Legume Research, 38 (4) 2015: 546-550
Print ISSN:0250-5371 / Online ISSN:0976-0571

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com/www.legumeresearch.in

Combining ability and gene action for yield and yield contributing traits in groundnut (*Arachis hypogaea* L.)

K. M. Boraiah*[1], I. Shanker Goud, Kotreshi Gejli,
C. R. Konda Somasekar and M. Vetriventhan[1]

Department of Genetics and plant Breeding,
University of Agricultural Sciences, Raichur-584 102, India.
Received: 11-02-2014 Accepted: 14-06-2014 DOI:10.5958/0976-0571.2015.00062.4

ABSTRACT

Three lines were crossed with seven testers in a L x T mating design to estimate combining ability for yield and its attributing traits in groundnut, *Arachis hypogaea* L. The variance due to specific combining ability (SCA) was greater than variance due to general combining ability (GCA) for all the characters under study except days to maturity which indicated the role of non-additive gene action in the inheritance of these characters. The parents R-2001-2, ICGV-00451, SEL-1 and GPBD-5 were identified as good general combiners for the most of the yield attributing characters as they recorded high *per se* with positive significant gca effects for pod yield/plant. Among 21 crosses evaluated, five crosses R-2001-2 x GPBD-5, ICGV-91114 x KRG-1, R-2001-2 x TPT-25, ICGV-00350 x TAG-24 and ICGV-00350 x TMV-2 exhibited high and positive significant sca effects for pod yield/plant.

Key words: Combining ability, gca effects, Gene action, sca effects.

Groundnut (*Arachis hypogaea* L.) is the most important oil seed and food legume crop in India. In the recent years, improved cultivars are extensively used in hybridization because they possess many favourable genes which may complement each other in hybrid combination. However, lack of requisite variability in cultivated groundnut has led to near genetic uniformity among the improved cultivars. Therefore, the information on the gene action governing the yield and its components in groundnut is essential for identifying the useful parents and useful cross combinations that could yield superior segregants. Line x Tester analysis is a simple and powerful tool for pinpointing the correct parents based on combining ability estimates. The knowledge on the relative importance of GCA and SCA variance is quite useful for understanding the relative components for the expression of particular trait. Therefore, the present investigation was undertaken to asses combining ability of parents and also to know the nature of gene action for 14 quantitative traits.

Twenty one crosses were obtained by crossing three genotypes *viz.*, ICGV-91114, ICGV-00350 and R-2001-2 as lines with seven testers *viz.*, TPT-25, TAG-24, TMV-2, KRG-1, Sel-1, ICGV-00451 and GPBD-5 in line x tester mating design. The resulting 21 crosses were sown along with the parents in a randomized block design with two replications during *Kharif* 2009. Each entry was sown in a row of 3 m length with a spacing of 30 cm between rows and 10 cm within a row. Observations were recorded on five randomly selected plants for 14 characters *viz.*,plant height, number of branches, days to 50 per cent flowering, number of flowers per plant, days to maturity, number of mature pods, number of immature pods, total number of pods, pod yield per plant, kernel yield per plant, shelling per cent, sound mature kernels, 100 kernel weight and oil content. The mean data of each character was subjected to Line x Tester analysis and mean sum of squares along with the variance of general combining ability (GCA) of the parents and specific combining ability (SCA) of the hybrids were worked out based on the procedure developed by Kempthorne (1957). Considering the mean performance and general combining ability (gca) effects, the parents were ranked as good or high/poor or low combiners.

The analysis of variance indicated that all the parents as well as crosses used in the present study were differed significantly for all the traits. Analysis of variance for combining ability (Table 1) revealed that the variance due to lines were highly significant for number of branches,

*Corresponding author's e- mail: bors_km@yahoo.co.in.
[1]Directorate of Seed Research, Kushmaur, Maunath Bhanjan (UP).

days to 50 per cent flowering, days to maturity and oil content and testers also exhibit significant differences for days to 50 per cent flowering, days to maturity and oil content, justifying the selection of parents for combining ability analysis. The variance due to interaction between lines and testers was significant for most of the characters, suggesting significant contribution of sca effects towards variation among the crosses. The variance due to specific combining ability (GCA) was greater than variance due to general combining ability (SCA) for all the characters under study except days to maturity which indicated the role of non-additive gene action in the inheritance of these characters (Table 1). However, the variance due to general combining ability was greater than variance due to specific combining ability for days to maturity and GCA: SCA ratio also more than unity for days to maturity indicating the predominant role of additive gene action in the inheritance of this character. The SCA variance for kernel yield was negative indicating role of additive portion of genetic variance in the inheritance of this trait.

