



Genetic Evaluation of Different Genotypes of *Sesamum spp.* and their intra and interspecific crosses under mid hill conditions of Himachal Pradesh

Singh Ritika* and Kumari Vedna

Department of Crop Improvement

CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176062, India

*email: ritika.singh139@gmail.com

ABSTRACT

Twelve parents and twenty three hybrids of sesame (*Sesamum indicum*, *S. mulayanum* and *S. radiatum*) were evaluated for twelve physiological and yield component characters viz., days to flower initiation, days to 50 % flowering, days to 75% maturity, plant height (cm), inter node length (cm), branches / plant, number of capsules /plant, seeds / capsule, 1000 seed weight (g), seed yield/ plant, biological yield/ plant (g) and harvest index (%) at the Experimental Farm area of the Department of Crop Improvement during kharif, 2013. The analysis of variance revealed the presence of sufficient genetic variability for all the characters under study. Based on the mean performance, crosses viz., IC-557261 x LTK-4, IC-557265 x LTK-4 and IC-557174 x TKG-371 significantly out yielded the standard check (LTK-4) for seed yield per plant. While IC-557247 x IC-557175, IC-557261 x IC-557265 and IC-557265 x LTK-4 were found to be significantly superior to the check for biological yield per plant. One cross combination i.e IC-557261 x LTK-4 was found to be significantly superior for seed per capsules. IC-557261 x IC-557247, IC-557265 x IC-557261 and Punjab Til No.1 x IC-557273 were found to be the best three cross combinations (significantly superior than check on the basis of per se performance) for number of capsules per plant. Many other promising cross combinations also appeared in present investigation which could be used in further breeding programme for sesame improvement.

Keywords: *Sesamum indicum*, *S. mulayanum*, *S. radiatum*, per se performance, seed yield

Received 21.09.2019

Revised 26.10.2019

Accepted 02.11.2019

INTRODUCTION

Oilseed crops are the backbone of agricultural economy of India from time immemorial. Oils are essential components of human diet being next to food grains, rich sources of energy and the earners of fat soluble vitamins A, D, E and K. Sesame (*Sesamum indicum* L.), a member of the family Pedaliaceae also known as sesame, til, gingelly, simsin, gergelim is the most ancient oilseed crop and one of the oldest cultivated plant in the world dating back to 3050-3500 B.C. and is also known as the "queen" of oil seed crops. It originated from tropical Africa and was taken to India at an early stage where it was domesticated and became a crop of the new world [2]. Sesame seeds contain 50 per cent oil and 20-25 per cent protein. The oil contains 47 per cent oleic acid, 39 per cent linoleic acid, 39 per cent mono unsaturated and 46 per cent poly unsaturated fatty acids. Though sesame occupies a place of prominence among oilseeds, its production has been relatively low as compared to other oilseed crops. The major constraints identified for most of the countries including India are, instability in yield, lack of wider adaptability, growing on marginal land non-synchronous maturity etc. Efforts to develop enhanced germplasm for use by the breeders in crop improvement are therefore a necessity. Therefore, the present investigation was carried for obtaining the first hand information, so as to select suitable genotypes for direct and indirect use in sesame improvement programme.

MATERIAL AND METHODS

Experimental material for the present study consisted of sesame (*Sesamum indicum* L.) genotypes comprised of five diverse cultivars i.e. TKG-371, Punjab Til No.1, BTLK-03-9, LTK-4 and Local Black and

