Madras Agric. J., 94 (7-12) : 162-167 July-December 2007
https://doi.org/10.29321/MAJ.10.100658

Studies on heterosis in genetically diverse lines of cultivated sesame (*Sesamum indicum* L.)

K. THIYAGU, G. KANDASAMY, N. MANIVANNAN AND V. MURALIDHARAN
Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore-641 003.

Abstract: A study was made in sesame *(Sesamum indicum* L.) to assess the extent of heterosis in 36 F_1 hybrids derived from Line x Tester fashion. The 36 F_1 hybrids and their parents were used to estimate the heterosis for 9 traits including seed yield. The parent VRI 1 used as a standard parent. Based on standard heterosis and *per se* performance the superior crosses were identified for each trait. Heterosis for yield was generally accompanied by heterosis for component traits. The crosses CO 1 x ORM 14, TMV 4 x ORM 17, TMV 5 x ORM 17, Paiyur 1 x ORM 14 and TNAU 2030-35 x ORM 14 could be used for pedigree breeding method due to additive x additive nature of epistatic gene action.

Key words: sesame, heterosis, relative heterosis, heterobeltiosis, standard heterosis

Introduction

Sesame *(Sesamum indicum* L.) is an important oilseed crops of India. The exploitation of heterosis has been a practical proposition in many allogamous crops and a few autogamous crops. Sesame, an autogamous crop, has not so far been amenable for heterosis breeding due to lack of economic methods for large-scale seed production. However, considerable cross-pollination has been recorded in the crop (Paramanantham, 1992). Heterosis is defined as the deviation of F_1 hybrid over its mid parent (Relative heterosis), better parent (Heterobeltiosis) and standard parent (Standard heterosis), as the consequence of hybridization. Heterosis breeding studies in sesame were initiated in India from 1935 onwards (Pal, 1945) and its varying degree for seed yield and other traits had been reported by Sarathe and Dabral (1969).

Many seeds in single pollination and availability of male sterility (Rangasamy and Rathinam, 1982 and Prabakaran *et al.*, 1995) offer scope for exploitation of hybrid vigour and heterosis breeding is gaining momentum to achieve quantum jump in yield of sesame.

Materials and Methods

The materials consisted of twelve lines *viz.,* CO 1, TMV 3, TMV 4, TMV 5, TMV 6, Paiyur 1, SVPR 1, VRI 1, Uma, TNAU 2030-35, TNAU 2030-70 and Varasampatty Local 1 (VL 1) and three testers *viz.*, ORM 7, ORM 14 and ORM 17 and the resulting thirty six hybrids were raised in randomized block design with two replication during 2003-04 at College Farm, Tamil Nadu Agricultural University, Coimbatore. Each treatment comprised a row of 6m length with a spacing of 30 x 30cm. Observations for morphological, reproductive and yield contributing characters were recorded on five random plants from each treatment. The mean values were used for estimation of heterosis over mid parent, better parent and standard parent (VRI 1).

Table 1. Analysis of variances (mean squares) for yield components in sesame

Sources	df	Days to 50 per cent flowering	Days to maturity	Plant height	No.of primary branches per plant	No.of capsules per plant	100 seed weight	Oil content	Seed yield per plant	Oil yield per plant
Replication	1	1.657	0.010	11.068	0.0001	6.030	0.0006	0.324	0.409	0.037
Parents	14	14.19**	112.83**	1555.28**	1.61**	2298.60**	0.0019**	41.92**	32.64**	7.34**
Crosses	35	13.31**	25.76**	230.00**	1.31**	713.24**	0.0003**	10.60**	10.04**	1.89**
Parents Vs crosses	1	39.23**	1062.50**	162.42**	0.81**	1814.96**	0.0004**	103.11**	17.69**	10.70**
Error	50	1.44	1.01	4.11	0.745	5.09	0.0001	2.17	0.25	0.06

* Significant at 5% level; ** Significant at 1% level

Results and Discussion

The analyses of variances for various economic traits are presented in table 1. Analysis of variance showed significant differences among parents for all the nine traits studied. This revealed the presence of significant variability in the experimental material. The crosses showed significant differences for all traits, which indicated the existence of variability among the crosses. The interaction between the parents and crosses recorded significant differences. This revealed that the choice of the exploitation of heterosis for all the metric traits studied. Sumathi and Kalaimani (2000) reported significant differences among parents and crosses for days to 50 per cent flowering, plant height, number of primary branches per plant, number of capsules per plant and seed yield per plant. Significant differences for days to maturity and oil content were reported by Karuppaiyan *et al.* (2000). Ramesh *et al.* (2000) reported significant difference for 100 seed weight.

