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Comparative Study of *per se* Performance in Sesame (*Sesamum indicum* L.)

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ABSTRACT: In present investigation the experimental materials consisted of parents and their 45 F_1's and 45 F_2's derived by crossing 10 diverse sesame genotypes (GT-3, GT-4, GT-6, AT-338, AT-324, IC-132186, GT-10, T-11, GJT-5 and GTF-1) in a half-diallel fashion, were evaluated during *Kharif* 2022 at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh. The parents recorded with highest seed yield per plant were AT-324 (6.45), GJT-5 (6.23) and AT-338 (5.77). Similarly, top five cross combinations for seed yield per plant were AT-338 × AT-324 (11.54), GT-6 × GT-10 (10.22), GT-3 × GT-4 (8.47), GT-4 × T-11 (7.28) and GT-4 × IC-132186 (6.99).

Keywords: Sesame, half-diallel, combining ability and heterosis.

INTRODUCTION

Oilseed crops play an important role in agriculture and industrial economy of our country. India ranks first in respect of total acreage and production of varieties of oilseed crops. Sesame is one of the most ancient and important oilseed crops grown next to groundnut and mustard in India. Sesame (*Sesamum indicum* L.) is a member of family Pedaliaceae with chromosome number 2n=2x=26. It is called "sesame" internationally, while it is called "benniseed" in West Africa; "simsim" in East Africa and "Til" in India (Bhalodiya *et al.*, 2019). Hybridization breeding has been a potential method of increasing yield in sesame (Zala, 2022). The crosses showing high *per se* performance also show high heterosis as well as high sca effect and parents with high *per se* also show high gca effect. Therefore, due consideration should be given to the study of *per se* performance which helps in developing superior varieties. This investigation was carried out to fulfill the basic objective of the study.

MATERIAL AND METHOD

The direct cross combinations derived from 10 genetically diverse parents (GT-3, GT-4, GT-6, AT-338, AT-324, IC-132186, GT-10, T-11, GJT-5 and GTF-1) through half-diallel mating were selfed to generate 45 F_2's during Summer 2022. The experimental materials *viz.*, 10 parents along with 45 F_1's, 45 F_2's and one standard check (GT-6) were evaluated in Randomized Block Design (RBD) with three replications during *Kharif* 2022 at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh.

The observation was recorded for total of 13 characters *viz.*, days to 50 per cent flowering, days to maturity, length of reproductive stem, number of capsules per plant, number of branches per plant, plant height, length of capsule, number of seeds per capsule, test weight, biological yield per plant, seed yield per plant, harvest index and oil content. The raw data was averaged to check the mean performance.

RESULT AND DISCUSSION

ANOVA: The analysis of variance (Table 1) revealed the presence of highly significant differences due to genotypes for all characters under study, this indicated that parents, F_1's and F_2's under study had sufficient genetic variability for different traits. Further, partitioning of genotypic variation indicated that the mean sums of squares due to parents were found significant for all the characters except days to maturity. Similarly, differences due to for F_1's (hybrids) as a group were also observed to be highly significant for seed yield and its related traits, indicating the presence of potential variability in the hybrids. The variation due to F_2's as a group was found highly significant for all the characters. The mean sum of squares due to parents *vs* F_1's was found to be significant for all the traits except seed yield per plant, that indicated the presence of significant amount of heterosis in cross combinations as a group heterosis for rest of the traits.

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

Source	d.f.	Mean sum of square												
		DF	DM	LRS (cm)	NCP	NBP	PH (cm)	LC (cm)	NSC	TW (g)	BYP (g)	SYP (g)	HI (%)	OC (%)
Replications	2	27.893*	0.490	206.688**	301.899**	1.253**	827.828**	0.024	21.549	0.003	215.519**	5.969**	140.493**	0.491**
Genotypes	99	53.291**	51.244**	262.939**	218.996**	1.993**	429.099**	0.205**	121.896**	1.037**	68.187**	7.729**	177.886**	7.419**
Parents	9	67.704**	27.930	135.096**	128.718**	2.362**	255.208**	0.121**	124.118**	0.466**	42.437**	5.663**	114.255**	5.056**
F_1's crosses	44	72.765**	48.492**	277.128**	251.860**	1.975**	431.845**	0.268**	130.523**	1.038**	80.071**	11.664**	177.905**	6.796**
P *vs* F_1's	1	34.910**	226.50**	710.16**	87.507*	1.996**	1268.251**	0.184**	92.732*	1.772**	83.973*	2.029	474.984**	14.582**
F_2's	44	27.241**	29.100**	147.496**	60.728**	0.642**	208.231**	0.164**	111.528**	0.473**	19.530**	3.233**	181.683**	5.736**
P *vs* F_2's	1	184.377**	55.227	421.528**	1547.723**	10.620**	929.154**	0.083	0.166	4.299**	309.011**	30.184**	65.871	10.578**
Error	198	6.597	15.052	12.672	12.941	0.050	61.325	0.025	17.486	0.023	9.299	0.506	26.368	0.036

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

Table 2: Mean values for parents, F_1's and F_2's for different characters studied in sesame.

