was compared on the basis of heterotic response and sca effects. The five best crosses selected on the basis of heterotic response, sca effects for seed yield and its components are presented in Table 1. A perusal of the observations shows that, in general, the heterotic response reflected in sca effects also since they were selected separately on the basis of their heterotic and sca effects. This indicates that ranking on the basis of heterotic response and sca effects was not different, which means that selection of crosses may be practiced on the basis of either heterotic or sca effects or both. These observations contradict with those of [9] who observed differences in heterotic and sca effects of the crosses. This might be due to the differences in the genetic make up of the material utilized in these two studies. It is evident that the crosses, X-198 x RT 54 for plant height, R 84-4-2 x V 16 for secondaries/plant and seed yield/plant, B 9 x R 84-360-3 for seed yield on main stem, RT 54 x VS 16 for seed yield on primaries and seed yield/plant and B 9 x R 84-4-2 for 1000-seed weight, were the combinations of high x high general combiners that produced high sca effects indicating the predominance of additive x additive gene interaction in these crosses for the respective traits; whereas all other top ranking hybrids were the combinations of high x low, low x high or low x low general combiners. This

Table 1. Best five crosses of sesame based on heterotic response and sca effects with gca effects of the parents involved (in parentheses)

Character	Heterosis	Sca effects
Plant height	RT 54 x R 84-360-3 (H x L)	RT 54 x R 84-360-3 (H x L)
	X-198 x RT 54 (H x H)	RT 54 x B 9 (H x L)
	X-198 x Gouri (H x L)	X-198 x Gouri (H x L)
	RT 54 x B 9 (H x L)	X-198 x RT 54 (H x H)
	Rauss 17-4 x R 84-360-3 (L x L)	Rause 17-4 x X-198 (L x H)
Primaries per plant	R 84-4-2 x VS 16 (L x H)	R 84-4-2 x VS 16 (L x H)
	Madhavi x VS 16 (L x H)	Madhavi x VS 16 (L x H)
	Rauss 17-4 x X-198 (L x L)	Rauss 17-4 x X-198 (L x L)
	Rauss 17-4 x VS 16 (L x H)	Rauss 17-4 x VS 16 (L x H)
	Rauss 17-4 x B 9 (L x L)	X-198 x RT 54 (L x H)
Secondaries per plant	Rauss 17-4 x Gouri (L x L)	B 9 x R 84-360-3 (L x H)
	Madhavi x B 9 (L x L)	Madhavi x VS 16 (L x H)
	R 84-4-2 x VS 16 (H x H)	R 84-4-2 x VS 16 (H x H)
	X-198 x VS 16 (L x H)	Rauss 17-4 x Gouri (L x L)
	Madhavi x VS 16 (L x H)	X-198 x VS 16 (L x H)
Capsules per plant	Rauss 17-4 x X-198 (L x L)	Madhavi x B 9 (L x L)
	X-198 x R 84-4-2 (L x H)	Rauss 17-4 x X-198 (L x L)
	Madhavi x B 9 (L x L)	X-198 x RT 54 (L x L)
	B 9 x R 84-4-2 (L x H)	Gouri x R 84-360-3 (H x H)
	X-198 x RT 54 (L x L)	Rauss 17-4 x R 84-4-2 (L x H)
Seed yield on main stem	R 84-4-2 x R 84-360-3 (H x H)	R 84-4-2 x R 84-360-3 (H x H)
	R 84-4-2 x VS 16 (H x L)	R 84-4-2 x VS 16 (H x L)
	RT 54 x VS 16 (L x L)	Rauss 17-4 x X-198 (L x L)
	B 9 x R 84-360-3 (H x H)	B 9 x R 84-360-3 (H x H)
	X-198 x R 84-4-2 (L x H)	RT 54 x VS 16 (L x L)
Seed yield on primaries	RT 54 x VS 16 (H x H)	R 84-4-2 x VS 16 (H x H)
	Madhavi x RT 54 (L x H)	Rauss 17-4 x R 84-360-3 (L x H)
	Madhavi x VS 16 (L x H)	RT 54 x R 84-4-2 (H x H)
	Rauss 17-4 x X-198 (L x L)	RT 54 x VS 16 (H x H)
	X-198 x RT 54 (L x H)	Madhavi x VS 16 (L x H)
Seed yield on secondaries	Madhavi x VS 16 (L x H)	Madhavi x VS 16 (L x H)
	Madhavi x B 9 (L x L)	B 9 x R 84-4-2 (L x H)
	Rauss 17-4 x X-198 (H x L)	Rauss 17-4 x X-198 (H x L)
	X-198 x RT 54 (L x L)	X-198 x RT 54 (L x L)
	Rauss 17-4 x Gouri (H x L)	Rauss 17-4 x Gouri (H x L)

(Contd.)

