International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating: 5.29
IJABR 2025; 9(7): 416-419
www.biochemjournal.com
Received: 02-04-2025
Accepted: 06-05-2025

Nunsavath Srinivas
Department of Genetics and Plant Breeding, College of Agriculture, Dharwad, University of Agricultural Sciences, Dharwad, Karnataka, India

Parameshwarappa SG
Deputy Directorate of Research, University of Agricultural Sciences, Dharwad, Karnataka, India

MD Ashfaq
Department of Genetics and Plant Breeding Agricultural College Jagtial, PJTSAU, Hyderabad, Telangana, India

Corresponding Author:
Nunsavath Srinivas
Department of Genetics and Plant Breeding, College of Agriculture, Dharwad, University of Agricultural Sciences, Dharwad, Karnataka, India

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

Nunsavath Srinivas, Parameshwarappa SG and MD Ashfaq

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i7f.4760

Abstract
Heterosis for seed yield and its components was studied in a set of line x tester crosses of 10 lines and 3 testers. The analysis of variance revealed highly significant differences among the genotypes for all the characters indicating that the genotypes exhibited significant differences for all the characters studied. The differences among the hybrids were also found highly significant for all the characters suggesting the presence of sufficient diversity among hybrids themselves for all the characters. The range of heterobeltiosis for seed yield per plant was from-10.6 to 29.56 percent, while the standard heterosis ranged from-7.74 to 40.35 percent. The cross DSM-34 X TKG-22 had recorded the highest standard heterosis for seed yield per plant followed by KMS-5-391 X TKG-22, DSM-33 X DS-5 and DSM-33 X JTS-8. These crosses also displayed favorable heterosis in key yield characteristics, indicating that the heterosis observed in seed yield can be attributed to the heterosis seen in its constituent traits. This presents an opportunity for further utilization in sesame breeding.

Keywords: Heterosis, hybrids, line x tester, seed yield and sesame

Introduction

Sesame (*Sesamum indicum* L., 2n=2x=26), known by various names such as sesamum, til, gingelly etc, holds the distinction of being the world's oldest spice and oilseed crop. Its origins trace back to tropical and subtropical regions, belonging to the Pedaliaceae family. Sesame is an annual, self-pollinated oilseed plant. It has been cultivated in Asia for more than 5000 years, as documented by Bisht *et al.* in 1998 [2]. The primary focus of sesame cultivation is its seeds, which possess around 50 percent oil content and 25 percent protein content. These seeds are a source of the antioxidants *viz*., sesamolin and sesamin. Notably, even though oleic and linoleic acids make up approximately 80 percent of sesame oil's total fatty acids, the oil remains remarkably resistant to oxidative degradation, as established by Uzun *et al.* in 2008 [14]. The abundant presence of unsaturated fats enhances the suitability of sesame oil for human consumption. Sesamum is regarded as the 'Queen of Oilseeds' due to its stable oil with a unique sweet flavor, yields an oil of exceptional medicinal quality when extracted from its seeds.

Globally sesame ranks as the sixth most significant oilseed crop. Among the nations engaged in sesame cultivation, Myanmar stands out as the foremost global producer of this crop. Within India, sesame cultivation spans an area of 1.62 million hectares, resulting in a production of 0.78 million tonnes and a productivity level of 485 kg/ha, according to the data from indiastat for the 2021-2022 period. In the state of Karnataka, sesame is grown on an area of 0.35 lakh hectares, resulting in a production of 0.23 lakh tonnes and a productivity rate of 754 kg/ha, as per the data presented in indiastat, 2021-2022. The primary cause behind the lower productivity levels of this crop can be attributed to its cultivation in less fertile and marginal soils, use of local varities, combined with inadequate agricultural management techniques. This underscores the urgent necessity for enhancing the crop's productivity by developing superior high yielding varieties or hybrids, contingent upon the accessibility of enhanced yields.

