

Original Research Article

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Line X Tester Analysis for Combining Ability in Cowpea [*Vigna unguiculata* (L.) Walp]

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ABSTRACT

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This investigation on line X tester cross of 8 lines and 3 testers and their 24 crosses in Cowpea indicated the preponderance of non-additive gene action for all characters under study. The lines CPD-83 and tester GS-9240 were good general combiners for grain yield per plant and most of yield contributing characters. High SCA effect observed in the hybrids viz. H 22 (CPD -83 X PCP-97102), H 11 (CPD -31 X GS-9240) and H 2 (CPD -219 X GS-9240) for grain yield per plant (g). The characters pod length (46.61%), number of grains per pod (40.36%), and harvest index (33.21%) exhibits high heritability while remaining all characters except plant height exhibits moderate heritability.

Introduction

A study on combining ability is essential to break the prevailing yield plateau in Cowpea crop.

The combining ability studies provide useful information for the selection of high order parents for effective breeding besides elucidating the nature and magnitude of gene action governing the expression of quantitative characters of economic importance. General combining ability is a

good estimate of additive gene action, whereas specific combining ability is a measure of non-additive gene action. Various biometrical methods have been successfully employed to assess the genetic make-up of different genotypes for developing suitable breeding methodology. Out of several methods, line X tester analysis provides valid information on combining ability effect of the genotypes. In the present study, an attempt was made to study the combining ability of ten characters in 11 cowpea genotypes and their 24 F₁ hybrids.

Materials and Methods

The 24 F₁'s were obtained by crossing 11 genotypes in line X tester design (8 lines and 3 testers) during *rabi*2015-16. The experimental materials comprised of 11 genotypes and their 24 F₁'s were grown in a randomized block design with two replications during *rabi*2016-17 at Experimental Research farm, Department of Agricultural Botany Dr. B S Konkan Krishi Vidyapeeth, Dapoli (MS).

Each genotype was sown in two rows (50 plants) with row to row and plant to plant distances were 30 cm and 20 cm, respectively. The experiment was conducted under irrigated conditions. Recommended crop production and protection practices were followed to raise a good crop. The observations were recorded on five plants from each replication. The general combining ability (GCA) effects of parents and specific combining ability (SCA) effects of hybrids were worked out as suggested by Kempthorne (1957).

Results and Discussion

The relative estimates of variances due to general combining ability effects (GCA) and specific combining ability effects (SCA) for various characters under study are given in Table 1.

The SCA variance was higher than GCA variance for all characters under study, indicates that these characters were under the control of non-additive gene action. Hence these traits can be improved through heterosis breeding. However, cowpea is a completely self-pollinated crop and hybrid seed production is also very difficult without CMS line, fixation of heterosis is not feasible. Therefore, hybridization followed by selection at later generations will be useful to improve all the traits. The results, in general are in accordance with the findings of Meena *et al.*,

(2010), Uma and Kalibowilla (2010) and Chaudhari *et al.*, (2013). Idahosa and Alike (2013), Kadam *et al.*, (2013), Patel *et al.*, (2013a) and Patel *et al.*, (2013b). High heritability estimates were obtained for the character pod length (46.61%), number of grains per pod (40.36%), and harvest index % (33.21), while remaining all characters except plant height exhibits moderate heritability which indicates a major role of non-additive gene action in the inheritance of these characters. This finding is in accordance with by Patel, *et al.*, (2010); Uma and Kalubowila, (2010); Chaudhari, *et al.*, (2013) and Patel, *et al.*, (2013) for number of pods per plant, days to 50 percent flowering, days to maturity, pod length, 100-seed weight and seed yield per plant.

The results obtained in general combining ability effect (Table 2) indicated that among the lines CPD-220 was good general combiners for the characters days to first flowering, days to 50 per cent flowering, days to maturity, numbers of flowers per plant, number of pods per plant, grain yield per plant, biological yield per plant, seed protein content and tryptophan content and tester GS-9240 was found to be good general combiner for the characters *viz.*, number of branches per plant, number of pods per cluster, test weight, grain yield per plant, biological yield per plant, harvest index and seed protein content.

The results obtained in specific combining ability effect (Table 3) indicated that among the 24 F₁ hybrids the highest magnitude of negative SCA effect for days to maturity exhibited for cross CPD-220 X GS-9240 (-4.021) followed by CPD-31 X NKO-32 and CPD-193 X NKO-32 (-3.896). The negative SCA effect is desirable because early maturity than the parents is advantageous. The estimates of SCA effect revealed that none of the hybrids was consistently proved to be superior for all the traits.

