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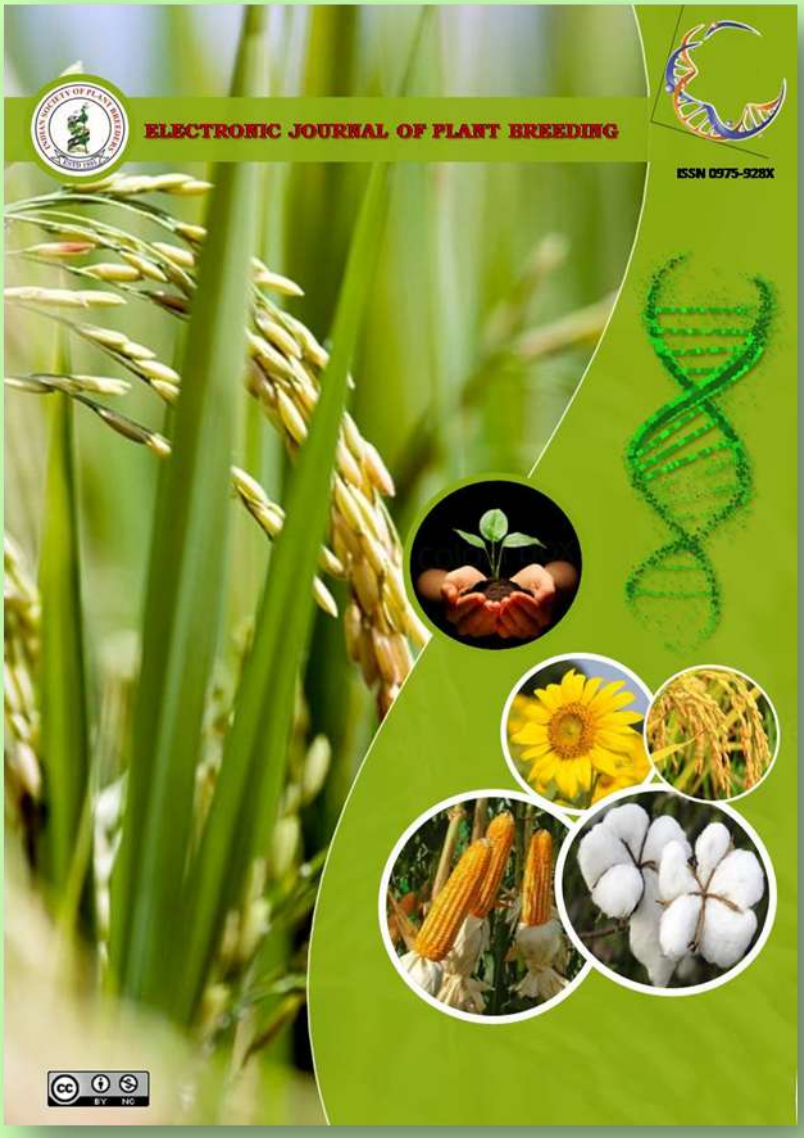

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Research Article

Combining ability analysis in sesame (*Sesamum indicum* L.)

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Abstract
An attempt was made to study the general and specific combining ability in sesame (*Sesamum indicum* L.) through line x tester analysis by using five lines and ten testers. A total of fifty crosses were developed and eleven quantitative traits were studied. Among the line AT-231 was the best general combiner for days to 50 % flowering, days to maturity, number of capsule per plant, number of seed per capsule, 1000 seed weight, oil content and seed yield per plant and the line RT-54 for days to maturity, width of capsule, 1000 seed weight and seed yield per plant and oil content. Among the tester KMR-69 showed positive gca effects for seed yield per plant and 1000 seed weight. The tester GT-3 was the best general combiner for days to 50 % flowering, oil content, length of capsule and width of capsule. The tester LOCAL was the best general combiner for number of capsule per plant, number of seed per capsule and 1000 seed weight. The tester PRACHI was the best general combiner for number of branches per plant. The cross RT-54 x KMR-69 exhibited significantly high sca effects for the characters *viz*., number of capsule per plant, width of capsule, 1000 seed weight and seed yield per plant and hence these crosses could be utilized for yield improvement through heterosis and pedigree breeding.

