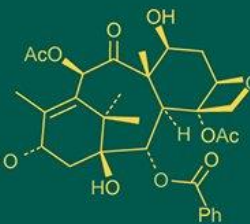
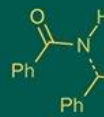
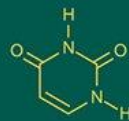
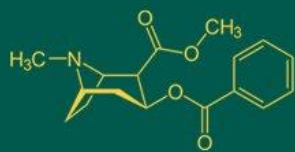


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(7): 2189-2195
www.biochemjournal.com
Received: 21-04-2026
Accepted: 23-05-2026

Rathod PS
Department of Agricultural
Botany, College of Agriculture,
Dr. Balasaheb Sawant Konkan
Krishi Vidyapeeth, Dapoli,
Maharashtra, India

Kunkerkar RL
Department of Agricultural
Botany, College of Agriculture,
Dr. Balasaheb Sawant Konkan
Krishi Vidyapeeth, Dapoli,
Maharashtra, India

Desai SS
Department of Agricultural
Botany, College of Agriculture,
Dr. Balasaheb Sawant Konkan
Krishi Vidyapeeth, Dapoli,
Maharashtra, India

Mane AV
Department of Agricultural
Botany, College of Agriculture,
Dr. Balasaheb Sawant Konkan
Krishi Vidyapeeth, Dapoli,
Maharashtra, India

Dodake SB
Department of Soil Science and
Agricultural Chemistry, College
of Agriculture, Dr. Balasaheb
Sawant Konkan Krishi
Vidyapeeth, Dapoli,
Maharashtra, India

Pethe UB
Department of Agricultural
Botany, College of Agriculture,
Dr. Balasaheb Sawant Konkan
Krishi Vidyapeeth, Dapoli,
Maharashtra, India

Karande GR
Department of Agricultural
Botany, College of Agriculture,
Vasanta Naik Marathwada
Krishi Vidyapeeth, Parbhani
(Latur Campus), Maharashtra,
India

Corresponding Author:
Rathod PS
Department of Agricultural
Botany, College of Agriculture,
Dr. Balasaheb Sawant Konkan
Krishi Vidyapeeth, Dapoli,
Maharashtra, India

Heterosis studies in sesame (*Sesamum indicum* L.) through line x tester analysis

**Rathod PS, Kunkerkar RL, Desai SS, Mane AV, Dodake SB, Pethe UB
and Karande GR**

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i7Sz.9383>

Abstract

The present investigation was conducted at Education and Research Farm, College of Agriculture, Dapoli (MH.) during Rabi 2024-25. The experimental materials comprised of 7 lines, 3 testers, 21 F₁'s made by using LxT mating design and 1 check viz., JLT 408 arranged in a Randomized Block Design with three replications. The analysis of variance revealed that the genotypic mean squares were highly significant for all studied characters. This stated that there was significant genetic variation among genotypes for every trait under study. Heterosis was worked-out over mid-parent; better parent and standard check JLT 408. The standard heterosis for seed yield per plant ranged from -26.82 to 144.08%. In present investigation highest significant positive heterosis was recorded by cross combinations JLT 408-2 X SHEKAR (144.08%) followed by AVTS 22-12 X JLS 907 (137.94%), AVTS 22-12 X SHEKAR (113.77%) over standard check and hence were found promising for seed yield per plant. Identified hybrids warrant further evaluation across locations, seasons and years to assess their suitability for commercial cultivation and release.

Keywords: Sesame, heterosis, mid-parent (MP), better-parent (BP) and standard check (SC)

Introduction

Sesame (*Sesamum indicum* L.), a diploid species with 2n = 26 chromosomes, is a significant oilseed crop in India. Classified under the Pedaliaceae family, it is often referred to as the 'Queen of Oilseeds' owing to its high oil content and distinctive nutty aroma and flavour. Sesame originated in Africa and subsequently spread to West Asia, India, China, and Japan, which became secondary centres of diversity (Weiss, 1983). Sesame is cultivated on 12.97 million hectares of land worldwide (FAOSTAT, 2024). Sesame is cultivated in eight Indian states: Rajasthan, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu, and Orissa. In India, sesame is cultivated over an area of 15.23 lakh hectares with a productivity of 527 kg/ha and production of 8.02 lakh tonnes (Indiastat, 2023). India holds a prominent position in the global oilseed scenario, accounting for 29% of the total area and 26% of production. In Maharashtra, for Kharif season the area under sesame crop is 3.85 thousand ha, production is 1.15 thousand tonnes and productivity is 227 kg/ha and for Rabi season area 1.32 thousand ha, production 0.92 thousand tonnes (Final advance estimates, Directorate of Economics and Statistics, GoM 2023-24) [29, 6, 9].

The utilization of hybrid vigour in sesame is contingent upon the degree of heterosis and the economic feasibility of large-scale hybrid seed production. Despite sesame being predominantly self-pollinating, notable cross pollination occurs (Mohammed *et al.*, 1965). Sesame shows high heterosis for yield traits, as reported by several studies. Sesame is particularly well-suited for commercial exploitation of heterosis due to several reasons like low seed rate, high seed multiplication ratio (1:150) and the epipetalous floral structure of sesame facilitate easy emasculation. In self-pollinated crops like sesame, exploiting heterosis holds significant potential. Out crossing diverse parents can break yield barriers, facilitating the development of new cultivars. Heterosis breeding become a significant tool for achieving higher yield and improved quality in sesame. In sesame the cost of hybrid seed production is low as compare to other oilseed crops hence exploiting hybrid vigour has become an effective method for sesame development.