The *per se* performance of parents was considered as the first criterion for selection. Based on *per se* performance ICGV-00451 and R-2001-2 were identified as desirable parents. The second criterion of selection is the general combining ability effects of parents as the parents with high mean values may not necessarily be able to transmit their superior traits to their progenies. The total number of pods per plant is one of the important components influencing pod yield. It is evident from the expression of positive and significant gca effects for total number of pods per plant by R-2001-2, SEL-1 and GPBD-5 (Table 2), it is possible to improve number of pods per plant by involving them in crossing programme. Interestingly the same genotypes were also good combiners for pod yield per plant. The line R-2001-2 was recorded positive and significant gca effects for plant height, number of branches, number of flowers per plant and number of mature pods per plant. However, the same parent was poor combiner for number of immature pods. The testers SEL-1 and GPBD-5 recorded positive and significant gca effects for pod yield, number of flowers per plant, total number of pods per plant and kernel yield per plant. The tester TAG-24 exhibited positive and significant gca effects for number of branches, days to 50 per cent flowering and number of mature pods per plant but poor combiner for pod yield per plant. Apparao (2000) also reported that TAG-24 as good general combiner for number of branches and days to 50 per cent flowering. The tester KRG-1 was poor combiner for most of the characters but it was identified as good combiner for oil content. Similarly, another widely adopted genotype TMV-2 was also poor combiner for most of the

TABLE 1: ANOVA for combining ability for 14 different characters in groundnut

Source of variance	Df	Plant height (g)	No. of branches per plant	Days to 50% flowering	No. of flowers per plant	Days to maturity	No. of mature pods/plant	No. of Immature Pods/plant	Total no. of pods/plant	Pod yield/ plant (g)	Kernel yield/ plant (g)	Shelling per cent	Sound mature kernel (%)	100 kernel weight (g)	Oil content (%)
Replication	1	1.55	0.0044	0.05	1.50	1.17	0.49	0.103	0.14	0.08	0.08	0.52	0.86	0.38	1.20
Line	2	88.50	9.52**	137.51**	108.95	674.38**	14.74	0.46	12.03	2.28	3.67	153.31	19.79	2.41	21.64*
Tester	6	15.67	0.38	28.24*	99.25	18.08*	9.84	1.36	10.98	5.17	2.52	125.41	30.55	62.51	12.91*
L x T	12	25.73**	0.64**	8.24**	76.18**	5.52*	18.69**	1.58**	25.48**	7.58*	4.16**	138.32**	23.20**	49.23**	4.65**
Error	20	0.67	0.03	0.68	0.71	1.82	0.38	0.06	0.43	0.26	0.08	0.99	0.81	1.72	0.43
Estimates of Variance Components															
σ2 gca		0.1273	0.00316	0.7392	0.3984	2.76	-0.1191	-0.007	-0.2224	-0.0489	-0.0211	-0.0928	0.0722	-0.0273	0.163
σ2 sca		12.5272	0.3062	3.7817	37.7357	1.85	9.1565	0.7581	12.523	3.6592	-0.0422	68.6692	11.1976	23.756	2.1113
σ2 gca/σ2 sca		0.01016	0.01032	0.19546	0.010558	1.49189	-0.01301	-0.00923	-0.01776	-0.01336	0.5	-0.00135	0.00644	-0.0011	0.0772

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

characters. However, it was exhibited significant gca effects for immature pods per plant and shelling per cent. Hence, based on gca effects, the parents R-2001-2, ICGV-00451, SEL-1 and GPBD-5 can be considered as superior parents for future use.

The top five crosses based on specific combining ability (sca) effects are presented in the Table 3. Out of 21 crosses seven crosses recorded significant positive sca effects for pod yield per plant. The best cross combination for pod yield per plant was R-20001-2 x GPBD-5 followed by ICGV-91114 x KRG-1, R-20001-2 x TPT-25, ICGV-00350 x TAG-24 and ICGV-00350 x TMV-2. The highest sca effects for pod yield was exhibited by the cross involving parents with high x high general combiners indicating the additive type of gene action for this trait. Such crosses could be exploited by simple conventional breeding programmes like pedigree method, which may give stable high performance progenies in advanced generations. The cross R-20001-2 x TPT-25 exhibited significant sca effects involving parents high x low general combiners obviously due to concentration of opposing alleles in parents which in crosses showed high allelic concentration. Transgressive segregants could be obtained in such crosses, if the additive genetic system present in low combiners, acts in a complementary fashion to maximize desirable attributes.

In general, in the present investigation majority of the crosses exhibited significant sca effects coupled with good per se performance for most yield attributing characters *viz.*, plant height, number of branches, number of flowers, number of mature and immature pods, total numbers of pods per plant, pod yield, kernel yield, shelling per cent, sound mature kernels, 100 kernel weight and oil content. These crosses involved low x low, high x low and low x high gca parents indicating that predominant role of non additive x non additive as well as additive x non additive gene inter actions were noticed for above characters. Therefore inter crossing of selected segregants in all possible combinations (Biparental mating system) and recurrent selection procedure followed by pedigree method would improve the yield in these cross combinations. These findings were also supported by Suneetha *et al*. (2006) and Jayalkshmi *et al*. (2002).

