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Heterosis and *Per se* performance studies in sesame (*Sesamum indicum* L.)

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Abstract
The present study comprised of a full diallel set of eight diverse parental lines and their 56 F_1s including reciprocals. The data were recorded for ten quantitative traits. The analysis of variance revealed highly significant differences due to genotypes for all the characters. Mean performance of parents revealed a significant difference for all the traits under study excluding days to 50 per cent flowering and seed yield. The parent TBS-3 was top in seed yield per plant followed by TBS-10 and TBS-105. Length of the capsule was found highest in the parent TBS-10. Parental line V-29 recorded the maximum number of seeds per capsule while 1000 seed weight and oil content were recorded as the highest in TBS-105. Regarding the mean performance of hybrids exhibited significant difference for all the traits under study. Hybrid TBS-105 x R-09 was the top yielder followed by TBS-105 x V-29 and TBS-7 x V-29. Hybrid TBS-12 x TBS-105 had displayed a maximum 1000-seed weight whereas, the highest oil content was recorded in hybrid TBS-105 x V-29. Among the 56 F_1s TBS-105 x R-09, TBS-105 x V-29 and TBS-7 x V-29 were top rankings crosses manifested highly significant and desirable heterosis for seed yield and either of the component traits viz., plant height, the number of branches, the number of capsules, capsule length and the number of seeds per capsule over mid, a better parent and standard check.

Key words: Mid parent heterosis, heterobeltiosis, standard heterosis, reciprocals, sesame.

INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the world's oldest oilseed crops grown across the globe. It is an important and ancient oil-yielding crop cultivated for its flavoursome, edible protein-rich seed and high-quality oil (Bhat *et al.*, 1999). Sesame seed contains high oil content (46 to 50 %) with 83 to 90 per cent unsaturated fatty acids, proteins (20 to 25 %) and various minor nutrients such as vitamins and minerals, a large number of characteristic lignans (sesamin, sesamol and sesamolin) and tocopherols (Fukuda *et al.*, 1985). Therefore, sesame seeds with high amounts of nutritional components are consumed as a traditional health food for their specific antihypertensive effect, anticarcinogenic, anti-inflammatory and antioxidative activity (Yokota *et al.*, 2007).

Plant breeders are challenged with a parent selection during the breeding of high yielding varieties. Although, plant breeders eliminate poor crosses in initial generations on the basis of their performance, information on the genetic architecture of yield and attributing traits will help to find out the improved crosses more competently. Several researchers suggested diallel analysis, is one of the best methods of understanding the genetic nature of biometric traits and to ascertain the prepotency of parents. Heterosis breeding provides information on probable gene action and helps in finding desirable genotypes. The present study was an attempt to estimate the genetic nature of quantitatively inherited traits and to ascertain the prepotency of parents as well as to determine the magnitude of heterosis for yield and its component traits.

MATERIALS AND METHODS

The experimental material used in the present study comprised of 56 F_1 crosses made by using an 8 x v8 diallel mating design including reciprocals. The 56 crosses were made during *kharif* , 2019 at Oilseed Research Station, Latur. A set of 67 genotypes comprised of 56 hybrids, eight parents and three standard checks *viz*., AKT-101, JLT-408 and GT-2 were grown in Randomized Block Design (RBD) with two replications during summer, 2020 at the Tissue Culture Unit, Parbhani. Each entry was sown in two rows having 3.0 m length with 45 × 15 cm spacing. The recommended agronomical practices and plant protection measures were adopted for raising a good crop. The observations were recorded on days to 50 per cent flowering, days to maturity, plant height, the number of branches per plant, the number of capsules per plant, capsule length, the number of seeds per capsule, 1000 seed weight, seed yield per plant and oil content. The replication wise mean values of each entry for the 10 traits were analyzed using Randomized Block Design (RBD) as suggested by Panse and Sukhatme (1961) and estimation of heterobeltiosis by Fonseca and Patterson (1968) and economic heterosis by Meredith and Bridge (1972). The replicated mean data were analyzed statistically using the software WINDOSTAT version 8.1.

RESULTS AND DISCUSSION

The analysis of variance from the mean data (**Table 1**) exhibited highly significant differences due to genotypes for all the traits, indicating parents possessed a sufficiently high genetic diversity. Further partitioning of the mean sum of squares due to parents were significant for all the traits except days to 50 per cent flowering, days to maturity, capsule length, the number of seeds per capsule, 1000 seed weight, seed yield per plant and oil content. The significant differences among parents for plant height, the number of branches and the number of capsules suggested greater diversity in the parental lines for respective traits. In the case of hybrids, significant differences were observed for all the traits excluding days to 50 per cent flowering and days to maturity indicating the varying performance of crosses. The mean sum of squares due to parents *vs* hybrids was also significant for all the characters except days to maturity, the number of branches per plant, capsule length, 1000-seed weight and oil content, indicated sufficient amount of heterosis was reflected in crosses for the yield contributing traits *viz*., days to 50 per cent flowering, plant height, the number of capsules and the number of seeds per capsule.

Mean performance of parents revealed a significant difference for all the traits under study excluding days to 50 per cent flowering and seed yield. Based on the mean performance the parent TBS-3 followed by TBS-10 and TBS-105 was top ranking for seed yield per plant. These parents also expressed good performance for yield contributing traits *viz*., the number of capsules per plant, length of capsule, the number of seeds per capsule and 1000-seed weight. Significantly early for days to maturity, more plant height, the number of branches and the number of capsules was recorded in parent TBS-7. Parent R-09 recorded a significantly high number of the capsule. Length of the capsule was found highest in the parent TBS-10. Parental line V-29 recorded the maximum number of seeds per capsule while 1000 seed weight and oil content were recorded more in TBS-105. Regarding the mean performance of hybrids exhibited significant difference for all the traits under study. None of the hybrids were found superior for all the traits based on mean values. Hybrid TBS-7 x TBS-12 displayed significantly earlier for days to 50 per cent flowering, while hybrid TBS-3 x V-29 was found early for days to maturity and the highest length of the capsule. TBS-12 x R-09 had recorded maximum plant height. TBS-7 x TBS-105 produced the maximum number of branches per plant. TBS-105 x R-09 had recorded the maximum number of capsules per plant and seed