Material and Methods

The present experiment was conducted at Botany garden, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka. The base material comprised of ten lines *viz*., IC413201, JLSG-06-08, DSM-33, DSM-91, DSM-34, IC413248, KMS-5-391, NIC-7979, DSM-9 and DSM-81 and three testers viz., DS-5, JTS-8 and TKG-22. Total thirty hybrids were produced using ten lines and three testers in Line x Tester mating design. The experimental material consisting of 43 entries involving 30 hybrids and their parents was sown in a RCBD design consisting of two replications during *Kharif* 2022. Each replication contained single row of each of forty three entries. Row length was four meter and the inter and intra row spacings followed were 30 cm and 15 cm, respectively.

The complete set of forty three entries including three checks DS-5(Local check), JTS-8 (Zonal check) and TKG-22 (National check) were evaluated for estimating heterosis in sesame. Observations were documented from five randomly selected plants in the parents and hybrids for ten quantitative traits *viz*., days to 50 percent flowering, days to maturity, plant height (cm), number of branches per plant, number of capsules per plant, the number of seeds per capsule, capsule length (cm), 1000 seed weight (g), seed yield per plant (g) and oil content (%).

Results and Discussion

The analysis of variance for the mean sum of squares for parents showed significant differences for almost all characters studied indicating the presence of sufficient variability among parents (Table 1). The variances due to lines and testers were significant for most the traits. Likewise, the difference among the parent's vs hybrids was significant for all the studied traits. This significant difference between hybrids vs parents showed the presence of heterosis.

The main aim of heterosis in the present study was to search out the best combination of parents giving high degree of heterosis and its exploitation to get superior hybrids. The degree of heterosis varied from cross to cross for all the studied traits. High heterosis in certain crosses and low in others revealed that nature of gene action varied with the genetic makeup of the individual parents (Table 2).

In sesame, earliness in flowering is a desirable trait. Significant and desirable (negative) estimates of heterobeltiosis were observed in eleven cross and two hybrids exhibited significant and negative standard heterosis. The standard heterosis values ranged from-15.05 (DSM-33 X DS-5 and NIC-7979 X JTS-8) to 1.08 percent (IC413248 X JTS-8) for days to 50 percent flowering and for days to maturity standard heterosis varied from-6.78 (DSM-33 X TKG-22, DSM-91 X DS-5) to 2.26 percent (DSM-91 X JTS-8). Similar findings have been reported by Jadhav and Mohrir (2013) [3], Vavdiya *et al.* (2014) [5], Kumar *et al.* (2015) [7] and Karande *et al.* (2018) [6].

For plant height Positive heterosis over standard check was observed in seven hybrids which ranges from 1.04 (DSM-9 X DS-5) to 10.70 percent (DSM-34 X JTS-8). The hybrid DSM-34 X JTS-8 exhibited the highest significant and positive standard heterosis (10.70%) followed by DSM-33 X JTS-8(9.56%). Jawahar *et al.* (2013) [4] reported similar results for this trait. For number of branches per plant, three hybrids over better parent and three hybrids over standard check exhibited significant and positive heterosis. Standard heterosis ranged from from-22.27 percent (DSM-81 X DS-5) to 13.87 percent (IC413201 X TKG-22). Similar results were noted by Parameshwarappa and Salimath (2010) [10].

The number of capsules per plant is a crucial quantitative trait that exerts a significant influence on seed yield per plant to a considerable extent in sesame. The highest level of standard heterosis percent observed in the hybrid DSM-33 X JTS-8 (21.09) followed by DSM-34 X JTS-8 (14.67). These findings were in consonance with Ozahely *et al.* (2020) [9]. The number of seeds per capsule is another crucial quantitative trait that directly contributes to seed yield per plant. The hybrids DSM-33 X JTS-8 (13.47) and DSM-34 X JTS-8 (13.17) showed high positive significant heterosis over standard check. These findings were in consonance with Kumar *et al.* (2015) [7].

The capsule length in sesame plays a significant role in influencing the number of seeds per capsule. The hybrid DSM-9 X DS-5 (14.21) recorded the highest positive heterosis over standard check followed by DSM-33 X TKG-22 (10.18) and DSM-9 X JTS-8 (9.47). These results are similar with Jeeva *et al.* (2020) [5]. 1000-seed weight is crucial characteristic that exhibits a direct and positive correlation with seed yield (Shekhara and Reddy, 1993) [13]. The hybrid KMS-5-391 X JTS-8 (10.80) recorded highest positive heterosis over standard check followed by IC413201 X TKG-22 (6.55) and KMS-5-391 X DS-5 (5.89). Rathod *et al.* (2023) [11] reported similar results for this trait.

