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Research Note

Combining ability analysis for yield related traits in F_2 generation of sesame (*Sesamum indicum* L.)

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Abstract

An attempt was made to study the general and specific combining ability in sesame through 6 x 6 diallel analysis for yield and yield contributing characters *viz.*, days to 50 % flowering, days to maturity, plant height, height to first capsule, number of branches per plant, number of internodes per plant, length of capsule, width of capsule, number of capsules per plant, number of capsules per leaf axil, number of seeds per capsule, 1000-seed weight, oil content and seed yield per plant. The analysis of variance for combining ability revealed that the mean squares due to GCA were higher than the corresponding mean squares due to SCA for days to 50 % flowering, plant height, height to first capsule, number of branches per plant, number of internodes per plant, number of capsules per leaf axil and oil content indicating the predominance of the additive type of gene action in the inheritance of these characters. Based on general combining ability, the parents G.Til-1, Borda-1, G.Til-2 and G.Til-10 were good general combiners for seed yield per plant, plant height, number of branches per plant, number of internodes per plant, length of capsule, number of capsules per plant and number of seeds per capsule. Borda-1 x G.Til-10, Kalyanpur-2 x Borda-1, G.Til-1 x Borda-1 and G.Til-2 x China were best specific combiners for seed yield and its components.

Key words:
Sesame, General combining ability, Specific combining ability, F2 generation.

Sesame (*Sesamum indicum* L.) often called as "Queen of Oilseeds" is the most important oilseed crop known for its excellent qualities of seed, oil and meal. Generally, the oil content in sesame ranges from 34 to 63% (Were *et al.*, 2006). It is sixth most important oil seed crop in India and has 18.30 lakh ha area with 7.70 lakh tonnes production and productivity of 419 kg/ha (FAO, 2012). The yield improvement achieved through conventional hybridization followed by selection has been only marginal suggesting acute need of proper strategy to select appropriate parent for seed yield improvement. Combining ability studies reveal the identification of parents with high general combining ability effects and the cross combinations with high specific combining ability effects. This in turn helps in choosing the parents to be included in a hybridization programme. Thus, for the effective exploitation of seed yield, some genetic analysis is required and the present study reveal the result of diallel analysis in sesame.

The present investigation was conducted using six parent diallel cross F_2 generation in a Randomized Block Design with three replications at Department of Genetics and Plant Breeding, Junagadh Agricultural University, Junagadh, Gujarat. Each plot with a spacing of 45 x 15 cm^2 consisted of single row of 3 m length. All need based agronomic practices were followed during the crop growth period to raise a good crop. Six parents *viz.*, G.Til-1, G.Til-2, Kalyanpur-2, Borda-1, China and G.Til-10 and their 15 F_2's were evaluated during summer 2013. Observations were recorded on randomly selected five plants from parents and 20 plants from F_2s in each entry for 14 quantitative traits including seed yield per plant for each replication. The mean values were used for the analysis of variance for experimental design. The estimation of combining ability was carried-out as per the Method-2, Model-I of Griffing (1956).

The analysis of variance (Table 1) for combining ability revealed that the mean squares due to GCA and SCA were significant for all the characters except 1000-seed weight for GCA and days to 50 % flowering, plant height, number of branches per plant and number of internodes per plant for SCA. Variances due to GCA were higher than the corresponding variances due to SCA for days to 50 % flowering, plant height, height to first capsule, number of branches per plant, number of internodes per plant, number of capsules per leaf axil and oil content indicating the involvement of additive type of gene action in the genetic control of these characters. This resulted in greater than unity ratio of σ^2 GCA/ σ^2 SCA for these characters. Similar results were reported by Saravanan and Nadarajan (2003) and Vavdiya (2013) for most of the traits except for number of internodes per plant and oil content. The variances due to SCA were higher than the corresponding variances due to GCA for days to maturity, length of capsule, width of capsule, number of capsules per plant, number of seeds per capsule, 1000-seed weight and seed yield per plant indicating the involvement of non-additive type of gene action in the inheritance of these characters. This resulted in less than unity ratio of σ^2 GCA/ σ^2 SCA for these characters. These findings are in concordance with Prajapati *et al.* (2006) for all the traits except for width of capsule and 1000-seed weight.

Selection of the parents for hybridization is an important aspect in the crop improvement programme and the performance of varieties in a trial may give an idea of their relative superiority. General combining ability (Table 2) of the parents revealed that the parents G.Til-1, Borda-1, G.Til-2 and G.Til-10 were good general combiners. G.Til-1 gave desirable gca effect simultaneously for eight characters *viz*., days to 50 % flowering, days to maturity, height to first capsule, length of capsule, width of capsule, number of capsule per leaf axil, number of seeds per capsule and oil content followed by Borda-1 for seven characters *viz.*, plant height, number of branches per plant, number of internodes per plant, length of capsule, number of capsules per plant number of seeds per capsule and seed yield per plant, G.Til-2 for five characters *viz*., days to maturity, height to first capsule, width of capsule, number of capsule per leaf axil and oil content and G.Til-10 for four characters *viz*., plant height, number of branches per plant, number of internodes per plant and oil content. The utilization of these four parents in sesame breeding programme has been suggested to develop high yielding and early maturing sesame culture.

