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Research Note

Study on the exploitation of heterosis in sesame (*Sesamum indicum* L.)

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Abstract
An experiment was conducted to study the expression of heterosis for ten characters in forty five crosses of sesame developed by crossing five lines with nine testers in line x tester mating design. The analysis of variance (line x tester) revealed significant differences among the genotypes for all the characters studied except for number of secondary branches. Heterosis was worked out over midparent, better parent and standard parents *viz.,* CO 1 and TMV 7. The cross TMV 5 x ORM 7 expressed significant and positive heterosis over mid parent, better parent and two standard varieties for single plant yield along with high *per se* performance. The crosses, TMV 5 x ORM 7, TMV 6 x VRI 1 and TMV 3 x CO 1 expressed highly significant standard heterosis for most of the traits including single plant yield and hence could be exploited for development of high yielding varieties.

Key words
Sesame, seed yield, relative heterosis, heterobeltiosis, standard heterosis

Sesame (*Sesamum indicum* L.) (2n=26), the most ancient oilseed crop of the world, mainly cultivated in tropical and subtropical conditions. It is being cultivated in Asia for last 5000 years (Joshi, 1961). It is regarded as the 'Queen of Oilseeds' as the quality of oil is of high nutritional and therapeutic value combined with stability. Sesame is the sixth most important oilseed crop of the world, occupying an area of 6.6 m. ha, with a production of 3.15 m. tons and its average productivity being 460 kg/ha. India is the largest sesame growing country in the world with an area of 1.85 m.ha, producing 0.64 m. tones but productivity wise it is among the lowest with 345 kg/ha (FAOSTAT, 2012), much lower than the world average productivity. This can be overcome by the commercial exploitation of heterosis.

Since this crop has epipetalous flower nature, easy emasculation and pollination procedure, pollen transfer by honey bee activity, more number of seed set in a capsule, more number of capsules per plant, low seed rate (5.0 kg/ha) and high multiplication ratio, it has more scope for manual hybrid seed production to exploit heterosis. Hence the present investigation was carried out to study the magnitude of heterosis expression for yield and its components to exploit in our breeding programme.

The material for the present study consisted of five females, which were released varieties *viz.,* TMV 3, TMV 4, TMV 5, TMV 6, Paiyur 1 and nine males *viz.,* CO 1, SVPR 1, TMV 7, VRI 1, VRI 2, Jaumer, ORM 7, ORM 14 and ORM 17. Crosses were made between these parents in Line x Tester mating design to develop 45 F_1 hybrids at Department of Oilseeds, Tamil Nadu Agricultural University, Coimbatore during *rabi*-summer 2010-11. Individual cross combinations along with their parents were raised in Randomized Block Design along with two checks *viz.,* TMV 7 and CO 1 in two replications, each in four meter row with the spacing of 30 x 30 cm, during *Kharif* 2011. The recommended package of practices for sesame was followed throughout the crop growing period. Observations were recorded for ten traits *viz.,* days to first flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of capsules in main stem, total number of capsules per plant, number of seeds per capsule, single plant yield (g) and 100 seed weight (mg). Ten plants each in parents and hybrids were randomly selected in each replication and observations on the quantitative traits were recorded on each plants. The mean values were used for estimation of heterosis over mid parent, better parent and standard check based on the procedure given by Kempthorne (1957).

The analysis of variance revealed significant differences among parents for the ten quantitative characters studied. This indicates the presence of significant variation in the experimental material for the traits observed. Significant variation was also observed among hybrids for all the characters except for days to maturity, indicating presence of variability among the crosses for the traits. The interaction among the crosses and parents recorded significant variation for all the observed traits except for number of secondary branches per plant indicating the possibility of exploiting heterosis for most of the traits. Significant variation was already reported by Thiyagu *et al.* (2007), Jadhav and Mohrir (2013) for most of the characters studied in this experiment.