For oil content ten hybrids expressed significant positive heterosis over standard check. The hybrid combination DSM-81 X TKG-22 (5.43) exhibited highest positive heterosis followed by NIC-7979 X JTS-8 (3.78) and DSM-91 X DS-5(3.55). These findings were align with Vekariya and Dhaduk (2018) [16]. In terms of seed yield per plant, five hybrids demonstrated significant and positive heterosis over standard check. The hybrid DSM-34 X TKG-22 (40.35) showed highest significant positive heterosis over standard check followed by KMS-5-391 X TKG-22 (31.51), DSM-33 X DS-5 (30.17), DSM-33 X JTS-8 (28.04) and KMS-5-391 X JTS-8 (27.54). These results were in contrast with Sandhya *et al.* (2021) [12] and Nehra *et al.* (2021) [8] reported standard heterosis ranged between-25.6% to 49.53% for seed yield per plant in sesame.

Table 1: Mean sum of squares for parents and hybrids in respect of ten characters in sesame (*Sesamum indicum* L.)

Source of variation	d.f	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Number of seeds per capsule	Capsule length (cm)	1000-seed weight (g)	Oil content (%)	Seed yield per plant (g)
Replications	1	2.97	10.46	32.04	0.01	8.01	1.93	0.03	0.02	0.00	1.65
Genotypes	42	7.84**	11.40**	56.43**	0.23**	41.46**	43.94**	0.24**	0.12**	12.31**	2.71**
Parents	12	4.37**	11.32**	25.42**	0.13**	30.45**	27.17**	0.13	0.06	3.33**	0.49**
Lines	9	2.31	10.53**	29.97**	0.14**	30.35**	28.65**	0.12	0.04	4.24**	0.63**
Testers	2	0.66	8.66**	13.15**	0.08	26.79**	15.32**	0.03	0.05	0.73**	0.07
Lines vs Testers	1	30.40**	23.71**	9.02	0.10**	38.63**	37.53**	0.49**	0.30	0.34	0.06
Hybrids	29	8.47**	10.41**	70.97**	0.27**	47.24**	51.09**	0.25**	0.12**	15.79**	3.08**
Parent vs Hybrids	1	31.08**	41.16**	6.76	0.38**	6.13	37.88**	1.18**	0.98**	19.15**	18.88**
Error	42	1.45	2.58	20.73	0.04	15.72	14.70	0.03	0.01	0.29	0.95

* _ Significant at 5% level of probability ** _ Significant at 1% level of probability

Table 2: Better parent heterosis and standard heterosis for quantitative traits in sesame (*Sesamum indicum* L.)