Keywords
Sesame, Line x Tester, GCA, SCA.

Introduction

Sesame (*Sesamum indicum* L.) is one of the oldest cultivated crop in the world and most important ancient oilseeds crop known to mankind. Sesame is grown for its seeds that contain approximately 50% oil, 25% protein and 15% carbohydrates. In world, sesamum is cultivated on an area of 105.76 lakh hectares with production of 61.11 lakh tonnes with a productivity of 535 kg/ha and having high productivity in the China (1234 kg/ha). India is the largest producer of sesame in the world and ranks first in terms of sesame-growing area (24%).Sesame has a wide range of genetic variability in its extensive germplasm collections. However, certain highly desirable traits have not been found so far, including good seed retention and resistance to certain diseases. Studies on combining ability are of paramount importance to select suitable parents for hybridization. The concept of combining ability analysis gives precise estimates of the nature and magnitude of gene actions involved in the inheritance of quantitative characters, which facilitate the identification of parents with good general combining ability (GCA) effects and crosses with good specific combining ability (SCA) effects. Hence, the present investigation was carried out to identify the best general combiners and specific cross combinations for increasing the seed yield and its components in sesame

Materials and Methods

The material for the present study consisted of five females, *viz*., AKT-101, AT-231, JLT-07, RT-54, SWETA and ten males *viz*., AT-255, KMR-69, KMR-114, GT-3, IC-502030, IC-502032, TKG-22, LOCAL, YLM-17, PRACHI. Crosses were made between these parents in Line x Tester mating design to develop 50 F_1 hybrids at the Oilseed Research Station, Latur during late kharif-2017-18.A total of 67 treatments, comprising 5 females, 10 males, 50 F_1's and 2 check hybrids *viz*., G-1 and JLT-408 were randomly separated in each replication. Each treatment comprised of two rows of 3 m length, row spaced at 45 cm apart and with plant to plant distance of 20 cm. Sowing was done on 4th july 2017. The recommended package of practices for sesame was followed throughout the crop growing period. Observations were recorded for eleven traits *viz*., days to 50 per cent flowering, days to maturity, plant height (cm), number of primary branches per plant, number of capsules per plant, number of seeds per capsule, length of capsule (cm), width of capsules (cm), 1000 seed weight (g), seed yield per plant (g) and oil content (%) .The data collected on each of the five observed plants were averaged and the mean values thus obtained were used for the statistical analysis for all the characters studied. The analysis of modified line x tester was done following the method suggested by Arunachalam (1974).

Result and Discussion

The analysis of variance was done to see the ignorance of differences among the treatments, replications and other partitioning source of variations. The analysis of variance (Table 1) revealed that, all the eleven characters showed highly significant treatment variances indicating the presence of considerable amount of variability in the experimental material used in present study.

Contribution of lines, testers and lines x testers of total variance for 11 characters are presented in Table 2.The per cent contribution of lines to total variance in hybrid was higher in magnitude as compared to testers for all the characters studied except Days to 50% flowering (17.40), Number of branches per plant (10.15) and oil content (17.77). The Per cent contribution of testers to total variance in cross where higher compared to line for the characters *viz*., days to 50 % flowering (24.11), number of branches per plant (11.65), and oil content (22.89). The Percentage contribution of lines x testers to total variance were higher for characters *viz*., Days to 50% flowering (58.49), number of branches per plant (78.19), number of capsule per plant (52.52), 1000 seed weight (39.31) and oil content (59.33).

Analysis of variance for combining ability analysis (Table 2) indicated the presence of significant differences among the lines, testers and line x tester interaction for all the characters studied. The significant variance for line × tester interaction indicates the importance of specific combining ability.

