Combining ability Analysis of Yield Components in Sesamum (*Sesamum Indicum L*)

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Combining ability analysis for four characters, viz. plant height, nnmber of branches, capsules per plant and grain yield in F1 diallel cross involving six diverse lines of sesamum are reported. The combining ab lity showed that GCA had higher magnitude than SCA. The estimates of heritability revealed that non-additive type of gene action was more important for all the characters. The estimates of variances for each line showed that Bahadurpur II was the best line for $\hat{\sigma}^2 gi$ whereas TS15-72 was good for transmitting SCA variances. Recurrent selection technique in early segregating generation is suggested for improvement of sesamum.

The breeder of self polinated crop is in general faced with a problem which may be resolved into two parts a) Choice of parents for hybridization b) Selection of best lines from hybrid progenies. The diallel cross technique which involves the crossing of a group of lines in all possible combinations, is an efficient method for the study of combining ability when the meterial consists of few selected lines. Combining ability is a useful tool with the plant breeder for formulating an efficient breeding programme to evolve superior strains of a crop. The present investigation was undertaken to estimate general and specific combining ability from a dialled set of six lines in sesamum.

Material and Methods

A diallel cross involving six lines, viz., pb Til No 1, Shahabad, Kalanag, Bahadurpur II, Til black and TS15-72 were utilised as parents in this investi-

gation. All $n^2 = 36$ possible hybrids (including parents, FI's and reciprocals) were sown according to a randomised block design with four replications. The inter row and inter plant spacing was 60cm and 30cm respectively. Each entry was represented by a single row of 3m lengh. The data was recorded on five plants in a row for plant height, number of branches, capsules per plant and grain yield. The data obtained for each trait were analysed statistically on a plot mean basis by the analysis of variance technique. The analysis for combining ability was conducted using Model 1 (the fixed effect model) and method I (parents, one sef of crosses and reciprocals) of Griffing (1956).

Results and Discussion

Mean values of plant height, number of branches, capsules per plant and grain yield are given in Table 1. The analysis of variance showed that parent and crosses differed significantly for all

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the characters. The GCA, SCA and reciprocal variances were highly significant for all the characters under study, (Table. 2) From these results it was evident that additive as well as non-additive gene effects were improtant. The comparison of general combining ability variance with specific combining ability variance indicates that GCA had higher magnitude for plant height, number of branches, capsules per plant and grain yield.

Estimates of 6^2g, 6^2s, 6^2r and h^2 in broad and narrow sense are presented in Table. 3. The variance components revealed that 6^2s estimates were higher for number of branches, capsules per plant and grain yield, thereby indicating that non-additive gene effects were more important in the inheritance, The heritability in the broad sense worked out from the variance components were very high for capsules per plant (97.93%) grain yield (97.0%) and number of branches (82.1%). The heritability estimates in narrow sense revealed fair estimates for plant height (23.30%) followed by capsules perplant (12.14%). Culp (1960) obtained heritability value of 40 to 50 per cent for plant height in four intervarietal crosses of sesame. Murty and Hakim (1974) in diallel analysis of sesame reported high estimates of heritabilty for days to flowering (52 percent), plant height (78 per cent) and number of primary branches (40 per cent) and low for number of secondary branches, number of capsules and seed yield. In the present study non-additive type of gene action are governing the expression of all the characters.

The GCA effects have been given in Table 4. Bahadurpur II was the best general combiner for all the traits, viz. plant height, number of branches, capsules per plant and grain yield. Kalanag was the next good combiner for all the characters. Pb Til No1, Til black and TS15-72 exhibited poor combining ability for all the characters. Shahabad was good general combiner for number of branches only. Table 5 shows the values of specific combining ability effects for different characters. Bahadurpur II × TS 15-72, Kalanag × Til black and Shahabad × Til black and Shahabad × TS15-72 showed significant SCA effects for plant height. Bahadurpur II × TS15-72 and Kalanag × Til black involved high and poor combining parents while Shahabad × TS15-72 involved both the poor combining parents. The combinations Pb Til No1 × Kalanag, Shahabad × Til black and Shahabad × TS15-72 had got significant effects for number of branches. All the three crosses involved poor and high combining parents. The crosses Til black × TS15-72, Shahabad × Til black, Kalanag × Bahadurpur II, Kalanag, TS15-72, Shahabad × TS15-72 and Bahadurpur II × TS15-72 exhibited significant effects for capsules per plant; two crosses involved high × high (Kalanag × Bahadurpur II) and high × Poor (Bhadurpur II × TS15-72) conbining parents, while in rest of crosses all the parents were poor combiner Seven cross combination, viz. Til black × TS15-72, Pb Til No 1 Kalanag, Bahadurpur II × TS15-72 Kalanag × TS15-72, Pb Til No1 × Bahadurpur II, Pb Til No1 × Til black and Bahadurpur II × Til black showed significant SCA effects for grain yield. Five cross combination involved were of high × poor combining parents. The best cross combination for grain yield invol-

ved both the poor combining parents. So SCA effects in different crosses for four characters studied indicated the presence of additive and non-additive type of gene action.

