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Heterosis studies for seed yield and its component traits in sesame [*Sesamum indicum* (L.)]

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Abstract

Heterosis for seed yield and its components was studied in a set of line × tester crosses of eight lines and four testers. Analysis of variance revealed significant differences among the genotypes for all the characters, indicating the presence of sufficient variability in the experimental material for all the characters studied. Differences among parents were also found highly significant for all the characters. The differences among hybrids were also found significant for all the characters suggesting the presence of sufficient diversity among hybrid themselves for all the characters. While, differences among the parents vs hybrids were also found significant for seven characters *viz*., plant height, height to first capsule, number of capsules per leaf axil, width of capsule, number of seeds per capsule, number of capsules per plant, 1000-seed weight, oil content and seed yield par plant. Heterosis was worked out over better parent and standard check variety, GT-6. The standard heterosis for seed yield per plant ranged from -21.938 to 36.759%. The crosses AT 522 x GT 3, IC 204528 x AT 338 and N 62-39 x AT 338 were good heterotic combinations for seed yield per plant, which recorded 42.60, 33.06 and 17.96% standard heterosis, respectively. The heterosis for seed yield per plant was associated with the heterosis expressed by its component characters.

Keywords: Line x tester, heterosis, heterobeltiosis, standard heterosis, sesame

Introduction

Sesame (*Sesamum indicum* L.) is a member of the order Tubiflorae and family Pedaliaceae with chromosome number 2n=26. It is probably the most ancient oilseed known and used by man and its domestication is lost in the mists of antiquity. Although originated in Africa, it spread early through West Asia to India, China and Japan which themselves became secondary distribution centres (Weiss, 1983) [19]. Among the oilseed crops, sesame has been cultivated for centuries, particularly in Asia and Africa for its high content of edible oil and protein. Sesame is also known as gingelly, gergelin, senniseed, simsim, etc. Sesame contains about 50-60% seed oil (Uzun *et al*., 2002) [16], which is of superior quality. It is called as the “Queen of oil seeds” because of its excellent qualities of the seed, oil and meal. Its oil contains an antioxidant called “Sesamol”, which imparts a high degree of resistance against oxidative rancidity and has a reducing effect on the plasma cholesterol and in conjunction with blood presser-lowering medicine, it also lowers the blood pressure (Shankar *et al.*, 2005) [13]. Sesame seed is rich in fat, protein, carbohydrates, fiber and some minerals. The oil is renowned for its stability because it strongly resists oxidative rancidity even after long exposure to air and sesame seeds are also known as the “seeds of immortality” (Bedigian and Harlan, 1986) [2]. Despite its importance as an oilseed crop, research on sesame has been scarce (Bedigian, 2003) [3].

Most of the high yielding varieties in sesame were developed through hybridization followed by selection. Although these varieties, gave higher yields, the potentiality of these varieties could not be improved significantly. Some of F_1 hybrids excel the improved variety by 50% or more. Hence, hybrid breeding appears to be promising in achieving the yield breakthrough required. Before going for a hybrid breeding programme, heterosis should be assessed for yield and yield contributing traits. Being an autogamous crop, sesame has not so far been amenable for heterosis breeding due to lack of economic method for large scale seed production. For commercial exploitation of heterosis, the basic requirements are identification of parents which show good heterosis and development of male sterility system to reduce the cost of hybrid seed. However, stable male sterile lines have not yet been

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developed in India (Ranganatha *et al*., 2012) [11].

Nevertheless, manual emasculation and pollination for the production of hybrids in sesame is the preferred route. This is possible because of epipetalous flower, easy emasculation and pollination, high number of seeds produced per flower, low seed rate and high multiplication ratio for manual seed production (Jadhav and Mohir, 2013) [9]. Heterosis of small amount for individual yield contributing characters may have an additive or synergistic effect on the end product (Sasikumar and Sardana, 1990) [12]. Therefore, the present study was undertaken to study the extent of heterosis for quantitative traits in sesame

Materials and Methods

The current investigation on sesame consisted of 44 genotypes, a line x tester set of twelve (8 lines and 4 testers) parentsand their 32 crosses. The experiment was laid out in randomized complete block design (RCBD) with three replications at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh (Gujarat) during *kharif*-2022. Observation were recorded for thirteen traits of five representative plants in each replication on Days to 50% flowering, Days to maturity (DM), Plant height (cm) (PH), Height to first capsule (HC), Number of branches per plant (NBPP), Number of capsules per plant (NCP), Length of capsule (cm) (LC), Width of capsule (cm) (WC), number of seeds per capsule (NSPC), Number of capsules per leaf axil (NCPL), 1000-seed weight (g) (TW), Oil content% (OC) and Seed yield per plant (g) (SYP). Data was analysed according to the model given by Kempthorne (1957) [9] to study combining ability variances and effects.