Table 1. Mean sum of squares for parents and F_1s for different characters

Source of variation	d.f.	Days to 50% flowering	Days to maturity	Plant height	Number of branches/ plant	Number of capsules/ plant	Length of capsule	Number of seeds/ capsule	1000 seed weight	Seed yield/ plant	Oil content
Replication	1	0.36	16.48	3.34	0.02	0.008	0.008	11.57	0.003	0.15	0.09
Genotypes	66	6.02*	23*	316.39**	0.29**	1387.7**	0.14**	83.64**	0.29*	33.50**	35.19**
Parents (P)	7	4.77	14.77	783.56**	0.22**	132.57*	0.13	59.2	0.25	0.23	32.05
Hybrids (F_1)	55	5.40	23.58	156.16**	0.31**	1246.2**	0.12*	78.41**	0.25*	28.02**	37.16**
P *vs* F_1	1	55.00**	55.00	4049.9**	0.18	16741**	0.25	427.18**	0.045	538.9**	0.01
Error	66	3.97	15.27	81.29	0.06	49.26	0.06	46.57	0.16	1.63	18.66

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

yield. R-20 x V-29 had produced the maximum number of seeds per capsule. TBS-12 x TBS-105 had displayed a maximum 1000-seed weight whereas, the highest oil content was recorded in hybrid TBS-105 x V-29. Hybrids TBS-105 x R-09 was top in seed yield per plant followed by TBS-105 x V-29 and TBS-7 x V-29 (**Table 2**).

Table 2. Mean performance of the parents and their F_1s including reciprocal hybrids for ten traits in sesame

S. No.	Parents/hybrids	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Length of capsule (cm)	Number of seeds per capsule	1000 seed weight (g)	Seed yield per plant (g)	Oil content (%)
	Parents										
1	TBS-3	43.50	88.50	143.500	3.165	69.500	3.015	60.250	4.350	10.075	37.055
2	TBS-7	40.50	86.50	110.500	3.500	66.665	2.785	57.750	4.375	9.775	39.300
3	TBS-10	43.00	88.50	117.500	3.500	64.500	3.385	58.000	4.215	10.000	36.620
4	TBS-12	40.50	87.50	112.500	3.165	64.500	3.085	56.000	4.515	9.665	44.675
5	TBS-105	43.00	89.00	116.665	3.165	61.000	2.730	56.000	4.820	9.830	46.030
6	R-09	44.00	95.50	127.335	3.000	73.665	2.855	56.500	3.675	9.660	41.765
7	R-20	40.00	88.50	78.165	2.500	46.000	2.800	65.755	4.050	9.105	35.750
8	V-29	42.00	88.50	94.165	3.500	63.000	3.370	71.000	3.930	9.250	43.935
	Parental mean	42.06	89.06	112.54	3.19	63.60	3.00	60.16	4.24	9.67	40.64
	Hybrids										
9	TBS-3 x TBS-7	42.00	87.00	119.665	3.165	78.000	3.250	62.000	4.270	12.685	36.205
10	TBS-3 x TBS-10	46.00	90.00	136.335	3.000	76.665	3.130	69.500	4.320	11.665	39.095
11	TBS-3 x TBS-12	42.50	88.50	128.165	3.835	89.000	2.985	63.250	4.645	14.620	40.975
12	TBS-3 x TBS-105	43.00	86.50	127.500	3.165	87.330	2.950	68.085	4.245	19.070	36.915
13	TBS-3 x R-09	42.00	86.50	132.355	3.670	138.000	3.030	61.755	4.650	19.080	36.090
14	TBS-3 x R-20	42.00	86.50	133.170	3.670	117.335	3.215	67.500	4.425	15.970	36.170
15	TBS-3 x V-29	41.50	84.50	123.835	3.500	80.835	3.515	66.500	4.145	13.490	44.090
16	TBS-7 x TBS-10	42.50	86.00	128.500	3.500	116.500	3.150	65.500	4.335	19.820	37.310
17	TBS-7 x TBS-12	41.00	86.50	133.170	3.000	121.000	3.000	67.835	4.720	20.855	48.380
18	TBS-7 x TBS-105	44.00	89.00	127.165	4.330	119.335	3.385	64.250	4.220	18.900	38.720
19	TBS-7 x R-09	46.00	87.50	123.665	3.500	67.835	3.300	74.250	3.705	14.170	43.175
20	TBS-7 x R-20	45.00	87.00	130.835	3.500	120.165	3.400	74.500	4.050	19.835	34.900
21	TBS-7 x V-29	45.00	89.00	134.165	3.165	150.500	3.270	64.750	4.095	23.500	47.045
22	TBS-10 x TBS-12	46.00	94.50	133.165	3.165	106.915	3.285	64.250	5.010	15.205	39.265
23	TBS-10 x TBS-105	42.50	92.50	126.835	3.165	112.500	3.300	67.505	4.065	19.940	38.150
24	TBS-10 x R-09	45.50	94.50	122.330	3.165	93.500	3.485	66.750	4.050	18.450	39.190
25	TBS-10 x R-20	43.00	92.00	125.000	3.500	116.000	3.330	66.000	4.300	19.160	39.970
26	TBS-10 x V-29	44.00	87.50	127.335	3.330	108.500	3.330	74.500	4.220	21.930	40.200
27	TBS-12 x TBS-105	44.00	92.50	134.670	3.835	116.500	3.170	57.750	5.220	19.165	43.600
28	TBS-12 x R-09	45.50	93.00	146.500	3.835	114.330	2.670	62.000	4.345	19.665	42.955
29	TBS-12 x R-20	45.50	87.50	139.835	3.500	105.830	3.130	53.500	4.135	12.485	47.170
30	TBS-12 x V-29	46.50	87.00	127.665	3.165	74.335	2.850	72.755	4.280	17.415	42.830
31	TBS-105 x R-09	44.00	93.00	146.000	4.165	167.165	3.000	69.500	3.935	24.420	45.170
32	TBS-105 x R-20	46.00	86.50	130.165	3.835	142.500	3.150	69.750	3.875	13.935	38.030
33	TBS-105 x V-29	43.50	93.50	122.835	3.565	113.165	3.230	68.000	4.420	23.750	49.305
34	R-09 x R-20	42.50	96.50	132.165	3.165	120.330	2.630	67.000	3.670	13.470	40.870
35	R-09 x V-29	43.50	97.50	128.000	3.565	125.500	2.970	60.250	3.645	19.020	43.655
36	R-20 x V-29	43.50	87.50	113.665	3.165	93.000	3.170	80.750	3.720	15.500	43.010
37	TBS-7 x TBS-3	45.50	91.50	130.835	3.000	56.335	2.600	64.500	4.425	11.565	37.230
38	TBS-10 x TBS-3	45.50	91.50	123.330	2.835	53.000	2.785	56.250	4.245	10.335	32.925