five *Sesamum mulayanum* (IC-557175, IC-557209, IC-557247, IC-557174 and IC-557273) and two *Sesamum radiatum* (IC-557261 and IC-557265) accessions. Sesame (*Sesamum indicum* L.) genotypes were sown during *kharif*, 2012 at Experimental Farm, Department of Crop Improvement, CSK HPKV, Palampur. Staggered sowing was done at 15 days interval to synchronize flowering, starting from second week of July to second week of August. Seeds of some of the wild annual sesame species were mechanically scarified prior to sowing to speed up the germination and kept for germination in petriplates in incubator at $25\pm 2^{\circ}\text{C}$. The germinated seedlings were transferred to the pots. Intra and interspecific hybrids were developed by random mating of cultivated genotypes and wild annual sesame species. F_1 hybrids along with their parents were evaluated during *kharif*, 2013 at the Experimental Farm, Department of Crop Improvement, Palampur. The F_1 hybrids along with their parents were raised in pots containing mixture of soil, sand and vermicompost in 2:1:1 ratio, in a completely randomized design (CRD) with equal replications. The average weekly meteorological data recorded at Agrometeorological Laboratory of Department of Agronomy, CSKHPKV, Palampur during cropping period. Five competitive plants were randomly selected for recording biometrical measurements on days to flower initiation, days to 50% flowering, days to 75% maturity, plant height, number of capsules per plant, Internode length, seeds per capsule, branches per plant, 1000-seed weight, seed yield per plant, biological yield per plant and harvest index. The data were subjected to statistical analysis. The analysis of variance was done as per CRD (1) based on the linear model (3).

RESULT AND DISCUSSION

Range and mean values of parents and their intra and interspecific crosses for different characters are presented in Table 1 and superior hybrids on the basis of *per se* performance are given in Table 2. The estimation of mean values revealed that among the cultivated and wild species of sesame, the range for days to flower initiation varied from 39.67-47.67 days for *S. indicum*, 49.67-53.00 days for *S. mulayanum* and 51.00-54.00 days for *S. radiatum*. However, in F_1 's, the range varied from 46.33-53.33 with an average of 50.45 days. Among different cross combinations, days to flower initiation varied from 46.33-49.67 days for *S. indicum* x *S. indicum* and 51.00-52.67 and 52.00-53.00 days for *S. mulayanum* x *S. mulayanum* and *S. radiatum* x *S. radiatum*, respectively. However, for interspecific crosses, the range varied from 50.00-51.33 days for *S. radiatum* x *S. indicum*, 48.33-53.33 days in *S. mulayanum* x *S. indicum* while *S. radiatum* x *S. mulayanum* took 53.33 days and *S. indicum* x *S. mulayanum* took 52.67 days. None of the crosses were found to be significantly superior to the check LTK-4 for days to flower initiation. Days to 50 per cent flowering varied from 50.33-58.67 days for *S. indicum*, 60.67-64.67 for *S. mulayanum* and 63.00-66.00 days for *S. radiatum* genotypes. In F_1 's, it ranged from 58.33-63.67 days with a mean value of 60.96 days. In intraspecific cross combinations, days to 50 per cent flowering ranged from 58.33-59.67 days in *S. indicum* x *S. indicum*, 60.00 to 63.00 days in *S. mulayanum* x *S. mulayanum* and *S. radiatum* x *S. radiatum*, respectively. For interspecific cross combinations, the range varied from 59.67-63.67 days in *S. mulayanum* x *S. indicum*, *S. radiatum* x *S. indicum*, *S. indicum* x *S. mulayanum* and *S. radiatum* x *S. mulayanum* crosses. None of the crosses were found to be superior over the check LTK-4 for days to 50 per cent flowering. Days to 75 per cent maturity varied from 88.33-99.00 days for *S. indicum* genotypes, 104.00-107.00 days for *S. mulayanum* and 104.33-109.00 days in *S. radiatum* genotypes. In F_1 's, it ranged from 100.67-105 days with a mean value of 102.74 days. Among different cross combinations, days to 75 per cent maturity varied from 100.67-102.33 days for *S. indicum* x *S. indicum*, 102.67-105.67 days, 101.84-104.67 days for *S. mulayanum* x *S. mulayanum* and *S. radiatum* x *S. radiatum*, respectively. For interspecific crosses, the range varied from 102.33-103.67 days for *S. radiatum* x *S. indicum*, 101.33-105.00 days in *S. mulayanum* x *S. indicum* while *S. indicum* x *S. mulayanum* took 105 days and *S. radiatum* x *S. mulayanum* crosses took 103.67 days. None of the crosses were found to be significantly superior the check LTK-4 for days to 75 per cent of maturity. Tall plants are desired over dwarf plants as tall plants have more internode length, higher branches and more capsules per plant which ultimately contribute to the seed yield per plant in sesame in this present study the plant height ranged from 99.93-131.33 cm for *S. indicum*, 135.27-171.63 cm and 131.33-131.37 cm for *S. mulayanum* and *S. radiatum*, respectively. For F_1 hybrids, it ranged from 103.57-172.73 cm with a mean value of 129.52 cm. Plant height for different cross combinations varied from 103.57-132.17 cm for *S. indicum* x *S. indicum* crosses, 140.73-143.33 cm for *S. mulayanum* x *S. mulayanum* and 132.43-132.70 cm for *S. radiatum* x *S. radiatum*. For interspecific crosses, the plant height varied from 125.47-136.10 cm for *S. radiatum* x *S. indicum*, 118.67-145.90 cm in *S. mulayanum* x *S. indicum* whereas *S. indicum* x *S. mulayanum* recorded 141.07 cm and *S. radiatum* x *S. mulayanum* recorded 172.73 cm. The crosses IC-557273 x IC-557174, IC-557261 x IC-557247 and IC-557247 x LTK-4 were the best three cross combinations which were found to be significantly superior (taller) to the check for plant height. Among F_1 's, the internode length ranged from 5.80-7.27 cm with a