Sr. No.	Genotypes	DF	DM	LRS (cm)	NCP	NBP	PH (cm)	LC (cm)	NSC	TW (g)	BYP (g)	SYP (g)	HI (%)	OC (%)
	Parents													
1.	**GT-3**	40.67	94.00	44.27	20.87	2.80	68.67	2.83	50.87	2.85	13.93	3.12	22.29	47.75
2.	**GT-4**	42.67	97.33	61.87	25.93	3.73	78.80	2.35	62.40	2.21	10.87	3.60	32.84	48.14
3.	**GT-6**	42.00	95.00	58.73	39.80	2.07	79.33	2.67	72.20	1.93	22.73	5.57	24.23	48.15
4.	**AT-338**	49.67	97.67	59.23	35.87	2.60	95.47	2.88	65.40	2.49	19.20	5.77	29.82	45.55
5.	**AT-324**	52.67	100.67	55.87	34.33	3.40	99.60	2.62	68.40	2.78	19.53	6.45	32.75	44.86
6.	**IC-132186**	53.33	96.67	46.40	21.07	4.07	85.27	2.62	58.40	1.89	15.20	2.43	16.02	44.50
7.	**GT-10**	44.33	101.33	52.27	35.27	4.40	79.60	2.29	55.20	2.27	17.60	4.54	28.32	46.48
8.	**T-11**	41.00	93.00	49.83	27.60	1.87	74.60	2.63	66.07	2.97	16.60	5.53	35.92	46.77
9.	**GJT-5**	43.33	92.67	46.67	31.87	2.07	79.60	2.88	63.13	2.90	21.47	6.23	29.65	47.31
10.	**GTF-1**	43.67	94.00	43.57	25.47	2.73	84.27	2.70	66.73	2.48	13.47	4.36	34.44	46.73
Parental mean		**45.33**	**96.23**	**51.87**	**29.81**	**2.97**	**82.52**	**2.65**	**62.88**	**2.48**	**17.06**	**4.76**	**28.63**	**46.62**
	F_1													
1.	GT-3 × GT-4	42.33	94.00	53.87	39.93	3.53	83.70	2.44	65.35	3.22	25.27	8.47	33.98	47.22
2.	GT-3 × GT-6	43.67	92.33	54.73	24.73	2.20	84.07	2.63	57.27	2.13	15.40	3.06	21.15	46.24
3.	GT-3 × AT-338	45.67	92.00	64.93	33.27	2.80	107.00	2.85	64.70	2.35	21.20	5.16	25.14	45.70
4.	GT-3 × AT-324	41.33	99.00	66.67	27.40	2.80	118.47	3.18	70.20	2.59	32.00	5.08	15.94	45.25
5.	GT-3 × IC-132186	41.33	97.67	68.87	32.60	2.47	94.60	2.98	72.60	2.75	23.27	6.60	28.37	46.22
6.	GT-3 × GT-10	49.67	94.00	73.40	44.07	3.13	105.80	3.23	62.33	1.57	25.80	4.41	16.94	47.44
7.	GT-3 × T-11	40.00	87.67	69.33	21.40	2.40	89.27	2.94	61.07	1.70	13.40	2.62	20.06	46.24
8.	GT-3 × GJT-5	42.00	90.67	65.07	26.40	2.53	93.20	3.43	70.07	1.59	20.13	3.07	16.09	45.71
9.	GT-3 × GTF-1	41.67	90.00	67.40	24.87	3.00	100.60	3.18	65.00	3.10	17.60	5.07	28.90	47.47
10.	GT-4 × GT-6	43.67	93.00	53.53	25.47	2.13	87.73	2.27	61.07	2.46	16.60	3.91	23.62	47.58
11.	GT-4 × AT-338	52.33	92.33	57.60	37.27	4.80	97.93	2.73	64.80	1.99	27.60	4.87	17.71	44.37
12.	GT-4 × AT-324	41.33	94.67	63.53	25.13	3.40	98.20	3.08	68.00	2.18	10.53	3.81	36.06	44.82
13.	GT-4 × IC-132186	42.00	90.33	64.27	52.80	4.43	93.80	2.97	69.67	1.88	26.93	6.99	25.99	44.30
14.	GT-4 × GT-10	50.33	93.00	65.60	39.87	5.27	107.13	2.83	67.73	1.67	20.47	4.61	22.60	44.71
15.	GT-4 × T-11	41.67	87.33	60.53	45.20	3.20	97.93	2.53	62.93	2.41	22.27	7.28	32.86	43.72