Table.1 Analysis of variance for combining ability for various traits in Cowpea

Sources of variations	df	D50%F	DM	PH	CPP	PPP	PL	GPP	TW	GYPP	HI
Lines	7	18.33**	18.45**	40.05	0.93**	30.48**	4.72**	1.61*	20.45**	50.37**	215.40*
Testers	2	141.44**	133.31**	136.04	0.38**	27.00**	2.61	1.04	73.25**	77.52**	56.50*
L X T	14	27.15**	26.15**	86.14	0.92**	26.62**	2.91**	1.45*	19.58**	39.07**	209.53*
Error	34	5.52	5.42	48.89	0.03	1.63	0.90	0.56	0.14	3.08	7.39
σ^2 GCA	-	0.250	0.241	-0.335	-0.002	0.042	0.018	0.002	0.170	0.234	-0.392
σ^2 SCA	-	10.815	10.364	18.625	0.447	12.493	1.008	0.445	9.719	17.994	101.067
H ²	-	14.18	14.29	-14.81	28.73	21.72	46.61	40.36	13.67	16.96	33.21

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

Table.2 General combining ability effects of parents for various traits

Sr. No.	Lines/ Testers	D50%F	DM	PH	CPP	PPP	PL	GPP	TW	GYPP	HI
Lines											
1.	CPD - 219	2.06*	2.15*	-0.27	-0.53**	- 2.92**	0.37	0.47	- 1.11**	-2.25**	6.45**
2.	CPD - 220	2.90**	2.81**	2.48	-0.08	1.58**	0.09	0.37	- 1.03**	2.22**	1.45
3.	CPD - 172	0.06	-0.02	1.82	0.80**	1.58**	-0.40	0.19	-0.03	-0.94	3.10**
4.	CPD - 31	0.56	0.646	0.32	0.28**	0.58	-0.93*	-0.21	- 0.73**	-1.12	-1.81
5.	CPD - 193	-1.94	-1.854	1.85	-0.07	-0.42	-1.20**	-0.94**	- 1.70**	-0.87	-7.21**
6.	CPD - 173	-1.60	-1.688	-3.23	-0.18**	1.92**	-0.25	-0.03	1.92**	-1.42	-5.97**
7.	CPD - 25	-1.10	-1.354	1.58	-0.03	- 3.92**	1.43**	-0.44	3.67**	-1.95*	-5.05**
8.	CPD - 83	-0.94	-0.688	-4.55	-0.18**	1.58**	0.88*	0.59	- 0.99**	6.33**	9.04**
	S.E. ±	0.96	0.950	2.85	0.07	0.52	0.39	0.31	0.15	0.72	1.11
Testers											
1.	PCP- 97102	3.31**	3.19**	-1.57	-0.14**	1.50**	-0.44	-0.04	- 2.26**	-1.39**	-0.83
2.	GS 9240	- 2.434**	- 2.44**	-1.79	-0.03	-0.75*	0.36	0.27	0.26**	2.54**	2.15**
3.	NKO 32	-0.88	-0.750	3.37	0.17**	-0.75*	0.08	-0.24	2.00**	-1.14*	-1.32
	S.E. ±	0.59	0.582	1.75	0.04	0.32	0.24	0.19	0.09	0.44	0.68

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

Table.3 Estimates of Specific combining ability effects for different characters in Twenty-four hybrids

