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Research Article

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

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Abstract
A study was conducted in sesame (*Sesamum indicum* L.) at Department of Botany, Pratishthan Mahavidyalaya, Paithan, Aurangabad (M.S.) to assess the extent of the heterosis for sixteen quantitative traits including seed yield per plant. Eight lines and six testers were crossed in line x tester manner to develop 48 F_1 hybrids. Analysis of variance revealed the significant differences among the crosses for all traits except days to 50 per cent flowering, days to maturity and number of seeds per capsule. Heterosis was worked out over mid parent, better parent and standard variety TKG-22. Crosses SI-3218 x S-0434, SI-3218 x Lalguda local, GSM-22 x SI-331517 and GSM-22 x Lalguda local were the best heterotic combinations for seed yield, which recorded 193.10, 191.38, 191.38 and 170.69 per cent standard heterosis respectively and could be utilized for hybrid development. Four hybrids namely, GSM-22 x SI-331517, IC-413204 x S-0434, IC-413204 x KMS-5-873 and IC-413202 x S-0434 were shown desirable heterosis for seed yield per plant along with yield components. These hybrids may be tested in large scale trial to confirm the superiority in heterosis.

Key words:
Sesame, heterosis, seed yield

Introduction

Sesame (*Sesamum indicum* L.) is an important oil seed crop and its seed contains 38-54% oil and 18-25% protein. It is sixth most important oil seed crop in India and has 1.94 mha area with 0.755 mt production and productivity of 389 kg/ha (Anon, 2012). The average productivity is very low as compare to other sesame growing countries and almost stagnant during the last few years. In India, the yield plateau and poor productivity can be overcome by commercial exploitation of heterosis. However, being an autogamous crop, has not so far been amenable for heterosis breeding due to lack of economic methods for large scale seed production. In spite of this, epipetatious flower, easy emasculation and pollination, high number of seeds (40-50) produced per flower, low seed rate (2.0-2.5 kg/ha) and high multiplication ratio (1:300) for manual seed production increases the scope of heterosis breeding in sesame. In sesame, several researchers 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 quantitative traits in sesame.

Material and methods:

The present study on sesame was conducted at Department of Botany, Pratishthan Mahavidyalaya, Paithan, Aurangabad (M.S.). Eight lines *viz.*, ES-111-284, IC-413231, IC-413208, IC-413204, IC-413209, IC-413202, GSM-22, SI-3218 and six testers *viz.*, KSM-5-343, SI-331517, KMR-116, KMS-5-873, S-0434 and Lalguda local, with varying morphological and agronomic characters were selected on the basis of *per se* performance during Summer 2009. The selected eight lines and six testers were crossed in line x tester manner during *kharif* 2009 to produce 48 hybrids. The spacing of 45 cm between rows and 30 cm between plants was adopted for the crossing programme. The resulting 48 hybrids along with 14 parents and check variety TKG-22 were evaluated during summer 2010 in randomized block design (RBD) with three replications and each plot consist of single row of 3 m length. 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 16 quantitative traits including seed yield per plant for each replication. The mean values were used for estimation of heterosis over mid parent, better parent and standard check as per the standard method.

Results and discussion

Analysis of variance (Table 1) revealed significant differences among parents for all traits except days to maturity, capsule length, seeds per capsule. This indicates the presence of the significant variability in the experimental material for the traits. The crosses showed significant differences for all the traits except days to 50 per cent flowering, days to maturity and seeds per capsule, which indicate the variability among the crosses for most of the traits. The interaction between crosses and parents recorded significant differences for only plant height for first capsule, internode distance, number of nodes on main stem, number of capsules per plant, seed yield per plant, 1000 seed weight and

oil content. This indicates that with exception of few traits heterosis could be exploited for most of the traits. Similar results were reported by Kar *et al.* (2002), Thiyagu *et al.* (2007) for most of the characters except days to 50 percent, days to maturity and seeds per capsule.