16.	GT-4 × GJT-5	42.67	88.33	58.80	39.53	2.40	92.20	3.01	67.87	1.75	25.47	6.39	24.55	48.46
17.	GT-4 × GTF-1	52.00	88.67	66.60	36.47	3.60	106.20	2.77	62.07	1.68	19.87	4.80	16.38	47.21
18.	GT-6 × AT-338	47.00	97.67	60.47	35.73	4.20	93.60	2.61	54.73	2.06	24.40	3.88	21.76	42.49
19.	GT-6 × AT-324	42.67	91.00	60.07	26.93	4.60	82.13	2.59	56.93	1.79	18.80	4.08	23.97	44.48
20.	GT-6 × IC-132186	42.67	96.00	75.73	56.33	3.60	114.93	2.93	63.73	2.74	13.13	3.14	41.46	46.11
21.	GT-6 × GT-10	41.33	90.33	55.33	27.13	2.53	80.13	2.83	65.53	2.17	25.00	10.22	26.83	45.38
22.	GT-6 × T-11	39.67	91.00	58.80	31.20	2.20	81.00	2.94	52.07	1.67	15.20	4.13	14.78	47.27
23.	GT-6 × GJT-5	41.00	91.00	63.20	27.27	2.87	86.20	2.55	61.00	3.48	19.33	2.77	41.91	45.82
24.	GT-6 × GTF-1	51.33	97.33	56.20	41.07	4.27	105.20	3.03	69.67	4.01	14.20	5.82	46.74	47.14
25.	AT-338 × AT-324	54.33	92.33	62.87	26.60	3.40	83.87	2.49	66.00	2.45	24.67	11.54	30.99	44.37
26.	AT-338 × IC-132186	52.00	98.33	45.40	20.07	2.73	76.47	2.41	48.27	2.87	14.47	4.39	22.90	45.50
27.	AT-338 × GT-10	52.33	100.00	52.53	23.33	3.80	79.47	2.92	64.80	1.68	12.80	2.87	11.68	46.74
28.	AT-338 × T-11	52.67	90.33	57.87	39.33	4.20	96.53	3.12	55.07	1.89	25.33	3.00	23.52	46.41
29.	AT-338 × GJT-5	51.67	92.67	54.80	26.27	3.20	85.67	2.59	66.73	1.44	17.87	4.20	25.05	45.84
30.	AT-338 × GTF-1	41.00	88.67	67.07	47.20	2.20	93.93	3.23	60.07	2.23	15.07	3.69	25.48	45.36
31.	AT-324 × IC-132186	48.67	89.33	38.33	35.13	3.67	82.73	2.57	71.80	2.07	18.67	5.27	28.20	47.52
32.	AT-324 × GT-10	53.00	101.67	42.00	39.13	5.20	78.80	2.25	56.93	1.62	11.73	3.68	31.54	48.49
33.	AT-324 × T-11	47.67	88.33	76.67	31.20	2.40	106.07	2.63	54.87	1.88	20.47	3.28	16.39	45.80
34.	AT-324 × GJT-5	53.67	92.67	47.47	13.07	3.53	68.87	2.39	56.40	2.73	9.87	2.50	26.14	47.33
35.	AT-324 × GTF-1	46.67	94.67	44.00	20.73	2.60	94.07	2.37	52.40	2.53	14.67	2.81	19.98	45.57
36.	IC-132186 × GT-10	57.67	101.67	46.00	40.20	3.60	78.00	2.37	62.13	1.07	20.40	3.44	16.77	42.79
37.	IC-132186 × T-11	47.67	86.33	46.67	21.87	2.60	78.40	2.53	54.00	2.56	13.93	3.13	24.35	42.73
38.	IC-132186 × GJT-5	47.00	97.67	44.80	24.07	3.40	73.53	2.44	55.87	2.69	15.20	3.70	24.32	46.22
39.	IC-132186 × GTF-1	46.33	98.00	57.27	23.73	3.07	87.60	2.39	46.20	2.09	16.67	2.36	15.61	45.30
40.	GT-10 × T-11	48.00	95.67	52.13	34.60	3.60	81.07	2.65	55.40	2.12	15.87	4.49	28.36	45.43
41.	GT-10 × GJT-5	51.33	98.67	49.93	24.13	3.20	79.80	2.59	56.07	2.27	13.00	3.18	25.34	43.45
42.	GT-10 × GTF-1	52.00	95.67	41.80	23.53	3.80	76.53	2.75	54.27	1.92	16.20	2.54	15.81	45.71
43.	T-11 × GJT-5	48.33	88.33	44.20	31.60	2.60	71.07	2.49	52.47	2.57	19.60	4.05	20.99	48.52
44.	T-11 × GTF-1	41.67	90.67	44.87	32.87	2.60	73.67	2.33	53.00	1.26	16.27	2.34	14.41	47.56
45.	GJT-5 × GTF-1	40.67	92.67	53.00	25.53	2.87	91.13	2.95	63.00	2.53	24.33	4.56	18.74	45.37
	F_1 mean	**46.53**	**93.19**	**57.20**	**31.69**	**3.26**	**89.74**	**2.73**	**60.94**	**2.21**	**18.91**	**4.47**	**24.23**	**45.85**
	F_2													
1.	GT-3 × GT-4	44.33	91.67	49.52	25.15	2.73	73.02	3.05	61.17	3.63	11.90	5.33	30.38	47.39
2.	GT-3 × GT-6	46.67	89.00	49.02	28.10	2.57	73.65	2.98	63.20	3.30	17.01	5.17	32.39	48.11
3.	GT-3 × AT-338	44.00	99.00	57.60	29.37	3.23	80.17	3.07	67.77	3.14	16.27	5.18	46.72	48.04
4.	GT-3 × AT-324	51.00	93.67	44.05	29.70	2.55	78.77	3.19	73.37	2.58	10.80	4.97	29.66	44.73
5.	GT-3 × IC-132186	50.00	100.67	52.65	27.22	2.32	70.83	2.83	70.10	2.52	15.57	4.57	28.56	46.32
6.	GT-3 × GT-10	50.33	92.00	54.75	18.10	2.13	71.33	2.77	79.63	3.46	16.33	4.51	25.51	49.23
7.	GT-3 × T-11	46.67	93.67	49.07	26.27	1.67	71.75	3.06	67.43	2.09	13.20	3.26	25.75	45.74
8.	GT-3 × GJT-5	42.33	94.33	58.15	20.47	1.92	82.48	3.22	75.00	2.90	14.93	3.79	30.87	48.58
9.	GT-3 × GTF-1	46.33	100.67	60.52	29.20	3.07	92.12	2.85	66.17	3.03	16.87	5.22	24.94	47.30
10.	GT-4 × GT-6	42.33	95.33	55.93	25.47	2.57	79.00	2.74	69.30	2.73	17.47	4.30	26.34	46.52
11.	GT-4 × AT-338	44.00	102.00	59.17	27.72	2.68	93.43	2.75	60.73	3.06	18.27	4.80	31.07	48.33
12.	GT-4 × AT-324	44.67	99.00	51.43	23.88	2.15	87.20	2.90	65.77	3.05	14.40	4.44	21.61	45.50
13.	GT-4 × IC-132186	45.67	98.00	56.10	24.42	2.33	93.23	2.87	62.83	2.34	15.33	3.32	29.69	50.10