SL. No	Hybrids	DFF		DM		PH		NBP		NCP	
		BPH	SH	BPH	SH	BPH	SH	BPH	SH	BPH	SH
1	IC 413201 X DS-5	-13.98 **	-13.98 **	-3.39	-3.39	-8.30	-8.30	-8.38	-8.38	-6.51	-6.51
2	IC 413201 X JTS-8	-3.30	-5.38 *	-1.70	-2.26	5.40	-0.16	11.27	3.40	-10.63	-3.65
3	IC 413201 X TKG-22	-6.45 *	-6.45 *	-3.28	0.00	-3.19	-4.96	10.13	13.87 *	-1.58	-2.60
4	JLSG-06-08 X DS-5	-11.83**	-11.83 **	-3.37	-2.82	-1.10	-1.10	6.02	6.02	-15.45 *	-15.45 *
5	JLSG-06-08 X JTS-8	0.00	-2.15	-3.93 *	-3.39	2.97	-2.14	9.86	2.09	-13.04	-6.25
6	JLSG-06-08 X TKG-22	-13.98 **	-13.98 **	-7.65 **	-4.52 *	-9.89	-11.54 *	-8.86	-5.76	6.47	1.39
7	DSM-33 X DS-5	-15.05 **	-15.05 **	-6.21 **	-6.21 **	7.15	7.15	2.09	2.09	6.60	6.60
8	DSM-33 X JTS-8	-3.30	-5.38 *	-1.71	-2.82	13.41 *	9.56	6.58	6.02	12.32	21.09 **
9	DSM-33 X TKG-22	-6.45 *	-6.45 *	-9.84 **	-6.78 **	-1.70	-3.50	-12.66*	-9.69	2.76	0.35
10	DSM-91 X DS-5	-9.68 **	-9.68 **	-6.78 **	-6.78 **	-11.23 *	-11.23 *	-20.16 **	-20.16 **	-22.22 **	-22.22 **
11	DSM-91 X JTS-8	-5.49 *	-7.53 **	3.43	2.26	4.52	-0.99	1.37	-3.14	-7.57	-0.35
12	DSM-91 X TKG-22	-9.68 **	-9.68 **	-8.20 **	-5.08 **	1.28	-0.57	-15.19 **	-12.30 *	-4.19	-8.77
13	DSM-34 X DS-5	-7.53 **	-7.53 **	-5.65 **	-5.65 **	-4.89	-3.50	11.69 *	12.57 *	-6.47	-0.87
14	DSM-34 X JTS-8	-1.10	-3.23	-1.71	-2.82	9.11	10.70 *	10.39	-9.69	6.36	14.67 *
15	DSM-34 X TKG-22	-3.23	-3.23	-3.28	0.00	-5.92	-4.54	-2.53	0.79	7.19	13.54*
16	IC 413248 X DS-5	-5.38 *	-5.38 *	-3.89 *	-2.26	-12.27 *	-12.27 *	-13.61 *	-13.61 *	-16.06 *	-16.06 *
17	IC 413248 X JTS-8	1.10	-1.08	-1.11	0.56	6.84	1.20	16.67 **	9.95	-10.23	-3.21
18	IC 413248 X TKG-22	-2.15	-2.15	-1.09	2.26	-3.40	-5.17	2.53	6.02	0.82	-3.99
19	KMS-5-391 X DS-5	-6.45 *	-6.45 *	-5.65 **	-5.65 **	-6.84	-6.84	2.56	4.71	-9.85	-8.59
20	KMS-5-391 X JTS-8	-4.40	-6.45 *	-2.84	-3.39	-7.63	-10.18 *	5.13	7.33	-2.33	5.30
21	KMS-5-391 X TKG-22	-6.45 *	-6.45 *	-3.83 *	-0.56	5.90	3.97	5.06	8.64	8.90	10.41*
22	NIC-7979 X DS-5	-13.98 **	-13.98 **	-3.37	-2.82	6.66	7.94	-4.45	-4.45	4.10	7.99
23	NIC-7979 X JTS-8	-13.19 **	-15.05 **	-5.62 **	-5.08 **	-7.43	-6.32	16.44 **	11.26 *	-6.44	0.87
24	NIC-7979 X TKG-22	-3.23	-3.23	-7.10 **	-3.95 *	-5.06	-3.92	-5.06	-1.83	-8.62	-5.21
25	DSM-9 X DS-5	-13.98 **	-13.98 **	-2.26	-2.26	-0.10	1.04	-12.99*	-12.30 *	-0.87	-0.87
26	DSM-9 X JTS-8	-10.99 **	-12.90 **	2.86	1.69	-10.07 *	-9.03	2.60	3.40	-6.60	0.69
27	DSM-9 X TKG-22	-2.15	-2.15	-6.01 **	-2.82	-5.52	-4.44	2.53	6.02	3.17	-1.04
28	DSM-81 X DS-5	-10.75 **	-10.75 **	-5.08 **	-5.08 **	-11.12 *	-11.12 *	-22.77 **	-22.77 **	-3.65	-3.65
29	DSM-81 X JTS-8	-6.59 *	-8.60 **	-1.14	-2.26	1.98	-3.39	16.90 **	8.64	-13.20 *	-6.42
30	DSM-81 X TKG-22	-3.23	-3.23	-8.74 **	-5.65 **	-0.11	-1.93	-6.33	-3.14	3.74	-1.22