Materials and Methods

The present investigation was carried out at Education and Research Farm, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (MH.) during Rabi 2024-25. The experimental materials comprised of ten parents out of which RMT 175, KMS 391, GT 10, JLS 710, AVTS-22-12, JLS 706 and JLT 408-2 were used as lines whereas, PT 1, SHEKAR and JLS 907 were used as testers. JLT 408 was used as standard check and 21 F₁'s were made by using LxT mating design. All the ten parents, standard check along with 21 F₁'s were raised in a Randomized Block Design with three replications. All the recommended package of practices was adopted for raising a healthy crop. Five randomly selected plants, from each plot of all the three replications were tagged and used for recording the observations on 13 traits viz., 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, length of capsule (cm), width of capsule (cm), 1000 seed weight (g), seed yield per plant (g), oil content (%), protein content (%) and carbohydrate content (%) and average values were computed across replications. The magnitude of heterosis was estimated in relation to mid parent, better parent and standard check values. They were thus, calculated as percentage increase or decrease of F₁s over the Mid-parent (MP), Better parent (BP) and Standard check (SC).

Results and Discussion

Analysis of variance (ANOVA)

The analysis of variance for various characters has been represented in Table 1. It showed that highly significant genotypic mean squares for all studied traits, indicating considerable genetic diversity among genotypes. Further, partitioning of genotypic variance into its components viz., parents, crosses and parents vs. crosses revealed highly significant differences for all the traits. This suggested that there were significant variations between the parents and crosses.

Heterosis

Days to 50% flowering

The negative and significant heterosis was desirable for the character days to 50% flowering. The average heterosis ranged from 6.25 (RMT 175 x SHEKAR) to 43.01% (JLS 706 x SHEKAR) whereas, heterobeltiosis ranged from 0.99 (RMT 175 x SHEKAR) to 36.63% (JLS 706 x SHEKAR) and heterosis over check JLT 408 ranged between 10.87 (RMT 175 x SHEKAR) to 55.43% (GT 10 x SHEKAR). None of the cross exhibited significant and negative average heterosis, heterobeltiosis or standard heterosis over check JLT 408.

Days to maturity: Negative heterosis for days to maturity indicated that the hybrids exhibited earliness. The ranges of heterosis were, average heterosis: -0.42 (RMT 175 x

SHEKAR) to 10.72% (KMS 391 x JLS 907), heterobeltiosis: -2.07 (RMT 175 x SHEKAR) to 10.48% (KMS 391 x JLS 907), Standard heterosis (JLT408): 0.87 (RMT 175 x PT 1) to 18.34% (GT 10 x SHEKAR). No cross exhibited significant negative relative heterosis, heterobeltiosis or heterosis over standard check JLT 408.

Plant height (cm)

The height of varieties or hybrids significantly impacts biomass production and economic yield. The ranges of heterosis were average heterosis: -19.87 (JLS 710 x JLS 907) to 8.85% (JLS 706 x JLS 907), heterobeltiosis: -20.00 (JLS 710 x JLS 907) to 8.67% (JLS 706 x JLS 907), heterosis over standard check (JLT 408): -6.25 (JLS 710 x JLS 907) to 33.20% (AVTS-22-12 x JLS 907). The significant positive heterosis showed by five crosses over mid parent, one cross showed positive heterosis over better parent and nineteen crosses showed significantly positive heterosis over check JLT 408. The significant positive heterosis over check was reported by Vavdiya et al. (2013). The significant negative heterosis in plant height was observed in five crosses. Similar findings were reported by Rajput et al. (2017), Vekariya and Dhaduk (2018) and Parameshwarappa et al. (2021) [25, 19, 26, 16].

Number of branches per plant

The number of branches is a key trait that substantially influences seed yield. Positively significant heterosis was desirable for this trait. Maximum and significant positive heterosis (100%) over mid parent and (90%) over better parent was found in cross JLS 706 x PT 1, whereas cross AVTS-22-12 x JLS 907 shown maximum significant positive heterosis (133.33%) over standard check JLT 408. Fourteen, seven and seventeen crosses showed significantly positive heterosis over mid parent, over better parent and over standard check JLT 408, respectively. Similar findings were reported by Parameshwarappa et al. (2021), Sandhya et al. (2021) and Rathod et al. (2022) [16, 20, 22].

Number of capsules per plant

Positively significant heterosis was desirable for this trait. Maximum and significant positive heterosis (62.82%) over mid parent was found in cross KMS 391 x PT 1, (50.62%) over better parent was found in cross JLS 706 x JLS 907 and (74.90%) over standard check JLT 408 was found in cross AVTS 22-12 x SHEKAR. Out of 21 crosses seventeen crosses displayed significantly positive heterosis over mid parent, sixteen crosses showed positive and significant heterosis over better parent and eighteen crosses recorded significantly positive heterosis over standard check JLT 408. Similar results were obtained by Kumar et al. (2021), Parameshwarappa et al. (2021), Rathod et al. (2022), Mistry et al. (2023) and Killi et al. (2025). [13, 16, 20, 14, 11]

Table 1: Analysis of variance for various characters in line x tester analysis of sesame (*Sesamum indicum* L.)