In the present investigation, heterosis for seed yield per plant ranged from -55.79 to 84.09, -58.06 to 65.31 and -28.62 to 193.10 per cent over mid parent, better parent and standard variety respectively (Table 2). Cross IC-413202 x KMS-5-873 showed highest mid parent and better parent heterosis. Crosses SI-3218 x S-0434, SI-3218 x Lalguda local, GSM-22 x SI-331517 and GSM-22 x Lalguda local were the best heterotic combinations for seed yield, which recorded 193.10, 191.38, 191.38 and 170.69 per cent standard heterosis respectively. Eight crosses *viz.*, SI-3218 x S-0434, SI-3218 x Lalguda local, GSM-22 x SI-331517, GSM-22 x Lalguda local, IC-413204 x S-0434, SI-3218 x KMS-5-343, GSM-22 x S-0434 and GSM-22 x KMS-5-343 showed more than 150% standard heterosis. Four crosses *viz.*, GSM-22 x KMS-5-873, SI-3218 x SI-331517, IC-413202 x S-0434 and ES-111-284 x KMS-5-343 showed more than 100% standard heterosis. Twelve crosses showed more than 50% standard heterosis. Nine crosses *viz.*, SI-3218 x S-0434, SI-3218 x Lalguda local, IC-413204 x S-0434, SI-3218 x KMS-5-343, SI-3218 x SI-331517, IC-413231 x SI-331517, ES-111-284 x SI-331517, IC-413204 x KMS-5-873 and IC-413202 x KMS-5-873 showed positive significant relative heterosis, heterobeltiosis and standard heterosis (Table 2). Similar extent of heterosis was also observed by Sankar and Kumar (2001), Kar *et al.* (2002), Kumar *et al.* (2003), Anuradha and Reddy (2008). In the present study, crosses showing the desirable heterosis for seed yield per plant along with other quantitative traits were identified (Table 3). Cross GSM-22 x SI-331517 showed desirable standard heterosis for seed yield per plant along with other six traits *viz.*, plant height, capsule bearing plant height, internode distance, capsule length, number of nodes on main stem and1000 seed weight, while IC-413204 x S-0434 showed desirable heterosis for seed yield per plant along with other six traits *viz.*, days to 50 per cent flowering, internode distance, plant height, capsule bearing plant height, number of nodes on main stem and number of capsules on main stem. Cross IC-413204 x KMS-5-873 had shown desirable relative heterosis for seed yield per plant along with plant height for first capsule, number of nodes for first capsule and internode distance, whereas cross IC-413202 x S-0434 showed desirable relative heterosis for seed yield per plant along with other four traits *viz.*, days to maturity, capsule bearing plant height, capsule length, number of capsules on main stem (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.*, GSM-22 x SI-331517, IC-413204 x S-0434, IC-413204 x KMS-5-873 and IC-413202 x S-0434 may be tested in large scale trail to confirm the superiority for heterosis.

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Table 1. Analysis of variances (mean squares) for sixteen quantitative traits in sesame

Source	Replication	Crosses	Parent	Crosses Vs parents	Error
df	2	47	13	1	122
D 50 % Flowering	0.3293	22.5994	35.2917*	5.9583	16.5989
Days to maturity	2.0612	69.1263	151.2527	139.9219	85.2542
Plant height (cm)	5.6954	306.0628**	271.9502**	22.3506	99.5918
Plant height for first capsule (cm)	0.6907	106.4479**	232.0132**	226.604**	4.8444
Capsule bearing plant height (cm)	3.8836	156.2603**	60.4914*	17.7419	31.9288
Number of primary branches	0.0032	1.724**	1.2905**	0.6308	0.1899
Inter node distance (cm)	0.0009	0.2109**	0.5121**	1.5926**	0.1045
Capsule length (cm)	0.0047	0.1387*	0.0222	0.0245	0.0816
Number of nodes on main stem	0.7748	58.4064**	51.4914**	58.145*	9.4586
Number of nodes for first capsule	0.0166	2.2602**	4.8079**	0.4059	0.3998
Number of capsules on main stem	2.7429	91.7622**	59.4804**	27.5858	11.4456
Number of capsules per plant	16.5156	1969.2998**	1190.0679**	1583.591**	104.9959
Number of seeds per capsule	2.628	89.3384	83.3509	246.1073	73.0252
Seed yield per plant (g)	0.7759	41.5843**	25.1445**	23.0019**	1.8411
1000 seed weight (g)	0.0003	0.1372**	0.0931**	0.1067*	0.0204
Oil content (%)	0.2815	85.1113**	18.3864*	416.7767**	8.8016

*Significance at 5% and **Significance at 1% level

Table 2. Mean, relative heterosis, heterobeltiosis and standard heterosis (per cent) for seed yield per plant in sesame

