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HETEROSIS IN SESAME

B. S. JADON* AND H. N. MEHROTRA

Rajasthan College of Agriculture,
Udaipur 313001

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ABSTRACT

The performance of 76 hybrids of *Sesamum indicum* L., involving 23 varieties/lines of diverse origin was studied to investigate midparent (MP) and better parent (BP) heterosis for seed yield and six other component characters over three environments. The MP and BP heterosis for seed yield ranged from 38.99 to 130.68% and 48.38 to 118.77%, respectively. Out of 76 hybrids, 36 showed significant positive heterosis over the corresponding BP for seed yield. Significant heterosis for other component characters, such as, capsules/plant, branches/plant, seeds/capsule, 1000-seed weight, plant height, and days to flowering was also observed, indicating their contribution towards seed yield. Crosses Type 85 × C 2 and Sel R × Type 10 involving high general combining parents, exhibited very high heterosis and sca effects for seed yield, and thus, need exploitation for developing high yielding lines.

Key words: Sesame, heterosis, combining ability.

Plant breeders have extensively explored and utilized heterosis in enhancing the yield in a number of crops. Information on the magnitude and direction of heterosis in sesame is meagre. Heterosis of varying degree for seed yield and other traits in sesame has been reported [1–3]. The present study has assessed the extent of heterosis for seed yield and its components over three environments in a 19 × 4 line–tester set and related heterosis to gca and sca effects.

MATERIALS AND METHODS

Nineteen lines/varieties of sesame, viz., IS 161, Sel R, Til No. 1, N 62-39, N 62-141, N 50-2, Sumerpur Local, Limbdi 9, Patan 64, Type 13, Type 85, Type 4, B 45, M 3-1, ES 107, ES 179, ES 73, ES 205 and ES 350 and four testers (TC 30, C 2, Type 10 and ES 380) were crossed in line × tester mating design. The 76 resulting hybrids along with their 23 parents were grown in a randomized block design with three replications each at three locations, i.e., Udaipur, Sumerpur in District Pali (Rajasthan), and Baghora in District Bhind (Madhya Pradesh). Each treatment comprised a row of 5 m length with 45 cm between spacing and 20 cm

*Present address: Wheat Research Station, Gujarat Agricultural University, Vijapur, Dist. Mehsana, Gujarat 382 870.

within rows. Observations were recorded on 10 competitive plants from each plot for seven quantitative traits. Heterosis over midparent (MP) and better parent (BP) was calculated over the environments as per standard procedure. Combining ability analysis was based on the procedure developed by Kempthorne [4].

RESULTS AND DISCUSSION

The mean squares for variation among genotypes, parents, and hybrids were significant for all the characters studied (Table 1). Variation due to parents v. hybrids comparison were highly significant for all the characters, indicating presence of heterotic response. The significant mean squares due to environment × parents, environment × hybrids and environment × parents v. hybrids points to the desirability of assessing heterotic responses over a wide range of environmental conditions.

Table 1. Analysis of variance for the experiment

Source of variation	d.f.	Days to flowering	Plant height	Branches per plant	Capsules per plant	Seeds per capsule	1000-seed weight	Seed yield per plant
Environments (E)	2	2342.2**	173.2*	320.6**	38676.1**	3238.2**	8.7	428.0**
Treatments (T)	98	98.1*	667.8**	14.0**	8265.9**	169.0**	0.3**	105.4**
Parents (P)	22	208.6**	960.3**	23.8**	3014.7**	285.4**	0.3**	23.0**
Hybrids (H)	75	66.5**	527.9**	11.2**	8083.4**	133.9**	0.3**	100.5**
P v. H	1	38.8**	4723.3**	8.6**	137474.0**	240.4*	4.4**	2281.0**
E × T	196	8.4**	209.0**	1.6	1433.6**	65.6	0.1	17.9**
E × P	44	12.9**	178.9**	2.0*	1907.6**	67.7	0.1	17.5**
E × H	150	6.2*	219.1**	1.5	1311.1**	62.8	0.1	17.8**
E × P v. H	2	75.3**	118.3	1.6	195.0	233.2	0.3*	32.1**
Error	588	3.9	41.5	1.2	111.3	46.4	0.1	4.3
No. of crosses with significant economic heterosis	MP	27	48	20	44	11	28	57
	BP	14	64	7	35	3	9	36
Range of economic heterosis	MP	−17.3 to 15.7	−14.6 to 34.9	−38.5 to 58.0	32.9 to 141.1	−13.9 to 25.1	−7.6 to 14.4	−39.0 to 130.7
	BP	−13.8 to 24.5	−7.3 to 49.8	−56.5 to 36.6	−45.4 to 125.2	−23.3 to 21.9	−9.9 to 11.8	−48.4 to 118.8
Mean heterosis	MP	−0.8	12.1	3.4	44.3	4.5	4.2	48.7
	BP	5.4	20.7	−11.1	29.2	−2.7	1.2	35.3

Significant* at $p = 0.05$, ** at $p = 0.01$.