The data on GCA effects indicated that the GCA effects varied significantly for different characters and in different parents. The best general combiners for different characters are listed in Table 3. The high GCA effects in desirable direction for seed yield and its components indicated that such lines would combine well with other lines to101produce superior progeny. In the present investigation among the line AT-231 (3.357) was the best general combiner for seed yield per plant and also recorded positive significant GCA effect for the trait no of capsule per plant (10.202), number of seed per capsule (7.106), length of capsule (0.220), 1000 seed weight (0.265) and oil content (1.045) and expressed negative but significant effect for the days to 50% flowering (1.640) and days to maturity (9.452)(Table 4.1- 4.2). The other line RT-54 (0.680) also exhibited desirable and significant GCA for seed yield per plant and expressed positive significant GCA effects for the traits *viz.*, width of capsule (0.055), 1000 seed weight (0.680) and oil content (1.189) and expressed negative but significant effect for the days to maturity (-1.830).Among the tester KMR-69 (1.359) showed significant positive GCA effects for seed yield per plant and also for 1000 seed weight (0.445). The tester GT-3 was the best general combiner for oil content (2.592) and width of capsule and negative but significant GCA effect for the days to 50% flowering (-1.740). The tester YLM-17 was the best general combiner for number of branches per capsule (0.272). The parent PRACHI was best general combiner for the character number of seed per capsule (7.683) and the tester LOCAL was best general combiner for the number of capsule per plant (3.896) and 1000 seed weight (0.485).These observations clearly indicate that there appeared to be close relationship between GCA and per se performance of most of the characters expressed by the parents. In turns it will help as criteria to select the parents for breeding programmes. Results on general combining ability for these traits were reported previously by Kumar and Vivekanandan (2009), Rajaram and Kumar (2011), Praveen Kumar *et al*. (2012), Musibau and Joseph (2014) Salah *et al*. (2014), Saxena and Bisen (2017).

The results on specific combining ability effects of crosses for different characters under study are presented in Table 5.

Among the all combination only one cross RT-54 x GT-3 (4.160) showed significantly desirable negative SCA effects for days to 50% flowering. The negative SCA for this trait was earlier observed by Rajaram and Kumar (2011) and Salah *et al*. (2014). Two cross combination AT-231 x KMR-114 (26.122) and SWETA x GT-3 (20.694) showed significantly positive SCA effects. Whereas three cross *viz*., AKT-101 x TKG-22 (-14.06), AT-231 x GT-3 (-20.048) and SWETA x PRACHI (-12.92) showed significantly negative SCA effects for the trait plant height Praveen kumar *et al* (2012), Salah *et al* (2014) were also reported the positive as well as negative SCA effect against plant height. Amongst the 50 crosses evaluated, seven cross combinations exhibited significantly positive SCA effects. The cross RT-54 x KMR-69 (4.835) expressed highly positively significant SCA effect followed by AT-231 x PRACHI (2.589) for seed yield per plant. The crosses *viz*., AT-231 X KMR- 114 (-3.520) and AKT-101 x KMR-69 (-2.911) were having significantly negative SCA effect for Seed yield per plant.

Cross combination RT-54 x YLM-17 (0.698) followed by RT-54 x KMR-69 (0.618) expressed significantly positive SCA effects, whereas one cross JLT-07 x PRACHI (-0.505) showed significantly negative SCA effects for the trait 1000

seed weight. Out of 50 crosses studied, seventeen crosses combinations showed desirable positive SCA effects for oil content. The highest positively significant SCA effect was expressed in the cross RT-54 x AT-255 (5.629), AKT-101 x IC-502030 (4.684), AT-231 x PRACHI (4.291), RT-54 x KMR-69 (4.259), SWETA x LOCAL (4.091), AKT-101 x KMR-69 (3.836), JLT-07 x AT-255 (3.675) and SWETA x KMR-114 (3.283). The significant negative effects oil content were found in thirteen cross combinations. These crosses could be utilized for heterosis and pedigree breeding traits in later generations.

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Table 1. Analysis of variance for parents and hybrids for yield and its component characters

Sr. No.	Characters	Sources of variation			
		Replication	Treatment	Error	S.E.(±)
		d.f. (1)	d.f. (66)	d.f. (66)	
1	**Days to 50% flowering**	0.377	12.370 **	2.252	1.06
2	**Day to maturity**	6.469	39.464 **	6.094	1.79
3	**Plant height**	5.260	5.260 **	81.901	6.30
4	**No. of branches / plant**	0.142	0.269 **	0.038	0.12
5	**No. of capsule / plant**	7.062	182.947 **	10.905	2.32
6	**Length of capsule**	0.013	0.121 **	0.010	0.068
7	**Width of capsule**	0.000	0.007 **	0.001	0.01
8	**No. of seed /capsule**	38.124	75.152 **	9.850	2.22
9	**1000 Seed weight**	0.018	0.433 **	0.033	0.12
10	**Seed yield / plant**	0.737	12.942 **	1.174	0.76
11	**Oil content**	3.058	45.831 **	0.964	0.69

*and ** indicated significance at 5 and 1 per cent level, respectively.