Sr. No.	Characters	Source of variation				
		Replication	Genotypes	Parents	Crosses	Parents Vs Crosses
	DF	2	30	9	20	1
1	Days to 50% flowering	0.226	78.439**	24.430**	48.852**	1156.247**
2	Days to maturity	0.978	48.883**	21.837**	46.430**	341.358**
3	Plant height (cm)	17.72	175.037**	176.815**	175.849**	142.801**
4	Number of branches per plant	0.036	9.571**	12.670**	7.338**	26.323**
5	Number of capsules per plant	63.909	1144.117**	846.669**	833.797**	10027.543**
6	Number of seeds per capsule	10.204	95.999**	61.633**	27.838**	1768.517**
7	Length of capsule (cm)	0.003	0.069**	0.116**	0.035**	0.321**
8	Width of capsules (cm)	0.001	0.006**	0.007**	0.003**	0.049**
9	1000-seed weight (g)	0.003	0.210**	0.162**	0.190**	1.052**
10	Seed yield per plant (g)	5.088	52.407**	12.035**	59.915**	265.594**
11	Oil content (%)	3.695	87.201**	186.565**	39.510**	146.744**
12	Protein Content (%)	0.496	16.758**	22.790**	14.322**	11.205**
13	Carbohydrate Content (%)	0.312	20.305**	23.958**	18.940**	14.714**

*Significant at 5% level of significance

**Significant at 1% level of significance

Table 2: Estimates of heterosis (%) over mid parent, better parent and standard check (JLT 408) for days to 50% flowering and days to maturity and plant height (cm) of 21 sesame hybrids

Sr. No.	Code	Hybrids	Days to 50% flowering			Days to maturity			Plant height (cm)		
			MP	BP	SC1	MP	BP	SC1	MP	BP	SC1
1	L1 x T1	RMT 175 X PT 1	10.99 **	6.00	15.22 **	-0.22	-0.86	0.87	-7.22 *	-10.00 **	5.47
2	L1 x T2	RMT 175 X SHEKAR	6.25	0.99	10.87 *	-0.42	-2.07	3.06	0.00	-0.66	17.97 **
3	L1 x T3	RMT 175 X JLS 907	14.92 **	14.29 **	13.04 **	0.65	-0.43	1.31	-5.00	-5.00	11.33 **
4	L2 x T1	KMS 391 X PT 1	28.50 **	24.00 **	34.78 **	6.75 **	6.52 *	6.99 *	-4.73	-14.20 **	17.97 **
5	L2 x T2	KMS 391 X SHEKAR	19.59 **	14.85 **	26.09 **	4.68	2.07	7.42 *	-0.61	-7.39 **	27.34 **
6	L2 x T3	KMS 391 X JLS 907	31.15 **	29.03 **	30.43 **	10.72 **	10.48 **	10.48 **	-7.67 **	-14.49 **	17.58 **
7	L3 x T1	GT 10 X PT 1	23.00 **	15.93 **	42.39 **	7.69 **	3.19	13.10 **	-3.96	-10.19 **	13.67 **
8	L3 x T2	GT 10 X SHEKAR	33.64 **	26.55 **	55.43 **	10.16 **	7.97 **	18.34 **	-4.78	-7.72 *	16.80 **
9	L3 x T3	GT 10 X JLS 907	32.02 **	18.58 **	45.65 **	8.56 **	3.59	13.54 **	-6.09 *	-9.57 **	14.45 **
10	L4 x T1	JLS 710 X PT 1	13.54 **	9.00 *	18.48 **	4.97 *	4.29	6.11 *	2.58	-0.33	16.41 **
11	L4 x T2	JLS 710 X SHEKAR	21.24 **	15.84 **	27.17 **	3.38	1.66	6.99 *	-0.50	-1.32	17.19 **
12	L4 x T3	JLS 710 X JLS 907	31.87 **	30.43 **	30.43 **	7.59 **	6.44 *	8.30 **	-19.87 **	-20.00 **	-6.25
13	L5 x T1	AVTS 22 - 12 X PT 1	23.58 **	16.96 **	42.39 **	10.04 **	6.05 *	14.85 **	6.37 *	-3.47	30.47 **
14	L5 x T2	AVTS 22- 12 X SHEKAR	24.88 **	18.75 **	44.57 **	3.48	2.02	10.48 **	-1.23	-7.23 *	25.39 **
15	L5 x T3	AVTS 22- 12 X JLS 907	24.75 **	12.50 **	36.96 **	10.08 **	5.65 *	14.41 **	5.57 *	-1.45	33.20 **
16	L6 x T1	JLS 706 X PT 1	34.38 **	29.00 **	40.22 **	8.62 **	7.69 **	10.04 **	8.43 **	5.35	23.05 **
17	L6 x T2	JLS 706 X SHEKAR	43.01 **	36.63 **	50.00 **	10.32 **	8.71 **	14.41 **	-0.50	-1.32	17.19 **
18	L6 x T3	JLS 706 X JLS 907	31.87 **	30.43 **	30.43 **	6.49 *	5.13	7.42 *	8.85 **	8.67 **	27.34 **
19	L7 x T1	JLT 408 - 2 X PT 1	15.46 **	12.00 **	21.74 **	0.65	0.43	1.31	7.99 **	5.78	21.48 **
20	L7 x T2	JLT 408 - 2 X SHEKAR	6.67	2.97	13.04 **	0.00	-2.07	3.06	4.68	2.96	22.27 **
21	L7 x T3	JLT 408 - 2 X JLS 907	19.57 **	17.02 **	19.57 **	2.40	1.73	2.62	-7.41 **	-8.33 *	7.42 *
		SE±	1.79	2.07	2.07	4.36	5.03	5.03	10.47	12.09	12.09
		CD 5%	3.58	4.13	4.13	8.71	10.06	10.06	20.97	24.19	24.19
		CD 1%	4.76	5.50	5.50	11.59	13.38	13.38	27.86	32.17	32.17
		Min value	6.25	0.99	10.87	-0.42	-2.07	0.87	-19.87	-20.00	-6.25
		Max value	43.01	36.63	55.43	10.72	10.48	18.34	8.85	8.67	33.20
		Range	6.25 to 43.01	0.99 to 36.63	10.87 to 55.43	-0.42 to 10.72	-2.07 to 10.48	0.87 to 18.34	-19.87 to 8.85	-20.00 to 8.67	-6.25 to 33.20