Heterosis was calculated as per cent increase or decrease over MP as well as corresponding BP. The heterosis over best cultivated variety was not calculated because different local varieties were under cultivation in the areas of experiment. The range of heterosis and number of crosses showing desirable heterotic response for the characters studied are presented in Table 1. Out of 76 crosses, 27 over MP and 14 over BP showed significant negative heterosis for days to flowering up to 17.3%. All the crosses involving TC 30 tester flowered earlier than their MP as well as respective BP. Out of 14 crosses showing negative BP heterosis for flowering time only cross TC 30 × Til No. 1 showed significant positive heterosis for seed yield.

For plant height, 48 hybrids over MP and 64 hybrids over BP showed positive heterosis. Of the 20 hybrids having more branches than MP, only 7 were superior to their corresponding BP. Crosses involving C 2 (highly branched) parent had more branches/plant. Heterosis for capsules/plant was to the extent of 141.2% over MP and 125.2% over BP with mean heteroses 44.3 and 29.2%, respectively. The magnitude of heterosis was higher in the crosses involving C 2. Crosses showing high BP heterosis also had the highest mean number of capsules/plant. For seeds/capsule and 1000-seed weight, heterosis was exhibited by a few crosses. Only three crosses showed BP heterosis for seeds/capsule, the highest being 25.1%. Heterosis up to 14.4% over MP and 11.8% over BP was recorded for 1000-seed weight. Out of 76

Table 2. Best four crosses selected for each character on the basis of heterotic response and sca effects along with gca effects of the parents involved (in parentheses)

Character	Heterosis	sca effects	Common cross
Days to flowering	ES 350 × TC 30 (A × H) Til No 1 × TC 30 (H × H) Sel R × TC 30 (L × H) ES 205 × TC 30 (L × H)	Sel R × TC 30 (L × H)	Sel R × TC 30
Plant height	IS 161 × Type 10 (A × L) ES 350 × Type 10 (H × L) Sumerpur local × Type 10 (H × L) Sumerpur local × TC 30 (H × L)	N 62-141 × C 2 (H × H) Sel R × C 2 (A × H) M 3-1 × ES 330 (H × H) ES 179 × TC 30 (L × L)	
Branches/plant	M 3-1 × ES 320 (H × L) M 3-1 × C 2 (H × H) ES 350 × C 2 (H × H) Limbdi 9 × C 2 (A × H)	M 3-1 × ES 320 (H × L) Sel R × TC 30 (A × A) N 58-2 × ES 380 (H × L) ES 350 × Type 10 (H × A)	M 3-1 × ES 320
Capsules/plant	Sel R × Type 10 (H × A) Sel R × ES 380 (H × L) Til No 1 × TC 30 (L × A) N 62-39 × Type 10 (H × A)	Til No. 1 × TC 30 (L × A) ES 179 × C 2 (A × H) B 34 × Type 10 (H × A) Type 85 × C 2 (H × H)	Til No. 1 × TC 30
Seeds/capsule	IS 161 × TC 30 (A × C) B 45 × ES 380 (A × A) ES 350 × TC 30 (A × A)	Non significant	
1000-seed weight	Type 13 × ES 380 (A × A) IS 161 × Type 10 (A × A) ES 179 × TC 30 (A × A) ES 350 × C 2 (A × A)	IS 161 × Type 10 (A × A)	IS 161 × Type 10
Seed yield/plant	IS 161 × ES 380 (A × A) Sel R × Type 10 (H × A) Til No 1 × TC 30 (A × L) S. local × ES 380 (H × A)	Til No. 1 × TC 30 (A × L) ES 179 × C 2 (L × H) Sel R × Type 10 (H × A) Type 25 × C 2 (H × H)	Til No. 1 × TC 30

H—high, A—average, and L—low general combiners.

hybrids, 36 had higher yield/plant than their corresponding BP. The heterosis ranged from –39.0 to 130.7% (MP) and –48.4 to 118.8% (BP). Maximum heterosis for this character was manifested in cross IS 161 × ES 380, though the cross had average yield potential. Cross C 2 × N 58-2 with the highest per se performance showed 78.0% BP heterosis. Crosses Til No. 1 × TC 30, Type 85 × C 2, Sumerpur Local × ES 380, B 45 × Type 10, N 62–141 × Type 10, and Sel R × Type 10 showed high heterosis coupled with high mean performance. Sarathe and Dabral [1] reported high heterosis for yield/plant (119.50%) and capsules/plant, and low heterosis for seeds/capsule and 1000-seed weight. Shrivas and Singh [3] observed that the magnitude of negative heterosis was higher than that of positive heterosis.