Specific combining ability (Table 3) in F_2 revealed that none of the F_2s was good specific combiner simultaneously for all the characters. Out of 15 F_2s, ten F_2s *viz.*, Borda-1 x G.Til-10, Kalyanpur-2 x Borda-1, G.Til-1 x Borda-1 and G.Til-2 x China exhibited significant positive SCA effect for seed yield per plant. The high SCA effect for seed yield per plant was due to desirable SCA effects for component characters *viz*., number of capsules per plant, plant height, capsule length etc. Hence, there is possibility of isolating transgressive segregants in later generation from these crosses.

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Table 1. Analysis of variance for combining ability for various characters in F_2 generation in sesame

Source of variation	df	Days to 50 % flowering	Days to maturity	Plant height	Height to first capsule	Number of branches per plant	Number of internodes per plant	Length of capsule
GCA	5	8.541**	8.914**	212.329**	94.692**	0.928**	6.164**	0.036**
SCA	15	1.778	3.077**	17.752	5.679**	0.096	1.116	0.007**
Error	40	0.955	0.377	10.634	1.371	0.073	0.856	0.002
σ^2GCA		0.948	1.067	25.212	11.665	0.107	0.663	0.004
σ^2SCA		0.823	2.7	7.118	4.308	0.022	0.26	0.005
σ^2GCA/ σ^2SCA		1.152	0.395	3.542	2.708	4.758	2.55	0.914

Table 1. Contd..

Source of variation	Df	Width of capsule	Number of capsules per plant	Number of capsules per leaf axil	Number of seeds per capsule	1000-seed weight	Oil content	Seed yield per plant
GCA	5	0.002**	79.433**	0.300**	13.584**	0.036	4.523**	5.635**
SCA	15	0.001**	48.888**	0.043**	4.873**	0.078**	0.484**	17.157**
Error	40	0.0002	9.643	0.007	1.057	0.021	0.113	0.598
σ^2GCA		0.0002	8.724	0.037	1.566	0.002	0.551	0.63
σ^2SCA		0.0005	39.246	0.036	3.817	0.058	0.371	16.559
σ^2GCA/ σ^2SCA		0.395	0.222	1.022	0.41	0.032	1.486	0.038

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

Table 2. Estimates of general combining ability effect for different characters in F_2 generation in sesame

Parents	Days to 50 % flowering	Days to maturity	Plant height (cm)	Height to first capsule (cm)	Number of branches per plant	Number of internodes per plant	Length of capsule (cm)
G.Til-1	-0.987**	-1.202**	-4.842**	-2.503**	-0.199*	-1.249**	0.062**
G.Til-2	-0.445	-0.402*	-5.350**	-3.220**	-0.358**	-0.526	-0.088**
Kalyanpur-2	-0.041	0.085	-2.865**	-2.253**	-0.014	-0.234	-0.026
Borda-1	1.999**	1.938**	6.817**	3.955**	0.378**	1.253**	0.048**
China	-0.389	-0.450*	1.317	-0.610	-0.258**	0.147	0.065**
G.Til-10	-0.137	0.031	4.923**	4.632**	0.451**	0.608*	-0.061**
SE(gi) ±	0.315	0.198	1.052	0.378	0.087	0.299	0.015
SE(gi-gj) ±	0.489	0.307	1.631	0.585	0.135	0.463	0.023

Table 2. Contd.

Parents	Width of capsule (cm)	Number of capsules per plant	Number of capsules per leaf axil	Number of seeds per capsule	1000-seed weight (g)	Oil content (%)	Seed yield per plant (g)
G.Til-1	0.022**	-1.280	0.245**	2.145**	0.028	0.578**	-0.548*
G.Til-2	0.012*	-2.378*	0.253**	-0.842*	-0.116*	0.316**	-0.805**
Kalyanpur-2	-0.009	-1.334	-0.140**	-0.942**	-0.003	-1.497**	-0.212
Borda-1	-0.017**	5.735**	-0.107**	0.746*	0.084	0.087	1.570**
China	0.001	-2.297*	-0.109**	0.195	0.024	0.178	-0.180
G.Til-10	-0.009	1.553	-0.142**	-1.302**	-0.017	0.338**	0.175
SE(gi) ±	0.005	1.002	0.026	0.332	0.046	0.109	0.250
SE(gi-gj) ±	0.007	1.553	0.041	0.514	0.072	0.168	0.387

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

Table 3. Estimates of specific combining ability effect for different characters in F_2 generation in sesame