DFF = Days to 50% flowering, DM= Days to maturity, PH= Plant height(cm), NBP= Number of branches per plant, NCP= Number of capsules per plant

Conclusion

The hybrids were exhibited high mean performance, high sca effects and high heterosis for more than one character *viz*., DSM-33 × DS-5 for days to 50 percent flowering, seed yield per plant and oil content, NIC-7979 × JTS-8 for days to 50 percent flowering, number of branches per plant and oil content, DSM-34 × TKG-22 for number of seeds per capsule and seed yield per plant. Hence these hybrids were identified as best potential heterotic hybrids and further these hybrids could be used as promising for commercial exploitation of heterosis in sesame.

References

1. Anonymous. Area, production and productivity of sesame. 2021-22. Available from: www.indiastat.com
2. Bisht IS, Mahajan RK, Loknathan TR, Agrawal RC. Diversity in Indian sesame collection and stratification of germplasm accessions in different diversity groups. Genetic Resources and Crop Evolution. 1998;45:325-335.
3. Jadhav RS, Mohrir MN. Heterosis studies for quantitative traits in sesame. Electronic Journal of Plant Breeding. 2013;4(1):1056-1060.
4. Jawahar LJ, Kuldeep SD, Sudheer K. Evaluation of sesame crosses for heterosis of yield and yield attributing traits. Journal of Tropical Agriculture. 2013;51(1-2):84-91.
5. Jeeva G, Saravanan K, Sowmiya CA. Assessment of combining ability and standard heterosis through diallel analysis in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2020;11(2):386-391.
6. Karande GR, Yamgar SV, Waghmode AA, Wadikar PB. Exploitation of heterosis for yield and yield contributing character in sesame (*Sesamum indicum* L.). International Journal of Current Microbiology and Applied Sciences. 2018;7(2):299-308.
7. Kumar N, Tikka SBS, Ram B, Dagla MC. Heterosis studies for agronomic trait under different environmental conditions in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2015;6(1):130-140.
8. Nehra A, Gothwal DK, Jeeterwal RC, Puniya SS, Gupta D, Ahmad S. The study of heterosis for seed yield and its attributes in sesame (*Sesamum indicum* L.) under normal environmental conditions of Rajasthan. The Pharma Innovation Journal. 2021;10(10):175-179.
9. Ozahely N, Vaddoria MA, Raval LJ, Maru DR, Hadvani JK. Heterosis for seed yield and its components in sesame (*Sesamum indicum* L.). The Pharma Innovation Journal. 2020;9(12):174-177.
10. Parameshwarappa SG, Salimath PM. Studies on combining ability and heterosis for yield and yield components in sesame (*Sesamum indicum* L.). Green Farming. 2010;3(2):91-94.
11. Rathod ST, Ghodke MK, Kalpande HV, Mehetre SP. Heterosis and *per se* performance studies in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2021;12(3):885-894.

12. Sandhya HR, Madhusudan K, Raveendra HR, Sahana SR. Exploitation of heterosis for seed yield and quality traits in sesame (*Sesamum indicum* L.). Biological Forum. 2021;13(3b):155-160.
13. Shekhara BC, Reddy CR. Correlation and path co-efficient analysis in sesame (*Sesamum indicum* L.). Annals of Agricultural Research. 1993;14:178-184.
14. Uzun B, Arslan Ç, Furat Ş. Variation in fatty acid compositions, oil content and oil yield in a germplasm collection of sesame (*Sesamum indicum* L.). Journal of the American Oil Chemists' Society. 2008;85(12):1135-1142.
15. Vavdiya PA, Dobariya KL, Babariya CA. Combining ability and gene action studies for seed yield and its components in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2014;5(4):688-694.
16. Vekariya VC, Dhaduk LK. Heterosis for seed yield and its components in sesame (*Sesamum indicum* L.). Journal of Pharmacognosy and Phytochemistry. 2018;7(5):956-958.