Table 2. Contd…

S. No.	Parents/hybrids	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	Length of capsule (cm)	Number of seeds per capsule	1000 seed weight (g)	Seed yield per plant (g)	Oil content (%)
39	TBS-12 x TBS-3	41.50	89.00	127.665	3.165	99.835	2.745	57.695	4.260	10.225	31.790
40	TBS-105 x TBS-3	44.00	96.50	127.335	3.415	81.835	3.295	57.945	4.440	10.155	41.580
41	R-09 x TBS-3	44.00	96.50	122.000	3.335	79.000	3.165	56.450	4.270	10.085	31.925
42	R-20 x TBS-3	47.50	92.50	122.335	2.165	53.665	3.295	62.200	4.365	10.675	39.695
43	V-29 x TBS-3	44.50	95.00	124.335	3.165	102.500	3.035	56.695	4.575	14.300	35.905
44	TBS-10 x TBS-7	45.00	93.50	117.335	3.330	75.500	3.245	69.695	4.465	13.170	40.745
45	TBS-12 x TBS-7	44.00	94.50	131.835	3.900	103.170	3.045	63.700	4.625	18.500	35.915
46	TBS-105 x TBS-7	44.50	96.50	113.335	2.900	65.500	3.065	68.950	4.545	11.940	41.285
47	R-09 x TBS-7	44.50	95.50	116.165	3.900	103.835	2.965	64.945	4.210	15.005	38.055
48	R-20 x TBS-7	43.00	94.00	130.000	3.165	100.500	3.595	60.945	4.165	15.585	39.800
49	V-29 x TBS-7	45.50	94.50	124.500	3.165	88.165	3.315	68.695	3.525	13.795	38.030
50	TBS-12 x TBS-10	46.00	92.50	127.665	3.165	71.085	3.395	69.445	3.305	13.340	51.885
51	TBS-105 x TBS-10	45.50	92.50	128.000	3.165	99.670	3.435	61.945	3.965	13.835	36.870
52	R-09 x TBS-10	43.50	92.50	126.835	3.165	65.830	2.580	63.280	4.370	16.005	39.930
53	R-20 x TBS-10	43.50	92.50	131.000	3.000	82.835	3.415	68.950	4.075	9.520	39.835
54	V-29 x TBS-10	46.00	92.50	136.500	2.750	91.000	2.985	68.445	3.930	13.455	35.535
55	TBS-105 x TBS-12	42.00	92.00	125.575	2.735	85.665	3.135	47.945	4.235	14.840	48.395
56	R-09 x TBS-12	43.50	94.00	124.665	3.000	102.665	3.365	61.445	4.335	16.705	41.445
57	R-20 x TBS-12	44.50	91.50	129.665	3.330	104.335	3.335	61.195	3.835	15.920	43.940
58	V-29 x TBS-12	43.50	88.00	153.830	2.900	102.835	3.080	78.700	3.955	21.030	44.095
59	R-09 x TBS-105	41.50	86.50	146.000	2.900	76.820	3.665	73.445	4.095	17.770	42.560
60	R-20 x TBS-105	41.50	90.50	148.665	2.735	72.835	2.695	67.695	4.125	15.440	43.135
61	V-29 x TBS-105	42.50	90.50	119.335	2.735	55.500	3.065	75.195	4.125	11.890	38.140
62	R-20 x R-09	42.50	92.50	151.335	3.830	137.835	3.145	59.445	3.815	14.670	42.035
63	V-29 x R-09	48.00	93.00	140.000	3.335	117.165	2.895	70.695	3.390	17.710	44.430
64	V-29 x R-20	45.50	86.50	120.000	3.565	96.830	3.065	71.695	3.945	14.330	44.885
65	AKT-101 ©	45.50	87.50	96.17	2.84	59.50	2.67	59.00	4.05	9.66	37.15
66	JLT-408 ©	45.50	87.50	128.84	3.17	63.34	2.65	60.25	3.23	11.36	42.03
67	GT-2 ©	44.50	87.50	106.50	3.00	67.34	2.60	53.50	3.32	10.16	36.90
	Hybrid mean	44.04	91.04	129.55	3.30	98.18	3.14	65.68	4.18	15.87	40.61
	C.V.	4.54	4.31	7.12	7.57	7.59	8.25	10.55	9.73	8.59	10.66
	S.E.	1.41	2.76	6.38	0.18	4.96	0.18	4.83	0.29	0.90	3.06
	C.D. 5%	3.98	7.80	18.00	0.49	14.01	0.51	13.63	0.81	2.55	8.63
	Range Lowest	40.00	84.50	78.17	2.17	46.00	2.58	47.95	3.23	9.11	31.79
	Range Highest	48.00	97.50	153.83	4.33	167.17	3.67	80.75	5.22	24.42	51.89

The estimated heterosis over the mid parent, better parent and standard variety for ten traits in F_1 and reciprocal F_1 crosses is presented in **Table 3**. The mid, better and standard heterosis for days to 50 per cent flowering ranged from -4.00 to 13.8, -4.6 to 12.35, -7.87 to 7.87 per cent, respectively. None of the crosses found significant negative heterosis over better parent and standard check.

Regarding plant height mid, better and standard heterosis ranged from -9.91 to 52.61, -14.98 to 36.74, and -12.03 to 19.40 per cent, respectively. Among the crosses, 15, 7, 0 F_1s and 12, 8, 3 no of reciprocals crosses revealed significant positive mid, better parent and standard heterosis, respectively. Reddy *et al.* (2015) and Rajput *et al.* (2017) reported significant positive heterosis in sesame. Dela and Sharma (2019) and

Chauhan *et al.* (2019) also reported significant positive heterobeltiosis in sesame.