mean value of 6.42 cm. For cultivated and wild sesame species, it varied from 5.79-6.21 cm for *S. indicum*, 6.43-7.03 and 6.56-6.83 cm for *S. mulayanum* and *S. radiatum*, respectively. Among different cross combinations, the range for internode length in intraspecific crosses varied from 5.83-6.82 cm for *S. indicum* x *S. indicum*, 6.10-6.82 cm and 6.29-6.98 cm for *S. mulayanum* x *S. mulayanum* and *S. radiatum* x *S. radiatum*, respectively. For interspecific cross combination, the range varied from 5.95-6.32 cm for *S. radiatum* x *S. indicum*, 5.93-7.12 cm in *S. mulayanum* x *S. indicum* while *S. indicum* x *S. mulayanum* recorded 6.08 cm and *S. radiatum* x *S. mulayanum* recorded 6.47 cm. On the basis of *per se* performance IC-557247 x LTK-4, IC-557174 x IC-557261 and IC-557273 x IC-557174 were found to be the best three cross combinations (significantly superior than the standard check LTK-4) for internode length. Number of branches per plant for different sesame species varied from 10.00-13.67 for *S. indicum*, 9.67-12.33 for *S. mulayanum* and 10.67-11.00 for *S. radiatum* genotypes. For F₁'s, branches per plant ranged from 12.00-14.67 with mean value of 13.80. Among different cross combinations, the range varied from 12.67-15.00 for *S. indicum* x *S. indicum*, *S. mulayanum* x *S. mulayanum* and *S. radiatum* x *S. radiatum*. In interspecific crosses, the range varied from 13.67-14.67 in *S. mulayanum* x *S. indicum* while *S. indicum* x *S. mulayanum* recorded 14.67 branches per plant, *S. radiatum* x *S. indicum* and *S. radiatum* x *S. mulayanum* recorded 13.67-14.33 branches per plant. The crosses IC-557247 x IC-557175, IC-557265 x IC-557261 and IC-557273 x IC-557174 were found to be significantly superior than standard check on the basis of *per se* performance. For F₁'s, the number of capsules per plant ranged from 35.00-39.00 with a mean value of 36.64. The number of capsules varied for cultivated and wild genotypes from 28.33-34.67 for *S. indicum*, *S. mulayanum* and *S. radiatum*, respectively. For intra specific crosses, capsules per plant varied from 35.00-37.67 for *S. indicum* x *S. indicum* 35.67-38.00 for *S. mulayanum* x *S. mulayanum* and 37.00-38.00 for *S. radiatum* x *S. radiatum* crosses. In interspecific cross combinations, *S. radiatum* x *S. indicum* recorded 35.33-36.00 capsules per plant, 35.33-37.33 in *S. mulayanum* x *S. indicum* while *S. indicum* x *S. mulayanum* recorded 37.67 capsules per plant and 39 capsules were recorded in *S. radiatum* x *S. mulayanum* cross. The crosses IC-557261 x IC-557247, IC-557265 x IC-557261 and Punjab Til No.1 x IC-557273 were found to be the best three cross combinations (significantly superior than check on the basis of *per se* performance) for number of capsules per plant.