Sr. No	Hybrid	D50%F	DM	PH	CPP	PPP	PL	GPP	TW	GYPP	HI
1	CPD -219 X PCP-97102	-0.31	-0.02	1.87	-0.26*	5.17**	0.10	0.40	1.51**	4.98**	3.30
2	CPD -219 X GS-9240	4.35*	3.81*	9.57	0.69**	3.67**	0.40	-0.40	-0.58*	5.66**	10.85**
3	CPD -219 X NKO-32	3.19	3.65*	1.74	0.01	-1.83	1.27	0.74	1.42**	-1.84	-2.09
4	CPD -220 X PCP-97102	2.69	2.48	-2.06	0.32**	-0.83	-1.15	-0.47	-0.38	2.49	-4.11*
5	CPD -220 X GS-9240	-4.31*	-4.02*	-0.49	0.87**	-4.33**	-0.43	1.27*	-0.41	-5.06**	-0.093
6	CPD -220 X NKO-32	-2.65	-2.69	-1.91	-1.01**	0.33	-0.33	-1.45**	-5.18**	-2.26	-1.81
7	CPD -172 X PCP-97102	0.35	0.48	-8.23	-0.06	-0.83	-0.41	0.07	3.72**	-2.72*	-10.22**
8	CPD -172 X GS-9240	-3.31	-3.69*	-0.49	-0.56**	-1.33	0.54	-0.17	-0.11	-1.26	4.17*
9	CPD -172 X NKO-32	3.44*	3.10	-1.96	0.43**	-2.58**	0.51	0.45	-0.75**	-3.80**	-3.74
10	CPD -31 X PCP-97102	-1.40	-1.06	-6.51	-1.22**	-4.08**	0.68	0.15	1.91**	-3.37*	-3.54
11	CPD -31 X GS-9240	-3.06	-3.23	-3.64	0.14	3.42**	-0.58	-0.37	1.41**	5.73**	15.97**
12	CPD -31 X NKO-32	-4.06*	-3.90*	-7.54	-0.14	-0.08	1.36	0.33	2.61**	-2.44	10.47**
13	CPD -193 X PCP-97102	3.44*	3.60*	-1.18	-0.24*	5.92**	0.47	-0.94	0.58*	5.41**	2.22
14	CPD -193 X GS-9240	3.104-	2.94	6.31	0.68**	-4.42**	0.78	1.30*	-1.04**	-3.49**	-9.11**
15	CPD -193 X NKO-32	-3.90*	-3.90*	7.89	-0.27*	0.92	-1.66*	-0.24	-4.69**	0.65	-3.94*
16	CPD -173 X PCP-97102	2.44	2.44	6.63	0.63**	0.92	-1.56*	-0.67	-0.02	1.31	-8.34**
17	CPD -173 X GS-9240	-3.13	-3.08	0.085	-0.17	-2.59**	-0.61	-0.85	-0.75**	-1.17	0.43
18	CPD -173 X NKO-32	-2.96	-2.75	-3.07	0.53**	0.42	-1.09	0.25	-1.33**	-2.29	-7.31**
19	CPD -25 X PCP-97102	-0.13	-0.42	1.90	-0.15	-1.58	-0.70	-0.37	-2.83**	-3.89**	-13.87**
20	CPD -25 X GS-9240	1.38	1.42	9.60	-0.18	0.92	-0.21	0.14	-2.23**	-0.06	-6.36**
21	CPD -25 X NKO-32	0.88	0.42	1.67	-0.63**	-1.58	-0.05	-0.33	-0.17	-0.36	-2.13
22	CPD -83 X PCP-97102	-0.46	-0.25	-4.40	0.33**	4.08**	-0.45	0.15	6.22**	5.74**	10.91**
23	CPD -83 X GS-9240	3.54*	3.42*	0.34	0.33**	-0.08	2.07**	0.17	0.97**	2.08	14.16**
24	CPD -83 X NKO-32	0.88	1.25	-6.13	-0.07	0.42	1.02	0.84	0.13	-0.06	4.16*
	SE±	1.66	1.65	4.944	0.115	0.903	0.669	0.529	0.262	1.240	1.923

Abbreviations

D50%F Days to 50 % flowering
DM Days to maturity
PH Plant height (cm)
CPP Number clusters per plant
PPP Number of pods per plant

PL Pod length (cm)
GPP Number of grains per pod
TW Test weight (g)
GYPP Grain yield per plant (g)
HI Harvest index (%)

The high SCA effect observed in the hybrids viz. H 22 (CPD -83 X PCP-97102), H 11 (CPD -31 X GS-9240) and H 2 (CPD -219 X GS-9240) for grain yield per plant (g). The best three hybrids for grain yield per plant were CPD -83 X PCP-97102 (good x poor), CPD -219 X GS-9240 (poor x good) and CPD -193 X PCP-97102 (poor x poor) had positive desired SCA effects and significant desired heterotic response over better parents as well as over all the standard checks. The crosses exhibiting high heterosis with desirable SCA effects did not always involve parents with high GCA effects thereby suggesting the importance of interallelic interaction. High yielding hybrids had high SCA effects, high heterosis as well as high *per se* performance for most of the yield contributing characters. This appears appropriate as grain yield being a complex character depends on a number of components traits. It is also clear that high degree of non-additive gene action for grain yield and its component traits observed in the present study favours hybrid breeding programme these findings are in agreement with the earlier findings Pandey B. and Singh, (2010); Meena, *et al.*, (2010); Uma and Kalibowilla, (2010) and Chaudhari, *et al.*, (2013).

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