The mean yield per plant, relative heterosis, heterobeltiosis and standard heterosis over two varieties in per cent are given in table 1. Heterosis for seed yield per plant ranged from -69.57 to

124.18 and from -71.54 to 104.13 per cent over mid parent and better parent respectively. It ranged from -74.12 to 64.51 and from -68.75 to 98.66 per cent over standard varieties *i.e.*, CO 1 and TMV 7 respectively. The cross TMV 5 x ORM 7 expressed significant and positive heterosis over mid parent, better parent and two standard varieties with the mean seed yield of 44.5 g/plant. The crosses TMV 3 x CO 1, TMV 5 x ORM 14 and TMV 6 x VRI 1 recorded significant and positive relative heterosis, heterobeltiosis and standard heterosis over CO 1 alone for seed yield per plant. Among forty five crosses studied, significant and positive relative heterosis was observed in eleven crosses, heterobeltiosis in nine crosses, while the standard heterosis was noted in only one cross (TMV 5 x ORM 7) over both the standard varieties used and four crosses over the standard check CO 1. Minimum number of crosses exhibiting standard heterosis as compared to relative heterosis and heterobeltiosis and this was already observed by Mothilal and Manoharan (2004), and Jawahar lal Jatothu *et al*. (2013).

The number of crosses with significant heterotic performance and range of heterosis for yield and yield components is given in table 2 and the best three hybrids for yield and other yield components are given in table 3. For earliness, none of the crosses exhibited significant relative heterosis and heterobeltiosis, while, the crosses TMV 4 x Jaumer and TMV 5 x ORM 7 showed significant and negative standard heterosis over TMV 7 and CO 1. For days to maturity, TMV 6 x ORM 17, TMV 3 x SVPR 1 and TMV 6 x SVPR 1 showed significant and negative standard heterosis over CO 1. For plant height, TMV 3 x CO 1 expressed significant and positive heterosis over midparent, better parent and over two standard varieties used. Significant positive heterosis for plant height was reported by Mothilal and Ganesan (2005) and Parimala *et al*. (2013). For number of primary and secondary branches, TMV 6 x VRI 1 showed significant and positive relative heterosis and heterobeltiosis. The cross TMV 5 x VRI 2 and TMV 3 x CO 1 expressed significant values of standard heterosis over TMV 7 and CO 1 for number of secondary branches.

For the number of capsules in main stem, Paiyur 1 x ORM 7 and Paiyur 1 x ORM 14 had the significant and positive heterosis over mid and better parent, while, TMV 5 x ORM 7, TMV 3 x ORM 7 and TMV 5 x Jaumer was significantly heterotic over the standard varieties CO 1 and TMV 7. The cross Paiyur 1 x ORM 7 recorded significant and positive relative heterosis, heterobeltiosis and standard heterosis for total number of capsules per plant. For number of seeds per capsule, Paiyur 1 x ORM 7 and TMV 3 x VRI 1 expressed significant and positive heterotic values on all the three bases. Significant heterosis for number of seeds per capsule was earlier reported by Mothilal and Ganesan (2005) and Parimala *et al*. (2013). For the trait single plant yield, TMV 5 x ORM 7 expressed significant and positive heterosis on all the three basis. The cross TMV 6 x VRI 1 showed positive heterobeltiosis and standard heterosis over TMV 7 and CO 1. Similar results were reported by Deepa Sankar and Ananda Kumar (2001), Saravanan and Nadarajan (2002) and Thiyagu *et al*. (2007). For 100 seed weight, Paiyur 1 x VRI 1, TMV 3 x Jaumer and TMV 5 x VRI 1 exhibited positive and highly significant heterosis on all the three bases.

To conclude, the six hybrids *viz*., TMV 5 x ORM 7, TMV 3 x CO 1, TMV 6 x VRI 1, TMV 3 x VRI 1, TMV 5 x Jaumer and Paiyur 1 x ORM 14 are to be concentrated for the exploitation of heterosis in sesame for the improvement of yield and other observed traits. The hybrid TMV 5 x ORM 7 expressed high standard heterosis for single plant yield, number of capsules in main stem, total number of capsules per plant, while the cross TMV 6 x VRI 1 showed heterotic vigour for three traits *viz.*, single plant yield, number of secondary branches, 100 seed weight. The hybrid TMV 3 x CO 1 was superior for single plant yield, plant height and number of secondary branches. For number of primary branches, number of capsules in main stem and number of seeds per capsule, the cross TMV 3 x VRI 1 was identified as highly heterotic over two standard checks. The cross TMV 5 x Jaumer expressed high heterosis for three traits *viz.*, plant height, total number of capsules per plant and number of capsules in main stem. For number of primary branches and total number of capusles per plant, the hybrid Paiyur 1 x ORM 14 had expressed high standard heterosis. These heterotic crosses can be utilized for yield improvement through heterosis breeding.