The mean values for number of seeds per capsule ranged from 34.33-37.67 for *S. indicum* and 27.67-30.67 for wild sesame genotypes. For F₁'s, the range varied from 31.00-34.00 seeds per capsule with a mean of 32.30. For intraspecific crosses, seeds per capsule varied from 31.33-33.67 for *S. indicum* x *S. indicum*, *S. mulayanum* x *S. mulayanum* and *S. radiatum* x *S. radiatum*. For interspecific cross combinations, the range varied from 31.00-34.00 for *S. radiatum* x *S. indicum*, *S. mulayanum* x *S. indicum*, *S. indicum* x *S. mulayanum* and *S. radiatum* x *S. mulayanum*. The crosses IC-557261 x LTK-4 was found to be significantly superior than the standard check.

The value for 1000-seed weight ranged from 2.11-2.24 g for cultivated genotypes and 2.08-2.29 g and 2.20-2.23 g for *S. mulayanum* and *S. radiatum*, respectively. For F₁'s, it ranged from 2.03-2.53 g with a mean value of 2.25 g. In intraspecific crosses, 1000-seed weight varied from 2.09-2.35 g for *S. indicum* x *S. indicum*, 2.14-2.31 g for *S. mulayanum* x *S. mulayanum* and 2.20-2.38 g for *S. radiatum* x *S. radiatum*. For interspecific cross combinations, the range varied from 2.39-2.49 g for *S. radiatum* x *S. indicum* and 2.06-2.36 g in *S. mulayanum* x *S. indicum*. In *S. indicum* x *S. mulayanum* and *S. radiatum* x *S. mulayanum*, the 1000-seed weight varied between 2.21-2.23 g. None of the cross combinations were found to be significantly superior to standard check for 1000-seed weight.

Seed yield per plant varied from 2.16-2.32 g for *S. indicum*, 2.17-2.35 g for *S. mulayanum* and 2.19-2.25 g for *S. radiatum*. For F₁'s, it ranged from 2.53-2.97 g with a mean value of 2.83 g. Among different cross combinations, seed yield per plant varied from 2.54-2.95 g for *S. indicum* x *S. indicum*, 2.62-2.84 g for *S. mulayanum* x *S. mulayanum* and 2.73-2.75 g in *S. radiatum* x *S. radiatum*. For interspecific crosses, the range varied from 2.76-3.00g in *S. radiatum* x *S. indicum*, *S. mulayanum* x *S. indicum*, *S. indicum* x *S. mulayanum* and *S. radiatum* x *S. mulayanum* crosses. The crosses viz., IC-557261 x LTK-4, IC-557265 x LTK-4 and IC-557174 x TKG-371 significantly out yielded the standard check LTK-4.