From the foregoing discussion, it may be concluded that non-additive gene actions are likely to play important role in the inheritance of yield and its attributing characters in groundnut. The crosses R-20001-2 x GPBD-5, ICGV-91114 x KRG-1, R-20001-2 x TPT-25, ICGV-00350 x TAG-24 and ICGV-00350 x TMV-2 were rated as best crosses for further improvement by adopting Biparental mating system and recurrent selection procedure fallowed by pedigree method.

TABLE 2: Estimates of general combining ability (gca) effects of female and male parents for 14 different characters in groundnut

Parents	Plant height (cm)	No.of branches per plant	Days to 50% flowering	No. of flowers per plant	Days to maturity	No. of mature pods/plant	No. of Immature Pods/plant	Total no.of pods/plant	Podyield/ plant(g)	Kernel yield/plant (g)	Shelling per cent	Sound mature kernel (%)	100 kernel weight(g)	Oil content (%)
Lines														
ICGV-91114	2.79**	-0.41**	-3.60**	-2.55**	-7.90**	-0.89**	0.21**	-0.68**	-0.41**	-0.25**	2.55**	1.36**	0.45	0.41*
ICGV-00350	-0.69**	-0.54**	2.15**	-0.43	2.81**	-0.23	-0.14	-0.37*	0.02	-0.34**	-3.74**	-0.50	-0.37	0.99**
R-2001-2	-2.10**	0.95**	1.44**	2.98**	5.10**	1.12**	-0.07	1.05**	0.39**	0.59**	1.19**	-0.86**	-0.08	-1.40**
Testers														
TPT-25	1.12**	0.27**	-2.17**	-0.03	-2.14**	0.92**	-0.60**	0.32	0.17	-0.38**	-4.91**	-0.90*	-3.93**	0.37
TAG-24	-0.27	0.32**	-1.08**	-2.70**	-1.31*	-1.38**	-0.16	-1.54**	-0.25	-0.43**	-0.05	0.10	-0.79	-1.33**
TMV-2	-1.86**	-0.38**	1.42**	-4.20**	-0.31	-0.89**	-0.58**	-1.47**	-0.68**	-0.34**	4.62**	-2.07**	0.39	-1.39**
KRG-1	-2.07**	-0.18*	-0.08	-4.40**	-1.14	-1.10**	0.34**	-0.77**	-1.31**	-0.8**	-3.63**	-2.57**	-2.91**	1.53**
SEL-1	-0.12	-0.15*	0.92*	4.80**	0.52	2.21**	-0.01	2.20**	0.97**	0.96**	3.96**	1.43**	5.93**	-1.72**
ICGV-00451	0.77*	0.05	3.58**	0.97*	2.69**	-0.15	0.53**	0.37	-0.27	0.38**	5.06**	4.10**	1.60**	1.78**
GPBD-5	2.45**	0.07	-2.58**	5.57**	1.69**	0.40	0.49**	0.88**	1.37**	0.61**	-5.05**	-0.07	-0.29	0.76*

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

TABLE 3: Top five crosses exhibiting maximum sca effects, their performance and gca status of parents