Table 2. Analysis of variance for combining ability for different eleven characters including parents in sesame.

Source of Variation	d.f.	Days to 50% flowering	Days to maturity	Plant height	No. of branches / plant	No. of capsule / plant	No. of seed / capsule	Length of capsule	Width of capsule	1000 Seed weight	Seed yield / plant	Oil content
Replications	1	0.377	6.469	5.260	0.142	7.062	38.124	0.013	0.000	0.018	0.737	3.058
Treatments	64	**12.370****	**39.464****	**397.866****	**0.269****	**182.947****	**75.152****	**0.121****	**0.007****	**0.433****	**12.942****	**45.831****
Parents	14	15.105**	30.800**	134.112	0.093**	114.631**	32.876**	0.017	0.002**	0.221**	4.274**	73.930**
Lines	4	18.350**	59.000**	212.555*	0.042	22.199	13.296	0.008	0.004**	0.034	1.046	2.348
Testers	9	12.667**	21.422**	45.055	0.043	162.785**	44.918**	0.016	0.001	0.294**	5.643**	65.347**
Lines v/s Testers	1	24.067**	2.400	621.847**	0.748**	50.968*	2.817	0.053*	0.003	0.308**	4.862*	437.508**
Parents v/s Crosses	1	1.186	56.882**	207.286	0.029	53.574*	491.995**	0.148**	0.010**	0.120	13.716**	140.877**
Crosses	49	11.817**	41.584**	477.140**	0.325**	205.106**	78.724**	0.150**	0.009**	0.499**	15.403**	35.863**
Error	64	2.252	6.094	81.901	0.038	10.905	9.850	0.010	0.001	0.033	1.174	0.946

*and ** indicated significance at 5and 1 percent level, respectively

Table 3. Proportional contribution of lines, testers and lines x testers for 11 charactes in sesame.

Sr. No.	Name of character	Percent contribution of		
		Lines	Testers	Lines x Testers
1	Days to 50% flowering	17.40	24.11	58.49
2	Day to maturity	78.34	3.56	18.09
3	Plant height	62.76	7.11	30.12
4	No. of branches / plant	10.15	11.65	78.19
5	No. of capsule / plant	34.61	7.86	52.52
6	No. of seed /capsule	58.91	6.55	34.53
7	Length Of capsule	82.81	4.60	12.58
8	Width of capsule	48.96	12.27	38.76
9	1000 Seed weight	35.67	25.01	39.31
10	Seed yield / plant	56.29	5.23	38.47
11	Oil content	17.77	22.89	59.33

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Table 4.1. Estimates of General combining ability (GCA) of Lines in sesame.

Parents	Days to 50% flowering	Days to maturity	Plant height	No. of branches / plant	No. of capsule / plant	No. of seeds / capsule	Length of capsules	Width of capsule	1000 Seed weight	Seed yield / plant	Oil content
					LINE						
AKT-101	-0.140	**-2.830****	-5.147*	-0.073	0.527	-2.504**	0.032	-0.019**	-0.070	-0.449	-0.478*
AT-231	**-1.640****	**-2.830****	-9.452**	-0.103*	**10.202****	**7.106****	**0.220****	-0.011	**0.265****	**3.357****	1.045**
JLT-07	0.060	-0.280	-5.892**	-0.078	-4.823**	3.456**	0.191**	0.046**	0.105*	-0.597*	**1.503****
RT-54	0.210	-1.830**	-3.417	0.012	0.847	-1.534*	0.025	**0.055****	0.242**	0.680**	1.189**
SWETA	1.510**	7.770**	**23.906****	**0.242****	-6.753**	-6.524**	-0.468**	-0.071**	-0.541**	-2.992**	-3.259**
S.E.(Gi)	0.3356	0.5520	2.0236	0.0433	0.7384	0.6840	0.0219	0.0061	0.408	0.2423	0.2175
S.E.(Gi-Gj)	0.4745	0.7807	2.8618	0.0613	1.0442	0.9673	0.0310	0.0086	0.0577	0.3426	0.3076
CD @95%	0.674	1.109	4.067	0.087	1.484	1.410	0.044	0.012	0.082	0.487	0.437
CD @99%	0.899	1.4794	5.4232	0.1161	1.9789	1.8330	0.0587	0.0163	0.1094	0.6493	0.5830