Table 3: Estimates of heterosis (%) over mid parent, better parent and standard check (JLT 408) for no. of branches per plant, no. of capsules per plant and no. of seeds per capsule of 21 sesame hybrids

Sr. No.	Code	Crosses /Hybrids	No. of branches per plant			No. of capsules per plant			No. of seeds per capsule		
			MP	BP	SC1	MP	BP	SC1	MP	BP	SC1
1	L1 x T1	RMT 175 X PT 1	20.00 *	0.00	25.00 *	56.82 **	24.19 **	55.87 **	26.04 **	24.56 **	29.09 **
2	L1 x T2	RMT 175 X SHEKAR	-11.76	-21.05 **	25.00 *	30.22 **	25.81 **	57.89 **	13.17 **	6.32	22.42 **
3	L1 x T3	RMT 175 X JLS 907	18.52 *	6.67	33.33 **	43.87 **	24.84 **	56.68 **	27.00 **	25.88 **	29.70 **
4	L2 x T1	KMS 391 X PT 1	68.42 **	60.00 **	33.33 **	62.82 **	32.75 **	54.25 **	23.49 **	19.88 **	24.24 **
5	L2 x T2	KMS 391 X SHEKAR	28.57 **	-5.26	50.00 **	35.77 **	35.30 **	58.30 **	19.66 **	10.53 *	27.27 **
6	L2 x T3	KMS 391 X JLS 907	-4.76	-16.67	-16.67	39.81 **	25.44 **	45.75 **	20.85 **	17.65 **	21.21 **
7	L3 x T1	GT 10 X PT 1	2.70	-29.63 **	58.33 **	5.09	-16.77 **	4.45	23.26 **	19.30 **	23.64 **
8	L3 x T2	GT 10 X SHEKAR	-4.35	-18.52 **	83.33 **	-0.17	-3.55	21.05 **	20.00 **	10.53 *	27.27 **
9	L3 x T3	GT 10 X JLS 907	38.46 **	0.00	125.00 **	30.11 **	12.90 *	41.70 **	12.12 **	8.82	12.12 *
10	L4 x T1	JLS 710 X PT 1	45.45 **	33.33 **	33.33 **	43.50 **	20.75 **	29.55 **	9.04 *	5.46	16.97 **
11	L4 x T2	JLS 710 X SHEKAR	41.94 **	15.79 *	83.33 **	22.75 **	17.65 **	37.65 **	1.88	0.00	15.15 **
12	L4 x T3	JLS 710 X JLS 907	0.00	0.00	0.00	7.91	0.38	7.69	5.38	1.64	12.73 **
13	L5 x T1	AVTS 22 - 12 X PT 1	22.58 **	-9.52	58.33 **	10.37 *	-16.99 **	20.65 **	14.76 **	9.57 *	24.85 **
14	L5 x T2	AVTS 22- 12 X SHEKAR	15.00 **	9.52	91.67 **	33.34 **	20.33 **	74.90 **	6.88	6.32	22.42 **
15	L5 x T3	AVTS 22- 12 X JLS 907	69.70 **	33.33 **	133.33 **	33.22 **	8.91 *	58.30 **	16.76 **	11.17 **	26.67 **
16	L6 x T1	JLS 706 X PT 1	100.00 **	90.00 **	58.33 **	41.51 **	23.46 **	21.46 **	10.25 **	4.74	20.61 **
17	L6 x T2	JLS 706 X SHEKAR	0.00	-26.32 **	16.67	3.39	-4.84	11.34	6.84	6.84	23.03 **
18	L6 x T3	JLS 706 X JLS 907	80.95 **	58.33 **	58.33 **	55.41 **	50.62 **	48.18 **	20.00 **	13.68 **	30.91 **
19	L7 x T1	JLT 408 - 2 X PT 1	26.32 *	20.00	0.00	41.65 **	23.36 **	21.86 **	18.52 **	12.28 **	16.36 **
20	L7 x T2	JLT 408 - 2 X SHEKAR	7.14	-21.05 **	25.00 *	24.20 **	14.54 **	34.01 **	12.54 **	1.58	16.97 **
21	L7 x T3	JLT 408 - 2 X JLS 907	42.86 **	25.00 *	25.00 *	19.49 **	15.57 *	14.17 *	20.74 **	14.71 **	18.18 **
		SE±	0.13	0.16	0.16	25.86	29.86	29.86	5.55	6.41	6.41
		CD 5%	0.27	0.31	0.31	65.36	59.73	59.73	18.58	12.82	12.82
		CD 1%	0.36	0.41	0.41	68.79	79.43	79.43	14.77	17.05	17.05
		Min value	-11.76	-29.63	-16.67	-0.17	-16.99	4.45	1.88	0.00	12.12
		Max value	100.00	90.00	133.33	62.82	50.62	74.90	27.00	25.88	30.91
		Range	-11.76 to 100.00	-29.63 to 90.00	-16.67 to 133.33	-0.17 to 62.82	-16.99 to 50.62	4.45 to 74.90	1.88 to 27.00	0.00 to 25.88	12.12 to 30.91

Number of seeds per capsule

Positive and significant heterosis was desirable for this trait. Maximum and significant positive heterosis (27.00%) over mid parent and (25.88%) over better parent was found in cross RMT 175 x JLS 907 and (30.91%) over standard check JLT 408 was found in cross JLS 706 x JLS 907. Out of 21 crosses seventeen crosses were exhibited significant positive heterosis over mid parent, twelve crosses were showed significantly positive heterosis over better parent and all twenty one hybrids were showed significantly positive heterosis over check JLT 408. Similar results were reported by Virani et al. (2017), Beniwal et al. (2018), Rathod et al. (2022) and Meena Kumari (2023) [27, 4, 20, 1 2].

