Electronic Journal of Plant Breeding, 6(1): 218-224 (Mar 2015)
ISSN 0975-928X

Research Note

Heterosis studies for quantitative traits in sesame *(Sesamum indicum* L.)

G.B.Chaudhari*, M.R.Naik[1], S.A.Anarase[2] and Y.G.Ban[2]
Oilseeds Research Station, MPKV, Jalgaon -425001 ;
[1]Navsari Agril.University, Navsari-396450 ;
[2]Department of Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri-413722 (Gujarat)
*E-mail: gbchaudhari@rediffmail.com

(Received: 30 Sep 2014; Accepted:15 Dec 2014)

Abstract
A study was conducted in sesame *(Sesamum indicum* L.) at Department of Genetics and Plant Breeding, N.M. College of Agriculture, NAU, Navsari (Gujarat) to assess the extent of heterosis for eleven quantitative traits. Five lines and ten testers were crossed in line x tester manner to develop 50 F_1 hybrids. Analysis of variance revealed the significant differences among the crosses for all traits. Heterosis was worked out over better parent and standard varieties Gujarat Til-4 and TKG-22. Five hybrids *viz.*, Gujarat Til-1 x JLS-116, Gujarat Til-2 x JLS-116, Gujarat Til-3 x AKT-64, Patan-64 x JLS-9707-2 and Patan-64 x JLT-408 showed desirable heterobeltiosis for seed yield per plant along with other six major yield contributing characters. The crosses Gujarat Til-3 x AKT-64, Gujarat Til-3 x PKV-NT-11, Gujarat Til-3 x JLS-9707-2 and Gujarat Til-3 x JLS-116 were the best heterotic combinations for seed yield, which recorded 85.81 and 98.08, 63.38 and 74.13, 63.38 and 74.13, 54.28 and 64.43 percent standard heterosis over Gujarat Til-4 and TKG-22, respectively. These crosses could be utilized for hybrid development after testing in large scale trials to confirm the superiority in heterosis.

Keywords
Sesame, heterobeltiosis, standard heterosis, seed yield.

Sesame (*Sesamum indicum* L.) generally known as *gingelly, benniseed, simsim, til* or *tal* is an ancient and important oilseed crop. It is described as the "Queen of oilseeds" because of its high oil (38-54%), protein (18-25%), calcium, phosphorous, oxalic acid contents and excellent qualities of the seed oil and meal. Sesame seed oil with 85% unsaturated fatty acids is highly stable and has reducing effect on cholesterol. The crop is cultivated in almost all parts of the country as sole or mixed crop during *kharif, semi- rabi, rabi* and *summer* seasons and raised over an area of about 17.06 lakh hectares with an annual production of about 6.85 lakh tones and productivity of 402 kg/ha, (Anonymous,2014).However, the average productivity is very low and stagnant as compared to Israel, China and other sesamum producing countries. This evidently indicates the potentiality of this crop for improvement in yield through commercial exploitation of heterosis. In recent years, efforts are under way to develop hybrids in sesame using different hybrid technologies as (a) manual emasculation and pollination; (b) use of chemical hybridizing agents; (c) development of genetic male sterile line and (d) development of the cytoplasmic genetic male sterile lines (Ranganatha, *et al.*, 2012). In sesame, several workers have already reported the presence of significantly high heterosis for yield and yield components. Heterosis of small amount for individual yield contributing characters may have an additive or synergistic effect on the end product (Sasikumar and Sardana, 1990). Therefore, the present study was undertaken to study the extent of heterosis for yield and yield components along with quality parameters in sesamum.

The present study on sesame was conducted at Department of Genetics and Plant Breeding, N.M.College of Agriculture, Navsari Agricultural University, Navsari (Gujarat). Five lines *viz.,* Gujarat Til-1, Gujarat Til-2, Gujarat Til-3, Phule Til No.1, Patan-64 and ten testers *viz.,* JLT-7, JLS-116, JLS- 206-10, JLS-110-12, JLS-9707-2, JLT-408, JLT-408-2, AKT-64, PKV-NT-11 and AKT-101, with varying morphological and agronomic characters were collected from diverse locations of Gujarat and Maharashtra state. The selected parents were crossed in line x tester mating design during *rabi* 2011 to produce 50 hybrids. The spacing of 45 cm between rows and 15 cm between plants was adopted for the crossing programme. The resulting 50 hybrids along with 15 parents and check varieties TKG-22 and G-Til 4 were evaluated during *rabi* 2012-13 in randomized block design (RBD) with three replications and each plot consist of single row of 3 m length at Navsari. All need based practices were followed during the crop growth period to maintain good crop stand. Observations were recorded on randomly selected five plants in each entry for all eleven quantitative traits including seed yield per plant in each

replication. The mean values were used for estimation of heterosis over better parent and standard checks.