*and ** indicated significance at 5 and 1 per cent level, respectively.

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Table 4.2. Estimates of general combining ability (GCA) of Testers in sesame.

Parents	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches / plant	No. of capsules / plant	No. of seeds / Capsule	Length of capsule	Width of capsule	1000 Seed weight	Seed yield / plant	Oil content
					TESTER						
AT-255	**0.060**	**-0.730**	-7.691	-0.148*	0.256	0.256	0.023	-0.032**	0.005	-0.346	**-3.953****
KMR-69	**-0.040**	0.370	1.803	-0.048	-0.304	-0.304	0.057	0.005	0.445**	**1.359****	**-2.463****
KMR-114	**1.960****	0.870	-1.207	-0.008	-0.944	-0.944	-0.001	-0.022*	-0.046	0.212	**1.911****
GT-3	**-1.740****	-0.030	-2.537	0.082	0.976	0.976	**0.079***	**0.037****	-0.076	0.191	**2.592****
IC-502030	**-1.540****	-1.430	-2.697	0.052	-2.024*	-2.024*	-0.122**	0.016	-0.216**	-0.718*	**-0.931****
IC-502032	**-0.640**	-0.630	-2.517	0.032	-0.824	-0.824	-0.037	-0.020*	-0.216*	-0.716*	**1.657****
TKG-22	**0.060**	-0.230	1.873	-0.098	0.236	0.236	-0.034	-0.027**	-0.066	-0.648	**-1.129****
LOCAL	**-0.240**	-0.530	4.363	-0.238**	**3.896****	**3.896****	0.019	0.008	**0.485****	-0.094	**0.473**
YLM-17	**2.060****	1.570*	0.923	**0.272****	-1.744	-1.744	0.062	0.031**	-0.311**	0.658	**1.745****
PRACHI	**0.674**	0.770	**7.683****	0.102	0.476	0.476	-0.048	0.000	-0.095	0.098	**0.099**
S.E.(Gi)	0.4745	0.7807	2.8618	0.0613	1.0442	0.9673	0.3010	0.0086	0.577	0.3426	0.3076
S.E.(Gi-Gj)	0.6711	1.1040	4.0473	0.0867	1.4768	1.3679	0.0438	0.0122	0.0816	0.4846	0.4350
CD @95%	0.954	1.569	5.751	0.123	2.098	1.994	0.062	0.017	0.116	0.689	0.618
CD @99%	1.2718	2.0921	7.6696	0.1642	2.7986	2.5923	0.0830	0.0230	0.1547	0.9182	0.8244

*and ** indicated significance at 5 and 1 per cent level, respectively.

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Table 5. Estimates of specific combining ability (SCA) for 11 characters in sesame.