14.	GT-4 × GT-10	43.00	99.00	52.85	21.13	1.73	77.32	2.80	64.47	3.61	15.07	4.49	32.94	49.35
15.	GT-4 × T-11	41.67	96.33	52.37	26.07	2.35	72.78	2.35	62.23	3.41	16.17	5.13	34.21	45.28
16.	GT-4 × GJT-5	51.00	97.33	54.27	29.07	3.18	86.40	2.63	59.23	3.24	15.80	5.22	42.72	49.53
17.	GT-4 × GTF-1	47.00	98.67	43.87	22.15	2.37	71.87	2.86	58.27	3.80	10.93	4.57	21.03	48.35
18.	GT-6 × AT-338	49.00	99.67	42.47	19.08	2.25	77.80	2.86	62.87	2.71	14.33	2.93	28.69	46.25
19.	GT-6 × AT-324	45.67	100.67	43.83	17.38	1.85	64.10	2.27	59.73	2.77	8.47	2.46	34.41	46.15
20.	GT-6 × IC-132186	47.33	99.33	40.58	19.88	1.62	65.97	2.40	58.50	2.91	8.67	2.96	30.86	45.60
21.	GT-6 × GT-10	52.33	100.33	37.25	20.90	2.45	66.77	2.77	67.57	2.79	11.63	3.57	27.27	47.48
22.	GT-6 × T-11	48.33	96.00	35.18	15.33	2.32	61.47	2.54	63.07	3.48	11.33	3.01	16.58	44.67
23.	GT-6 × GJT-5	46.67	98.00	37.40	16.52	2.18	59.98	2.55	58.83	2.66	12.93	2.14	24.41	46.23
24.	GT-6 × GTF-1	50.00	96.33	40.75	25.37	2.18	68.13	2.55	56.80	2.60	13.50	3.32	31.87	45.43
25.	AT-338 × AT-324	47.00	95.67	53.13	19.88	2.80	75.22	2.76	62.97	3.10	12.30	3.86	26.47	46.29
26.	AT-338 × IC-132186	50.00	95.67	44.95	22.73	2.10	65.67	2.33	57.77	2.12	10.77	2.82	37.15	46.29
27.	AT-338 × GT-10	50.33	97.33	41.38	19.47	2.27	69.10	2.39	54.50	3.35	9.43	3.45	25.51	47.49
28.	AT-338 × T-11	48.67	101.33	46.28	15.22	1.82	67.37	2.42	56.90	2.90	9.57	2.40	32.57	47.65
29.	AT-338 × GJT-5	49.33	98.33	52.68	23.28	2.02	74.72	2.34	56.17	2.72	11.20	3.63	29.26	47.71
30.	AT-338 × GTF-1	47.33	94.00	51.15	22.13	2.08	79.92	2.64	65.10	3.23	14.73	4.25	17.42	47.19
31.	AT-324 × IC-132186	45.67	93.67	44.48	18.38	2.72	80.67	2.78	59.70	3.23	17.43	3.05	29.78	49.35
32.	AT-324 × GT-10	47.33	104.67	47.65	24.17	2.20	82.22	2.83	68.77	2.77	14.03	4.12	42.93	48.44
33.	AT-324 × T-11	49.67	96.00	44.12	24.63	1.85	77.00	2.78	70.63	3.09	13.27	4.98	26.84	48.42
34.	AT-324 × GJT-5	48.67	96.00	45.70	20.58	1.73	85.32	2.87	68.63	2.65	12.40	3.30	22.50	49.37
35.	AT-324 × GTF-1	50.67	96.33	38.75	22.42	2.03	85.25	2.76	65.97	2.71	16.50	3.69	22.17	48.15
36.	IC-132186 × GT-10	51.67	102.00	45.62	15.87	1.95	69.30	2.65	67.77	2.60	12.77	2.77	23.12	46.40
37.	IC-132186 × T-11	49.33	99.33	42.20	19.30	1.92	79.85	2.58	58.67	3.17	14.30	3.19	21.09	48.59
38.	IC-132186 × GJT-5	50.67	100.33	65.18	21.00	3.23	93.33	2.74	60.27	2.32	14.13	2.94	14.38	46.21
39.	IC-132186 × GTF-1	51.67	99.67	45.60	16.12	2.33	74.45	2.63	55.03	2.70	14.37	2.00	21.10	47.35
40.	GT-10 × T-11	50.33	100.00	47.90	19.75	2.03	79.53	2.66	67.57	2.44	15.50	3.27	14.29	48.74
41.	GT-10 × GJT-5	50.33	99.67	35.72	12.25	1.68	70.38	2.74	66.00	2.53	11.60	1.62	13.91	47.20
42.	GT-10 × GTF-1	53.67	100.00	47.02	12.95	1.82	78.12	2.52	52.90	2.59	11.00	1.54	21.58	46.65
43.	T-11 × GJT-5	49.33	98.33	39.68	21.18	2.45	74.40	2.63	58.07	2.72	13.97	2.96	34.40	47.25
44.	T-11 × GTF-1	53.67	99.67	44.47	25.72	3.52	78.12	2.35	53.43	2.64	9.47	3.31	20.78	47.19
45.	GJT-5 × GTF-1	47.67	99.33	44.78	18.62	2.82	76.15	2.44	52.47	2.92	12.07	2.46	8.86	45.51
	F_2 mean	**48.07**	**97.73**	**47.72**	**21.86**	**2.31**	**76.36**	**2.70**	**62.96**	**2.90**	**14.33**	**3.65**	**26.99**	**47.48**
	Check													
	GT-6	42.00	95.00	58.73	39.80	2.07	79.33	2.67	72.20	1.93	22.40	5.57	24.23	48.15
	Overall mean	**47.10**	**95.54**	**52.40**	**27.08**	**2.80**	**82.98**	**2.71**	**62.04**	**2.55**	**16.29**	**4.13**	**25.91**	**46.75**
	S.Em±	**1.48**	**2.24**	**2.05**	**2.08**	**0.13**	**4.52**	**0.09**	**2.41**	**0.09**	**1.76**	**0.41**	**2.96**	**0.55**
	CD at 5%	**4.14**	**6.25**	**5.72**	**5.79**	**0.36**	**12.61**	**0.27**	**6.73**	**0.25**	**4.91**	**1.15**	**8.27**	**1.53**
	CV (%)	**5.45**	**4.06**	**6.78**	**13.28**	**8.06**	**9.44**	**5.88**	**6.74**	**5.99**	**18.72**	**17.22**	**19.82**	**2.03**