The data on range of three types of heterosis, number of hybrids having significant heterosis and best crosses are presented in table 2. The extent of heterosis for days to 50 per cent flowering varied from -15.31 to 8.42% where five crosses exceeded the standard heterosis, while 21 crosses surpassed the standard parent for days to maturity in which heterosis was ranging from -13.09 to 13.53%. These findings are in consonance with Krishnaiah *et al.* (2002). In general, heterosis for days to 50 per cent flowering and days to maturity were required in negative direction, hence the crosses Uma x ORM 17 (-15.31) and SVPR 1 x ORM 17 (-13.09) could be used in future crop improvement programmes for development of early maturing varieties. The characters that contributed to vegetative growth such as plant height and number of primary branches exhibited heterosis upto 69.83 and 38.57% respectively, which was in concurrence with the findings of Santha *et al.* (2001). A desirable degree of vegetative growth is essential for realizing high yield as total dry

Table 2. Range of heterosis for yield and its contributing traits in sesame

Character	Relative heterosis			Heterobeltiosis			Standard heterosis		
	Range	No.of significant crosses	Best cross	Range	No.of significant crosses	Best cross	Range	No.of significant crosses	Best cross
Days to 50 per cent flowering	-9.78 to 6.25	9	Uma x ORM 17	-15.31 to 6.19	9	Uma x ORM 17	-12.63 to 8.42	5	Uma x ORM 17
Days to maturity	-9.46 to 2.67	22	Uma x ORM 17	-6.63 to 13.53	2	SVPR 1 x ORM 17	-13.09 to 1.05	21	SVPR 1 x ORM 7
Plant height	-2.11 to 23.74	-	Uma x ORM 7	7.17 to 69.83	-	TMV3x ORM 7	-23.62 to 11.99	12	SVPR 1 x ORM 7
No. of primary branches per plant	-22.81 to 38.57	17	TNAU 2030-70 x ORM 14	-35.92 to 27.63	5	TNAU 2030-70 x ORM 14	-33.33 to 23.81	16	TMV5 x ORM 17
No. of capsules per plant	-17.07 to 35.87	23	TNAU 2030-70 x ORM 14	-39.41 to 24.72	2	SVPR 1 x ORM 17	-50.89 to 17.42	5	CO1 x ORM 14
100-seed weight	-2.52 to 18.81	22	SVPR 1 x ORM 14	-14.71 to 13.21	7	SVPR 1 x ORM 17	-8.47 to 10.17	2	TMV3 x ORM 17
Oil content	-11.67 to 19.63	6	CO1 x ORM 14	-24.35 to 0.66	-	CO1 x ORM 14	-16.09 to 15.07	1	CO1 x ORM 14
Seed yield per plant	-18.72 to 46.85	16	TMV5x ORM 17	-41.78 to 37.76	1	SVPR 1 x ORM 17	-51.60 to 41.81	7	CO1 x ORM 14
Oil yield per plant	-22.69 to 60.72	13	CO1 x ORM 14	-49.25 to 30.35	1	SVPR 1 x ORM 17	-54.09 to 63.11	5	CO 1 x ORM 14

matter production is one of the components deciding high grain yield in crops. Out of 36 crosses 12,16 and 5 crosses showed significant positive standard heterosis for the characters plant height, number of primary branches per plant and number of capsules per plant, in which heterosis ranged from -23.62 to 23.74, -35.92 to 38.57 and -50.89 to 35.87. Similar results were reported by Saravanan and Nadarajan (2002). Two hybrids for 100-seed weight, one hybrid for oil content, seven hybrid for seed yield per plant and five hybrids for oil yield per plant showed significant positive standard heterosis.

The hybrid vigour for seed yield and oil yield varied from -51.60 to 46.85 and -54.09 to 63.11 respectively. The highest value of heterosis was being observed in the cross CO 1 x ORM 14. Heterosis for yield was also reported earlier by Deepa Sankar and Ananda Kumar (2001) and Saravanan and Nadarajan (2002).

Grafius (1959) suggested that there could not be any one gene system for yield *per se* and that the yield was an end product of multiplicative interaction between yield components. Sasikumar and Sardana (1990) also opined that hybrid vigour of small magnitude for individual yield component might have additive or synergistic effects on yield. From the above said discussion, the hybrids having higher non-additive component could be utilized for exploitation of hybrid vigour and other hybrids having additive component could be used for further improvement through selection.