Sr. No.	Crosses	Days to 50% flowering	Day to maturity	Plant height	No. of branches / plant	No. of capsules / plant	No. of seeds / capsule	Length of capsule	Width of capsule	1000 Seed weight	Seed yield / plant	Oil content
1	AKT-101 x AT-255	-0.060	-0.270	1.901	-0.087	-9.527**	5.304*	-0.039	-0.063**	0.271*	-0.881	-5.254**
2	AKT-101 x KMR-69	-0.460	-0.370	6.307	0.413**	-9.847**	1.064	-0.063	-0.035	-0.370**	**-2.911****	3.836**
3	AKT-101 x KMR-114	-1.460	0.130	-11.183	0.323*	5.613*	-1.096	-0.130	0.002	0.221	2.246**	-0.413
4	AKT-101 x GT-3	3.740**	0.030	5.047	-0.067	0.033	**-7.216****	0.115	-0.012	-0.449**	-1.963*	-0.034
5	AKT-101 x IC-502030	-2.460*	-0.570	12.507	-0.287*	-4.667	0.384	-0.064	0.034	0.090	0.566	4.684**
6	AKT-101 x IC-502032	-2.860**	-0.870	-2.773	-0.467**	8.283**	-4.016	-0.124	-0.030	0.001	0.314	0.446
7	AKT-101 x TKG-22	-1.060	-0.770	-14.063*	-0.737**	4.553	**8.124****	0.153*	0.022	0.390**	2.561**	2.892**
8	AKT-101 x LOCAL	3.440**	**6.030****	2.447	**0.753****	6.673**	-1.336	0.005	-0.023	-0.009	1.072	-8.650**
9	AKT-101 x YLM-17	-1.260	-1.570	1.587	-0.357*	-7.027**	-5.496*	0.017	0.094**	-0.015	-2.345**	-0.252
10	AKT-101 x PRACHI	**2.440***	-1.770	-1.773	0.513**	5.913*	4.284	0.127	0.010	-0.130	1.345	2.744**
11	AT-231 x AT-255	1.440	-0.270	-7.394	0.643**	8.798**	-0.706	-0.012	-0.036	-0.365**	0.888	-1.697*
12	AT-231 x KMR-69	0.540	2.630	-8.888	-0.507**	-1.122	0.254	-0.001	0.012	0.446**	0.913	**-7.187****
13	AT-231 x KMR-114	2.040	2.130	**26.122****	-0.347*	**-17.462****	-4.306	0.002	-0.036	-0.125	-3.520**	-0.036
14	AT-231 x GT-3	0.240	-1.970	**-20.048****	0.013	-14.342**	0.974	**-0.233****	0.000	0.116	-1.704*	0.918
15	AT-231 x IC-502030	-0.960	0.430	-2.888	0.343*	6.358**	0.774	0.128	0.076**	0.056	-0.360	2.261**
16	AT-231 x IC-502032	1.640	-0.370	-5.368	0.413**	4.658	6.374**	0.063	0.042*	-0.285*	2.588**	-0.717
17	AT-231 x TKG-22	-3.560**	-1.770	5.192	-0.357*	1.978	0.014	0.010	-0.021	0.306*	-0.430	0.539
18	AT-231 x LOCAL	-2.560*	-1.470	-4.548	-0.067	-6.002*	-5.946*	0.032	0.009	-0.145	-2.364**	2.807**
19	AT-231 x YLM-17	0.740	0.430	7.092	0.223	3.598	2.894	-0.051	-0.039*	-0.350**	1.404	-1.175
20	AT-231 x PRACHI	0.440	0.230	10.732	-0.357*	**13.538****	-0.326	0.059	-0.008	0.436**	2.589**	4.291**
21	JLT-07 x AT-255	-1.260	-3.320	-11.354	**-0.682****	0.323	-0.656	-0.023	-0.088**	0.496**	0.797	3.675**
22	JLT-07 x KMR-69	-0.660	0.080	0.552	-0.182	-8.197**	3.504	-0.022	-0.045*	0.005	-1.228	1.435*
23	JLT-07 x KMR-114	0.840	1.080	0.612	0.378**	-3.037	2.144	0.041	0.007	-0.155	-0.161	-2.359**
24	JLT-07 x GT-3	0.540	1.480	4.292	0.188	4.283	5.424*	0.091	0.043*	0.025	1.730*	0.360

Contd….