References

Deepa Sankar and Ananda Kumar 2001. Heterosis for yield and yield components in sesame (*Sesamum indicum* L.). *Sesame and Safflower Newsletter*, **16**: 6-8.

FAOSTAT. 2012. http://faostat.fao.org/site/567/default.aspx# ancor

Jadhav, R.S. and Mohrir, M.N. 2013. Heterosis studies for quantitative traits in sesame (*Sesamum indicum* L.). *Electron. J. Plant Breed.*, **4**(1): 1056-1060

Jawahar lal Jatothu, Kuldeep Singh Dangi and Sudheer Kumar, S. 2013. Evaluation of sesame crosses for heterosis of yield and yield attributing traits. *J. Trop. Agric*. **51**(1-2): 84-91

Joshi, A.B. 1961. *Sesamum*. Indian Central Oilseeds Committee, Hyderabad, India, pp.62-77

Kempthrone, O. 1957. An introduction to genetic statistics. John Wiley and Sons Ins., New York, pp: 458-471

Mothilal, A. and Ganesan, K.N. 2005. Heterosis studies in Sesame *(Sesamum indicum* L.). *Agric. Sci. Digest,* **25**(1): 74-76.

Mothilal, A. and Manoharan, V. 2004. Heterosis and combining ability in sesame (*Sesamum indicum* L.). *Crop Res.*, **27**: 282-287.

Parimala, K., Swarnalatha Devi, I., Bharathi, V., Raghu, B., Srikrishnalatha, K. and Vishnuvardhan Reddy, A. 2013. Heterosis for yield and its component traits in sesame (*Sesamum indicum* L*.). Intl. J. App. Biol. and Pharm. Tech*. **4**(4): 65 – 68

Saravanan, S. and Nadarajan, N. 2002. Studies on Heterosis in Sesame *(Sesamum indicum* L.) *Indian J. Genet.,* **62**(3): 271-272

Thiyagu, K., Kandasamy, G., Manivannan, N. and Muralidharan, V. 2007. Studies on heterosis in genetically diverse lines of cultivated sesame (*Sesamum indicum* L.). *Madras Agric. J.,* **94**(7-12): 162-167.

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Table 1. Mean, relative heterosis, heterobeltiosis and standard heterosis (per cent) for seed yield per plant in sesame