Analysis of variance (Table 1) revealed significant differences among the parents and hybrids for the traits studied indicating the presence of significant variation among them. Sumathi and Kalaimani, (2000) also reported significant differences among parents and crosses for days to 50% flowering, plant height, branches per plant, capsules per plant and seed yield per plant. Highly significant interaction between crosses and parents indicates that heterosis could be exploited for most of the traits in sesamum. Similar results were reported by (Kar, *et al.*,2002; Thiyagu, *et al.*,2007) for most of the characters except days to 50 percent flowering, days to maturity and seeds per capsule. While, (Ramesh, *et al.,* 2000) reported significant differences for 1000 seed weight.

In the present investigation, heterobeltiosis for seed yield per plant ranged from -38.12 to 89.65 percent; while the range of standard heterosis over Gujarat Til-4 and TKG-22 was -38.89 to 85.81 and -34.87 to 98.08 percent, respectively (Table 2). The cross Patan-64 x JL-408 showed highest heterosis over better parent (89.65%). While, the cross Gujarat Til-3 x AKT-64 recorded highest standard heterosis of 85.82 and 98.08 percent over both checks *viz.*, Gujarat Til-4 and TKG-22, respectively. Gujarat Til-3 x AKT-64, Gujarat Til-3 x PKV-NT-11, Gujarat Til-3 x JLS-9707-2, Gujarat Til-3 x JLS-116, Patan-64 x AKT-101 were the best heterotic combinations for standard heterosis against Gujarat Til-4, which recorded 85.81%, 63.38%, 63.38%, 54.28% and 53.58% respectively. These crosses also recorded 98.08%, 74.13%, 74.13%, 64.43% and 63.68% standard heterosis over TKG-22. Out of 30 crosses exhibiting significant positive heterosis for seed yield, 10 crosses recorded heterobeltiosis higher than 50 percent. Twenty seven and thirty crosses exhibited significant positive standard heterosis over Gujarat Til-4 and TKG-22, respectively. However, only 6 and 10 crosses recorded standard heterosis more than 50 percent over the standard checks, G-Til 4 and TKG 22. Twenty six crosses showed positive and significant heterobeltiosis as well as standard heterosis over both standard checks, (Table 2). Similar extent of heterosis was also observed by Deepa Sankar and Ananda Kumar, (2001); Shekhat *et al., (*2008); Padma Sundari and Kamala, (2012); Salunke *et al.,(*2013) and Patel *et al.(*,2013).

The crosses showing significant heterosis for seed yield per plant along with other quantitative traits are given in Table 3. Crosses Gujarat Til-1 x JLS-116, Gujarat Til-2 x JLS-116, Gujarat Til-3 x AKT-64, Patan-64 x JLS-9707-2 and Patan-64 x JLT-408 showed desirable heterobeltiosis for seed yield per plant along with other six major yield contributing characters. Further, the crosses Gujarat Til-1 x AKT-101, Gujarat Til-1 x PKV-NT-11 and Patan-64 x JLT-408 exhibited significant positive standard heterosis over Gujarat Til-4, while crosses Gujarat Til-1 x JLS-116, Gujarat Til-3 x JLT-7, Gujarat Til-3 x JLS-116, Gujarat Til-3 x PKV-NT-11, Phule Til No-1 x JLS-116 and Phule Til No-1 x JLS-110-12 exhibited significant positive standard heterosis over TKG-22 for seed yield per plant along with six other traits *viz.*, plant height, branches per plant, capsules per plant, capsule length, seeds per capsule and 1000 seed weight. Number of crosses exhibiting significant standard heterosis in desirable direction over standard checks Gujarat Til-4 and TKG-22 were 6 and 18, respectively. Similar results were found by (Deepa Sankar and Ananda Kumar, 2001; Kar *et al,*. 2002; Mishra and Sikarvar, 2001; Senthilkumar *et al.,*. 2003;Raghunaiah *et al.*, 2008 and Vavdiya *et al,*. 2013). Therefore, the cross combinations *viz.*, Gujarat Til-3 x AKT-64, Gujarat Til-3 x PKV-NT-11, Gujarat Til-3 x JLS-9707-2 and Gujarat Til-3 x JLS-116 may be tested in large scale trial to confirm their superiority for heterosis

Authors are thankful to Oilseeds Research Station,Jalgaon (MS), Agricultural Research Station, Amreli (Gujarat) and All India Coordinated Research Project on Oilseeds, College of Agriculture, Nagpur (MS) for supply of breeding material.

References

Anonymous, 2014. *Directorate of Economics & Statistics, Govt.of India*

Deepa Sankar, P. and Ananda Kumar, C.R. 2001. Heterosis for yield and yield components in sesame (*S. indicum* L.). *Sesame and Safflower Newslr.*, **16**: 6-8.

