HETEROSIS STUDIES FOR QUANTITATIVE TRAITS IN SESAME (S*esamum indicum* L.)

***VAVDIYA, P. A., BABARIYA, C. A. AND DOBARIYA, K. L.**

DEPARTMENT OF GENETICS AND PLANT BREEDING
JUNAGADH AGRICULTURAL UNIVERSITY
JUNAGADH - 362 001, GUJARAT, INDIA

E-mail : pareshvavdiya@gmail.com, gpbplant@gmail.com

ABSTRACT

A study was conducted in sesame (Sesamum indicum L.) to assess the extent of heterosis for fifteen quantitative traits including seed yield per plant. Twelve lines and three testers were crossed in a line x tester fashion to develop 36 F_1 hybrids. The analysis of variance for experimental design revealed highly significant differences among the genotypes, parents and hybrids for all the characters. The standard heterosis and heterobeltiosis for seed yield per plant ranged from -12.32 to 137.39 per cent and -21.58 to 52.67 per cent, respectively. The crosses NIC-75 x G.Til-10, IC-81564 x G.Til-10, NIC-75 x G.Til-4 and AT-238 x G.Til-10 were the best four heterotic combinations for seed yield per plant, which recorded 137.39, 128.74, 111.34 and 100.42 per cent standard heterosis over standard variety G Til-4, respectively. The heterosis for seed yield per plant was associated with the heterosis expressed by its component characters.

KEY WORDS: Heterobeltiosis, sesame, standard heterosis

INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the most ancient and important oilseed crops and its seed contains 50 per cent oil and 25 per cent protein. It is sixth most important oilseed crop in India and cultivated in 19.01 lakh hectares area with 8.10 lakh tones production and productivity of 426 kg/ha. The yield improvement achieved through conventional hybridization followed by selection has been only marginal. Although sesame is largely a self pollinated crop, high level of heterosis for yield and its components has been reported by Fatteh *et al*. (1995), Padmavathi (1998) and Jadhav and Mohrir (2013). But, the commercial exploitation of this phenomenon is feasible only, if the means of producing hybrid seeds economically could be made available. Further, with convincing reports on availability of heterosis and possibility of commercial hybrids, generation of cytoplasmic male sterility system in sesame using the possible wild donors can ease the production of hybrids. The sesame plant has distinct features favourable for hybrid seed production. 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 quantitative traits in sesame.

MATERIALS AND METHODS

The present study on sesame was conducted at Department of Genetics and Plant Breeding, Junagadh Agricultural University, Junagadh, Gujarat. Twelve diverse lines *viz.*, IC-205314, IC-43063, IC-81564, IC-204983, AT-164, AT-238, AT-115, Borda-1, Patan-64, TNAU-12, Keriya-2, NIC-75 and three testers *viz.*, G.Til-3, G.Til-4 and G.Til-10 were crossed in a line x tester mating design during summer 2012. The resulting 36 hybrids along with 15 parents and a check variety, G.Til-4 were evaluated during kharif 2012 in a Randomized Block Design with three replications. Each plot with a spacing of 45 x 15 cm consisted of single row of 3 m length. All need based agronomic practices were followed during the crop growth period to raise a good crop. Observations were recorded on randomly selected five plants in each entry for 15 quantitative traits including seed yield per plant for each replication. The mean values were used for the analysis of variance for experimental design. The estimation of heterosis over better parent and standard check was carried out as per the statistical procedure suggested by Kempthorne (1957).

RESULTS AND DISCUSSION

Analysis of variance (Table 1) showed highly significant differences among the genotypes for all the characters, indicating the presence of sufficient variability in the experimental material for all the traits. Differences amongst the hybrids and parents were also found highly significant for all characters under investigation. The interaction between parents and hybrids recorded significant differences for all the characters except for days to 50 per cent flowering, number of branches per plant, number of internodes per plant, oil content and protein content. This indicated that with exception of few traits, heterosis could be exploited for most of the traits. Similar results were reported by Thiyagu *et al*. (2007) and Jadhav and Mohrir (2013) for most of the characters except days to 50 per cent flowering, days to maturity and seeds per capsules.

In the present investigation, heterosis for seed yield per plant ranged from -21.58 to 52.67 and -12.32 to 137.39 per cent over better parent and standard variety, respectively (Table 2). Cross NIC-75 x G.Til-4 showed highest better parent heterosis, while the cross NIC-75 x G.Til-10 exhibited highest standard heterosis. Crosses NIC-75 x G.Til-10, IC-81564 x G.Til-10, NIC-75 x G.Til-4 and AT-238 x G.Til-10 were the best four heterotic combinations for seed yield per plant, which recorded 137.39, 127.74, 111.34 and 100.42 per cent standard heterosis, respectively. Nine crosses showed more than 50 per cent standard heterosis. Fourteen crosses *viz.*, IC-205314 x G.Til-3, IC-205314 x G.Til-4, IC-43063 x G.Til-3, IC-43063 x G.Til-4, IC-81564 x G.Til-3, IC-81564 x G.Til-10, AT-238 x G.Til-10, Borda-1 x G.Til-4, TNAU-12 x G.Til-3, TNAU-12 x G.Til-4, Keriya-2 x G.Til-3, NIC-75 x G.Til-3, NIC-75 x G.Til-4 and NIC-75 x G.Til-10 showed positive significant heterobeltiosis as well as standard heterosis (Table 2). Similar extent of heterosis was also observed by Sankar and Kumar (2001), Kar *et al.* (2002), Senthil Kumar *et al.* (2003) and Anuradha and Reddy (2008).