Kadambavana Sundaram (1980) suggested that heterotic expression over standard variety should be given due importance for exploitation of commercial hybrids. The mean and standard heterosis for selected hybrids are presented in table 3. Based on *per se* performance and heterosis for seed yield, oil yield and its component characters and earliness, the hybrids CO 1 x ORM 14, TMV 4 x ORM 17, TMV 5 x ORM 17, Paiyur 1 x ORM 14 and TNAU 2030-35 x ORM 14 could be used for pedigree breeding method due to additive x additive nature of epistatic gene action. However, the selection should be postponed to later generation for improvement of yield and yield related traits.

References

Deepa Sankar, P. and Ananda Kumar, C.R. (2001). Heterosis for yield and yield components in sesame (*Sesamum indicum* L.). *Sesame and Safflower Newsl.,* **25(l):** 91-95.

Grafius, J.K. (1959). Heterosis in barely. *Agronomy J.,* **51** : 551-554.

Kadamapavana Sundaram, M. (1980). Combining ability as related to gene action in cotton (*G. hirsutum* L.) Ph.D. Thesis, Tamil Nadu Agrl. Univ., Coimbatore.

Karuppaiyan, R., Ramasamy, P., Santha, S., Arulmozhi, N. and Sundaresan, N. (2000). Combining ability analysis in sesame (*Sesamum indicum* L.). *J. Oilseeds Res.,* **17:** 255-259.

Krishnaiah, G., Rajareddy, K., Reddy, G.L.K. and Reddy Sekar. (2002). Identification of superior heterotic crosses for yield and yield components in sesame. *Crop Res.,* **24 (1)**: 72-76.

Pal, B.P. (1945). Studies in hybrid vigour. I. Notes on the manifestation of hybrid vigour in Gram, Sesamum, Chilli and Maize. *Indian J. Genet.,* **5** : 106-121.

Paramanathan, S. (1992). Insect pollination of cotton and sesame. M.Phil. Dissertation. Madurai Kamarajar University, Madurai: 98.

Table 3. Mean and standard heterosis for selected hybrids

Characters	Hybrids with superior mean, *sca* effect and standard heterosis	Mean	Standard heterosis
Days to 50 per cent flowering	CO 1 x ORM 17	45.0*	-5.26 *
	VRI 1 x ORM 17	44.0*	-7.37 **
Days to maturity	VRI 1 x ORM 14	87.0*	-8.90 **
Plant height	CO 1 x ORM 14	122.3*	10.68**
	TMV4xORM 17	123.75*	11.99**
Number of primary branches per plant	CO 1 x ORM 7	5.05*	20.24 **
	TMV5xORM17	5.20*	23.81 **
Number of capsules per plant	CO 1 x ORM 14	131.75*	17.42**
	TMV4 x ORM 17	128.4*	14.44 **
	TMV5xORM 17	124.9*	11.32 **
100-seed weight	Paiyur 1 x ORM 17	0.31	5.08
Oil content	CO 1 x ORM 14	43.18*	15.07**
	TNAU 2030-70 x ORM 17	38.6	2.85
Seed yield per plant	CO 1 x ORM 14	11.62*	41.81 **
	TMV4xORM 17	13.94*	24.13**
	TMV5xORM17	14.93*	32.99 **
	Paiyur 1 x ORM 14	13.63*	21.37**
	TNAU 2030-35 « ORM 14	12.35*	9.97*
Oil yield per plant	CO 1 x ORM 14	6.88*	63.11 **
	Paiyur 1 * ORM 14	5.29*	25.62 **
	TMV4xQRM17	5.38*	27.64 **

* significant at 5% level ; ** Significant at 1% level.

Prabakaran, A.J., Sree Rangasamy, S.R. and Ramalingam, R.S. (1995). Identification of cytoplasmic induced male sterility in sesame through wide hybridization. *Curr. Sci.*, **68** : 1044.

Ramesh, S., Sheriff, A., Mohan Rao, A. and Lalitha Reddy, S.S. (2000). Prediction of the frequency of heterotic hybrids based on *gca* effects of parents over a number of characters in sesame *(Sesamum indicum* L.) *Crop Res.*, **19(2)** : 310-314.

Rangasamy, M. and Rathinam, M. (1982). Mutagen induced male sterile line in sesame. *Indian J. Genet.*, **42** : 142.

Santha, S., Arulmozhi, N. and Naina Mohammed, S.E. (2001). Heterosis in genetically diverse lines in sesame. *J. Ecobiol.*, **13** : 83-88.

Sarathe, M.L. and Dabral, K.C. (1969). Hybrid vigour in sesamum. *Sci. cult.*, **35 :** 572-573.

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

Sasikumar, B. and Sardana, S. (1990). Heterosis for yield and yield components in sesame. *Indian J. Genet.*, **14** : 87-88.

Sumathi, P. and Kalaimani, S. (2000). Combining ability studies for yield and its attributes in sesame. *Madras Agric. J.*, **87:** 645-650.