For biological yield per plant, the mean values for genotypes varied from 14.96-17.02 g for *S. indicum*, 17.30-19.48 and 17.18-17.59 g for *S. mulayanum* and *S. radiatum*, respectively. For F₁'s, it varied from 15.30-17.77 g with a mean value of 16.10 g. Among different crosses, biological yield per plant for intraspecific crosses varied from 15.27-17.23 g for *S. indicum* x *S. indicum*, 16.50-17.76 g for *S. mulayanum* x *S. mulayanum* and 15.73-16.71 g for *S. radiatum* x *S. radiatum*. For different interspecific cross combinations, the range varied from 15.62-16.94 g for *S. radiatum* x *S. indicum*, *S. mulayanum* x *S. indicum* and *S. indicum* x *S. mulayanum* while *S. radiatum* x *S. mulayanum* recorded 18.57 g. Best three cross combinations which were found to be significantly superior than standard check for biological yield per plant are IC-557247 x IC-557175, IC-557261 x IC-557265 and IC-557265 x LTK-4. The range for harvest

index in cultivated genotypes varied from 13.52-14.86 per cent while the *S. mulayanum* and *S. radiatum* accessions ranged from 11.20-13.26 per cent and 12.76-12.77 per cent, respectively. For F₁'s, the range was comparatively very high from (14.77- 19.27 %) with a mean value of 17.63 per cent. For different cross combinations, harvest index varied from 14.75-18.40 per cent for *S. indicum* x *S. indicum*, 16.01-16.87 per cent for *S. mulayanum* x *S. mulayanum* and 16.43-17.40 per cent for *S. radiatum* x *S. radiatum*. However, for interspecific crosses, the range varied from 16.87-19.26 per cent for *S. radiatum* x *S. indicum*, *S. mulayanum* x *S. indicum*, *S. indicum* x *S. mulayanum* and *S. radiatum* x *S. mulayanum*. The crosses IC-557261 x LTK-4, IC-557265 x IC-557247 and IC-557174 x TKG-371 were the best three cross combinations which appeared as significantly superior than the standard check for harvest index. These results were in harmony with the results obtained by others researchers in sesame (7,9,8,4,6 and5)

In the present investigation amongst different inter and intra specific cross combinations none of the hybrids showed superiority over standard check (LTK-4) for four characters viz., days to flower initiation, days to 50% flowering, days to 75% maturity and 1000 seed weight where as for rest of the rest characters the top three ranking cross combinations on basis of *per se* performance were IC-557247 x LTK-4, IC-557273 x IC-557174, IC-557261 x IC-557274 for plant height. IC-557247 x LTK-4, IC-557174 x TKG-371, IC-557273 x IC-557174 for internode length, IC-557247 x IC-557175, IC-557265 x IC-557261, IC-557273 x IC-557174 for branches per plant, IC-557261 x IC-557247, IC-557265 x IC-557261, Punjab Til No.1 x IC-557273 for number of capsules per plant, IC-557261 x LTK-4 for seeds per capsule, IC-557261 x LTK-4, IC-557265 x LTK-4, IC-557174 x TKG-371 for seed yield per plant, IC-557247 x IC-557175, IC-557261 x IC-557265, IC-557265 x LTK-4 for biological yield per plant and IC-557261 x LTK-4, IC-557261 x IC-557247, IC-557174 x TKG-371 for harvest index. Therefore the promising intra and interspecific cross combinations obtained from the present investigation can be used in further breeding programmes by testing them more extensively, for the improvement of yield and yield related traits in sesame.