In the present study, four crosses showing the desirable heterosis for seed yield per plant to the tune of more than 100 per cent along with other quantitative traits were identified (Table 3). Cross NIC-75 x G.Til-10 showed desirable standard heterosis for seed yield per plant along with other five traits *viz.*, plant height, number of branches per plant, number of internodes per plant, number of capsules per plant and protein content, while IC-81564 x G.Til-10 showed desirable heterosis for seed yield per plant along with other eight traits *viz.*, days to 50 per cent flowering, Plant height, number of branches per plant, number of internodes per plant, number of capsules per plant, number of seeds per capsule, 1000-seed weight and protein content. Cross NIC-75 x G.Til-4 had shown desirable standard heterosis for seed yield per plant along with plant height, number of branches per plant, number of internodes per plant, length of capsule, number of capsules per plant, number of seeds per capsule and protein content, whereas cross AT-238 x G.Til-10 showed desirable standard heterosis for seed yield per plant along with other five traits *viz.*, plant height, number of branches per plant, length of capsule, number of capsules per plant and number of seeds per capsule (Table 3). Similar results were found by Ganesh *et al.* (1999), Sankar and Kumar (2001), Kar *et al.* (2002) and Thiyagu *et al.* (2007). Therefore these cross combinations *viz.*, NIC-75 x G.Til-10, IC-81564 x G.Til-10, NIC-75 x G.Til-4 and AT-238 x G.Til-10 may be tested in large scale trial to confirm the superiority for heterosis and can be exploited for developing superior varieties.

CONCLUSION

The crosses NIC-75 x G.Til-10, IC-81564 x G.Til-10, NIC-75 x G.Til-4 and AT-238 x G.Til-10 were the best four heterotic combinations for seed yield per plant, which recorded 137.39, 128.74, 111.34 and 100.42 per cent standard heterosis over standard variety G Til-4, respectively, may be tested in large scale trial to confirm the superiority for heterosis and can be exploited for developing superior varieties.

REFERENCES

Anuradha, T. and Reddy, G. L. K. (2008). Study of heterosis and inbreeding depression in sesame (*Sesamum indicum* L.). *Agric. Science Digest*, **28** (3) : 157-164.

Fateh, U. G., Patel, N. A., Chaudhari, F. P., Dangariya, C. J. and Patel, P. G. (1995). Heterosis and combining ability in sesame (*Sesamum indicum L.*). *J. Oilseeds Res.*, **12**(2): 184-190.

Ganesh, S. K., Sakila, M. and Bastian, D. (1999). Utilization of heterosis breeding for the development of superior hybrids in sesame (*Sesamum indicum* L.). *Sesame Safflower Newsl.*, **14** : 6-8.

Jadhav, R. S. and Mohrir, M. N. (2013). Heterosis studies for quantitative traits in sesame (S*esamum indicum* L.). *Electronic J. Pl. Breeding*, **4**(1): 1056-1060.

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.

Kempthorne, O. (1957). An Introduction to genetic statistics. John Wiley and Sons, Inc. New York, USA, pp: 468-473.

Padmavathi, N. (1998). Heterosis potential of sesame (*Sesamum indicum L.*) crosses in F_1 and F_2 generations. *Indian J. Agric. Sci*., **68**(11): 750-751.

Sankar, P. D. and Kumar, C. R. A. (2001). Heterosis for yield and yield components in sesame (*Sesamum indicum* L.). *Sesame Safflower Newsl.*, **16** : 6-8.

Sasikumar, B and Sardana, S. (1990). Heterosis for yield and yield components in sesame (*Sesamum indicum L.*). *Indian J. Genet.*, **50**(1): 45-49.

Senthil Kumar, P., Pushpa, R., Ganeshan, J. and Fernandez-Martinez, J. (2003). Heterosis For Yield and Yield Components In Sesame. *Sesame and Safflower Newsl.*, **18**: 12-14.

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): 162-167.

