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COMBINING ABILITY IN SESAME

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ABSTRACT

Combining ability studies on seed yield, yield components and oil content were conducted from an 8 × 8 half-diallel cross of sesame over two years. Additive genetic variance was of greater importance for number of primary branches/plant, number of secondary branches/plant, number of capsules/plant and seed yield/plant while, additive and non-additive genetic variances were equally important for days to flowering, 1000-seed weight and oil content. gca and sca manifested significant interaction with year for all characters. The relative magnitude of non- additive × year interaction was greater than additive × year interaction. The variety B 9 was best general combiner for seed yield and its major components. B14 × B 9 emerged best specific combiner for seed yield and its components. For augmenting seed yield and oil content simultaneously the cross combination MT 67-52 × TC 25 was found promising.

Key words : Sesame, combining ability, gene effects, genotype × year interaction.

Sesamum indicum L. is an important oilseed crop. However, sesame seed yields are possibly the lowest of all major oilseeds in India because of unavailability of cultivars responsive to different agro-ecological situations and management conditions [1]. Previous reports indicate the existence of considerable amount of genotypic variation among sesame varieties [2, 3]. For implementation of a successful breeding program, combining ability study helps to identify superior parents and crosses to get desirable recombinants. It is known that quantitative characters are influenced by the environment. A knowledge of genotype × environment interaction during the studies on combining ability may be more meaningful to understand the precise nature of inheritance of yield and yield components. Reports on this aspect are meagre in sesame. The present study, therefore, has been undertaken to analyse the data of two years of an 8 × 8 half-diallel cross for yield and yield components.

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MATERIALS AND METHODS

Three widely adapted varieties of West Bengal (B 67, B 14 and B 9) and five other diverse varieties (R 9, MT 67-52, T 12, RT 4 and TC 25) having specific desirable characteristics like high seed yield/plant, high oil content and tolerance to diseases comprised the parents of diallel cross. The 28 F_{1s} and 8 parents were grown in two years during pre-kharif season in randomized block design with four replications at the Calcutta University's Agriculture Farm, Baruipur. Each genotype was grown in a single row 3 m long with the spacing of 30 cm between rows and 8 cm between plants. The recommended intercultural practices were followed for raising the crop. Five competitive plants from each genotype were randomly selected from each replication for recording observations on number of primary branches/plant, number of secondary branches/plant, days to flowering, number of capsules/plant, 1000-seed weight, seed yield/plant and oil content. The progeny means were used for statistical analysis. Combining ability analysis was done according to Singh [4, 5] using Method 2, Model I of Griffing [6].

RESULTS AND DISCUSSION

The analysis of variance for combining ability for the data pooled over years (Table 1) showed that mean squares due to gca were significant for all the characters.

Table 1. Analysis of variance (mean squares) for combining ability over years

Source	d.f.	Number of primary branches/ plant	Number of secondary branches/ plant	Days to flowering	Number of capsules/ plant	1000-seed weight	Seed yield/ plant	Oil content
gca	7	0.52**	1.13**	21.39**	287.51**	0.03*	6.65**	69.30**
sca	28	0.19	0.48	10.16**	95.32	0.03**	2.26	13.71**
Year	1	6.27**	17.50**	5836.50**	541.75**	0.01	213.55**	28.80**
gca × Year	7	0.59**	0.56	16.28**	630.17**	0.02*	8.31**	20.98**
sca × year	28	0.22	0.49*	2.55**	132.64**	0.02*	3.07**	13.74**
Error	210	0.17	0.32	1.02	70.21	0.01	1.49	1.59
$\frac{\sigma_a^2}{\sigma_a^2 + \sigma_{na}^2}$		0.81	0.51	0.31	0.63	0.20	0.57	0.53

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

On the contrary, mean squares due to sca were significant only for days to flowering, 1000-seed weight and oil content. The results of predictability ratio as suggested by Sokol and Baker [7] was computed to assess the relative magnitude of two variances. The results revealed that additive gene effect was predominant for number of primary branches/plant, number of secondary branches/plant, number of capsules/plant and seed yield/plant. Similar finding was reported by Djima [8]. Pedigree method of selection would be more useful for accumulation of desirable genes in these characters. Both additive and non-additive gene effects were equally important for days to flowering, 1000-seed weight and oil content. The finding is in close agreement with previous reports [9-12]. In the improvement of days to flowering, 1000-seed weight and oil content breeding method like recurrent selection might be effective as both additive and non-additive gene effects were important for the genetic control of these characters.