Table 3: Best parents for *per se* and gca and best crosses combinations for *per se*, sca, heterobeltiosis and SH for various characters in sesame.

Sr. No.	Characters	Best parents			Best cross combinations					
		Per se	GCA		*Per se*		SCA		Heterobeltiosis	Standard heterosis
			F_1	F_2	F_1	F_2	F_1	F_2		
1.	Days to 50 per cent flowering	**GT-3**	**GT-3**	**GT-4**	$P_3 \times P_8$	$P_2 \times P_8$	$P_2 \times P_5$	$P_5 \times P_6$	$P_5 \times P_6$	-
		T-11	GT-6	**GT-3**	$P_1 \times P_8$	$P_1 \times P_9$	$P_2 \times P_6$	$P_1 \times P_9$	-	-
		GT-6	**GT-4**	-	$P_9 \times P_{10}$	$P_2 \times P_3$	$P_3 \times P_7$	$P_2 \times P_7$	-	-
		GT-4	T-11	-	$P_4 \times P_{10}$	$P_2 \times P_7$	*$P_1 \times P_5$*	-	-	-
		GJT-5	GTF-1	-	*$P_1 \times P_5$*	$P_1 \times P_4$	$P_1 \times P_6$	-	-	-
2.	Days to maturity	GJT-5	T-11	**GT-3**	***$P_6 \times P_8$***	$P_1 \times P_3$	$P_5 \times P_6$	$P_1 \times P_3$	$P_5 \times P_6$	**$P_6 \times P_8$**
		T-11	-	-	**$P_2 \times P_8$**	$P_1 \times P_2$	*$P_6 \times P_8$*	$P_1 \times P_7$	$P_6 \times P_8$	**$P_2 \times P_8$**
		GT-3	-	-	**$P_1 \times P_8$**	$P_1 \times P_7$	*$P_5 \times P_8$*	$P_5 \times P_6$	$P_3 \times P_4$	**$P_1 \times P_8$**
		GTF-1	-	-	$P_2 \times P_9$	$P_1 \times P_5$	$P_3 \times P_4$	-	$P_2 \times P_6$	**$P_5 \times P_8$**
		GT-6	-	-	***$P_5 \times P_8$***	**$P_1 \times P_8$**	-	-	-	$P_8 \times P_9$
3.	Length of reproductive stem (cm)	**GT-4**	**GT-3**	**GT-4**	**$P_5 \times P_8$**	$P_1 \times P_{10}$	$P_5 \times P_6$	$P_6 \times P_9$	$P_1 \times P_{10}$	**$P_5 \times P_8$**
		AT-338	**GT-4**	**AT-338**	$P_3 \times P_6$	$P_6 \times P_9$	$P_3 \times P_7$	$P_1 \times P_{10}$	$P_1 \times P_6$	$P_3 \times P_7$
		GT-6	GT-6	**GT-3**	***$P_1 \times P_7$***	$P_2 \times P_4$	*$P_1 \times P_7$*	$P_1 \times P_9$	$P_1 \times P_7$	**$P_1 \times P_7$**
		AT-324	**AT-338**	-	**$P_1 \times P_8$**	$P_1 \times P_9$	*$P_1 \times P_6$*	$P_1 \times P_7$	$P_1 \times P_9$	**$P_1 \times P_8$**
		GT-10	-	-	***$P_1 \times P_6$***	$P_1 \times P_4$	$P_1 \times P_{10}$	$P_2 \times P_3$	$P_1 \times P_8$	**$P_1 \times P_6$**
4.	Number of capsules per plant	GT-6	**GT-4**	**GT-4**	$P_3 \times P_6$	$P_1 \times P_5$	$P_3 \times P_7$	$P_1 \times P_{10}$	$P_2 \times P_6$	$P_3 \times P_7$
		AT-338	GT-10	**GT-3**	***$P_2 \times P_6$***	$P_1 \times P_4$	*$P_2 \times P_6$*	$P_2 \times P_9$	$P_2 \times P_8$	**$P_2 \times P_6$**
		GT-10	**GT-3**	**AT-338**	$P_4 \times P_{10}$	$P_1 \times P_{10}$	$P_2 \times P_9$	$P_1 \times P_6$	$P_1 \times P_6$	**$P_2 \times P_9$**
		AT-324	GT-6	**AT-324**	*$P_2 \times P_8$*	**$P_2 \times P_9$**	$P_1 \times P_7$	$P_8 \times P_{10}$	$P_1 \times P_2$	-
		GJT-5	-	-	$P_1 \times P_{10}$	$P_1 \times P_3$	*$P_2 \times P_8$*	$P_1 \times P_5$	$P_2 \times P_{10}$	-
5.	Number of branches per plant	GT-10	GT-10	**GT-4**	*$P_2 \times P_7$*	$P_8 \times P_9$	$P_3 \times P_6$	$P_8 \times P_{10}$	$P_4 \times P_9$	$P_2 \times P_3$
		IC-132186	IC-132186	IC-132186	*$P_5 \times P_7$*	$P_6 \times P_9$	$P_4 \times P_9$	$P_6 \times P_9$	$P_4 \times P_8$	$P_1 \times P_3$
		GT-4	**AT-324**	**GT-3**	*$P_2 \times P_4$*	$P_1 \times P_4$	*$P_2 \times P_7$*	$P_1 \times P_4$	$P_3 \times P_4$	**$P_2 \times P_9$**
		AT-324	**GT-4**	GTF-1	$P_3 \times P_5$	**$P_2 \times P_9$**	*$P_2 \times P_4$*	$P_2 \times P_9$	$P_2 \times P_4$	$P_3 \times P_9$
		GT-3	**AT-338**	-	$P_2 \times P_6$	$P_1 \times P_{10}$	*$P_5 \times P_7$*	$P_1 \times P_{10}$	$P_8 \times P_9$	$P_1 \times P_8$
6.	Plant height (cm)	**AT-324**	**AT-324**	**AT-324**	***$P_1 \times P_5$***	$P_2 \times P_4$	$P_3 \times P_7$	$P_1 \times P_{10}$	$P_3 \times P_7$	**$P_1 \times P_5$**
		AT-338	**AT-338**	**GT-4**	$P_3 \times P_6$	$P_6 \times P_9$	*$P_1 \times P_5$*	$P_6 \times P_9$	$P_2 \times P_7$	$P_3 \times P_7$
		IC-132186	**GT-3**	-	***$P_2 \times P_7$***	$P_2 \times P_6$	$P_5 \times P_8$	$P_2 \times P_6$	$P_1 \times P_7$	**$P_2 \times P_7$**
		GTF-1	-	-	**$P_1 \times P_4$**	$P_1 \times P_{10}$	*$P_2 \times P_7$*	$P_2 \times P_4$	$P_2 \times P_9$	**$P_1 \times P_4$**
		GT-10	-	-	$P_2 \times P_{10}$	$P_2 \times P_5$	$P_1 \times P_7$	-	$P_1 \times P_9$	$P_3 \times P_4$
7.	Length of capsule (cm)	**AT-338**	**GT-3**	**GT-3**	***$P_1 \times P_9$***	**$P_1 \times P_9$**	$P_2 \times P_5$	$P_1 \times P_9$	$P_2 \times P_7$	**$P_1 \times P_9$**