Length of capsule (cm)

For this character out of 21 crosses five crosses were exhibited positive and significant heterosis over mid parent. Ten crosses showed positive heterosis over better parent and over standard check out of which one cross JLS 710 x PT 1 was significant. Maximum and significantly positive heterosis (11.68%) over mid parent, (10.94%) over better parent and (8.43%) over standard check JLT 408 was found in cross JLS 710 x PT 1. Similar findings obtained by Gaikwad and Lal (2011), Vavdiya et al. (2013), Visat et al. (2016), Rajput et al. (2017), Virani et al. (2017) and Beniwal et al. (2018) [8, 25, 28, 19, 27, 4, 25].

Width of capsule (cm)

Maximum and significantly positive heterosis (15.12%) over mid parent, (14.81%) over better parent and (13.02%) over standard check JLT 408 was found in cross JLS 706 x JLS 907. Out of twenty one crosses eight crosses showed significantly positive heterosis over mid parent. Three crosses

exhibited significantly positive heterosis over better parent. Four crosses recorded significantly positive heterosis over standard check JLT 408. Similar findings were reported by Vavdiya et al. (2013) [25].

1000-seed weight (g)

Thousand seed weight is one of the important traits to have direct positive association with seed yield (Shekhara and Reddy, 1993). Maximum and significantly positive heterosis (18.59%) over mid parent, (14.66%) over better parent and (15.82%) over standard check JLT 408 was found in cross JLT 408-2 x SHEKAR. Out of 21 crosses, significant positive mid-parent heterosis was recorded in six crosses. Significant positive heterosis over the better parent and standard check JLT 408 was observed in four and six crosses, respectively. Similar findings were supported by Vekariya and Dhaduk (2018), Kumar et al. (2021) and Meena Kumari (2023) [26, 13, 12].

Seed yield per plant (g)

For the character seed yield per plant positive and significant heterosis was desirable. Significantly positive as well as negative heterosis over mid parent, better parent and standard check JLT 408 were observed for this character. Maximum and significantly positive heterosis over mid parent (123.50%) was found in cross KMS 391 x PT 1. Significantly positive heterosis over better parent (122.63%) and (144.08%) over standard check JLT 408 was found in cross JLT 408-2 x SHEKAR. Out of 21 crosses fifteen crosses showed positive and significant heterosis over mid parent. Eleven crosses showed significant and positive heterosis over better

Table 4: Estimates of heterosis (%) over mid parent, better parent and standard check (JLT 408) for length of capsule (cm), width of capsule (cm) and 1000-seed weight (g) of 21 sesame hybrids

Sr. No.	Code	Hybrids	Length of capsule (cm)			Width of capsule (cm)			1000-seed weight (g)		
			MP	BP	SC1	MP	BP	SC1	MP	BP	SC1
1	L1 x T1	RMT 175 X PT 1	3.53	2.00	2.73	3.06	-1.94	5.21	5.51	1.11	10.65 *
2	L1 x T2	RMT 175 X SHEKAR	-11.70 **	-14.80 **	-7.72 *	5.29	3.65	3.65	4.85	1.72	2.03
3	L1 x T3	RMT 175 X JLS 907	2.64	2.22	3.80	6.13	5.29	3.65	5.49	3.94	4.26
4	L2 x T1	KMS 391 X PT 1	3.84	1.94	-0.36	8.22 **	-0.97	6.25	7.43	3.15	12.88 *
5	L2 x T2	KMS 391 X SHEKAR	0.18	-6.36 *	1.43	6.34	0.52	0.52	5.56	2.22	2.94
6	L2 x T3	KMS 391 X JLS 907	6.31 *	2.46	4.04	12.78 **	7.41 *	5.73	14.39 **	12.49 *	13.29 *
7	L3 x T1	GT 10 X PT 1	9.18 **	2.55	0.24	5.00	-8.25 *	-1.56	14.33 **	1.30	10.85 *
8	L3 x T2	GT 10 X SHEKAR	1.77	-8.77 **	-1.19	4.05	-6.25	-6.25	6.75	1.18	-4.56
9	L3 x T3	GT 10 X JLS 907	2.53	-5.38	-3.92	7.87 *	-2.12	-3.65	18.46 **	10.62 *	7.71
10	L4 x T1	JLS 710 X PT 1	11.68 **	10.94 **	8.43 **	2.02	-1.94	5.21	8.58	0.83	10.34 *
11	L4 x T2	JLS 710 X SHEKAR	0.81	-4.71	3.21	4.71	4.17	4.17	14.72 **	14.41 *	7.91
12	L4 x T3	JLS 710 X JLS 907	0.90	-1.64	-0.12	6.60 *	6.32	5.21	7.48	5.52	2.74
13	L5 x T1	AVTS 22-12 X PT 1	5.19	0.97	-1.31	5.48	-1.94	5.21	3.78	-5.84	3.04
14	L5 x T2	AVTS 22-12 X SHEKAR	-5.45 *	-13.49 **	-6.29 *	0.27	-3.65	-3.65	1.82	-0.97	-6.59
15	L5 x T3	AVTS 22-12 X JLS 907	4.71	-1.29	0.24	8.20 *	4.76	3.13	10.39 *	5.73	2.94
16	L6 x T1	JLS 706 X PT 1	6.23 *	0.49	-1.78	8.63 **	3.88	11.46 **	0.96	-2.78	6.39
17	L6 x T2	JLS 706 X SHEKAR	-4.25	-13.60 **	-6.41 *	10.53 **	9.37 **	9.37 **	-11.87 *	-14.91 **	-13.79 **
18	L6 x T3	JLS 706 X JLS 907	9.63 **	1.87	3.44	15.12 **	14.81 **	13.02 **	-8.93 *	-10.71 *	-9.53
19	L7 x T1	JLT 408-2 X PT 1	4.76	1.70	-0.59	3.70	1.94	9.37 **	-3.33	-7.04	1.72
20	L7 x T2	JLT 408-2 X SHEKAR	0.06	-7.46 *	0.24	1.79	0.00	3.65	18.59 **	14.66 **	15.82 **
21	L7 x T3	JLT 408-2 X JLS 907	2.45	-2.34	-0.83	5.67	3.02	6.77	6.24	4.32	5.38
		SE±	0.01	0.01	0.01	0.001	0.001	0.001	0.02	0.03	0.03
		CD 5%	0.01	0.02	0.02	0.001	0.002	0.002	0.05	0.06	0.06
		CD 1%	0.02	0.02	0.02	0.002	0.002	0.002	0.06	0.07	0.07
		Min value	-11.70	-14.80	-7.72	-0.27	-8.25	-6.25	-11.87	-14.91	-13.79
		Max value	11.68	10.94	8.43	15.12	14.81	13.02	18.59	14.66	15.82
		Range	-11.70 to 11.68	-14.80 to 10.94	-7.72 to 8.43	-0.27 to 15.12	-8.25 to 14.81	-6.25 to 13.02	-11.87 to 18.59	-14.91 to 14.66	-13.79 to 15.82