The difference between the years was highly significant for all the traits except for 1000-seed weight (Table 1). Both gca and sca exhibited significant interaction with year except for number of secondary branches/plant in case of gca and number of primary branches/plant in case of sca indicating the role of environment in influencing variances. The σ^2 sy/σ^2gy ratios were greater than unity for all the traits suggesting that sca variance exhibited greater interaction than gca variance with year. The σ^2g/σ^2gy ratios were less than unity for all the characters except for number of secondary branches/plant, 1000-seed weight and oil content. Similarly, σ^2s/σ^2sy ratios were less than unity in all the traits except for days to flowering. Significance of interaction as well as the ratios between estimates of main effects and interaction effects warrant conducting experiments over different environments for obtaining unbiased estimates of genetic variances.

The parent B 9 showed significantly high or very high gca effect for seed yield/plant, number of primary branches/plant, number of secondary branches/plant and number of capsules/plant (Table 2). The parents B 14 and R 9 exhibited high gca effects for number of primary branches/plant and number of capsules/plant respectively. Similarly, the parents RT 4 and MT 67-52 for days to flowering and TC 25, RT 4, T 12, R 9 and MT 67-52 for oil content were characterized by very high gca effects. None of the parents evinced good gca effects for all the characters. However, the parent B 9 can be considered as the good general combiner for seed yield/plant and some of its components like number of primary branches/plant, number of secondary branches/plant and number of capsules/plant. The *per se* performance of this variety was also highest for seed yield/plant.

Table 2. Estimates of gca effects of parents

Characters \ Parents	B-67	B-14	B-9	R-9	MT-67-52	T-12	RT-4	TC-25	S.E.(g_i)
Primary branches/plant	–0.02	0.27**	0.18*	–0.21*	–0.10	0.08	–0.10	–0.10	0.09
Secondary branches/plant	–0.06	–0.19	0.39**	–0.18	0.11	0.02	–0.32**	0.23	0.12
Days to flowering	–0.75**	0.20	–0.03	–2.09**	0.62**	0.05	1.23**	0.77**	0.21
Number of capsules/plant	0.03	–0.99	2.16	6.79**	1.32	–1.06	–6.57**	–1.68	1.75
1000-seed weight	–0.09**	–0.02	0.01	0.01	0.03	0.01	0.02	0.03	0.02
Seed yield/plant	–0.82**	0.29	0.99**	0.04	–0.17	0.17	–0.71**	0.20	0.26
Oil content	–1.75**	–1.95**	–2.85**	1.41**	0.62*	1.44**	1.45**	1.64**	0.26

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

The five top ranking cross combinations selected on the basis of *per se* performance involved high, medium and low general combiners. Parents were classified as high or good, medium or average and low or poor combiners on the basis of their gca effects. Parents with desirable and gca effects, were considered high or good combiners while parents showing insignificant estimates but in desirable direction were classified as average or medium combiners. Poor or low combiners had undesirable gca effects. The top ranking five cross combinations selected on the basis of *per se* performance in general exhibited significantly positive or highly positive sca effects for all the traits. But the ranking of cross combinations was not consistent for *per se* performance and sca effects (Table 3). The top ranking five cross combinations involved parents with significantly positive general combining ability effects for oil content. While, the cross combinations for days to flowering involved average combiners. In other words, additive or additive × additive gene effect was predominant in the genetic control of these cross combinations. For other characters no such trend was observed as the top ranking cross combinations involved high × high, high × medium, high × low or low × low general combiners.