Table 1. Mean values of parents and their hybrids for different characters in sesame

Genotypes	Days to flower initiation	Days to 50 % flowering	Days to 75% maturity	Plant height (cm)	Inter node length (cm)	Branches / plant	Number of capsules /plant	Seeds / capsule	1000 seed weight (g)	Seed yield/ plant	Biological yield/ plant (g)	Harvest index (%)
<i>S. indicum</i>												
TKG-371	39.67	50.33	87.67	111.80	6.21	10.33	30.33	34.67	2.11	2.16	15.99	13.52
Punjab Til No.1	43.33	53.67	88.33	99.93	5.95	10.33	30.00	36.00	2.17	2.20	15.84	13.90
LTK-4	46.00	56.33	91.33	105.63	5.79	13.67	34.67	37.67	2.24	2.32	17.02	13.60
BTLK-03-9	47.67	57.67	94.67	131.33	6.05	12.33	29.00	36.33	2.13	2.18	16.10	13.63
LOCAL BLACK	46.00	58.67	99.00	110.17	5.98	10.00	29.33	34.33	2.16	2.21	14.96	14.86
<i>S. mulayanum</i>												
IC-557175	51.33	60.67	104.00	171.63	6.43	12.33	32.33	30.33	2.29	2.35	17.72	13.26
IC-557209	53.00	63.33	106.00	161.87	7.03	12.33	28.33	30.67	2.11	2.18	19.48	11.20
IC-557247	53.00	64.67	107.00	135.27	6.78	10.67	29.33	29.67	2.17	2.23	17.78	12.56
IC-557174	52.67	64.00	105.67	136.60	6.49	10.00	29.67	27.67	2.08	2.17	18.28	11.92
IC-557273	49.67	61.33	104.33	151.17	7.00	9.67	29.67	28.00	2.25	2.28	17.30	13.18
<i>S. radiatum</i>												
IC-557261	54.00	66.00	109.00	131.33	6.56	10.67	30.67	30.67	2.20	2.19	17.18	12.76
IC-557265	51.00	63.00	104.33	131.37	6.83	11.00	31.33	28.67	2.23	2.25	17.59	12.77
<i>S. indicum</i> x <i>S. indicum</i>												
TKG-371x Punjab Til No.1	46.33	58.33	100.67	103.97	5.83	13.67	36.67	33.00	2.35	2.87	16.14	17.84
TKG-371 x Local Black	49.33	59.67	101.33	103.57	6.14	13.67	35.00	32.33	2.29	2.90	15.77	18.40
Punjab Til No.1 x TKG-371	49.67	59.67	101.33	118.63	5.96	12.67	37.33	32.33	2.09	2.81	15.31	18.40
Punjab Til No.1 X BTLK-03-9	48.67	59.33	102.33	104.67	6.10	13.33	35.67	31.33	2.12	2.90	15.97	18.18
LTK-4 x BTLK-03-9	49.00	60.00	102.33	126.77	6.06	13.67	36.67	31.67	2.09	2.86	15.90	18.04
LTK-4 x Local Black	47.67	59.33	101.67	111.40	6.33	14.00	37.67	32.67	2.18	2.95	16.37	18.11
BTLK-03-9 x TKG-371	49.00	60.00	102.33	127.33	6.48	13.33	36.67	33.67	2.09	2.78	15.27	18.26
BTLK-03-9 x Local Black	48.33	59.67	101.33	132.17	6.82	14.33	37.33	32.67	2.12	2.83	15.50	18.28
Local Black x TKG-371	47.33	58.67	101.00	110.37	5.87	12.00	35.33	32.33	2.35	2.54	17.23	14.75

Contd...