Table 5: Estimates of heterosis (%) over mid parent, better parent and standard check (JLT 408) for seed yield per plant (g), oil content (%) and protein content (%) of 21 sesame hybrids

Sr. No.	Code	Hybrids	Seed yield per plant (g)			Oil content (%)			Protein content (%)		
			MP	BP	SC1	MP	BP	SC1	MP	BP	SC1
1	L1 x T1	RMT 175 X PT 1	92.86 **	36.61 **	89.64 **	-1.99	-5.75 **	-7.17 **	-10.19 **	-11.06 **	-7.04 **
2	L1 x T2	RMT 175 X SHEKAR	62.25 **	44.79 **	101.00 **	17.01 **	3.45	1.89	-23.18 **	-27.88 **	-24.62 **
3	L1 x T3	RMT 175 X JLS 907	35.60 **	10.82	53.83 **	11.01 **	-5.36 **	-6.79 **	8.85 **	-0.96	3.52 *
4	L2 x T1	KMS 391 X PT 1	123.50 **	69.14 **	90.53 **	5.14 **	4.98 *	-4.53 *	3.47 *	-4.90 **	-2.51
5	L2 x T2	KMS 391 X SHEKAR	50.54 **	48.08 **	66.80 **	11.63 **	2.39	-7.17 **	-2.12	-5.21 **	-13.07 **
6	L2 x T3	KMS 391 X JLS 907	-9.64	-19.49	-9.31	12.67 **	-0.52	-9.81 **	15.96 **	15.79 **	-0.50
7	L3 x T1	GT 10 X PT 1	37.66 *	6.31	12.93	-3.94 *	-19.09 **	-26.42 **	9.60 **	-4.90 **	-2.51
8	L3 x T2	GT 10 X SHEKAR	32.87 **	31.21 *	42.95 **	13.82 **	3.74	-21.51 **	-12.78 **	-20.55 **	-27.14 **
9	L3 x T3	GT 10 X JLS 907	104.79 **	87.30 **	98.96 **	27.79 **	21.20 **	-15.85 **	9.20 **	2.64	-12.06 **
10	L4 x T1	JLS 710 X PT 1	87.79 **	41.35 **	61.78 **	-0.96	-3.45	-7.55 **	16.49 **	7.35 **	10.05 **
11	L4 x T2	JLS 710 X SHEKAR	76.24 **	72.01 **	96.87 **	11.83 **	0.10	-4.15 *	-3.53 *	-6.30 **	-14.07 **
12	L4 x T3	JLS 710 X JLS 907	-16.11	-25.78 *	-15.05	2.34	-11.72 **	-15.47 **	12.12 **	11.63 **	-3.52 *
13	L5 x T1	AVTS 22-12 X PT 1	57.84 **	10.92	58.25 **	16.64 **	1.66	-7.55 **	-15.55 **	-21.55 **	-19.58 **
14	L5 x T2	AVTS 22-12 X SHEKAR	69.91 **	49.83 **	113.77 **	24.87 **	18.20 **	-10.57 **	-5.45 **	-7.40 **	-15.08 **
15	L5 x T3	AVTS 22-12 X JLS 907	106.23 **	66.77 **	137.94 **	26.69 **	25.00 **	-13.21 **	-2.17	-3.43	-15.08 **
16	L6 x T1	JLS 706 X PT 1	-17.60	-38.91 **	-26.82	-6.05 **	-10.06 **	-10.57 **	12.92 **	-13.24 **	-11.06 **
17	L6 x T2	JLS 706 X SHEKAR	-31.17 **	-34.28 **	-21.28	3.88 *	-8.54 **	-9.06 **	35.62 **	8.49 **	-0.50
18	L6 x T3	JLS 706 X JLS 907	-21.24	-31.67 *	-18.15	8.60 **	-7.78 **	-8.30 **	38.57 **	13.78 **	-2.51
19	L7 x T1	JLT 408-2 X PT 1	58.58 **	21.13	32.80 *	-13.29 **	-17.77 **	-16.60 **	-27.52 **	-33.82 **	-32.16 **
20	L7 x T2	JLT 408-2 X SHEKAR	123.32 **	122.63 **	144.08 **	16.14 **	1.40	2.83	-13.96 **	-17.26 **	-24.12 **
21	L7 x T3	JLT 408-2 X JLS 907	12.20	1.17	10.92	8.23 **	-8.84 **	-7.55 **	14.45 **	13.78 **	-2.51
		SE±	1.20	1.38	1.38	0.87	1.00	1.00	0.12	0.14	0.14
		CD 5%	2.39	2.76	2.76	1.75	2.01	2.01	0.23	0.27	0.27
		CD 1%	3.18	3.67	3.67	2.31	2.67	2.67	0.31	0.36	0.36
		Min value	-31.17	-38.91	-26.82	-13.29	-19.09	-26.42	-27.52	-33.82	-32.16
		Max value	123.50	122.63	144.08	27.79	25.00	2.83	38.57	15.79	10.05
		Range	-31.17 to 123.50	-38.91 to 122.63	-26.82 to 144.08	-13.29 to 27.79	-19.09 to 25.00	-26.42 to 2.83	-27.52 to 38.57	-33.82 to 15.79	-32.16 to 10.05