Table 3. Five top ranking cross combinations selected on the basis of *per se* performance along with respective sca effect and gca status

Cross combinations	*Per se* performance	sca effect	gca effect
Number of primary branches/plant			
B 14 × B 9	4.88	0.41	H × H
B 67 × B 14	4.50	0.23	L × H
B 67 × R 9	4.38	0.58*	L × L
B 9 × TC 25	4.38	0.27	H × L
R 9 × T 12	4.38	0.48	L × M
Number of secondary branches/plant			
B 14 × B 9	2.62	0.68	L × H
MT 67-52 × TC 25	2.62	0.54	M × M
R 9 × TC 25	2.38	0.58	L × M
T 12 × TC 25	2.38	0.38	L × M
B 9 × R 9	2.25	0.29	H × L
Days to flowering			
RT 4 × TC 25	36.38	4.06**	H × M
MT 67-52 × RT 4	35.38	3.21**	M × H
B 14 × MT 67-52	32.88	1.75	M × M
B 14 × TC 25	32.62	1.35	M × H
MT 67-52 × T 12	32.12	1.15	M × M
Number of capsules/plant			
R 9 × MT 67-52	120.50	14.64**	H × M
B 67 × R 9	110.38	5.81	L × H
B14 × B 9	110.00	11.09*	L × M
B 67 × MT 67-52	106.12	7.03	L × M
B 9 × TC 25	105.88	7.66	M × L
1000-seed weight			
B 9 × MT 67-52	3.42	0.27**	M × M
RT4 × TC 25	3.35	0.19*	M × M
MT 67-52 × TC 25	3.28	0.11	M × M
B 9 × R 9	3.23	0.10	M × M
R 9 × TC 25	3.23	0.07	M × M

(*Table 3 contd.*)

Seed yield/plant			
B 14 × B 9	17.10	2.17*	M × H
R 9 × RT 4	15.68	2.53*	L × L
B 9 × TC 25	15.55	0.56	H × M
MT 67-52 × TC 25	14.96	1.12	L × M
R 9 × T 12	14.83	0.80	L × M
Oil content			
T 12 × TC 25	52.62	4.94**	H × H
R 9 × TC 25	50.25	2.59*	H × H
T 12 × RT 4	50.11	2.61*	H × H
MT 67-52 × TC 25	49.21	2.54*	H × H
RT 4 × TC 25	49.08	1.37	H × H

H - High general combiner * Significant at 5% level
M - Medium general combiner **Significant at 1% level
L - Low general combiner

Conventional breeding methods exploit only additive or additive × additive gene effects in any self-pollinated crop. No cross combination exhibited significantly positive sca effect and high *per se* performance coupled with parents having high gca effects consistently for all the characters. The cross combination B 14 × B 9 appeared to be the best for seed yield/plant because this cross combination exhibited significantly positive sca effect, high *per se* performance and also involved parents with high × average combining ability effects. Moreover, this cross combination also exhibited good *per se* performance, high sca estimate and involved at least one parent having good gca for number of primary branches/plant, number of secondary branches/plant and number of capsules/plant. Therefore, additive and or additive × additive gene action was implicated in this cross combination for seed yield/plant and some of its components and so it would be the best choice to obtain transgressive segregants. The cross combination B 9 × TC 25 although not so good like B 14 × B 9, can be selected for getting desirable recombinants because this cross combination also exhibited high *per se* performance and highly positive sca effect with one parent having good gca effect for seed yield/plant and number of primary branches/plant. On the contrary, the cross combination R 9 × RT 4 although manifested highest sca effect for seed yield/plant with high *per se* performance, but the parents were poor general combiners. The cross combination T 12 × TC 25 showed highly significant positive sca effect and highest *per se* performance for oil content.

In any oilseed crop, improvement of seed yield/plant along with oil content are most desirable consideration. The present finding revealed that the cross combination MT 67-52 × TC 25 exhibited high sca effects both for seed yield/plant and oil content with high *per se*performance. Moreover, additive gene effect was predominant in the genetic control of this cross combination specially for oil content and also to some extent for seed yield/plant. Hence, this cross combination could throw desirable recombinants in the subsequent generations having high seed yield/plant and more oil content.

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