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Genotypes	Days to flower initiation	Days to 50 % flowering	Days to 75% maturity	Plant height (cm)	Inter node length (cm)	Branches / plant	Number of capsules /plant	Seeds / capsule	1000 seed weight (g)	Seed yield/ plant	Biological yield/ plant (g)	Harvest index (%)
S. indicum x S. malayanum												
Punjab Til No.1x IC-557273	52.67	62.67	105.00	141.07	6.08	14.67	37.67	32.67	2.21	2.89	16.72	17.27
S. malayanum x S. indicum												
IC-557247 x Punjab Til No.1	50.33	59.67	101.33	122.53	5.93	13.67	37.33	32.33	2.06	2.82	16.00	17.65
IC-557247 x LTK-4	52.67	63.67	104.00	145.90	7.12	14.00	35.67	33.33	2.36	2.84	15.77	17.99
IC-557174 x TKG-371	53.33	63.67	105.00	135.70	7.11	14.67	36.67	31.00	2.13	2.89	15.63	18.48
IC-557174 X Punjab Til No.1	48.33	59.00	101.33	118.67	6.65	13.67	35.67	33.00	2.30	2.76	15.93	17.29
IC-557273 x Local Black	52.33	62.33	103.33	140.13	6.89	13.67	35.33	31.67	2.23	2.87	15.97	17.96
S. malayanum x S. malayanum												
IC-557247 x IC-557175	52.00	63.33	105.67	143.30	6.10	15.00	38.00	31.33	2.31	2.84	17.76	16.01
IC-557174 x IC-557247	51.00	60.33	102.67	140.73	6.82	12.67	35.67	32.33	2.14	2.78	16.50	16.87
IC-557273 x IC-557174	52.67	63.33	104.67	152.57	7.26	14.67	37.00	32.00	2.30	2.62	16.18	16.27
S. radiatum x S. indicum												
IC-557261 x LTK-4	51.33	61.00	102.33	136.10	5.95	13.67	36.00	31.67	2.49	2.99	15.62	19.26
IC-557265 X LTK-4	50.00	60.67	102.67	125.47	6.32	14.00	35.33	34.00	2.39	3.00	16.94	17.68
S. radiatum x S. malayanum												
IC-557261 x IC-557247	53.33	63.33	103.67	172.73	6.47	14.33	39.00	32.67	2.23	2.85	15.34	18.57
S. radiatum x S. radiatum												
IC-557261 X IC-557265	53.00	62.00	102.33	132.70	6.98	15.00	37.00	31.33	2.38	2.75	16.71	16.43
IC-557265 x IC-557261	52.00	62.33	104.67	132.43	6.29	13.00	38.00	31.67	2.20	2.73	15.73	17.40
Mean	49.93	60.62	101.84	130.20	6.42	12.88	34.50	32.22	2.22	2.62	16.44	16.07
Range	39.67-54	50.33-66	87.67-109	99.93-172.73	5.79-7.26	9.67-15.00	28.33-39.00	27.67-37.67	2.06-2.49	2.16-3.00	14.96-19.48	11.20-19.26
CD (5 %)	1.67	1.53	2.38	6.41	0.67	0.84	1.02	1.14	0.21	0.49	1.16	2.18

Table2. Top three ranking cross combinations on basis of per se performance, for different characters

Characters	Cross combinations
Days to flower initiation	-
Days to 50 per cent flowering	-
Days to 75 per cent maturity	-
Plant height	IC-557247 x LTK-4, IC-557273 x IC-557174, IC-557261 x IC-557274
Internode length	IC-557247 x LTK-4, IC-557174 x TKG-371, IC-557273 x IC-557174
Branches per plant	IC-557247 x IC-557175, IC-557265 x IC-557261, IC-557273 x IC-557174
Number of capsules per plant	IC-557261 x IC-557247, IC-557265 x IC-557261, Punjab Til No.1 x IC-557273
Seeds per capsule	IC-557261 x LTK-4
1000-seed weight	-
Seed yield per plant	IC-557261 x LTK-4, IC-557265 x LTK-4, IC-557174 x TKG-371
Biological yield per plant	IC-557247 x IC-557175, IC-557261 x IC-557265, IC-557265 x LTK-4
Harvest index	IC-557261 x LTK-4, IC-557261 x IC-557247, IC-557174 x TKG-371

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CITATION OF THIS ARTICLE

Singh Ritika and Kumari Vedna. Genetic Evaluation of Different Genotypes of *Sesamum spp.* and their intra and interspecific crosses under mid hill conditions of Himachal Pradesh. *Bull. Env. Pharmacol. Life Sci.*, Vol 8 [12] November 2019: 75-80