Table 1 (contd.)

Character	Heterosis	Sca effects
1000-seed weight	B 9 x R 84-4-2 (H x H)	B 9 x R 84-4-2 (H x H)
	Rauss 17-4 x B 9 (L x H)	Madhavi x R 84-360-3 (H x L)
	B 9 x R 84-360-3 (H x L)	Gouri x R 84-4-2 (H x H)
	VS 16 x R 84-360-3 (L x L)	Madhavi x Rauss 17-4 (H x L)
	Madhavi x R 84-4-2 (H x H)	VS 16 x R 84-360-3 (L x L)
Oil content	Madhavi x Gouri (H x L)	B 9 x R 84-4-2 (L x L)
	Madhavi R 84-360-3 (H x H)	RT 54 x B 9 (H x L)
	Gouri x R 84-360-3 x H x H)	X-198 x RT 54 (H x H)
	VS 16 x R 84-360-3 (L x H)	Gouri x VS 16 (L x L)
	Rauss 17-4 x Gouri (L x L)	Rauss 17-4 x Gouri (L x L)
Seed yield/plant	RT 54 x VS 16 (H x H)	R 84-4-2 x VS 16 (H x H)
	Madhavi x VS 16 (L x H)	Rauss 17-4 x X-198 (L x L)
	R 84-4-2 x VS 16 (H x H)	Madhavi x VS 16 (L x H)
	Rauss 17-4 x X-198 (L x L)	Rauss 17-4 x R 84-360-3 (L x H)
	Madhavi x RT 54 (L x H)	RT 54 x VS 16 (H x H)

H—high, L—low general combiners.

indicated that gene interaction for the crosses exhibiting highest heterosis for most of the traits was accountable to additive x dominance and dominance x dominance types of gene effects, which was also observed by [18].

Crosses showing highest positive heterosis for seed yield in comparison to the best parent and their performance interms of heterosis, gca effects of parents and heterosis for component traits are presented in Table 2. The five best hybrids selected for their higher mean values for seed yield over the best parent exhibited highly significant and positive heterosis for seed yield/plant, highly significant and positive sca effects and represented all possible combinations of high x high, low x high and low x low general combiners; indicating all three types of gene interaction effects, i.e., additive x additive, additive x dominance and dominance x dominance, respectively. The two crosses, R 84-4-2 x VS 16 and RT 54 x VS 16 were the best hybrids involving high x high general combiners and are capable of giving maximum transgressive effects. The former cross also possessed significant heterosis for seven other component characters in addition to seed yield, excepting for plant height and oil per cent. The considerable proportion of additive genetic variance available for several of the traits including seed yield in these two crosses may profitably be exploited by adopting pedigree breeding and selection. The cross Rauss 17-4 x X-198 expressed high MP heterosis (76.4%) and was a combination of low x low general

Table 2. Best heterotic crosses of sesame for seed yield and their performance in related parameters

Cross	Yield per plant (g)	Heterosis %		Sca effects	Gca effects		Significant heterosis for
		MP	BP		P_1	P_2	
Rauss 17-4 x X-198	15.7	76.3	57.5	4.77**	-0.91*	-0.77**	All traits
RT 54 x VS 16	17.4	73.0	62.5	3.49**	0.19**	1.08**	Seed yield on mainstem, primaries, secondaries, and 1000-seed weight
R 84-4-2 x VS 16	21.5	71.7	50.0	7.02**	0.77**	1.08**	All traits except plant height
Madhavi x VS 16	17.3	70.4	61.5	4.50**	-0.92**	1.08**	All traits except plant height
X-198 x VS 16	15.0	61.4	39.9	2.03**	-0.77**	1.08**	All traits except plant height and 1000-seed weight
Best parent (R 84-360-3)	14.8						

combiners only. This cross also showed significant heterosis for all the other traits except for per cent oil. The other two crosses, i.e., Madhavi x VS 16 and X-198 x VS 16 were the combinations of low x high general combiners which also registered significant heterosis for seven and six other related traits, respectively. Heterosis for seed yield in these 5 best hybrids was accompanied by heterosis for all other characters (except plant height and oil content), the highest magnitude of contribution being from the components of seed yield, i.e., seed yield on main stem, seed yield on primaries and secondaries. In the crosses in which additive x dominance and dominance x dominance gene interactions are involved, simultaneous exploitation of both additive and dominance genetic variances be done by following inter se crossings in all possible combinations among the selects in the segregating populations and subjecting to recurrent selection followed by pedigree method of breeding.

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