S.No	Cross	Mean (g/plant)	Relative heterosis	Hetero-beltiosis	Standard heterosis	
					TMV7	CO1
1.	TMV 3 x CO 1	31.7	46.08**	31.54*	17.19	41.52 **
2.	TMV 3 x SVPR 1	12.7	-21.36	-34.20*	-53.05	-43.30 **
3.	TMV 3 x TMV 7	20.7	-5.69	-15.85	-23.48 *	-7.59
4.	TMV 3 x VRI 1	14.2	-24.27	-26.42	-47.50 **	-36.61 *
5.	TMV 3 x VRI 2	16.4	-23.36	-30.21*	-39.37 **	-26.79
6.	TMV 3 x Jaumer	15.9	-15.87	-17.62	-41.22 **	-29.02 *
7.	TMV 3 x ORM 7	17.9	-3.76	-7.25	-33.83 **	-20.09
8.	TMV 3 x ORM 14	23.6	27.57	22.28	-12.75	5.36
9.	TMV 3 x ORM 17	26.0	37.57*	34.72*	-3.88	16.07
10.	TMV 4 x CO 1	21.4	-5.93	-11.20	-20.89	-4.46
11.	TMV 4 x SVPR 1	16.2	-5.81	-24.30	-40.11 **	-27.68
12.	TMV 4 x TMV 7	7.0	-69.57**	-71.54**	-74.12 **	-68.75 **
13.	TMV 4 x VRI 1	8.0	-59.60**	-62.62**	-70.43 **	-64.29 **
14.	TMV 4 x VRI 2	25.4	13.14	8.09	-6.10	13.39
15.	TMV 4 x Jaumer	17.5	-12.28	-18.22	-35.30 **	-21.88
16.	TMV 4 x ORM 7	27.0	37.40**	26.17	-0.18	20.54
17.	TMV 4 x ORM 14	16.3	-16.62	-23.83	-39.74 **	-27.23
18.	TMV 4 x ORM 17	10.4	-47.87**	-51.40**	-61.55 **	-53.57 **
19.	TMV 5 x CO 1	26.2	14.16	8.71	-3.14	16.96
20.	TMV 5 x SVPR 1	25.1	44.25**	15.14	-7.21	12.05
21.	TMV 5 x TMV 7	15.6	-32.76**	-36.59**	-42.33 **	-30.36 *
22.	TMV 5 x VRI 1	22.3	11.50	2.29	-17.56	-0.45
23.	TMV 5 x VRI 2	22.1	-2.43	-5.96	-18.30	-1.34
24.	TMV 5 x Jaumer	28.5	41.44**	30.73*	5.36	27.23
25.	TMV5 x ORM 7	44.5	124.18**	104.13**	64.51 **	98.66 **
26.	TMV5 x ORM 14	28.7	45.32**	31.65*	6.10	28.12 *
27.	TMV 5 x ORM 17	17.5	-13.15	-19.72	-35.30 **	-21.88
28.	TMV 6 x CO 1	27.7	23.11	14.94	2.40	23.66
29.	TMV 6 x SVPR 1	17.0	0.29	-18.66	-37.15 **	-24.11
30.	TMV 6 x TMV 7	22.3	-1.98	-9.35	-17.56	-0.45
31.	TMV 6 x VRI 1	30.2	54.48**	44.50**	11.65	34.82 *
32.	TMV 6 x VRI2	27.3	22.97	16.17	0.92	21.87
33.	TMV 6 x Jaumer	20.4	3.55	-2.39	-24.58 *	-8.93
34.	TMV 6 x ORM 7	17.3	-10.82	-17.22	-36.04 **	-22.77
35.	TMV 6 x ORM 14	10.6	-45.08**	-49.28**	-60.81 **	-52.68 **
36.	TMV 6 x ORM 17	16.9	-14.21	-19.14	-37.52 **	-24.55
37.	Paiyur 1 x CO 1	24.2	13.08	0.41	-10.54	8.04
38.	Paiyur 1 x SVPR 1	25.1	58.36**	34.22*	-7.21	12.05
39.	Paiyur 1 x TMV 7	12.3	-43.19**	-50.00**	-54.53 **	-45.09 **
40.	Paiyur 1 x VRI 1	17.2	-6.78	-8.02	-36.41 **	-23.21
41.	Paiyur 1 x VRI 2	14.1	-33.18*	-40.00**	-47.87 **	-37.05 **
42.	Paiyur 1 x Jaumer	20.9	12.63	12.03	-22.55	-6.47
43.	Paiyur 1 x ORM 7	28.4	55.19**	51.87**	4.99	26.79
44.	Paiyur 1 x ORM 14	25.5	40.11**	36.36**	-5.73	13.84
45.	Paiyur 1 x ORM 17	19.5	4.84	4.28	-27.91 *	-12.95

*, ** Significant at 5 and 1 per cent level, respectively

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Table 2. Number of crosses with desirable heterotic performance and range of heterosis for yield and yield components

Particulars	Days to 50% flowering	Days to maturity	Plant height	No. of 1° branches	No. of 2° branches	No. of capsules in main stem	Total no. of capsules	No. of seeds / caps	100 seed weight	Single plant yield
No. of crosses with desirable relative heterosis	0	6	3	11	10	20	26	15	18	11
No. of Crosses with desirable heterobeltiosis	0	13	1	6	5	10	11	9	7	9
No. of Crosses with desirable standard heterosis over TMV 7	2	0	8	21	16	11	13	6	7	1
No. of Crosses with desirable standard heterosis over CO 1	16	11	1	0	10	15	7	4	9	4
Range of relative heterosis (%	-19.61 to 38.81	-5.44 to 14.51	-25.26 to 34.58	-33.86 to 59.46	-37.78 to 142.62	-33.62 to 74.92	-35.62 to 147.60	-5.70 to 18.0	-4.41 to 25.02	-69.57 to 124.18
Range of hetero-beltiosis (%)	-15.82 to 30.32	-6.09 to 6.44	-29.85 to 23.11	-36.36 to 36.36	-50.05 to 114.63	-36.89 to 48.09	-39.84 to 65.71	-9.87 to 14.71	-6.15 to 24.12	-71.54 to 104.13
Range of standard heterosis (%) over TMV 7	-2.33 to 17.42	3.158 to 31.58	-2.07 to 67.73	-12.19 to 51.22	-34.88 to 118.61	-37.14 to 52.25	-25.45 to 85.48	-5.74 to 17.83	-1.96 to 27.45	-68.75 to 98.66
Range of standard heterosis (%) over CO 1	-17.00 to 1.00	-11.71 to 12.61	-27.43 to 24.29	-56.52 to 10.42	-57.58 to 42.42	-43.49 to 36.88	-40.26 to 48.64	-9.30 to 13.37	-8.40 to 19.08	-74.12 to 64.51