Cross	Mean (g/plant)	Relative heterosis	Heterobeltiosis	Standard heterosis
ES-111-284 x KSM-5-343	11.82	38.08 **	19.15	103.79 **
ES-111-284 x SI-331517	10.10	35.57 **	31.17 *	74.14 **
ES-111-284 x KMR-116	8.54	7.02	-2.51	47.24 *
ES-111-284 x KMS-5-873	5.66	1.98	-21.39	-2.41
ES-111-284 x S-0434	8.70	-1.14	-16.35	50.00 *
ES-111-284 x Lalguda local	9.66	2.22	-17.44	66.55 **
IC-413231 x KSM-5-343	9.10	4.48	-8.27	56.90 **
IC-413231 x SI-331517	10.26	35.00 **	33.25 *	76.90 **
IC-413231 x KMR-116	7.74	-4.80	-11.64	33.45
IC-413231 x KMS-5-873	4.28	-24.91	-42.93 **	-26.21
IC-413231 x S-0434	6.50	-27.37 *	-37.50 **	12.07
IC-413231 x Lalguda local	5.40	-43.75 **	-53.85 **	-6.90
IC-413208 x KSM-5-343	4.16	-55.79 **	-58.06 **	-28.28
IC-413208 x SI-331517	5.22	-37.11 **	-41.35 **	-10.00
IC-413208 x KMR-116	9.32	5.55	4.72	60.69 **
IC-413208 x KMS-5-873	5.94	-7.19	-33.26 **	2.41
IC-413208 x S-0434	9.50	-1.55	-8.65	63.79 **
IC-413208 x Lalguda local	5.40	-47.57 **	-53.85 **	-6.90
IC-413204 x KSM-5-343	6.70	-17.59	-32.46 **	15.52
IC-413204 x SI-331517	9.52	35.61 **	23.64	64.14 **
IC-413204 x KMR-116	5.94	-21.32	-32.19 *	2.41
IC-413204 x KMS-5-873	9.32	82.03 **	47.00 **	60.69 **
IC-413204 x S-0434	15.30	82.80 **	47.12 **	163.79 **
IC-413204 x Lalguda local	10.70	18.63	-8.55	84.48 **
IC-413209 x KSM-5-343	5.28	-36.08 **	-46.77 **	-8.97
IC-413209 x SI-331517	8.00	11.89	3.90	37.93
IC-413209 x KMR-116	5.74	-25.26 *	-34.47 **	-1.03
IC-413209 x KMS-5-873	7.26	38.29 *	10.00	25.17
IC-413209 x S-0434	8.20	-3.53	-21.15 *	41.38 *
IC-413209 x Lalguda local	8.10	-11.48	-30.77 **	39.66 *
IC-413202 x KSM-5-343	9.44	27.40 *	-4.84	62.76 **
IC-413202 x SI-331517	9.62	52.70 **	24.94	65.86 **
IC-413202 x KMR-116	4.14	-39.39 **	-52.74 **	-28.62
IC-413202 x KMS-5-873	8.10	84.09 **	65.31 **	39.66 *
IC-413202 x S-0434	12.38	61.83 **	19.04	113.45 **
IC-413202 x Lalguda local	8.00	-3.61	-31.62 **	37.93
GSM-22 x KSM-5-343	14.80	17.83 *	-2.63	155.17 **
GSM-22 x SI-331517	16.90	47.60 **	11.18	191.38 **
GSM-22 x KMR-116	7.18	-40.07 **	-52.76 **	23.79
GSM-22 x KMS-5-873	14.20	48.69 **	-6.58	144.83 **
GSM-22 x S-0434	14.83	15.86 *	-2.43	155.69 **
GSM-22 x Lalguda local	15.70	16.73 *	3.29	170.69 **
SI-3218 x KSM-5-343	14.95	50.10 **	49.50 **	157.76 **
SI-3218 x SI-331517	14.02	58.42 **	40.20 **	141.72 **
SI-3218 x KMR-116	7.10	-24.31 *	-29.00 **	22.41
SI-3218 x KMS-5-873	5.82	-16.26	-41.80 **	0.34
SI-3218 x S-0434	17.00	66.67 **	63.46 **	193.10 **
SI-3218 x Lalguda local	16.90	55.76 **	44.44 **	191.38 **

*Significance at 5% and **Significance at 1% level

Table 3. List of hybrids showing standard heterosis for seed yield per plant along with other characters in sesame

Cross	Characters
GSM-22 x SI-331517	Plant height, capsule bearing plant height, internode distance, capsule length, number of nodes on main stem and1000 seed weight
IC-413204 x S-0434	Days to 50 per cent flowering, internode distance, plant height, capsule bearing plant height, number of nodes on main stem and number of capsules on main stem.
IC-413204 x KMS-5-873	Plant height for first capsule, number of nodes for first capsule and internode distance
IC-413202 x S-0434	Days to maturity, capsule bearing plant height, capsule length, number of capsules on main stem