		GJT-5	GJT-5	**AT-324**	$P_4\times P_{10}$	**$P_1\times P_5$**	$P_1\times P_9$	$P_3\times P_4$	$P_1\times P_9$	**$P_1\times P_7$**
		GT-3	**AT-338**	-	**$P_1\times P_7$**	$P_1\times P_4$	$P_1\times P_7$	$P_2\times P_6$	$P_2\times P_5$	$P_2\times P_9$
		GTF-1	-	-	**$P_1\times P_5$**	$P_1\times P_8$	$P_2\times P_9$	$P_2\times P_{10}$	$P_1\times P_7$	**$P_1\times P_5$**
		GT-6	-	-	**$P_1\times P_{10}$**	$P_1\times P_2$	$P_2\times P_6$	$P_3\times P_7$	$P_2\times P_6$	**$P_1\times P_{10}$**
8.	Number of seeds per capsule	GT-6	**GT-4**	**AT-324**	$P_1\times P_6$	$P_1\times P_7$	$P_1\times P_6$	$P_1\times P_7$	$P_1\times P_6$	-
		AT-324	**AT-338**	**GT-3**	$P_5\times P_6$	$P_1\times P_9$	$P_1\times P_9$	$P_1\times P_9$	$P_1\times P_7$	-
		GTF-1	**AT-324**	-	$P_1\times P_5$	$P_1\times P_5$	$P_5\times P_6$	$P_1\times P_6$	$P_2\times P_6$	-
		T-11	**GT-3**	-	$P_1\times P_9$	$P_5\times P_8$	$P_2\times P_7$	$P_6\times P_7$	$P_1\times P_9$	-
		AT-338	-	-	$P_2\times P_6$	$P_1\times P_6$	$P_1\times P_5$	$P_4\times P_{10}$	-	-
9.	Test weight (g)	T-11	**AT-324**	**GT-4**	**$P_3\times P_{10}$**	$P_2\times P_{10}$	$P_3\times P_{10}$	$P_2\times P_{10}$	$P_4\times P_5$	$P_4\times P_5$
		GJT-5	**GT-3**	**GT-3**	$P_3\times P_9$	**$P_1\times P_2$**	$P_4\times P_5$	$P_3\times P_8$	$P_3\times P_{10}$	**$P_3\times P_{10}$**
		GT-3	GJT-5	T-11	**$P_1\times P_2$**	$P_2\times P_7$	$P_1\times P_2$	$P_5\times P_6$	$P_3\times P_7$	**$P_1\times P_2$**
		AT-324	-	-	**$P_1\times P_{10}$**	$P_3\times P_8$	$P_4\times P_7$	$P_2\times P_7$	$P_4\times P_7$	**$P_1\times P_{10}$**
		AT-338	-	-	$P_4\times P_6$	$P_1\times P_7$	$P_3\times P_7$	$P_1\times P_7$	$P_1\times P_2$	$P_4\times P_7$
10.	Biological yield per plant (g)	GT-6	**GT-3**	-	**$P_1\times P_5$**	**$P_2\times P_4$**	$P_1\times P_5$	$P_2\times P_4$	$P_1\times P_2$	**$P_1\times P_5$**
		GJT-5	**AT-338**	-	**$P_2\times P_4$**	$P_2\times P_3$	$P_2\times P_6$	$P_5\times P_6$	$P_2\times P_6$	**$P_2\times P_4$**
		AT-324	-	-	**$P_2\times P_6$**	$P_5\times P_6$	$P_9\times P_{10}$	-	$P_1\times P_5$	**$P_2\times P_6$**
		AT-338	-	-	$P_1\times P_7$	$P_1\times P_3$	$P_3\times P_7$	-	$P_1\times P_6$	-
		GT-10	-	-	$P_2\times P_9$	$P_1\times P_{10}$	$P_2\times P_4$	-	$P_2\times P_{10}$	-
11.	Seed yield per plant (g)	**AT-324**	**GT-4**	**GT-4**	**$P_4\times P_5$**	**$P_1\times P_2$**	$P_4\times P_5$	$P_1\times P_{10}$	$P_1\times P_2$	**$P_4\times P_5$**
		GJT-5	**AT-338**	**GT-3**	**$P_3\times P_7$**	$P_2\times P_9$	$P_3\times P_7$	$P_1\times P_6$	$P_1\times P_6$	**$P_3\times P_7$**
		AT-338	**AT-324**	**AT-324**	**$P_1\times P_2$**	$P_1\times P_{10}$	$P_1\times P_2$	$P_2\times P_9$	$P_2\times P_6$	**$P_1\times P_2$**
		GT-6	-	-	**$P_2\times P_8$**	$P_1\times P_4$	$P_1\times P_6$	$P_1\times P_3$	$P_3\times P_7$	**$P_2\times P_8$**
		T-11	-	-	**$P_2\times P_6$**	$P_1\times P_3$	$P_2\times P_8$	-	$P_4\times P_5$	**$P_2\times P_6$**
12.	Harvest index (%)	T-11	**GT-4**	**GT-4**	**$P_3\times P_{10}$**	$P_1\times P_4$	$P_4\times P_5$	$P_5\times P_7$	$P_3\times P_7$	$P_4\times P_5$
		GTF-1	**AT-324**	**AT-338**	$P_3\times P_9$	$P_5\times P_7$	$P_3\times P_{10}$	$P_1\times P_4$	$P_4\times P_5$	$P_3\times P_{10}$
		GT-4	-	-	$P_3\times P_6$	$P_2\times P_9$	$P_3\times P_7$	$P_2\times P_9$	-	**$P_3\times P_7$**
		AT-324	-	-	**$P_2\times P_5$**	$P_4\times P_6$	$P_1\times P_2$	$P_4\times P_6$	-	**$P_2\times P_5$**
		AT-338	-	-	**$P_1\times P_2$**	$P_3\times P_5$	$P_4\times P_6$	$P_8\times P_9$	-	**$P_1\times P_2$**
13.	Oil content (%)	GT-6	**GT-3**	**GT-4**	$P_8\times P_9$	$P_2\times P_6$	$P_5\times P_7$	$P_5\times P_6$	$P_5\times P_6$	-
		GT-4	GJT-5	GT-10	$P_5\times P_7$	$P_2\times P_9$	$P_5\times P_6$	$P_2\times P_6$	$P_5\times P_7$	-
		GT-3	GTF-1	GJT-5	$P_2\times P_9$	$P_5\times P_9$	$P_8\times P_9$	$P_5\times P_9$	-	-
		T-11	GT-6	**GT-3**	$P_2\times P_3$	$P_2\times P_7$	$P_4\times P_7$	$P_6\times P_8$	-	-
		GTF-1	**GT-4**	-	$P_8\times P_{10}$	$P_5\times P_6$	$P_2\times P_3$	$P_5\times P_8$	-	-

