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Diallel analysis in soybean

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Abstract: Combining ability was studied in a 6 x 6 diallel set of soybean *(Glycine max* (L.) Merrill.) for seed yield and its components. The study revealed that the variances due to *gca* and *sca* were significant for all the characters, indicating the characters were governed by both additive and non-additive gene action. The *sca* variance was higher than *gca* variance for most of the characters, indicating preponderance of non-additive gene action in the inheritance of these traits. The genotypes Co1 and MACS 124 were found to be the good general combiners while four hybrids *viz.* Co1 x EC 9472, MACS 124 x Bragg, Co1 x Co2 and Co1 x EC 4296 were identified as best specific combiners for seed yield and other productive traits. ***(Keywords : Diallel, Combining ability, Soybean)***

The ability of the inbreds to transmit their desirable attributes to their hybrid progenies is called combining ability. The breeding value of the inbred lines ultimately depends upon their ability to produce superior hybrids in combination with other inbred lines. Thus combining ability analysis aids plant breeders in the identification and selection of potential parents in terms of the performance of the hybrids to be used either for heterosis breeding or for selecting recombinant inbreds following line selection and progeny testing. Further, this analysis elucidate the nature and magnitude of various types of generation involved in the expression of quantitative traits. Spraque and Tatum (1942) were the first to put forward the concept of combing ability in terms of genetic variations, using single crosses in maize. In the present investigation, diallel involving six parents were studied for combining ability of parents and best cross combinations.

Materials and methods

Six soybean genotypes *viz.* Co 1, MACS 124, Bragg, EC 4296, Co 2 and EC9472 were selected and crossed among themselves in a 6 x 6 complete diallel fashion during summer, 1996 at Agricultural Research Station, Pattukkottai. The six parents and 30 hybrids were raised during *kharif* 1996 in a randomised block design replicated three times, each parent and F_1 consisting of 20 plants raised with an uniform spacing of 45 cm x 20cm. Ten competitive plants were selected in each genotype at random for recording details of observations for all the characters *viz.* days to flowering, days to maturity, plant height, number of branches, number of pods, 100 seed weight, protein content, oil content, drymatter production and seed yield. Combining ability analysis was made using method 1, model 1 as suggested by Griffing (1956). The analysis included the parents, F_1's direct and the reciprocals.

Results and discussion

In the present study, six parents and 30 hybrids were subjected to combining ability analysis. The analysis of variance for all the ten characters studied are presented in Table 1.

High magnitude of gca variance over sca variance indicating additive gene action for plant height have been reported by Weber *et al.* (1970), Paschal and Wilcox (1975), and Kaw and Menon (1981).

Component analysis in the present study has indicated that both grain yield and yield components were largely controlled by non-additive variance. Based on this, it is therefore suggested that selection in early generation may not be fruitful and hence selection should be postponed to later generations. Intermating of segregants and effecting selection in the progenies may yield good result.

The gca effects of parents for different characters (Table 2) showed that Co I and MACS 124 were good combiners for seed yield. For other characters, Co I and MACS 124 recorded significant and positive gca effects except for

Table 1. Analysis of variance for 6 x 6 diallel

S.No	Character/Source	Mean square		
		Replication d.f.=2	Parents & hybrids d.f.=35	Error d.f=70
1.	Days to flowering	0.36	30.45	0.22
2.	Days to maturity	2.12	24.26	0.26
3.	Plant height	2.54	68.14	0.78
4.	No.of branches	0.06	1.07	0 03
5.	No.of pods	145.52	1288.77	56.20
6.	100 seed weight	0.06	2.39	0.05
7.	Protein content	1.30	4.38	0.05
8.	Oil content	0.11	2.21	0.06
9.	DMP	6.35	422.52	2.85
10.	Seed yield	3.27	104.51	2.35

** All significant at P = 0.01 level.

oil content in the case of Co I and for MACS 124 for days to flowering, protein content and oil content. High gca effects are mostly due to additive gene action or additive x additive interaction effects (Griffing, 1956). In view of this genotypes Co 1 and MACS 124 could be considered as the best general combiners for exploitation towards the development of improved varieties.

The performance of the parents *per se* together with nature of combing ability provides the criteria for choice of parents for hybridisation programme. In the present study, there was close agreement between *per se* performance of the parents *viz.* Co 1 and MACS 124 and their *gca* effects. Similar observation have been recorded by Kaw and Menon (1980), and Harer and Deshmukh (1993). The study revealed that the variance due to gca and sca were significant for all the characters indicating that characters were governed both by additive and non-additive gene action. The significance of both gca and sca variances for seed yield, days to maturiety and plant height as in the present study was also reported by Weber *et al.* (1970), and for 100 seed weight, days to maturity and plant height by Paschal and Wilcox (1975). Kew and Menon (1981) observed significant gca and sca variances for days to flowering, days to maturity, plant height and number of branches, and Sharma and Phul (1994) for plant height, number of branches, number of pods, 100 seed weight, seed yield, days to flowering, days to maturity, oil content and protein content.

In the present study, sca variance was higher than gca variance for all the characters except plant height, indicating the preponderance of nonadditive gene action in the inheritance of these traits, while preponderance of additive gene action was reported for oil content by Weber *et al.* (1970) and for days to maturity, number of branches, number of pods and seed yield by Halwanker and Patil (1993). Sharma and Phul (1994) observed high gca variance for number of branches, number of pods, 100 seed weight, seed yield, days to flowering, days to maturity, oil content and protein content. For the improvement of self pollinated crops, high gca effects of a particular cross combination will be useful, if it is combined by high gca effects of the respective parents, unlike the cross pollinated crops were gca effect alone is of primary consideration (Raghaviah and Joshi, 1986). These observations are applicable to soybean which is also a self pollinated crop.