Heterobeltiosis

It was calculated as the deviation of F_1 from the better parent (Fonesca and Patterson, 1968) [8] and was expressed as per cent basis by the following formula:

$$\text{Heterobeltiosis (\%)} = \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} \times 100$$

Standard heterosis

It was calculated as the deviation of F_1 from the standard check (GT-6) and expressed as per cent basis by the following formula:

$$\text{Standard heterosis (\%)} = \frac{\overline{F_1} - \overline{SC}}{\overline{SC}} \times 100$$

Results and Discussion

Analysis of variance for experimental design revealed significant differences among genotypes and hybrids for all the traits indicating the presence of sufficient amount of genetic variability for all the traits under study. The mean square due to parents as well as hybrids were also found highly significant for all the characters studied indicating substantial amount of genetic variability present among parents and hybrids, respectively for all the thirteen traits. The mean square due to parent *vs* hybrids comparison was also found highly significant for the most of characters except days to 50% flowering, days to maturity, number of branches per plant and length of capsule (cm). Significant mean square for most of the traits indicating the presence of considerable genetic diversity in the material studied. Similar results were reported by Virani *et al.* (2017) [15].

The details on range of heterobeltiosis and standard heterosis as well as number of hybrids having significant heterosis are presented in Table 2. The extent of heterosis for days to 50% flowering varied from -7.408 to 7.408%, where nine crosses exceeded the standard heterosis in desirable direction. Two crosses surpassed the standard parent for days to maturity in which heterosis ranged from -5.735 to 8.244. These findings are in consonance with Chaudhari *et al.* (2017) [4], Vekariya and Dhaduk (2018) [17] and Chauhan *et al.* (2019) [5]. The crosse AT 482 x GT 3 could be exploited for this trait.

The characters contributing towards vegetative growth such as plant height and number of branches per plant exhibited heterosis upto -8.233 to 11.912and 27.869 to 86.886%, respectively. The results are in concurrence with the findings of Virani *et al.* (2017) [15] and Vekariya and Dhaduk (2018) [18,17]. A desirable degree of vegetative growth is essential for realizing high yield as total dry matter production is one of the components deciding high seed yield in crop plants. Out of 32 crosses, nine crosses showed significant positive standard heterosis for the length of capsule, in which heterosis ranged from -4.983 to 6.142% respectively. A total of four hybrid for number of capsules per plant, four hybrids for number of seeds per capsule and 22 hybrids for 1000-seed weight hybrids showed significant positive standard heterosis. Similar results have been reported for these characters by Vekariya and Dhaduk (2018) [17] and Dela and Sharma (2019) [7].

The hybrid vigour for seed yield per plant varied -21.938 to 36.759%. A total of three hybrids registered significant standard heterosis for seed yield per plant. The highest value for heterosis was displayed by the cross AT-522 × GT-3. Heterosis for seed yield has been reported by Vekariya and Dhaduk (2018) [17], Chauhan *et al.* (2019) [5], Chemeda*et al.* (2019) [6] and Dela and Sharma (2019) [7]. Heterosis in case of oil content varied from -5.597 to3.451%. Four crosses registered positive standard heterosis out of 45 hybrids. Vekariya and Dhaduk (2018) [17] also reported significant positive heterosis for this trait.

The crosse AT-522 x GT -3 which showed high heterosis for seed yield per plant also had high heterosis for number of capsules per plant, number of seeds per capsule, 1000-seed weight (g) and oil content (%). The results thus, revealed that the heterosis for seed yield per plant was associated with the heterosis expressed by its component characters (Table 3). Likewise, the cross AT 482 x AT 338 also showed desirable sca effect for number of seeds per capsule, oil content (%) and seed yield per plant (g).

Table 1: Analysis of variance (mean square) for line × tester design for seed yield and its contributing characters in sesame

Sources of variation	d.f.	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Height to first capsule (cm)	Number of capsules per plant	Length of capsule (cm)
Replications	2	11.143	19.795	23.130	0.165	5.887*	16.522	0.010
Genotypes	43	14.651**	25.866**	57.750**	0.390**	6.892**	133.209**	0.011**
Parents:	11	21.037**	36.626**	62.427**	0.596**	8.017**	139.134**	0.008*
P. *vs* H.	1	8.593	4.470	565.957**	0.071	19.321**	225.365**	0.001
Hybrids	31	12.580**	22.738**	39.697**	0.327**	6.092**	128.134**	0.012**
Error	86	3.965	7.291	14.548	0.117	1.888	22.138	0.003

Sources of variation	d.f.	Width of capsule (cm)	Number of seed per capsule	Number of capsules per leaf axil	1000-seed weight (g)	Oil content (%)	Seed yield per plant (g)
Replications	2	0.002	17.026	0.083*	0.098	0.905	1.436
Genotypes	43	0.003**	24.577**	0.173**	0.318**	5.264**	3.204**
Parents:	11	0.008**	20.409**	0.1655**	0.135**	7.327**	2.694**
P. *vs* H.	1	0.013**	38.337**	0.738**	0.388**	43.220**	7.712**
Hybrids	31	0.002**	25.613**	0.158**	0.380**	3.307**	3.240**
Error	86	0.001	8.062	0.025	0.040	0.316	0.467

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

Table 2: Range of heterobeltiosis and standard heterosis with number of significant crosses in positive and negative direction over better parent and standard check for various characters in sesame