The GCA of the parents was directly related to the per se performance of the parents i.e. the parents with high mean showed high GCA effects. The GCA of the parents in general had no bearing on the SCA effects of the crosses i.e. the crosses involving the high general combining parents were not necessarily having the high SCA effects. Some of the crossss involving the parents with poor GCA exhibited high SCA effects. The Cross Til black×TS15-72 involved both the poor combiner parents but have highest SCA effects for grain yield and capsules per plant. Cross Pb Til No1×Kalanag had highest SCA effects for number of baranches. However, these crosses had low or medium expression for these characters. Such crosses are expected to throw transgressive segregated and can be exploited in the breeding programme.

Estimates of general combining ability and average specific combining ability variances associated with each parent are given in Table 6. The negligible specific combining ability variance associated with Bahadurpur II for grain yield, capsules per plant and plant height indicated that it uniformally transmitted these characters to all its hybrids whereas high specific combining

ability variance with TS15-72 indicates that there were specific combinations of TS15-72 with certain parents in respect of all the characters under study. Similarly Pb *Til* No1 possesses high general combining ability variance for grain yield, capsules per plant and number of branches

From the present study it was evident that mostly the non-additive type of gene action occur in the material. The experimental population arose from crossing chosen homozygous lines and did not represent sample of the sesame population as a whole. The maximum grain production in sesamum may be attainable only with a system which can exploit both additive and non-additive genetic variances. This can be achieved by following recurrent selection techniques i.e. by intermating most desirable segregants in the early segregating generations leading to the accumulation of favourable additive gene. The non-additive genetic variances will also be exploited simultaneously.

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TABLE-1. Meen values for plant height (cm), number of branches, capsules per plant and grain yield in a 6 x 6 diallel set of sesamum.

Parent / cross	Plant height	Number of branches	Capsules per plant	Grain yield
Pb Til No1	119.1	4.5	75.7	6.1
Shahabad	120.6	5 9	112.0	12.6
Kalanag	128 2	5.1	110.8	10.1
Bahadurpur II	134.6	5.2	151.7	17.6
Til black	119.3	5.0	84.6	7,9
TS 15-72	120.5	5.2	85 6	6.7
Pp Til No1 X Shahabad	127.4	5,0	92.7	7.6
„ X Kala-nag	128 6	5.5	9.44	9.9
„ X Baha-durpur II	127.4	5.1	79.1	7.3
., X Til black	116.4	4.8	67.1	7.1
„ X TS15-72	101 5	3 5	54.0	4.0
Shahabad X Pb Til No1	114.9	5 0	74.3	5.6
„ X Kalanag	130.7	5.4	106.5	10.2
„ X Baha-durpur II	137,7	5.6	119.9	11.9
„ X Til black	123 3	4.9	88.1	8.4
„ X TS15-72	124 3	4 8	96.2	7.6
Kala-nag X Pb Til No. 1	126 9	5.5	95.5	11.0
„ X Sha-habad	134.1	5.8	104 2	100
„ X Bahadurpur II	135.7	5.7	115.5	13.0
., X Til black	128 9	5.7	113.9	10.8
„ X TS15-72	122.1	4.6	98 7	9.9
Bahadurpur II X Pb Til No1	137.6	5.5	102.9	12 6
„ X Shahabad	123.4	6.1	120.4	13.1
„ X Kalanag	132.3	5 6	116.2	11.5
„ X Til black	125 1	6.0	108 5	14.9
„ X TS15-72	136.9	6·1	118.7	14.3
Til black X Pb Til No1	114.7	4.5	79 8	7.7
„ X Shahabad	108.3	4.5	63.6	4 9
„ X Kalanag	137.1	4.6	98.5	9.4
„ X Bahadurpur II	125.4	4.6	79.6	8.9
„ X TS15-72	121.8	4.5	83.7	8.5
TS15-72 X Pb Til No1	119.4	4.1	65 8	4.8
„ X Shahabad	111,8	4.8	71.4	5.4
, X Kalanag	130.4	6.3	131 4	13.2
„ X Bahadurpur II	139.5	5 6	122.8	13.6
., X Til black	126.9	5.7	112.5	12,4
SE	1.99	0.14	2.95	0.46
CD 5%	3.94	0.28	5.84	910,

TABLE-2　Analyses of variance for combining ability (Mean squares) and ratio of GCA/SCA for four characters