Among the 30 hybrids studied, significant and positive gca effect for seed yield was observed

Table 2. Estimates of gca effects for parents

S. No	Parent	Days .to flowering	Days to maturitv	Plant height	No.of branches	No.of pods	1,00-seed weight	Protein content	Oil content	DMIP	Seed yield
1.	Co 1	1.61**	1.38**	5.06**	0.68**	17.94**	0.58**	0.77**	-0.10*	10.85**	5.13
2.	MACS 124	-0-11	0.46**	1.73**	0.07*	6.44**	0.28**	-0.05	-0.07	4.53**	1.88**
3.	Bragg	-0.75**	-0.37**	-0.23	-0.46**	-14.24**	-0.25**	-1.07*	0.29**	-7.74**	-4.12**
4.	EC 4296	2.75* *	1.82**	0.82**	0.13**	2.53*	0.03	-0.09**	-0.19**	-0.49	0.42
5.	Co 2	-2.78**	-3.09**	-4.52**	-0.21**	-9.39**	0.32**	0.63**	-0.46**	-4.20**	-1.83**
6.	EC 9472	-0.72**	-0.20*	-2.87**	-0.21**	-3.29**	-0.96**	-0-19**	0.15**	-2.95**	-1.48**
SE(gi)		0.07	0.08	0.13	0.03	1.14	0.03	0.03	0.04	0.26	0.23
CD at P=0.05		0.14	0.16	0.25	0.06	2.27	0.06	0.06	0.08	0.52	0.46

Table 3. Estimate of sca effects for hybrids.

Hybrid	Days to flowering	Days to maturity	Plant height	No. of branches	No. of pods	100 seed weight	Protein content	Oil content	DMP	Seed yield
Co 1 x MACS 124	-0.44**	-0.57**	1 3**	0.10**	0.1	-0.14	0.68**	-0.25**	-0.83	-0.24
Co 1 x Bragg	-1.47**	-0.74**	0.60	-0.61**	—28.54**	0.14	0.74**	0.31**	-15.27**	-9.28**
Co 1 x EC 4296	1.03**	-1.77**	-1.25	0.29**	13.36**	-0.02	-0.19*	0.30**	5.63**	3.16**
Co 1 x Co 2	0.22	1.31**	-1.17**	0.36**	10.68**	-0.20*	0.13	-0.65**	5.76**	3.44**
Co l x EC 9472	-1.50**	0.43*	0.77*	0.27**	26.27**	0.98**	0.75**	-1.43**	17.67**	8.31**
MACS 124 x Bragg	-2.58**	-3.49**	-2.05**	0.33**	20.68**	-0.31**	0.72**	0.22	12.93**	6.19**
MACS 124 x EC4296	-042**	2.31**	0.35	-023**	-0.75	0.27**	-0.52**	0.24**	1.29**	1.23*
MACS 124 x Co 2	-0.89**	0.06	-0.36	-0.16**	7.24**	-0.07	-0.25**	-0.11	1.52*	-0.07
MACS 124 x 9472	1.06**	0.18	0.32	0.15*	-20.00**	-0-78**	-0.21	-0.69**	-1151**	-5.92**
Bragg x EC 4296	2.22	0.98**	0.14	-0.26**	-4.70	-0.21	0.62**	-0.93**	-2.43**	-0.14
Bragg x Co2	2.58**	1.90**	4.93**	0.11	8.52**	-0.30**	0.81**	-0.37**	2.61	2.16**
Bragg x EC 9472	0.03	1.18**	-2.27**	0.05	5.75*	-0.19*	-1.41**	0.26**	1.15**	1.94*
EC 4296 x Co 2	-4.75**	-2.30**	-0.67*	-0.05	-2.75	0.14	-0.25**	-0.30**	0.45	-1.27*
EC 4296 x EC 9472	-0.64**	-2.02**	0.61	0.05	6.21	0.38	-0.28**	0.91**	2.73**	0.62
Co2 x EC 9472	0.56**	-1.60**	0.64*	-0.01	-0.63*	-0.76**	-0.88**	1.72**	-5.54**	-2.36**
SE(gi)	0.16	0.18	0.31	0.06	2.60	0.08	0.08	0.09	0.59	0.53
CD at P=0.05	0.32	0.36	0.62	0.12	5.18	0.16	0.16	0.18	1.18	1.06

(Table 3) for seven hybrids and non of the reciprocals registered significant gea for this character.

In general, it could be seen that majority of the hybrids have recorded significant gca effects for three most important productive traits viz. seed yield, drymatter production and number of pods.

Of the 30 cross combinations Co 1 x EC 9472 had significant and positive gca effects for seed yield and other yield components except oil content, MACS 124 x Bragg with similar effects for seed yield, number of pods, drymatter production, protein and oil content, Co 1 x Co 2 for important yield components and Co 1 x EC 4296 with such positive sca effects for seed yield and other characters could be considered as the best combinations for productive traits worthy of exploitation.

The reflection of gca effects in the superior specific combinations for different characters revealed that the best four hybrids for the most economical characters namely seed yield, drymatter production and number of pods involved, combination between parents of high x low (Col x EC 9472) and high x average (Col x EC 4296) general combiners. In no case low x low combiners yielded superior specific combinations, as also observed by Kaw and Menon (1980).

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