In the case of the number of branches per plant, mid, better and standard heterosis ranged from -23.57 to 39.27, -31.60 to 31.60 and -13.59 to 36.81 per cent, respectively. Sumathi and Muralidharan (2008) reported that the number of branches per plant has a high association with grain yield in sesame. For the number of branches 11, 6, 6 F_1s and 3, 1 and 3 no of reciprocals displayed significant positive mid, better and standard heterosis, respectively. Six straight crosses *viz*., TBS-3 x TBS-12, TBS-7 x TBS-105, TBS-12 x TBS-105, TBS-12 x R-09, TBS-105 x R-09 and TBS-105 x R-20 displayed significant positive mid parent, better parent and standard heterosis, respectively. One reciprocal cross R-20 x R-09 exhibited highly significant positive mid parent, a better parent and standard heterosis for the same trait. In the present study, some of the crosses revealed negative and significant mid, better and standard heterosis indicating genes with negative effects were dominant for this trait. Parimala *et al.* (2013) and Nayak *et al.* (2017) also reported both negative and positive significant heterosis for this trait.

Regarding the number of capsules per plant mid parent, a better parent and standard heterosis ranged from -20.90 to 166.36, -23.74 to 133.61 and -21.29 to 148.26 per cent, respectively, in F_1 and reciprocals (**Table 3**). The total of 13 out of 56 (F_1 and reciprocal F_1) crosses *viz*., TBS-3 x TBS-12, TBS-7 x TBS-12, TBS-7 x R-20, TBS-7 x V-29, TBS-10 x TBS-105, TBS-10 x R-20, TBS-10 x V-29, TBS-12 x TBS-105, TBS-12 x R-09, TBS-12 x R-20, R-09 x V-29 and R-20 x V-29 had revealed positive and significant mid, better and standard heterosis, respectively for this trait. Significant positive heterosis and heterobeltiosis in sesame were also reported by Shobha Rani *et al.* (2015), Patel *et al.* (2016) and Chaudhari *et al.* (2017).

Table 3. Heterosis over mid parent, better parent and best check in 56 F_1s crosses for ten traits in sesame (Per cent)

Crosses	Days to 50 per cent flowering						Days to maturity					
	Heterosis		Heterobeltiosis		Standard heterosis		Heterosis		Heterobeltiosis		Standard heterosis	
	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC
TBS-3 x TBS-7	0	8.33	-3.45	4.6	-5.62	2.25	-0.57	4.57	-1.69	3.39	-0.57	4.57
TBS-3 x TBS-10	6.36	5.2	5.75	4.6	3.37	2.25	1.69	3.39	1.69	3.39	2.86	4.57
TBS-3 x TBS-12	1.19	-1.19	-2.3	-4.6	-4.49	-6.74	0.57	1.14	0	0.56	1.14	1.71
TBS-3 x TBS-105	-0.58	1.73	-1.15	1.15	-3.37	-1.12	-2.54	8.73*	-2.81	8.43	-1.14	10.29*
TBS-3 x R-09	-4	0.57	4.55	0	-5.62	-1.12	-5.98	4.89	-9.42*	1.05	-1.14	10.29*
TBS-3 x R-20	0.6	13.8**	-3.45	9.2	-5.62	6.74	-2.26	4.52	-2.26	4.52	-1.14	5.71
TBS-3 x V-29	-2.92	4.09	-4.6	2.3	-6.74	0	-4.52	7.34	-4.52	7.34	-3.43	8.57
TBS-7 x TBS-10	1.8	7.78	-1.16	4.65	-4.49	1.12	-1.71	6.86	-2.82	5.65	-1.71	6.86
TBS-7 x TBS-12	1.23	8.64	1.23	8.64	-7.87	-1.12	-0.57	8.62*	-1.14	8	-1.14	8.00
TBS-7 x TBS-105	5.39	6.59	2.33	3.49	-1.12	0	1.42	9.97*	0	8.43	1.71	10.29*
TBS-7 x R-09	8.88*	9.88	4.55	5.33	3.37	0	-3.85	4.95	-8.38	0	0	9.14
TBS-7 x R-20	11.8**	6.83	11.11*	6.17	1.12	-3.37	-0.57	7.43	-1.69	6.21	-0.57	7.43
TBS-7 x V-29	9.09*	10.3*	7.14	8.33	1.12	2.25	1.71	8	0.56	6.78	1.71	8.00
TBS-10 x TBS-12	10.2*	10.2*	6.98	6.98	3.37	3.37	7.39	5.11	6.78	4.52	8	5.71
TBS-10 x TBS-105	-1.16	5.81	-1.16	5.81	-4.49	2.25	4.23	4.23	3.93	3.93	5.71	5.71
TBS-10 x R-09	4.6	0	3.41	-1.14	2.25	-2.25	2.72	0.54	-1.05	-3.14	8	5.71
TBS-10 x R-20	3.61	4.82	0	1.16	-3.37	-2.25	3.95	4.52	3.95	4.52	5.14	5.71
TBS-10 x V-29	3.53	8.24	2.33	6.98	-1.12	3.37	-1.13	4.52	-1.13	4.52	0	5.71
TBS-12 x TBS-105	5.39	0.6	2.33	-2.33	-1.12	-5.62	4.82	4.25	3.93	3.37	5.71	5.14
TBS-12 x R-09	7.69	2.96	3.41	-1.14	2.25	-2.25	1.64	2.73	-2.62	-1.57	6.29	7.43
TBS-12 x R-20	13	10.6*	12.35*	9.88	2.25	0	-0.57	3.98	-1.13	3.39	0	4.57
TBS-12 x V-29	12.7	5.45	10.71*	3.57	4.49	-2.25	-1.14	0	-1.69	-0.56	-0.57	0.57
TBS-105 x R-09	1.15	-4.6	0	-5.68	-1.12	-6.74	0.81	-6.23	-2.62	-9.42*	6.29	-1.14
TBS-105 x R-20	10.8	0	6.98	-3.49	3.37	-6.74	-2.54	1.97	-2.81	1.69	-1.14	3.43
TBS-105 x V-29	2.35	0	1.16	-1.16	-2.25	-4.49	5.35	1.97	5.06	1.69	6.86	3.43
R-09 x R-20	1.19	1.19	-3.41	-3.41	-4.49	-4.49	4.89	0.54	1.05	-3.14	10.29*	5.71
R-09 x V-29	1.16	11.6**	-1.14	9.09	-2.25	7.87	5.98	1.09	2.09	-2.62	11.43*	6.29
R-20 x V-29	6.1	11*	3.57	8.33	-2.25	2.25	-1.13	-2.26	-1.13	-2.26	0	-1.14