Sr. No.	Crosses	Days to 50 % flowering	Days to maturity	Plant height	Height to first capsule	Number of branches per plant	Number of internodes per plant	Length of capsule
1	G.Til-1 x G.Til-2	1.483	1.883**	5.870*	2.739**	0.424	1.274	-0.023
2	G.Til-1 x Kalyanpur-2	-1.138	-1.671**	-1.199	-0.328	0.131	-0.385	-0.079
3	G.Til-1 x Borda-1	1.906*	1.743**	2.170	-0.720	0.139	1.911*	0.157**
4	G.Til-1 x China	-1.440	-1.669**	1.670	-0.755	-0.042	0.584	0.080*
5	G.Til-1 x G.Til-10	0.641	0.383	2.931	0.720	0.116	0.390	0.059
6	G.Til-2 x Kalyanpur-2	1.304	1.412**	-1.674	-1.561	-0.378	0.076	-0.044
7	G.Til-2 x Borda-1	-2.119*	-1.190*	1.045	1.130	-0.003	0.555	-0.029
8	G.Til-2 x China	1.935*	3.331**	-2.105	-3.972**	0.083	0.578	0.011
9	G.Til-2 x G.Til-10	-0.984	-1.367*	1.206	0.987	0.408	-0.616	-0.076
10	Kalyanpur-2 x Borda-1	-0.474	-1.794**	-4.807	-2.470*	0.287	-0.487	0.036
11	Kalyanpur-2 x China	-0.136	-0.257	-1.224	-0.072	-0.344	0.103	0.022
12	Kalyanpur-2 x G.Til-10	-0.721	-0.605	-7.213*	-2.647*	-0.053	-1.008	0.038
13	Borda-1 x China	0.124	-0.159	2.579	2.120*	-0.036	0.399	0.081*
14	Borda-1 x G.Til-10	0.956	0.826	2.689	4.028**	0.289	0.138	-0.100*
15	China x G.Til-10	-1.440	-2.103**	2.222	-0.024	0.141	0.561	-0.007
	SE (s_{ij}) ±	0.866	0.545	2.891	1.038	0.240	0.820	0.041
	SE(s_{ij}-s_{ik}) ±	1.293	0.813	4.314	1.549	0.358	1.224	0.060
	SE(s_{ij}-s_{kl}) ±	1.197	0.752	3.994	1.434	0.331	1.133	0.056

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

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Table 3. Contd...

Sr. No.	Crosses	Width of capsule	Number of capsules per plant	Number of capsules per leaf axil	Number of seeds per capsule	1000-seed weight	Oil content	Seed yield per plant
1	G.Til-1 x G.Til-2	0.041**	9.043**	-0.268**	-0.083	0.015	-0.128	1.703*
2	G.Til-1 x Kalyanpur-2	0.011	-1.901	-0.141*	1.817*	-0.055	-1.096**	2.193**
3	G.Til-1 x Borda-1	-0.003	8.230**	-0.108	3.758**	0.072	-0.639*	4.138**
4	G.Til-1 x China	0.022	1.261	0.044	-0.541	-0.035	0.910**	3.322**
5	G.Til-1 x G.Til-10	0.002	1.145	-0.139	1.683	0.033	-0.553	-0.310
6	G.Til-2 x Kalyanpur-2	-0.018	0.397	-0.250**	-0.722	-0.384**	-0.199	2.943**
7	G.Til-2 x Borda-1	0.017	-3.955	-0.083	0.629	0.276*	-0.409	0.114
8	G.Til-2 x China	-0.005	9.793**	-0.181*	1.207	0.336**	-0.081	4.102**
9	G.Til-2 x G.Til-10	0.009	1.109	-0.198**	-2.746**	0.164	-0.640	0.927
10	Kalyanpur-2 x Borda-1	0.031*	4.418	0.111	-1.454	0.686**	0.209	3.861**
11	Kalyanpur-2 x China	0.006	-3.835	0.046	-2.943**	0.019	-1.062**	0.082
12	Kalyanpur-2 x G.Til-10	0.013	-8.718**	0.079	-1.119	-0.090	0.735*	-0.386
13	Borda-1 x China	-0.022	-3.470	0.013	1.128	-0.267*	0.131	1.347*
14	Borda-1 x G.Til-10	-0.055**	10.080**	0.046	-2.704**	-0.246	-0.345	4.342**
15	China x G.Til-10	0.006	1.095	0.048	1.317	0.223	0.287	1.506*
	SE (s_{ij}) ±	0.013	2.753	0.072	0.911	0.127	0.298	0.685
	SE(s_{ij}-s_{ik}) ±	0.019	4.108	0.108	1.360	0.190	0.445	1.023
	SE(s_{ij}-s_{kl}) ±	0.018	3.803	0.100	1.259	0.176	0.412	0.947

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