Kar, U. C., Swain, D. and Mahapatra, J. R. 2002. Line x tester analysis in sesame *(Sesamum indicum* L.). *Madras Agric. J.*, **89** (1-3) : 9-13.

Mishra, A.K. and Sikarwar, R.S. 2001. Heterosis and combining ability analysis in sesame. *Sesame and Safflower Newslr.*, **16**: 1-5.

Padma Sundari, M. and Kamala, T. 2012. Heterosis in *Sesamum indicum* L. *Asian J. Agric. Sci*, **4** (4): 287-290.

Patel,B.N., Patel,K.M., Patel B.N. and Patel,R. 2013. Line x Tester analysis for seed yield and concomitant traits in sesame. *Bioinfolet.* **10** (3A) : 791-794.

Raghunaiah, E., Ganga Kishan, A. and Ansari, N.A. 2008. Combining ability and heterosis for yield and yield components in sesame (*S. indicum* L.). *J. Res. ANGRAU*, **36** (2&3) : 9-16.

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.

Ranganatha, A.R.G., Lokesha,R., Tripathi,A., Tabassum,A., Paroha,S. and Shrivastava, M.K. 2012. Sesame improvement-Present status and future strategies. J. *Oilseeds Res.,* **29** (1) : 1-26.

Salunke, D. P., Lokesha, R. and Banakar, C.K. 2013. Heterosis for yield and its components in sesame, (*S. indicum* L.). *Bioinfolet.* **10** (1a) : 68-71.

Sasikumar, B. and Sardana, S. 1990. Heterosis for yield and yield components in sesame. *Indian J. Genet.,* **50** (1) : 45-50.

Senthil Kumar, P., Pushpa, R. and Ganesan, J. 2003. Heterosis for yield and yield components in sesame (*S. indicum* L.) *Sesame and Safflower Newslr,* **18**: 12-14.

Shekhat, H. G., Dhaduk, L. K. and Vachhani, J. H. 2008. Heterosis and inbreeding depression in sesame (*S. indicum* L.). *J. Oilseeds Res.*, **25** (1): 22-24.

Sumathi, P. and Kalaimani, S. 2000. Combining ability studies for yield and its attributes in sesame. *Madras Agric. J.*, **87** (10-12): 645-650.

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.

Vavdiya, P.A., Dobariya, K.L., Babariya, C.A. and Sapovadiya, M.V. 2013. Heterosis for seed yield and its components in sesame (*S. indicum* L.) *Electronic J. Plant Breed.*, **4** (3): 1246-1250.

Table 1. Analysis of variance for eleven quantitative traits in sesamum.

Source	D.F.	Days to 50% flowering	Plant height (cm)	Branches per plant	Capsules per plant	Capsule length (cm)	Days to maturity	Seed yield per plant (g)	Seeds per capsule	1000-seed weight (g)	Oil content (%)	Protein content (%)
Replications	2	14.77	22.14	0.021	23.91	0.037	3.47	0.60	30.39	0.019	4.46	1.99
Genotypes	64	22.96**	146.54**	0.414**	200.56**	0.078**	26.08**	8.31**	85.67**	0.247**	31.76**	3.09**
Parents	14	51.48**	106.14**	0.29**	107.13**	0.036**	43.79**	1.55**	33.08**	0.179**	30.91**	3.26**
Females (F)	4	45.73**	95.33**	0.12**	133.53**	0.049**	37.93**	1.79**	11.44	0.248**	9.65	1.25
Males (M)	9	42.85**	115.69**	0.39**	49.75**	0.035**	27.41**	1.30**	44.00**	0.143**	39.74**	3.82**
Females vs Males (F vs M)	1	152.1**	63.40*	0.01	517.96**	0.000	214.68**	2.86**	21.37	0.222**	36.41**	6.30*
Parents vs Hybrids (P vs H)	1	127.61**	1412.50**	6.29**	2994.91**	1.072**	45.43*	112.05**	1108.04**	2.249**	326.01**	16.83**
Hybrids	49	12.68**	132.25**	0.33**	170.23**	0.069**	20.63**	8.12**	79.83**	0.226**	26.01**	2.77**
Error	128	5.75	15.75	0.03	12.99	0.013	7.72	0.27	11.11	0.015	4.09	1.36

*,** Significant at 1% and 5% level of significance

Table 2. Mean, heterobeltiosis and standard heterosis (%) for seed yield per plant in sesamum.