Table 3. Contd…

Crosses	Plant height						Number of branches per plant					
	Heterosis		Heterobeltiosis		Standard heterosis		Heterosis		Heterobeltiosis		Standard heterosis	
	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC
TBS-3 x TBS-7	-5.78	3.02	-16.61 **	-8.83	-7.12	1.55	-5.03	-9.98	-9.57	-14.29	0	-5.21
TBS-3 x TBS-10	4.47	-5.49	-4.99	-14.06 *	5.82	-4.27	-9.98	-14.93 *	-14.29	-19.00**	-5.21	-10.43
TBS-3 x TBS-12	0.13	-0.26	-10.69	-11.03	-0.52	-0.91	21.17 **	0	21.17 **	0	21.17 **	0
TBS-3 x TBS-105	-1.99	-2.11	-11.15	-11.26	-1.04	-1.16	0	7.9	0	7.9	0	7.9
TBS-3 x R-09	-2.26	-9.91	-7.77	-14.98 *	2.73	-5.31	19.06 **	8.19	15.96	5.37	15.96	5.37
TBS-3 x R-20	20.15 **	10.38	-7.2	-14.75 *	3.36	-5.05	29.57 **	-23.57 **	15.96	-31.60**	15.96	-31.60 **
TBS-3 x V-29	4.21	4.63	-13.70 *	-13.36 *	-3.88	-3.49	5.03	-5.03	0	-9.57	10.58	0
TBS-7 x TBS-10	12.72	2.93	9.36	-0.14	-0.26	-8.93	0	-4.86	0	-4.86	10.58	5.21
TBS-7 x TBS-12	19.43 **	18.24 *	18.37 *	17.19*	3.36	2.33	-9.98	17.03*	-14.29	11.43	-5.21	23.22 **
TBS-7 x TBS-105	11.96	-0.22	9	-2.85	-1.3	-12.03	29.93 **	-12.98	23.71 **	-17.14*	36.81 **	-8.37
TBS-7 x R-09	3.99	-2.31	-2.88	-8.77	-4.01	-9.83	7.69	20.00 **	0	11.43	10.58	23.22 **
TBS-7 x R-20	38.70 **	37.81 **	18.40 *	17.65*	1.55	0.9	16.67 *	5.5	0	-9.57	10.58	0
TBS-7 x V-29	31.11 **	21.66 **	21.42 *	12.67	4.14	-3.36	-9.57	-9.57	-9.57	-9.57	0	0
TBS-10 x TBS-12	15.80 *	11.01	13.33	8.65	3.36	-0.91	-5.03	-5.03	-9.57	-9.57	0	0
TBS-10 x TBS-105	8.33	9.32	7.94	8.94	-1.55	-0.65	-5.03	-5.03	-9.57	-9.57	0	0
TBS-10 x R-09	-0.07	3.61	-3.93	-0.39	-5.05	-1.55	-2.62	-2.62	-9.57	-9.57	0	0
TBS-10 x R-20	27.77 **	33.90 **	6.38	11.49	-2.98	1.68	16.67 *	0	0	-14.29	10.58	-5.21
TBS-10 x V-29	20.32 **	28.98 **	8.37	16.17*	-1.16	5.95	-4.86	-21.43 **	-4.86	-21.43 **	5.21	-13.11
TBS-12 x TBS-105	17.53 *	9.59	15.43	7.64	4.53	-2.53	21.17 **	-13.59	21.17 **	-13.59	21.17 **	-13.59
TBS-12 x R-09	22.17 **	3.96	15.05 *	-2.1	13.71	-3.24	24.41 **	-2.68	21.17 **	-5.21	21.17 **	-5.21
TBS-12 x R-20	46.68 **	36.01 **	24.30 **	15.26	8.54	0.64	23.57 **	17.56 *	10.58	5.21	10.58	5.21
TBS-12 x V-29	23.55 **	48.87 **	13.48	36.74**	-0.91	19.40 **	-5.03	-12.98	-9.57	-17.14 *	0	-8.37
TBS-105 x R-09	19.67 **	19.67 **	14.66 *	14.66**	13.32	13.32	35.12 **	-5.92	31.60 **	-8.37	31.60 **	-8.37
TBS-105 x R-20	33.62 **	52.61 **	11.57	27.43**	1.03	15.39 *	35.39 **	-3.44	21.17 **	-13.59	21.17 **	-13.59
TBS-105 x V-29	16.53 *	13.2	5.29	2.29	-4.66	-7.37	6.98	-17.93 **	1.86	-21.86 **	12.64	-13.59
R-09 x R-20	28.63 **	47.28 **	3.79	18.85**	2.58	17.46 *	15.09	39.27 **	5.5	27.67**	0	21.01 **
R-09 x V-29	15.58 *	26.41 **	0.52	9.95	-0.65	8.67	9.69	2.62	1.86	-4.71	12.64	5.37
R-20 x V-29	31.92 **	39.27 **	20.71 *	27.44**	-11.77	-6.86	5.5	18.83 *	-9.57	1.86	0	12.64

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

In the case of capsule length 3, 2, 13 F_1s and 2, 2 and 10 no of reciprocals crosses revealed significant positive mid parent, a better parent and standard heterosis, respectively. It ranged from -12.97 to 31.24, -23.78 to 28.39 and -2.62 to 37.27 per cent for the mid parent, better parent and standard heterosis, respectively. Prajapati *et al.* (2010) and Kumar *et al.* (2015) reported similar results in sesame.

Heterosis for the number of seeds per capsule ranged from -13.61 to 30.57, -20.15 to 29.99 and -20.42 to 30.62 per cent and crosses 5, 2, 5 no of F_1s and 6, 1 and 2 no of reciprocals showed significant positive mid parent, a better parent and standard heterosis, respectively. Cross TBS-7 x R-09 showed significant heterobeltiosis and standard heterosis, TBS-105 x R-09 significant positive heterosis and heterobeltiosis and TBS-7 x R-20, TBS-10 x V-29, TBS-12 x V-29 and R-20 x V-29 exhibited significant standard heterosis over JLT-408. Similar results were also obtained by Kumar *et al.* (2015), Patel *et al.* (2016), Dela and Sharma (2019) and Chauhan *et al.* (2019) in sesame.