Sr. No.	Characters	Desirable aspect	Range of heterosis		Number of crosses with significant heterosis			
					H_1		H_2	
			H_1 (%)	H_2 (%)	+ve	-ve	+ve	-ve
1	Days to 50% flowering	Early	-9.091 to 13.282	-7.408 to 7.408	7	3	4	9
2	Days to maturity	Early	-3.943 to 10.623	-5.735 to 8.244	12	3	5	2
3	Plant height (cm)	High	-10.296 to 15.188	-8.233 to 11.912	13	2	5	2
4	Number of branches per plant	High	-31.148 to 18.605	27.869 to 86.886	5	11	32	0
5	Height to first capsule (cm)	Low	-5.643 to 25.789	-17.033 to 11.226	12	0	3	5
6	Number of capsules per plant	More	-47.121 to 43.000	-36.349 to 23.284	5	8	4	20
7	Length of capsule (cm)	High	-5.530 to 3.270	-4.983 to 6.142	2	6	9	3
8	Width of capsule (cm)	High	-17.533 to 5.448	-4.725 to 9.449	2	18	10	1
9	Number of seeds per capsule	More	-12.935 to 7.689	-7.488 to 15.894	3	13	4	4
10	Number of capsules per leaf axil	More	-44.596 to 11.833	-57.212 to -19.457	1	23	0	32
11	1000 seed weight (g)	High	-24.837 to 22.905	-11.150 to 32.508	9	5	22	2
12	Oil content (%)	High	-5.966 to 2.864	-5.597 to 3.451	7	11	4	18
13	Seed yield per plant (g)	High	-30.853 to 34.886	-21.938 to 36.759	7	8	8	6

+ve = Positive and -ve = Negative

Conclusion

It can be concluded from present investigation that AT 522 x GT 3, IC 204528 x AT 338 and N 62-39 x AT 33were found to be the more heterotic cross combinations for seed yield and yield contributing traits on the basis of *per se performance* and heterosis over standard check. Therefore, these crosses may be advanced and exploited in future breeding programmes for improving yield and its components in sesame.

References

1. Bedigian D. Evolution of sesame revisited: domestication, diversity and prospects. Genet Resour Crop Evol. 2003;50:779-787.
2. Bedigian D, Harlan JR. Evidence for cultivation of sesame in the ancient world. Econ Bot. 1986;40(2):137-154.
3. Chemeda D, Ayana A, Wakjira A, Zeleke H. Heterosis in sesame (*Sesamum indicum* L.) hybrids of diverse parental lines for agro-morphology characters in Ethiopia. East Afr J Sci. 2019;13(1):39-50.
4. Chaudhary MH, Patel SR, Chaudhari VB, Nayak AJ. Studies on the magnitude of heterosis for seed yield and its components in sesame (*Sesamum indicum* L.). Int J Dev Res. 2017;7(8):14282-14288.
5. Chauhan BB, Gami RA, Prajapati KP, Patel JR, Patel RN. Study of per se performance and heterosis for seed yield and component traits in sesame (*Sesamum indicum* L.). Curr Agric Res J. 2019;7(3):408-416.
6. Dela GJ, Sharma LK. Heterosis for seed yield and its components in sesame (*Sesamum indicum* L.). J Pharmacogn Phytochem. 2019;8(4):1345-1351.
7. Fonseca S, Patterson FL. Hybrid vigour in seven parental diallel cross in common winter wheat (*Triticum aestivum* L.). Crop Sci. 1968;8:85-88.
8. Jadav RS, Mohrir MN. Heterosis studies for quantitative traits in sesame (*Sesamum indicum* L.). Electron J Plant Breed. 2013;4(1):1056-1060.
9. Kempthorne O. An Introduction to Genetic Statistics. New York: John Wiley and Sons Inc.; c1957. p. 545.
10. Ranganatha ARG, Lokesha R, Tripathy A, Tabassum A, Shrivastava MK. Sesame improvement: present status and future strategies. J Oilseeds Res. 2012;29(1):1-26.
11. Sasikumar B, Sardana S. Heterosis for yield and yield components in sesame (*Sesamum indicum* L.). Indian J Genet. 1990;50:45-49.
12. Shankar D, Sambandam G, Rao RM, Pugalendi KU. Modulation of blood pressure, lipid profiles and redox status in hypertensive patients taking different edible oils. Clin Chim Acta. 2005;355:97-104.
13. Uzun B, Ulger S, Cagirgan MI. Comparison of determinate and indeterminate types of sesame for oil content and fatty acid composition. Turk J Agric For. 2002;26:269-274.
14. Vekariya VC, Dhaduk LK. Heterosis for seed yield and its components in sesame (*Sesamum indicum* L.). J Pharmacogn Phytochem. 2018;7(5):956-958.
15. Virani MB, Vachhani JH, Kacchadia VH, Chavadhari RM, Mungra RA. Heterosis studies in sesame (*Sesamum indicum* L.). Electron J Plant Breed. 2017;8(3):1006-1012.
16. Weiss EA. Oilseeds Crops. New York: Longman; c1983.