Parent Fourteen crosses were exhibited significant and positive heterosis over standard check JLT 408. Similar results were reported by Beniwal et al. (2018), Karande et al. (2018), Abdel-Rhman et al., (2019), Amarnath et al. (2019), Bhattacharjee (2021), Sandhya et al. (2021) and Killi et al. (2025)^[4, 10, 1, 2, 5, 22, 11].

Oil content (%)

Positive and significant heterosis was desirable for this trait. Maximum and significantly positive heterosis over mid parent (27.79%) was found in cross GT 10 x JLS 907, over better parent (25.00%) was found in cross AVTS-22-12 x JLS 907 and over standard check JLT 408 (2.83%) was found in the cross JLT 408-2 x SHEKAR. Out of 21 crosses fifteen crosses were recorded significantly positive heterosis over mid parent, four crosses were recorded significantly positive heterosis over better parent and no cross showed significantly positive heterosis over standard check JLT 408. Similar reports indicating positive heterosis for this trait were reported by Kumar et al. (2021), Prakash and Dasgupta (2021), Sandhya et al. (2021), Mistry et al. (2023)^[13, 18, 22, 14].

Protein content (%)

The maximum and significantly positive mid parental heterosis (38.57%) was found in cross JLS 706 x JLS 907, heterobeltiosis (15.79%) was found in cross KMS 391 x JLS 907 and standard heterosis over JLT 408 (10.05%) was found in cross JLS 710 x PT 1. Eleven hybrids manifested

significantly positive heterosis over mid parent. Six crosses exhibited significantly positive heterosis over better parent. Two crosses were showed significantly positive heterosis over standard check JLT 408. Similar findings were reported by Patel et al. (2016), Gadade et al. (2017)^[17, 7].

Carbohydrate content (%)

Maximum and significantly positive heterosis over mid parent (18.56%) was found in cross JLT 408-2 x PT1, over better parent (9.63%) was found in cross AVTS-22-12 x PT 1 and over standard check JLT 408 (54.55%) was found in the cross GT 10 x JLS 907. Eight crosses exhibited significantly positive heterosis over mid parent, five crosses exhibited significantly positive heterosis over better parent and nineteen crosses showed significantly positive heterosis over standard check JLT 408. Similar findings were reported by Gadade et al. (2017), Thakur et al. (2017)^[7, 24].

In present investigation the cross combinations JLT 408-2 x SHEKAR, AVTS-22-12 x JLS 907, AVTS-22-12 x SHEKAR, RMT 175 x SHEKAR and GT 10 x JLS 907 were found promising for seed yield per plant with heterosis and component showing significant desired heterosis. The crosses JLT 408-2 x SHEKAR, AVTS-22-12 x JLS 907 and GT 10 x JLS 907 recorded maximum significant and positive heterosis for the character oil content. Hybrid development in sesame not only enhances seed yield and oil content, but also improves seed quality, thereby boosting the productivity and profitability of the crop.

Table 6: Estimates of heterosis (%) over mid parent, better parent and standard check (JLT 408) for carbohydrate content (%) of 21 sesame hybrids

Sr. No.	Code	Hybrids	Carbohydrate content (%)		
			MP	BP	SC1
1	L1 x T1	RMT 175 X PT 1	-9.90 **	-20.64 **	4.85
2	L1 x T2	RMT 175 X SHEKAR	5.70 **	-7.27 **	23.64 **
3	L1 x T3	RMT 175 X JLS 907	-24.91 **	-36.65 **	-7.27 *
4	L2 x T1	KMS 391 X PT 1	-6.86 **	-12.84 **	15.15 **
5	L2 x T2	KMS 391 X SHEKAR	12.20 **	4.55 *	39.39 **
6	L2 x T3	KMS 391 X JLS 907	2.43	-8.49 **	33.94 **
7	L3 x T1	GT 10 X PT 1	-0.90	-5.46 **	37.58 **
8	L3 x T2	GT 10 X SHEKAR	2.59	-1.71	43.03 **
9	L3 x T3	GT 10 X JLS 907	5.90 **	5.59 **	54.55 **
10	L4 x T1	JLS 710 X PT 1	-6.63 **	-16.06 **	10.91 **
11	L4 x T2	JLS 710 X SHEKAR	6.60 **	-4.55 *	27.27 **
12	L4 x T3	JLS 710 X JLS 907	18.41 **	1.86	49.09 **
13	L5 x T1	AVTS 22-12 X PT 1	11.68 **	9.63 **	44.85 **
14	L5 x T2	AVTS 22-12 X SHEKAR	8.84 **	6.36 **	41.82 **
15	L5 x T3	AVTS 22-12 X JLS 907	-2.99	-9.32 **	32.73 **
16	L6 x T1	JLS 706 X PT 1	1.02	0.23	34.55 **
17	L6 x T2	JLS 706 X SHEKAR	-9.40 **	-9.71 **	21.21 **
18	L6 x T3	JLS 706 X JLS 907	-11.45 **	-15.11 **	24.24 **
19	L7 x T1	JLT 408-2 X PT 1	18.56 **	5.50 *	39.39 **
20	L7 x T2	JLT 408-2 X SHEKAR	1.54	-10.00 **	20.00 **
21	L7 x T3	JLT 408-2 X JLS 907	2.55	-12.63 **	27.88 **
		SE±	0.23	0.27	0.27
		CD 5%	0.47	0.54	0.54
		CD 1%	0.62	0.72	0.72
		Min value	-24.91	-36.65	-7.27
		Max value	18.56	9.63	54.55
		Range	-24.91 to 18.56	-36.65 to 9.63	-7.27 to 54.55