Table 3. Contd…

Crosses	Number of capsules per plant						Length of capsule					
	Heterosis		Heterobeltiosis		Standard heterosis		Heterosis		Heterobeltiosis		Standard heterosis	
	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC
TBS-3 x TBS-7	14.57	-17.25	12.23	-18.94	15.84	-16.34	12.07	-10.34	7.79	-13.76	21.72 *	-2.62
TBS-3 x TBS-10	14.43	-20.90 *	10.31	-23.74*	13.86	-21.29 *	-2.19	-12.97	-7.53	-17.73*	17.23	4.31
TBS-3 x TBS-12	32.84 **	49.01 **	28.06 **	43.65 **	32.17 **	48.27 **	-2.13	-10	-3.24	-11.02	11.8	2.81
TBS-3 x TBS-105	33.84 **	25.42 **	25.65 *	17.75	29.69 **	21.53 *	2.7	14.71	-2.16	9.29	10.49	23.41 *
TBS-3 x R-09	92.78 **	10.36	87.33 **	7.24	104.95 **	17.32	3.24	7.84	0.5	4.98	13.48	18.54
TBS-3 x R-20	103.18 **	-7.07	68.83 **	-22.78*	74.26 **	-20.3	10.58	13.33	6.63	9.29	20.41 *	23.41 *
TBS-3 x V-29	22.02 *	54.72 **	16.31	47.48 **	20.05	52.22 **	10.1	-4.93	4.3	-9.94	31.65 **	13.67
TBS-7 x TBS-10	77.64 **	15.12	74.75 **	13.25	73.02 **	12.13	2.11	5.19	-6.94	-4.14	17.98	21.54 *
TBS-7 x TBS-12	84.50 **	57.31 **	81.50 **	54.76**	79.70 **	53.22 **	2.21	3.75	-2.76	-1.13	12.36	14.04
TBS-7 x TBS-105	86.95 **	2.61	79.01 **	-1.75	77.23 **	-2.73	22.76**	11.15	21.54*	10.05	26.78 **	14.79
TBS-7 x R-09	-3.32	47.99 **	-7.91	40.96**	0.74	54.21 **	17.02*	5.14	15.59	3.85	23.60 *	11.05
TBS-7 x R-20	113.31 **	78.41 **	80.25 **	50.75**	78.46 **	49.25 **	21.75**	28.74**	21.43*	28.39**	27.34 **	34.64 **
TBS-7 x V-29	132.14 **	35.99 **	125.76 **	32.25**	123.51 **	30.93 **	6.26	7.72	-2.97	-1.63	22.47 *	24.16 *
TBS-10 x TBS-12	65.76 **	10.21	65.76 **	10.21	58.78 **	5.57	1.55	4.95	-2.95	0.3	23.03 *	27.15 **
TBS-10 x TBS-105	79.28 **	58.84 **	74.42 **	54.53**	67.08 **	48.02 **	7.93	12.35	-2.51	1.48	23.60 *	28.65 **
TBS-10 x R-09	35.35 **	-4.71	26.93 **	-10.64	38.86 **	-2.24	11.7	-17.31*	2.95	-23.78**	30.52 **	-3.37
TBS-10 x R-20	109.95 **	49.93 **	79.84 **	28.43 *	72.27 **	23.02 *	7.68	10.43	-1.62	0.89	24.72 *	27.90 **
TBS-10 x V-29	70.20 **	42.75 **	68.22 **	41.09**	61.13 **	35.15 **	-1.41	-11.62	-1.62	-11.82	24.72 *	11.8
TBS-12 x TBS-105	85.66 **	36.52 **	80.62 **	32.81**	73.02 **	27.22 *	9.03	7.82	2.76	1.62	18.73	17.42
TBS-12 x R-09	65.50 **	48.61 **	55.20 **	39.37**	69.79 **	52.47 **	-10.1	13.3	-13.45	9.08	0	26.03 **
TBS-12 x R-20	91.55 **	88.84 **	64.08 **	61.76**	57.17 **	54.95 **	6.37	13.34	1.46	8.1	17.23	24.91 *
TBS-12 x V-29	16.6	61.31 **	15.25	59.43**	10.4	52.72 **	-11.7	-4.57	-15.43	-8.61	6.74	15.36
TBS-105 x R-09	148.27 **	14.09	126.93 **	4.28	148.26 **	14.09	7.43	31.24**	5.08	28.37**	12.36	37.27 **
TBS-105 x R-20	166.36 **	36.14 **	133.61 **	19.4	111.63 **	8.17	13.92	-2.53	12.5	-3.75	17.98	0.94
TBS-105 x V-29	82.52 **	-10.48	79.63 **	-11.9	68.06 **	-17.58	5.9	0.49	-4.15	-9.05	20.97 *	14.79
R-09 x R-20	101.11 **	130.37 **	63.35 **	87.11**	78.70 **	104.70 **	-6.98	11.23	-7.88	10.16	-1.5	17.79
R-09 x V-29	83.66 **	71.46 **	70.37 **	59.05**	86.38 **	74.00 **	-4.58	-6.99	-11.87	-14.09	11.24	8.43
R-20 x V-29	70.64 **	77.67 **	47.62 **	53.70**	38.12 **	43.80 **	2.76	-0.65	-5.93	-9.05	18.73	14.79

Heterosis for 1000-seed weight ranged from -24.28 to 15.89, -26.80 to 10.96 and -16.3 to 28.89 per cent for the mid parent, better parent and standard heterosis, respectively. Two crosses viz., TBS-10 x TBS-12 and TBS-12 x TBS-105 showed significant positive standard heterosis for this trait (Imran *et al.,* 2017 and Nayak *et al.,* 2017).

Regarding seed yield per plant, the heterosis was ranged from -0.34 to 150.59, -4.8 to 148.42 and -11.26 to 114.87 per cent for mid parent, better parent and standard heterosis, respectively. The total of 27, 26 and 22 no of F_1s crosses and 20, 18 and 14 no of reciprocal F_1s exhibited significant mid parent, better parent and standard heterosis, respectively. Chaudhari *et al.* (2015) noted desirable heterosis for seed yield and other yield contributing traits. The best promising crosses for their both better parent and standard heterosis were 22 *viz*., TBS-3 x TBS-12, TBS-3 x TBS-105, TBS-3 x R-09, TBS-3 x R-20, TBS-7 x TBS-10, TBS-7 x TBS-12, TBS-7 x TBS-105, TBS-7 x R-09, TBS-7 x R-20, TBS-7 x V-29, TBS-10 x TBS-12, TBS-10 x TBS-105, TBS-10 x R-09, TBS-10 x R-20, TBS-10 x V-29, TBS-12 x TBS-105, TBS-12 x R-09, TBS-12 x V-29, TBS-105 x R-09, TBS-105 x V-29, R-09 x V-29 and R-20 x V-29 and reciprocal F_1 crosses TBS-12 x TBS-7, R-09 x TBS-7, R-20 x TBS-7, TBS-105 x TBS-12, R-09 x TBS-12, V-29 x TBS-12, R-09 x TBS-12, V-29 x TBS-12, R-09 x TBS-105, R-20 x R-09, V-29 x R-09 and V-29 x R-20. Georgiev *et al.* (2011) and Parimala *et al.* (2013) also reported significant positive heterosis over mid parent and better parent for this trait.