Likewise, the mean sum of square for parents *vs* F_2's was found to be highly significant for all the traits except days to maturity, length of capsule, number of seeds per capsule and harvest index.

Bhattacharjee *et al*. (2021); Disowja *et al*. (2021); Kumar *et al*. (2022); Zala (2022) in sesamum.

Mean performance: Data recorded from five plants for parents and hybrids and 20 plants for F_2 were averaged and presented in Table 2, for all the 13 traits except days to 50 per cent flowering and days to maturity as these were recorded on plot basis. The overall mean value observed for parental lines, F_1's and F_2's was 4.76, 4.47 and 3.65, which ranged from 2.43 (IC-132186) to 6.45 (AT-324), 2.34 (T-11 × GTF-1) to 11.54 (GT-6 × GTF-1) and 1.54 (GT-10 × GTF-1) to 5.33 (GT-3 × GT-4), respectively. The parents recorded with highest seed yield per plant were AT-324 (6.45), GJT-5 (6.23) and AT-338 (5.77). Similarly, top five cross combinations for this trait were, AT-338 × AT-324 (11.54), GT-6 × GT-10 (10.22), GT-3 × GT-4 (8.47), GT-4 × T-11 (7.28) and GT-4 × IC-132186 (6.99). In total the number of best performing parents, F_1's and F_2's over grand mean were 5, 8 and 1, respectively.