Sr. No.	Crosses	Days to 50% flowering	Day to maturity	Plant height	No. of branches / plant	No. of capsules / plant	No. of seeds / Capsule	Length of capsule	Width of capsule	1000 Seed weight	Seed yield / plant	Oil content
25	JLT-07 x IC-502030	-0.160	-0.120	-5.848	-0.482**	4.183	-1.576	0.177*	-0.011	0.316*	1.224	0.833
26	JLT-07 x IC-502032	-0.060	-1.420	-1.328	0.238	-1.567	-0.376	0.062	-0.005	-0.075	-0.778	0.515
27	JLT-07 x TKG-22	2.240*	3.680*	5.882	0.568**	-3.897	-5.836*	-0.001	0.037	0.166	-0.751	-7.159**
28	JLT-07 x LOCAL	-0.260	-1.020	2.492	-0.242	3.523	6.504**	-0.089	-0.008	-0.034	0.770	2.139**
29	JLT-07 x YLM-17	0.040	-1.120	-0.268	-0.102	13.423**	-4.656*	-0.137	0.009	-0.190	0.918	-0.663
30	JLT-07 x PRACHI	-1.260	0.680	4.972	0.318*	-9.037**	-4.476*	-0.097	0.060**	-0.505**	-2.517**	1.223
31	RT-54 x AT-255	-0.410	1.730	4.071	0.028	8.053**	-4.866*	-0.007	0.063**	-0.342*	0.355	**5.629****
32	RT-54 x KMR-69	1.690	-2.370	0.877	-0.172	19.433**	-4.706*	0.119	0.051*	0.618**	**4.835****	4.259**
33	RT-54 x KMR-114	0.190	-1.870	-3.413	-0.412**	10.293**	5.934*	-0.128	0.023	-0.092	0.477	-0.475
34	RT-54 x GT-3	**-4.610****	**-2.970**	-9.983	-0.002	5.313*	-0.386	0.032	-0.016	0.138	2.158**	-2.936**
35	RT-54 x IC-502030	2.190*	0.430	0.177	0.328*	-6.987**	0.214	-0.072	-0.025	-0.422**	-2.158**	-3.243**
36	RT-54 x IC-502032	2.790*	4.630*	10.697	0.298*	-6.637**	1.014	0.093	0.016	0.088	-2.080**	-2.741**
37	RT-54 x TKG-22	2.590*	-0.770	-0.493	0.228	-7.367**	0.354	-0.170*	-0.047*	-0.472**	-2.338**	1.815*
38	RT-54 x LOCAL	-2.910**	-2.470	2.917	-0.282*	-6.447**	3.494	0.062	-0.002	-0.272*	-0.172	-0.387
39	RT-54 x YLM-17	1.390	3.430	-3.843	0.108	-3.047	1.134	0.164*	-0.025**	**0.698****	1.141	0.271
40	RT-54 x PRACHI	-2.910**	0.230	-1.003	-0.122	-12.607**	-2.186	-0.091	-0.039*	0.058	-2.219**	-2.193**
41	SWETA x AT-255	0.290	2.130	12.778	0.098	-7.647**	0.924	0.081	**0.124****	-0.060	-1.158	-2.353**
42	SWETA x KMR-69	-1.110	0.030	1.154	0.448*	-0.267	-0.116	-0.033	0.017	**-0.700****	-1.608*	-2.343**
43	SWETA x KMR-114	-1.610	-1.470	-12.136	0.058	4.593	-2.676	**0.215****	0.004	0.241	0.959	3.283**
44	SWETA x GT-3	0.090	3.430	20.694**	-0.132	4.713*	1.204	-0.005	-0.015	0.221	-0.220	1.692*
45	SWETA x IC-502030	1.390	-0.170	-3.946	0.098	1.113	0.204	**-0.169***	**-0.074****	-0.390**	0.729	-4.535**
46	SWETA x IC-502032	-1.510	-1.970	-1.226	-0.482**	-4.737*	-2.996	-0.094	-0.023	0.271*	-0.043	2.497**
47	SWETA x TKG-22	-0.210	-0.370	3.484	0.298*	4.733*	-2.656	0.008	0.009	-0.390**	0.959	1.913**
48	SWETA x LOCAL	2.290*	-1.070	-3.306	-0.162	2.253	-2.716	-0.010	0.024	0.461**	0.695	4.091**
49	SWETA x YLM-17	-0.910	-1.170	-4.566	0.128	-6.947**	6.124**	0.007	-0.039*	-0.145	-1.117	1.819*
50	SWETA x PRACHI	1.290	0.630	-12.926*	-0.352*	2.193	2.704	0.002	-0.023	0.141	0.803	-6.065**
	SE(±)	1.0611	1.7456	6.3993	0.1370	2.3350	2.1629	0.0692	0.0192	0.1291	0.7662	0.6879

*and ** indicated significance at 5and 1 percent level, respectively.

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