Table 3. Contd…

Crosses	Number of seeds per capsule						1000-seed weight					
	Heterosis		Heterobeltiosis		Standard heterosis		Heterosis		Heterobeltiosis		Standard heterosis	
	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC
TBS-3 x TBS-7	5.08	9.32	2.9	7.05	2.9	7.05	-2.12	1.43	-2.4	1.14	5.43	9.26
TBS-3 x TBS-10	17.55	-4.86	15.35	-6.64	15.35	-6.64	0.88	-0.88	-0.69	-2.41	6.67	4.81
TBS-3 x TBS-12	8.82	-0.74	4.98	-4.24	4.98	-4.24	4.79	-3.89	2.88	-5.65	14.69	5.19
TBS-3 x TBS-105	17.14	-0.31	13	-3.83	13	-3.83	-7.42	-3.16	-11.93	-7.88	4.81	9.63
TBS-3 x R-09	5.79	-3.3	2.5	-6.31	2.5	-6.31	15.89	6.42	6.9	-1.84	14.81	5.43
TBS-3 x R-20	7.14	-1.27	2.65	-5.41	12.03	3.24	5.36	3.93	1.72	0.34	9.26	7.78
TBS-3 x V-29	1.33	-13.61	-6.34	-20.15*	10.37	-5.9	0.12	10.51	-4.71	5.17	2.35	12.96
TBS-7 x TBS-10	13.17	20.42*	12.93	20.16	8.71	15.68	0.93	3.96	-0.91	2.06	7.04	10.25
TBS-7 x TBS-12	19.27*	12	17.46	10.3	12.59	5.73	6.19	4.05	4.54	2.44	16.54	14.2
TBS-7 x TBS-105	12.97	21.23*	11.26	19.39	6.64	14.44	-8.21	-1.14	-12.45	-5.71	4.2	12.22
TBS-7 x R-09	29.98**	13.69	28.57**	12.46	23.24*	7.79	-7.95	4.6	-15.31	-3.77	-8.52	3.95
TBS-7 x R-20	20.64*	-1.31	13.3	-7.32	23.65*	1.15	-3.86	-1.13	-7.43	-4.8	0	2.84
TBS-7 x V-29	0.58	6.71	-8.8	-3.25	7.47	14.02	-1.38	-15.11	-6.4	-19.43*	1.11	-12.96
TBS-10 x TBS-12	12.72	21.83*	10.78	19.73	6.64	15.26	14.78	-24.28 **	10.96	-26.80 **	23.70 *	-18.4
TBS-10 x TBS-105	18.43*	8.68	16.39	6.8	12.04	2.81	-10.02	-12.23	-15.66	-17.74	0.37	-2.1
TBS-10 x R-09	16.59	10.53	15.09	9.1	10.79	5.03	2.66	10.77	-3.91	3.68	0	7.9
TBS-10 x R-20	6.66	11.43	0.37	4.86	9.54	14.44	4.05	-1.39	2.02	-3.32	6.17	0.62
TBS-10 x V-29	15.5	6.12	4.93	-3.6	23.65*	13.6	3.62	-3.5	0.12	-6.76	4.2	-2.96
TBS-12 x TBS-105	3.13	-14.38	3.13	-14.38	-4.15	-20.42 *	11.84	-9.27	8.3	-12.14	28.89 **	4.57
TBS-12 x R-09	10.22	9.24	9.73	8.75	2.9	1.98	6.11	5.86	-3.77	-3.99	7.28	7.04
TBS-12 x R-20	-12.12	0.52	-18.64*	-6.93	-11.2	1.57	-3.44	-10.45	-8.42	-15.06	2.1	-5.31
TBS-12 x V-29	14.57	23.94**	2.47	10.85	20.76*	30.62 **	1.36	-6.34	-5.2	-12.4	5.68	-2.35
TBS-105 x R-09	23.56*	30.57**	23.01*	29.99**	15.35	21.90 *	-7.36	-3.59	-18.36 *	-15.04	-2.84	1.11
TBS-105 x R-20	14.57	11.2	6.08	2.95	15.77	12.36	-12.63	-6.99	-19.61 *	-14.42	-4.32	1.85
TBS-105 x V-29	7.09	18.42*	-4.23	5.91	12.86	24.80 *	1.03	-5.71	-8.3	-14.42	9.14	1.85
R-09 x R-20	9.61	-2.75	1.89	-9.6	11.2	-1.34	-4.98	-1.23	-9.38	-5.8	-9.38	-5.8
R-09 x V-29	-5.49	10.89	-15.14	-0.43	0	17.34	-4.14	-10.85	-7.25	-13.74	-10	-16.3
R-20 x V-29	18.09*	4.85	13.73	0.98	34.02*	19	-6.77	-1.13	-8.15	-2.59	-8.15	-2.59

The single economic trait in sesame is oil content. Only one reciprocal hybrid TBS-12 x TBS-10 showed significant positive mid parent heterosis (27.65 %) and standard heterosis (23.43 %) for oil content. The crosses TBS-7 x TBS-12 and TBS-105 x V-29 manifested highly significant and desirable heterosis for seed yield and desirable heterosis over better parent and standard check (JLT-408) for oil content.

It can be concluded from the present study that F_1 hybrids and reciprocals TBS-105 x R-09 (148.42 % and 114.87 %), TBS-105 x V-29 (141.61 % and 108.97 %) and TBS-7 x V-29 (140.41 % and 106.78 %) were the top ranking crosses manifested highly significant heterosis for seed yield over better parent and standard check (JLT-408), respectively. The hybrid TBS-105 x R-09 showed significant heterosis for component traits like the number of branches per plant, the number of capsules per plant and number of seeds per capsule, TBS-105 x V-29 for the number of capsules per plant and length of capsule, TBS-7 x V-29 for the number of capsules per plant and length of capsules (**Table 4**). Heterosis and *per se* performance indicated that F_1 hybrids TBS-105 x R-09, TBS-105 x V-29 and TBS-7 x V-29 were found promising for commercial exploitation. The selected crosses for each trait have a high potential to be used for recombination breeding to improve yield and oil content in the form of pure lines.