References

- Abdel-Rhman RH, Okasha SA, Elareny IM. Correlation, path coefficient analysis and genetic variability for assessment of yield and its components in F1 hybrid population of *Sesamum indicum* L. International Journal of Agriculture and Environment Research. 2019;5(1):2455-6939.
- Amarnath T, Ram S, Gogulakrishnan J, Narayanan R. Studies on line × tester analysis in *Sesamum indicum* L. International Journal of Bio-resource and Stress Management. 2019;10(5):456-460.
- Anonymous. Economic Survey of Maharashtra. Directorate of Economics and Statistics, Planning Department, Government of Maharashtra; 2025.
- Beniwal BR, Meena RC, Kumar KK, Sastry EVD, Solanki ZS. Studies on line × tester analysis in sesame (*Sesamum indicum* L.). International Journal of Tropical Agriculture. 2018;36(1):131-140.
- Bhattacharjee M, Kundagrami S, Dasgupta T. Combining ability for quantitative traits in sesame through line × tester analysis. The Bioscan. 2021;16(4):239-246.
- FAOSTAT. Food and Agriculture Organization; 2024.
- Gadade BV, Kachare DP, Satbhai RD, Naik RM. Nutritional composition and oil quality parameters of *Sesamum indicum* L. genotypes. International Research Journal of Multidisciplinary Studies. 2017;3(7):1-13.
- Gaikwad KB, Lal JP. Heterosis and inbreeding depression in sesame (*Sesamum indicum* L.). Current Advances in Agricultural Sciences. 2011;3(1):54-56.
- Indiastat. Agriculture Production; 2023.
- Karande GR, Yamgar SV, Waghmode AA, Wadikar PB. Exploitation of heterosis for yield and yield contributing characters in sesame (*Sesamum indicum* L.). International Journal of Current Microbiology and Applied Sciences. 2018;7(2):299-308.
- Killi F, Beycioglu T, Kan T. The heterosis effect for yield and some plant characteristics in sesame (*Sesamum indicum* L.). Turkish Journal of Agriculture-Food Science and Technology. 2025;13(8):2194-2200.
- Kumari BM. Studies on the expression of heterosis in inter-specific hybrids of *Sesamum indicum* L. Madras Agricultural Journal. 2023;110(4-6):1-14.
- Kumar R, Patel JA, Rahevar PM, Patel RM. Deciphering combining ability and gene action study in elite genotypes of sesame (*Sesamum indicum* L.) using diallel mating design. Emerging Life Sciences Research. 2021;7(1):1-6.
- Mistry P, Zala P, Jagtap P. Heterosis and combining ability studies in sesame. Journal of Oilseeds Research. 2023;40(Special Issue).
- Mohammed SV, Srinivasalu NR, Chandrashekhara P. Studies on natural cross pollination in *Sesamum orientale* L. Madras Agricultural Journal. 1965;52:452-452.
- Parameshwarappa SG, Palakshappa MG, Banu H, Holeyannavar P. Manifestation of heterosis and combining ability for yield and its attributes in sesame (*Sesamum indicum* L.) using line × tester mating design. The Pharma Innovation Journal. 2021;10(3):851-856.
- Patel RM, Chauhan RM, Patel JA. Heterosis for yield and yield components in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2016;7(4):1151-1154.
- Prakash SH, Dasgupta T. General and specific combining ability in sesame (*Sesamum indicum* L.) for seed yield and related traits. Current Journal of Applied Science and Technology. 2021;40(12):81-87.

19. Rajput SD, Harer PN, Kute NS. Heterosis and its relation with combining ability in sesame (*Sesamum indicum* L.) for quantitative traits. International Journal of Current Research. 2017;9(9):56971-56973.
20. Rathod ST, Gitte VK, Dhuppe MV, Borgaokar SB, Gawande S. Heterosis and per se performance studies in sesame (*Sesamum indicum* L.). The Pharma Innovation Journal. 2022;11(1):1176-1182.
21. Reddy CDR, Haripriya S. Heterosis and combining ability in sesame. Indian Journal of Genetics. 1993;53(1):21-27.
22. Sandhya HR, Madhusudan K, Raveendra HR, Sahana SR. Exploitation of heterosis for seed yield and quality traits in sesame (*Sesamum indicum* L.). Biological Forum - An International Journal. 2021;13(3B):155-160.
23. Shull GH. Heterosis. Genetics. 1914;33:430-446.
24. Thakur V, Paroha S, Mishra RP. Chemical characterization and fatty acid composition of different sesame varieties. International Journal of Current Microbiology and Applied Sciences. 2017;6(12):1936-1943.
25. Vavdiya PA, Dobariya KL, Babariya CA, Sapovadiya MV. Heterosis for seed yield and its components in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2013;4(3):1246-1250.
26. 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.
27. Virani MB, Vachhani JH, Kachhadia VH, Chavadhari RM, Mungala RA. Heterosis studies in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2017;8(3):1006-1012.
28. Visat M, Patel M, Devaliya S, Modha K. Heterosis for yield and its components in sesame (*Sesamum indicum* L.). Advances in Life Sciences. 2016;5(18):7602-7605.
29. Weiss EA. Oilseed Crops. New York: Longman; 1983. 660 p.