Sr.	Genotypes	Mean	Heterobeltiosis	Standard Heterosis over	
				G.Til-4	TKG-22
1	GT-1 x JLT-7	7.79	27.07**	26.65**	34.99**
2	GT-1 x JLS-116	6.89	30.64**	12.03	19.40**
3	GT-1 x JLS-206-10	7.78	51.13**	26.49**	34.82**
4	GT-1 x JLS-110-12	7.01	9.81	13.98*	21.48**
5	GT-1 x JLS-9707-2	6.44	6.62	4.71	11.61
6	GT-1 x JLT-408	5.76	33.85**	-6.39	-0.23
7	GT-1 x JLT-408-2	5.55	-4.20	-9.80	-3.87
8	GT-1 x AKT-64	6.46	6.31	4.98	11.89
9	GT-1 x PKV-NT-11	6.23	7.78	1.30	7.97
10	GT-1 x AKT-101	8.32	57.31**	35.16**	44.05**
11	GT-2 x JLT-7	6.77	10.43	10.08	17.32*
12	GT-2 x JLS-116	8.50	61.15**	38.19**	47.29**
13	GT-2 x JLS-206-10	7.50	45.63**	21.89**	29.91**
14	GT-2 x JLS-110-12	8.88	39.04**	44.31**	53.81**
15	GT-2 x JLS-9707-2	5.92	-1.99	-3.74	2.60
16	GT-2 x JLT-408	6.53	42.92**	6.07	13.05
17	GT-2 x JLT-408-2	4.73	-18.41*	-23.19**	-18.13*
18	GT-2 x AKT-64	6.26	3.02	1.73	8.43
19	GT-2 x PKV-NT-11	4.88	-15.68*	-20.75**	-15.53*
20	GT-2 x AKT-101	5.11	-3.28	-16.90*	-11.43
21	GT-3 x JLT-7	8.57	39.78**	39.33**	48.50**
22	GT-3 x JLS-116	9.49	55.04**	54.28**	64.43**
23	GT-3 x JLS-206-10	7.49	22.26**	21.67**	29.68**
24	GT-3 x JLS-110-12	7.59	18.79**	23.29**	31.41**
25	GT-3 x JLS-9707-2	10.05	64.18**	63.38**	74.13**
26	GT-3 x JLT-408	9.20	50.24**	49.51**	59.35**
27	GT-3 x JLT-408-2	7.36	20.2**	19.61**	27.48**
28	GT-3 x AKT-64	11.43	86.72**	85.81**	98.08**
29	GT-3 x PKV-NT-11	10.05	64.18**	63.38**	74.13**
30	GT-3 x AKT-101	9.72	58.74**	57.96**	68.36**
31	PT-1 x JLT-7	6.57	7.07	6.72	13.74
32	PT-1 x JLS-116	8.15	44.65**	32.5**	41.22**
33	PT-1 x JLS-206-10	7.82	38.73**	27.09**	35.45**
34	PT-1 x JLS-110-12	7.84	22.76**	27.41**	35.80**
35	PT-1 x JLS-9707-2	6.43	6.45	4.55	11.43
36	PT-1 x JLT-408	5.91	4.91	-3.90	2.42
37	PT-1 x JLT-408-2	3.76	-35.10**	-38.89**	-34.87**
38	PT-1 x AKT-64	3.76	-38.12**	-38.89**	-34.87**
39	PT-1 x PKV-NT-11	6.47	11.82	5.09	12.01
40	PT-1 x AKT-101	7.49	32.94**	21.78**	29.79**
41	Patan-64 x JLT-7	7.19	17.17*	16.79*	24.48**
42	Patan-64 x JLS-116	7.03	33.16**	14.19*	21.71**
43	Patan-64 x JLS-206-10	6.25	21.29**	1.52	8.20
44	Patan-64 x JLS-110-12	7.26	13.67*	17.98**	25.75**
45	Patan-64 x JLS-9707-2	8.97	48.48**	45.83**	55.43**
46	Patan-64 x JLT-408	8.98	89.65**	45.88**	55.48**
47	Patan-64 x JLT-408-2	4.75	-18.07*	-22.86**	-17.78*
48	Patan-64 x AKT-64	6.89	13.33	11.92	19.28**
49	Patan-64 x PKV-NT-11	6.18	6.80	0.38	6.99
50	Patan-64 x AKT-101	9.45	78.75**	53.58**	63.68**
	Range		**-38.12-89.65**	**-38.89-85.81**	**-34.87-98.08**

*,** Significant at 1% and 5% level of significance.

Table 3. Number of crosses showing heterosis for seed yield per plant along with other characters in sesamum.

Sr. No.	Characters	No. of crosses with heterosis in desired direction		
		Heterobeltiosis	Standard Heterosis over Gujarat Til-1	Standard Heterosis over TKG-22
1	Seed yield per plant	30	27	30
2	Plant height	14	38	35
3	Branches per plant	23	23	34
4	Capsules per plant	26	48	41
5	Capsule length	17	8	33
6	Seeds per capsule	19	27	44
7	1000 seed weight	21	9	6
8	Days to 50 % flowering	20	2	--
9	Days to maturity	14	--	2
10	Oil content	16	34	15
11	Protein content	--	--	--