Table 3. Contd…

Crosses	Seed yield per plant						Oil content					
	Heterosis		Heterobeltiosis		Standard heterosis		Heterosis		Heterobeltiosis		Standard heterosis	
	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC	Cross	REC
TBS-3 x TBS-7	27.81 *	16.52	25.91	14.79	11.61	1.76	-5.17	-2.48	-7.88	-5.27	-13.87	-11.43
TBS-3 x TBS-10	16.21	2.96	15.78	2.58	2.64	-9.06	6.13	-10.62	5.51	-11.15	-6.99	-21.67 *
TBS-3 x TBS-12	48.13 **	3.6	45.11 **	1.49	28.64 *	-10.03	0.27	-22.21*	-8.28	-28.84**	-2.52	-24.37 *
TBS-3 x TBS-105	91.61 **	2.03	89.28 **	0.79	67.80 **	-10.65	-11.14	0.09	-19.80 *	-9.67	-12.18	-1.08
TBS-3 x R-09	93.36 **	2.2	89.38 **	0.1	67.88 **	-11.26	-8.42	-18.99	-13.59	-23.56*	-14.14	-24.05 *
TBS-3 x R-20	66.53 **	11.31	58.51 **	5.96	40.52 **	-6.07	-0.64	9.04	-2.39	7.12	-13.95	-5.57
TBS-3 x V-29	39.61 **	47.99 **	33.90 *	41.94 **	18.7	25.82 *	8.88	-11.33	0.35	-18.28	4.89	-14.58
TBS-7 x TBS-10	100.46 **	33.20 **	98.20 **	31.70 *	74.40 **	15.88	-1.71	7.34	-5.06	3.68	-11.24	-3.07
TBS-7 x TBS-12	114.56 **	90.33 **	113.35 **	89.26 **	83.50 **	62.78 **	15.22	-14.46	8.29	-19.61*	15.09	-14.56
TBS-7 x TBS-105	92.81 **	21.81	92.27 **	21.46	66.30 **	5.06	-9.25	-3.23	-15.88	-10.31	-7.89	-1.78
TBS-7 x R-09	45.82 **	54.41 **	44.96 **	53.50**	24.68 *	32.03 **	6.52	-6.11	3.38	-8.88	2.71	-9.47
TBS-7 x R-20	110.12 **	65.10 **	102.92 **	59.44 **	74.53 **	37.13 **	-7	6.06	-11.2	1.27	-16.97	-5.32
TBS-7 x V-29	147.04 **	45.02 **	140.41 **	41.13 **	106.78 **	21.38	13.04	-8.62	7.08	-13.44	11.92	-9.53
TBS-10 x TBS-12	54.64 **	35.67 **	52.05 **	33.40 *	33.79 **	17.38	-3.4	27.65 **	-12.11	16.14	-6.59	23.43 *
TBS-10 x TBS-105	101.11 **	39.54 **	99.40 **	38.35 **	75.45 **	21.73	-7.68	-10.78	-17.12	-19.90*	-9.24	-12.29
TBS-10 x R-09	87.69 **	62.82 **	84.50 **	60.05	62.34 **	40.83 **	-0.01	1.88	-6.17	-4.39	-6.77	-5.01
TBS-10 x R-20	100.58 **	-0.34	91.60 **	-4.8	68.59 **	-16.23	10.46	10.09	9.15	8.78	-4.91	-5.23
TBS-10 x V-29	127.84 **	39.79 **	119.30 **	34.55*	92.96 **	18.39	-0.19	-11.77	-8.5	-19.12	-4.37	-15.46
TBS-12 x TBS-105	96.61 **	52.24 **	94.96 **	50.97 **	68.63 **	30.58 **	-3.86	6.71	-5.28	5.14	3.72	15.13
TBS-12 x R-09	103.52 **	72.88 **	103.47 **	72.84 **	73.03 **	46.99 **	-0.61	-4.11	-3.85	-7.23	2.19	-1.4
TBS-12 x R-20	33.03 **	69.63 **	29.18 *	64.72 **	9.85	40.08 **	17.3	9.27	5.58	-1.65	12.22	4.53
TBS-12 x V-29	84.14 **	122.36 **	80.19 **	117.59 **	53.23 **	85.04 **	-3.33	-0.47	-4.13	-1.3	1.89	4.9
TBS-105 x R-09	150.59 **	82.35 **	148.42 **	80.77 **	114.87 **	56.36 **	2.9	-3.05	-1.87	-7.54	7.46	1.25
TBS-105 x R-20	47.19 **	63.08 **	41.76 **	57.07 **	22.61	35.86 **	-6.99	5.49	-17.38	-6.29	-9.53	2.62
TBS-105 x V-29	148.95 **	24.63 *	141.61 **	20.96	108.97 **	4.62	9.61	-15.21	7.11	-17.14	17.3	-9.27
R-09 x R-20	43.57 **	56.35 **	39.44 **	51.86**	18.52	29.08 *	5.45	8.46	-2.14	0.65	-2.77	0
R-09 x V-29	101.16 **	87.31 **	96.89 **	83.33 **	67.36 **	55.83 **	1.88	3.69	-0.64	1.13	3.85	5.7
R-20 x V-29	68.89 **	56.14 **	67.57 **	54.92**	36.38 **	26.09 *	7.95	12.66	-2.11	2.16	2.32	6.78

*Significant at 5% level ** Significant at 1% level

Table 4. Top ranking hybrids classified on the basis of *per se* performance and standard heterosis for yield and component traits.

Hybrids	Seed yield/ plant (g)	Heterosis over best check (%)	Standard heterosis over related traits	
			Significant heterosis	Desirable heterosis
TBS-105 x R-09	24.42	114.87	NB, NC, NS	LC, NS, OC
TBS-105 x V-29	23.75	108.97	NC, LC	NS, SW, OC
TBS-7 x V-29	23.50	106.78	NC, LC	NS, OC

Note: *NC= Number of capsules, NB=Number of branches, LC=Length of capsule, SW= 1000 seed weight, NS= Number of seeds/ capsule and OC= Oil content*

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