Source	D. F.	Plant height	Number of branches	Capsules/ plant	Grain yield
GCA	5	291.42 ^{XX}	0.95 ^{XX}	2024.13 ^{XX}	44.10 ^{XX}
SCA	15	84.56 ^{XX}	0.59 ^{XX}	411.81 ^{XX}	9.66 ^{XX}
Reciprocal effects	15	45.44 ^{XX}	0.29 ^{XX}	180.53 ^{XX}	0.99 ^{XX}
GCA / SCA		3.45	1.61	4.92	4.57
Error	105	10.52	0.04	23.16	0.57

X Significant at 5% / XX Significant at 1%

TABLE-3　Estimates and heritability in broad and narrow sense for four character in a 6 X 6 diallel set of sesamnm

Estimates	Plant height	Number of branches	Capsules/plant	Grain yield
6^2g	117.04	0.38	833.73	18.13
6^2s	112 18	8.33	6888.63	137.72
6^2r	262.55	1.87	118.63	3.15
h^2bs	0.4563	0.8201	0.9793	0.97
h^2ns	0.2330	0.0357	0.1214	0.11

TABLE-4 General combining ability effects for four characters in a 6 X 6 diallel set of sesamum

Parents	Plant heigh	Number of branches	Capsules / plant	Grain yield
Pb Til No1	X −4.27	X −0.38	X −17.36	X −2.25
Shahabad	X −2.26	X 0.14	X −0.34	X −0.58
Kalanag	X 4.91	X 0.24	X 10.92	X 1·01
Bahadurpur II	X 7.16	X 0.35	X 19-47	X 3.29
Til black	X −3.15	X −0.20	X −8.40	X −0.66
TS15-72	X −2.40	X −0.14	X −3.28	X −0.81
SE	0.85	0.05	1.27	0.19
CD	2.87	0.16	3.88	0.61

*Significant at 5%

TABLE-5. Specific conbining ability effects for four characters in a 6 X 6 diallel set of sesamum

Cross	Plant height	Number of branches	Capsules/plant	Grain yield
Pb Til No1 X Shahabad	2.33	0.08	4.09	-0.81
Pb Til No1 X Kalanag	1,75	0.48 ˣ	4.28	1,94 ˣ
Pb Til No1 X Bahadurpur II	4.25	0.12	-7.22	0.83 ˣ
Pb Til No1 X Til black	-2.38	0.06	2.10	0.58 ˣ
Pb Til No1 x TS15-72	-8.24 ˣ	-0.84 ˣ	-16.57 ˣ	2.28 ˣ
Sha-habad x Kalanag	-4.39	0.07	-2.18	-0.08
Shahabad x Bahadurpur II	0.29	0.20	4.90	0.05
Shahabad x Til black	-4 14	0.41 ˣ	12.52 ˣ	-1.84 ˣ
Shahabad x TS15-72	5.69 ˣ	0.36 ˣ	9.70 ˣ	-1.85 ˣ
Kalanag x Bahadurpur II	3.43	0.10	10.66 ˣ	1.80 ˣ
Kalanag x Til black	5.88 ˣ	0.06	6.57	0.01
Kalanag x TS15-72	-1.62	0.19	10.29 ˣ	1.60 ˣ
Bahadurpur II x Til black	-4.11	0.09	-13.24 ˣ	0,46 ˣ
Bahadurpur II x TS15-72	8.08 ˣ	-0.59 ˣ	8.45 ˣ	1.73 ˣ
Til black x TS15-72	4,49	0.27	12.67 ˣ	2 19 ˣ
SE	2.75	0.17	4.09	0.20
CD	7.41	0 46	10 89	1,50

*Significant at 5%

TABLE 6   Estimates of general combining ability and specific combining ability variances associate
with eech parent

Parent		Plant	Number of branches	Capsules/Plant	Grain yield.
Pb Til No1	$\hat{6}^2 gi$	16.04	0.13	296,54	4.94
	$\hat{6}^2 si$	17.14	0.21	74.17	2.09
	$\hat{6}^2 e$	10.52	0.04	23.16	0.57
Shaha-bad	$\hat{6}^2 gi$	2.92	0.01	—	0.22
	$\hat{6}^2 si$	10.69	0.06	56.71	1.30
Kalanag	$\hat{6}^2 gi$	21.92	0.05	14.42	0.90
	$\hat{6}^2 si$	9.93	0.04	54.07	1.96
Bhadurpur II	$\hat{6}^2 gi$	49.08	0.11	336.31	10.70
	$\hat{6}^2 si$	20.13	0.08	91.75	1.35
Til black	$\hat{6}^2 gi$	7.73	0.03	65.73	0.32
	$\hat{6}^2 si$	15.72	0.03	47.67	1.76
TS15-72	$\hat{6}^2 gi$	3.57	0.01	5.93	0.54
	$\hat{6}^2 si$	39.20	0.30	159.25	4.31

$\hat{6}^2 gi$ = General combining ability variance of i th parent

$\hat{6}^2 si$ = Specific combining ability variance of i th parent.

$\hat{6}^2 e$ = Error variance.