Comparison with heterosis and gca/sca effect: The relationship of *per se* performance with heterobeltiosis (marked with under line) and standard heterosis (marked with bold) is presented in Table 3. Among the top five cross studied for various traits, the cross combinations which showed high *per se* performance also had high heterobeltiosis and standard heterosis for all the traits. These crosses were IC-132186 × T-11 ($P_6 \times P_8$) and AT-324 × T-11 ($P_5 \times P_8$) for days to maturity; GT-3 × GT-10 ($P_1 \times P_7$), GT-3 × T-11 ($P_1 \times P_8$) and GT-3 × IC-132186 ($P_1 \times P_6$) for length of reproductive stem; GT-4 × IC-132186 ($P_2 \times P_6$) for number of capsules per plant; GT-4 × GT-10 ($P_2 \times P_7$) for plant height; GT-3 × GJT-5 ($P_1 \times P_9$) and GT-3 × GT-10 ($P_1 \times P_7$) for length of capsule; GT-6 × GTF-1 ($P_3 \times P_{10}$) and GT-3 × GT-4 ($P_1 \times P_2$) for test weight; GT-3 × AT-324 ($P_1 \times P_5$) and GT-4 × IC-132186 ($P_2 \times P_6$) for biological yield per plant and AT-338 × AT-324 ($P_4 \times P_5$), GT-6 × GT-10 ($P_3 \times P_7$), GT-3 × GT-4 ($P_1 \times P_2$) and GT-4 × IC-132186 ($P_2 \times P_6$) for seed yield per plant. It was observed from such comparison that majority of the crosses showing high *per se* performance for the studied traits also indicated high heterobeltiosis and high standard heterosis. The presence of appreciable amount of heterotic effects in most of the crosses for different traits studied may be attributed to non-allelic interaction, which can either increase or decrease the expression of heterosis.

Among parents GT-4, AT-324, GT-3 and AT-338 offer the best possibilities of exploitation for the development of improved pure lines with enhanced seed yielding ability as being recorded with high per se along with high gca effect for most of the traits. It is suggested that population involving these lines in a multiple crossing programme may be developed for isolating desirable recombinants.

In Table 3, the relationship between *per se* performance and sca effects for F_1 generation is marked with italic, while for F_2 generation it is marked with wavy line. In case of seed yield per plant, four crosses *viz*., AT-338 × AT-324 ($P_4 \times P_5$), GT-6 × GT-10 ($P_3 \times P_7$), GT-3 × GT-4 ($P_1 \times P_2$) and GT-4 × T-11 ($P_2 \times P_8$) in F_1 generation and three crosses *viz*., GT-4 × GJT-5 ($P_2 \times P_9$), GT-3 × GTF-1 ($P_1 \times P_{10}$) and GT-3 × GT-6 ($P_1 \times P_3$) in F_2 generation exhibited high *per se* performance with significant sca effects. Among top five cross studied, three cross combinations AT-338 × AT-324 ($P_4 \times P_5$), GT-6 × GT-10 ($P_3 \times P_7$) and GT-3 × GT-4 ($P_1 \times P_2$) performed consistently in F_1 generation for high *per se* performance, significant sca effects along with high heterobeltiosis and standard heterosis. These findings are akin with Abd-Elrhman *et al*. (2019); Sirohi *et al*. (2020); Bhattacharjee *et al*. (2021); Disowja *et al.* (2021); Kabi *et al.* (2021); Kumar *et al*. (2021); Zala (2022) in sesame for seed yield per plant.

CONCLUSIONS

Among parents GT-4, AT-324, GT-3 and AT-338 offer the best possibilities of exploitation for the development of improved pure lines with enhanced seed yielding ability as being recorded with high per se along with high gca effect for most of the traits. Three cross combinations AT-338 × AT-324 ($P_4 \times P_5$), GT-6 × GT-10 ($P_3 \times P_7$) and GT-3 × GT-4 ($P_1 \times P_2$) performed consistently in F_1 generation for high *per se* performance, significant sca effects along with high heterobeltiosis and standard heterosis. These parents and cross could be utilized further in multiple crossing programme or hybrids could be further evaluated to be released as variety.

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Conflict of Interest. None.

REFERENCES

Abd-Elrhman, R. H. A., Okasha, S. A. and Elareny, I. M. (2019). Correlation, path coefficient analysis and genetic variability for assessment of yield and its components in F_1 hybrid population of sesame (*Sesamum indicum* L.). *Int. J. Agric. Environ. Res.*, *5*(1), 130-147.

Bhalodiya, D., Dhaduk, H. K. L., Kumar, S., Gediya, L. N. and Patel, H. P. (2019). Line × tester analysis for seed yield, protein and oil content and SSR based diversity in sesame (*Sesamum indicum* L.). *Ecol. Genet. Genom., 13,* 1-8.

Bhattacharjee, M., Kundagrami, S. and Dasgupta, T. (2021). Combining ability for quantitative traits in sesame through line × tester analysis. *The Bioscan*, *16*(1), 239-246.

Disowja, A., Parameswari, C., Gnanamalar, R. P. and Vellaikumar, S. (2021). Heterosis and combining ability studies in sesame (*Sesamum indicum* L.). *Electron. J. Plant Breed., 12*(2), 347-352

Kabi, M., Baisakh, B., Dash, M., Tripathy, S. K., Sahu, S. and Panigrahi, K. K. (2021). Gene action and combining ability study in sesame. *Plant Arch*., *21*(1), 1810-1818.

Kumar, R., Patel, J. A. and Joshi, D. P. (2022). Identification of potential hybrids for heterosis breeding in sesame

(*Sesamum indicum* L.). *Ann. Plant Soil Res.*, *24*(2): 324-330.
Kumar, R., Patel, J. A., Rahevar, P. M and Patel, R. M. (2021). Deciphering combining ability and gene action study in elite genotypes of sesame (*Sesamum indicum* L.) using diallel mating design. *Emer. Life Sci. Res., 7*(1), 1-6.
Sirohi, S., Kumhar, S. R. and Kumari, B. (2020). Heterosis and combining ability studies in sesame (*Sesamum indicum* L.). *J. Oilseeds Res.*, *37*(1), 16-20.
Zala, R. G. (2020). Exploitation of heterosis, inbreeding depression, combining ability and gene action for seed yield and its components in sesame (*Sesamum indicum* L.). Ph. D. (Agri.) Thesis (Unpublished) Submitted to Junagadh Agricultural University, Junagadh.

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