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Table 3. Best three crosses showing high heterotic vigour for yield and yield components

Character	Relative heterosis	Heterobeltiosis	Standard heterosis	
			TMV 7	**CO 1**
Days to flowering	--	--	TMV 4 x Jaumer	TMV 4 x Jaumer
			TMV 5 x ORM 7	TMV 5 x ORM 7
			--	Paiyur 1 x ORM 17
Days to maturity	--	--	--	TMV 6 x ORM 17
				TMV 3 x SVPR 1
				TMV 6 x SVPR 1
Plant height (cm)	TMV 3 x CO 1	TMV 3 x CO 1	TMV 3 x CO 1	TMV 3 x CO 1
	Paiyur 1 x SVPR 1	--	TMV 5 x Jaumer	--
	TMV 3 x SVPR 1	--	Paiyur 1 x CO 1	--
No. of 1° branches	TMV 6 x VRI 1	TMV 5 x ORM 14	Paiyur 1 x ORM 14	--
	TMV 5 x VRI 1	TMV 6 x VRI 1	TMV 3 x VRI 1	
	TMV 4 x SVPR 1	TMV 5 x VRI 1	TMV 5 x ORM 14	
No. of 2° branches	TMV 6 x Jaumer	TMV 6 x VRI 1	TMV 5 x VRI 2	TMV 5 x VRI 2
	TMV 6 x VRI 1	TMV 6 x Jaumer	TMV 3 x CO 1	TMV 3 x CO 1
	TMV 5 x SVPR 1	TMV 6 x ORM 7	TMV 6 x VRI 1	TMV 6 x VRI 1
No. of capsules in main stem	Paiyur 1 x SVPR 1	Paiyur 1 x ORM 7	TMV 5 x ORM 7	TMV 5 x ORM 7
	Paiyur 1 x ORM 7	Paiyur 1 x Jaumer	TMV 3 x ORM 7	TMV 3 x ORM 7
	Paiyur 1 x ORM 14	Paiyur 1 x ORM 14	TMV 5 x Jaumer	TMV 5 x Jaumer
Total no. of capsules/plt	Paiyur 1 x SVPR 1	Paiyur 1 x ORM 7	Paiyur 1 x ORM 7	Paiyur 1 x ORM 7
	Paiyur 1 x ORM 7	Paiyur 1 x ORM 14	Paiyur 1 x ORM 14	Paiyur 1 x ORM 14
	TMV 5 x Jaumer	TMV 3 x ORM 17	TMV 5 x Jaumer	TMV 5 x Jaumer
No. of seeds/capsule	Paiyur 1 x ORM 7	TMV 3 x VRI 1	Paiyur 1 x ORM 7	Paiyur 1 x ORM 7
	TMV 3 x VRI 1	Paiyur 1 x ORM 7	TMV 3 x VRI 1	TMV 3 x VRI 2
	TMV 3 x ORM 17	TMV 3 x ORM 17	TMV 3 x TMV 7	TMV 3 x VRI 1
Single plant yield	TMV 5 x ORM 7	TMV 5 x ORM 7	TMV 5 x ORM 7	TMV 5 x ORM 7
	Paiyur 1 x SVPR 1	Paiyur 1 x ORM 7	TMV 3 x CO 1	TMV 3 x CO 1
	Paiyur 1 x ORM 7	TMV 6 x VRI 1	TMV 6 x VRI 1	TMV 6 x VRI 1
100 seed weight	Paiyur 1 x VRI 1	Paiyur 1 x VRI 1	Paiyur 1 x VRI 1	Paiyur 1 x VRI 1
	TMV 3 x Jaumer	TMV 3 x Jaumer	TMV 3 x Jaumer	TMV 3 x Jaumer
	TMV 3 x VRI 1	TMV 3 x VRI 1	--	--