The performance of the crosses was compared on the basis of heterotic response and sca effect. The four best crosses selected on the basis of heterotic response and sca effects for yield and its components are presented in Table 2. A perusal of the table shows that only one cross was common in both comparisons for days to flowering, branches/plant, capsules/plant, 1000-seed weight, and seed yield/plant. This indicates that ranking on the basis of heterotic response and sca effect was different, though high sca effect denotes heterotic response. However, high heterosis over poor parents could result into different ranking. Also, with the same amount of heterosis the sca effect may be less where the per se performance of parents is higher. This means that selection of the crosses based on heterotic response would be more realistic than on the basis of sca effects.

The gca effects of parents involved in the crosses showing high heterotic response and sca effect are also presented in Table 2. It is evident that in cross Type 85 × C 2 for seed yield and capsules/plant, and N 62-141 × C 2 and M 3-1 × ES 380 for plant height, the high × high general combiners produced high sca effects, whereas all other top ranking crosses were combinations of high × low, average × average, average × low, or low × low general combiners. This indicated

Table 3. Best economic heterotic crosses for yield and their performance in related parameters

Best cross	Mean yield, q/ha	Heterosis, %		sca effects	gca effects		Significant heterosis for other traits
		MP	BP		P_1	P_2	
IS 161 × ES 380	14.5	130.7	108.5	3.91**	−0.76	−0.48	I, IV, V
Sel R × Type 10	19.0	125.8	118.8	4.64**	2.64	−0.13	I
Til No 1 × TC 30	17.1	116.3	88.6	6.32**	−0.27	−0.79**	I, III, V, VI
S. local × ES 380	17.0	115.9	93.8	3.46**	2.14**	−0.48	I, II, III, V
Type 85 × C 2	18.9	110.1	101.5	4.58**	1.10	1.41**	I, III, V
N 62-141 × Type 10	16.9	114.6	107.4	2.83**	2.34**	−0.13	I
B 45 × Type 10	16.9	93.1	80.2	3.44**	1.78**	−0.13	I
N 62-141 × C 2	15.6	83.3	65.6	−0.02	2.34**	1.41**	I, III, IV, V
B 45 × C 2	17.0	80.5	80.5	1.93	1.78**	1.41**	I, III, V
Sel R × C 2	15.7	73.3	66.7	−0.22	2.64**	1.41**	I, V
Best parent (N 85-2)	11.8						

I) Capsules/plant, II) seeds/capsule, III) 1000-seed weight, IV) branches/plant,
V) plant height, and VI) days to flowering.

that in the present study, gene interaction for the crosses exhibiting highest heterosis for most of the traits was accountable to additive × dominance and dominance × dominance types of gene effects.

Crosses showing highest positive heterosis for seed yield in comparison to the best parent and their performance in terms of heterosis, sca effects, gca effects of parents, and heterosis for component traits are presented in Table 3. Crosses Type 85 × C 2 and Sel R × Type 10 gave the best hybrids, exhibiting very high mean and heterosis as well as significant sca effect capable of giving maximum transgressive effects. Cross Type 85 × C 2 involved high × high, whereas cross Sel R × Type 10 was between high × average general combiners. Crosses N 62-141 × C 2, B 45 × C 2, and Sel R × C 2 between high × average combiners with considerable heterotic response also need exploitation for developing high yielding lines. Heterosis for seed yield in these crosses was accompanied by heterosis for capsules/plant, 1000-seed weight, and plant height. The above mentioned high heterotic crosses involving high × high or high × average general combiners showed considerable additive genetic variance that can be exploited for developing high yielding pure lines through progeny selection.

REFERENCES

1. M. L. Sarathe and K. C. Dabral. 1969. Hybrid vigour in sesamum. Sci. Cult., **35:** 572–573.
2. D. S. Murthy. 1975. Heterosis, combining ability and reciprocal effects for agronomic and chemical characters in sesame. Theor. Appl. Genet., **45:** 294–297.
3. S. R. Shrivas and S. P. Singh. 1981. Heterosis and combining ability in sesamum. Indian J. Genet., **41**(1): 1–4.
4. O. Kempthorne. 1957. An Introduction to Genetical Statistics. John Wiley and Sons., New York: 545.