Table 1: Analysis of variance for experimental design for different characters in sesame

Source	d.f.	Days to 50 Per Cent Flowering	Days to Maturity	Plant Height (cm)	Height to First Capsule (cm)	Number of Branches Per Plant	Number of Internodes Per Plant	Length of Capsule (cm)	Width of Capsule(cm)
Replications	2	1.026	1.379	15.006	1.668	0.096	0.154	0.004	0.001
Genotypes	50	52.873**	57.364**	793.076**	343.233**	4.143**	63.687**	0.252**	0.014**
Parents	14	83.990**	66.041**	743.934**	318.781**	4.463**	51.414**	0.456**	0.017**
Hybrids	35	41.698**	53.810**	785.340**	346.974**	4.133**	70.305**	0.177**	0.012**
P. Vs H.	1	8.358	60.298**	1751.820**	554.612**	0.001	3.875	0.022*	0.046**
Error	100	3.566	4.426	28.496	8.138	0.061	2.362	0.005	0.001

Table 1 : Contd….

Source	d.f.	Number of Capsules Per Plant	Number of Capsules Per Leaf Axil	Number of Seeds Per Capsule	1000-Seed Weight (g)	Oil Content (%)	Protein Content (%)	Seed Yield Per Plant (g)
Replications	2	13.362	0.008	0.113	0.006	2.300	0.262	1.097
Genotypes	50	1512.039**	0.908**	105.650**	0.510**	10.411**	15.298**	66.570**
Parents	14	1157.152**	1.375**	147.264**	0.627**	16.364**	12.446**	29.026**
Hybrids	35	1526.734**	0.633**	64.842**	0.459**	8.033*	16.844**	67.680**
P. Vs H.	1	5966.109**	3.974**	951.330**	0.679**	10.298	1.132	553.330**
Error	100	11.648	0.008	15.103	0.005	4.711	0.914	1.756

,** Significant at 5% and 1% levels, respectivel

Table 2 : Mean, heterobeltiosis and standard heterosis (per cent) of 36 crosses for seed yield per plant in sesame

Cross	Mean	Heterobeltiosis (%)	Standard heterosis (%)
IC-205314 x G.Til-3	15.89	23.59*	33.53**
IC-205314 x G.Til-4	16.45	27.98**	38.26**
IC-205314 x G.Til-10	21.97	7.98	84.62**
IC-43063 x G.Til-3	16.96	47.66**	42.49**
IC-43063 x G.Til-4	18.10	52.10**	52.10**
IC-43063 x G.Til-10	22.31	9.63	87.45**
IC-81564 x G.Til-3	16.54	17.64**	38.96**
IC-81564 x G.Til-4	14.08	0.19	18.35
IC-81564 x G.Til-10	27.22	33.78**	128.74**
IC-204983 x G.Til-3	14.05	3.11	18.07
IC-204983 x G.Til-4	13.46	-1.20	13.14
IC-204983 x G.Til-10	21.12	3.82	77.51**
AT-164 x G.Til-3	12.25	2.80	2.91
AT-164 x G.Til-4	12.66	6.30	6.41
AT-164 x G.Til-10	17.31	-14.91*	45.49**
AT-238 x G.Til-3	11.98	4.30	0.64
AT-238 x G.Til-4	12.17	2.24	2.24
AT-238 x G.Til-10	23.85	17.22**	100.42**
AT-115 x G.Til-3	12.25	-9.97	2.97
AT-115 x G.Til-4	11.73	-13.81	-1.43
AT-115 x G.Til-10	15.96	-21.58**	34.09**
Borda-1 x G.Til-3	20.64	13.22	73.42**
Borda-1 x G.Til-4	20.91	14.74*	75.74**
Borda-1 x G.Til-10	22.71	11.62	90.84**
Patan-64 x G.Til-3	11.46	-0.20	-3.70
Patan-64 x G.Til-4	11.56	-2.83	-2.83
Patan-64 x G.Til-10	16.52	-18.79**	38.85**
TNAU-12 x G.Til-3	15.20	32.37**	27.73*
TNAU-12 x G.Til-4	16.69	40.28**	40.28**
TNAU-12 x G.Til-10	17.56	-13.71*	47.54**
Keriya-2 x G.Til-3	15.36	33.76**	29.08*
Keriya-2 x G.Til-4	10.43	-12.32	-12.32
Keriya-2 x G.Til-10	21.39	5.11	79.72**
NIC-75 x G.Til-3	20.77	26.08**	74.54**
NIC-75 x G.Til-4	25.15	52.67**	111.34**
NIC-75 x G.Til-10	28.25	38.84**	137.39**

,** Significant at 5% and 1% levels, respectively

Table 3 : Promising four hybrids with respect to standard heterosis for seed yield per plant and other characters in sesame

Cross	Characters
NIC-75 x G.Til-10	Plant height, number of branches per plant, number of internodes per plant, number of capsules per plant and protein content
IC-81564 x G.Til-10	Days to 50 % flowering, Plant height, number of branches per plant, number of internodes per plant, number of capsules per plant, number of seeds per capsule, 1000-seed weight and protein content
NIC-75 x G.Til-4	Plant height, number of branches per plant, number of internodes per plant, length of capsule, number of capsules per plant, number of seeds per capsule and protein content
AT-238 x G.Til-10	Plant height, number of branches per plant, length of capsule, number of capsules per plant and number of seeds per capsule

[MS received: September 15, 2013] *[MS accepted: September 26, 2013]*