Character	Crosses	sca effects	gca status of parents	
			Female	male
Plant height(cm)	R-2001-2 x GPBD-5	6.03**	Low	High
	R-2001-2 x TAG-24	4.02**	Low	Low
	ICGV-91114 x ICGV-00451	3.17**	High	High
	ICGV-00350 x SEL-1	2.74**	Low	Low
	ICGV-00350 x KRG-1	2.34**	Low	Low
Number of branches/plant	R-2001-2 x TAG-24	0.92**	High	High
	ICGV-91114 x ICGV-00451	0.74**	Low	Low
	R-2001-2 x TPT-25	0.62**	High	High
	ICGV-00350 x TMV-2	0.51**	Low	Low
	ICGV-91114 x SEL-1	0.29*	Low	Low
Days to 50 *per cent* flowering	R-2001-2 x TMV-2	-2.77**	Low	Low
	ICGV-00350 x I CGV-00451	-2.49**	Low	Low
	ICGV-91114 x ICGV-00451	-2.40**	High	Low
	ICGV-00350 x TPT-25	-1.40**	Low	High
	ICGV-91114 x SEL-1	-2.40*	High	Low
Number of flowers/plant	R-2001-2 x GPBD-5	10.92**	High	High
	ICGV-91114 x ICGV-00451	8.55**	Low	High
	ICGV-00350 x TMV-2	4.10**	Low	Low
	R-2001-2 x SEL-1	3.94**	High	High
	ICGV-00350 x KRG-1	3.80**	Low	Low
Days to maturity	ICGV-00350 x GPBD-5	-2.48*	Low	Low
	ICGV-00350 x I CGV-00451	-1.98	Low	Low
	R-2001-2 x SEL-1	-1.60	Low	Low
	R-2001-2 x KRG-1	-1.43	Low	Low
	ICGV-91114 x TAG-24	-1.26	High	High
Number of mature pods/plant	R-2001-2 x GPBD-5	5.38**	High	Low
	ICGV-91114 x KRG-1	2.64**	Low	Low
	R-2001-2 x TPT-25	2.42**	High	High
	ICGV-00350 x KRG-1	2.13**	Low	Low
	ICGV-91114 x ICGV-00451	1.69**	Low	Low
Number of immature pods/plant	ICGV-00350 x SEL-1	-1.45**	Low	Low
	R-2001-2 x ICGV-00451	-1.04**	Low	Low
	ICGV-91114 x GPBD-5	-0.89**	Low	Low
	ICGV-91114 x TAG-24	-0.84**	Low	Low
	R-2001-2 x TMV-2	0.35**	Low	High
Total number of pods/plant	R-2001-2 x GPBD-5	5.80**	High	High
	ICGV-91114 x KRG-1	3.00**	Low	Low
	R-2001-2 x TPT-25	2.88**	High	Low
	ICGV-91114 x SEL-1	2.83**	Low	High
	ICGV-00350 x TMV-2	2.09**	Low	Low
Pod yield/plant (g)	R-2001-2 x GPBD-5	3.17**	High	High
	ICGV-91114 x KRG-1	1.19**	Low	Low
	R-2001-2 x TPT-25	1.62**	High	Low
	ICGV-00350 x TAG-24	1.16**	Low	Low
	ICGV-00350 x TMV-2	1.20**	Low	Low
Kernel yield/plant (g)	R-2001-2 x GPBD-5	2.91**	High	High

	R-2001-2 x TPT-25	1.16**	High	Low
	ICGV-91114 x KRG-1	1.09**	Low	Low
	ICGV-00350 x I CGV-00451	1.00**	Low	High
	ICGV-91114 x ICGV-00451	0.77**	Low	High
Shelling per cent	R-2001-2 x GPBD-5	12.05**	High	Low
	ICGV-91114 x TAG-24	9.33**	High	Low
	R-2001-2 x TPT-25	8.19**	High	Low
	ICGV-00350 x SEL-1	7.99**	Low	High
	ICGV-91114 x KRG-1	6.91**	High	Low
Sound mature kernel (%)	ICGV-91114 x KRG-1	5.64**	High	Low
	R-2001-2 x GPBD-5	4.86**	Low	Low
	R-2001-2 x TPT-25	3.69**	Low	Low
	ICGV-00350 x SEL-1	3.00**	Low	High
	ICGV-00350 x I CGV-00451	2.33**	Low	High
100 kernel weight(g)	R-2001-2 x GPBD-5	7.21**	Low	Low
	ICGV-91114 x KRG-1	6.55**	Low	Low
	R-2001-2 x TPT-25	4.80**	Low	Low
	ICGV-00350 x SEL-1	3.58**	Low	High
	ICGV-91114 x TAG-24	3.18**	Low	Low
Oil content (%)	ICGV-00350 x I CGV-00451	2.35**	High	High
	R-2001-2 x GPBD-5	1.34**	Low	High
	R-2001-2 x SEL-1	1.23*	Low	Low
	ICGV-91114 x KRG-1	1.17*	High	High
	R-2001-2 x TMV-2	1.13*	Low	Low

REFERENCES

Apparao, G. (2000). Heterosis and combining ability analysis for morphological characters and biotic stresses in groundnut *(Arachis hypogaea* L.). M.Sc (Ag.) Thesis, University of Agricultural Sciences, Dharawad.

Jayalakshmi, V., Raja Reddy, C., Reddy, P. V. and Lakshmikantha Reddy, G. (2002). Combining ability analysis of morphological and physiological attributes in groundnut, *(Arachis hypogaea* L.), *Indian Journal of Agricultural Research*, **36**: 177-181.

John, K., Vasanthi, R. P. and Venkateswarlu, O. (2009). Studies in variability and character association in Spanish bunch groundnut. *Legume Research*, **32**: 65-69.

Kempthorne, O. (1957). An Introduction to Genetic Studies. First edition, John Wiley and Sons, New York. pp. 458-471.

Suneetha, K., Dasaraha Rami Reddy, C. and Ramana, J. V. (2006). Line x Tester analysis for combining ability in groundnut *(Arachis hypogaea* L.). *The Andhra Agricultural Journal*., **53**: 49-52.