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Combining ability studies in cowpea *(Vigna unguiculata* L.Walp *)*

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ABSTRACT

Combining ability analysis of 36 F_1s of a diallel cross (excluding reciprocals) and their nine parents showed general combining ability variance which was highly significant for all the characters, while specific combining ability variance was highly significant for all the characters except crude fiber content, involving both additive and non- additive gene effects for the expression of green pod yield and its component traits. The crosses GC-4 x CGD-25. Pusa falguni x CGD-352 and CGD-370 x CGD-25 were found to be most promising potential cross combinations for their exploitation in future breeding programme of cowpea.

Key words: GCA, SCA, parents, hybrids and cowpea

Cowpea (*Vigna unguiculata* L. Walp) is one of the important sources of cheap and high quality vegetable protein grown mainly for tender pods as vegetable. Cowpea as a crop has many uses such as pulse fodder, cover crop and green manure. It can fix atmosphere nitrogen in the soil by symbiotic bacteria to the extent of 6-131 kg/ha per year (Ayanaba and Dart.,1997). To increase the green pod yield of cowpea, knowledge of combining ability effect and variance have paramount significance in deciding the selection of parents and breeding method for obtaining new recombinants of desirable type.

MATERIALS AND METHODS

The parental material consisted of nine lines of cowpea *viz.*, Pusa falguni, GC-4, CGD-340, CGD-362, CGD-118, CGD-77, CGD-402, CGD-340 and CGD-25 were crossed in all possible combinations (excluding reciprocals). Thirty six hybrids along with nine parents were grown on Agronomy Instructional farm, Sardarkrushinagar Dantiwada Agricultural university, Sardarkrushinagar during kharif 2008. The entries were grown in a randomized block design (RBD) with three replications. Seed were dibbled at a distance of 45 cm between row and 10 cm between plants. All plants in a plot were taken in to consideration for recording green pod yield and days to 50% flowering and days to first picking, whereas five competive plants were considered for recording plant height (cm), number of primary branches per plant, number of pods per plants, pod length (cm), number of seeds per pod, protein content (%) and crude fiber content (%) The statistical analysis was done by employing method 2, model-1 of Griffing (1956a)

RESULTS AND DISCUSSION

The analysis of variance (Table 1) showed significant difference among genotypes for all the characters under study. Significant gca and sca variances indicated the importance of both additive and non-additive gene effects. The mean square due to gca and sca were significant for all the characters expect crude fibre content, indicating additive as well as non-additive gene action were important in the expression of these characters.

The estimate of GCA effects (Table 2) revealed that, none of the parent was found to be consistently good general combiners for all characters as also reported by Buhecha (1991) and Sawant (1995). The parent Pusa falguni was good general conbiner for most of the character *viz.*, days to 50 per cent flowering, day to first picking, plant height, pod length, number of seeds per pod, number of branch per plant, green pod yield per plant and crude fiber content. The GC-4

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Table1 Analysis of variance for combining ability in cowpea

Source of variation	Days to 50% flowering	Days to first picking Plant height (cm)	Plant height (cm)	No. of branches per plant	Pod length (cm)	No. of seeds per pod	No. of pods per plant	Green pod yield per plant (g)	Protein content (%)	Crude fiber (%)
GCA	7.47**	10.14**	46.48**	0.21*	2.48**	3.08**	115.25**	1282.87**	1.34**	0.34*
SCA	6.89**	6.20**	44.24**	0.95**	3.54**	3.56**	55.51**	487.35**	3.19**	0.29
Error	0.95	1.05	1.77	0.09	0.18	0.18	1.85	19.13	0.03	0.005
σ2gca	0.05	0.35	0.20	-0.06	-0.09	-0.04	5.43	72.31	-0.16	0.004
σ2sca	5.94	5.15	42.47	0.85	3.35	3.37	53.65	468.21	3.16	0.28
σ2gca/ σ2sca	0.008	0.06	0.004	-0.07	-0.02	-0.01	0.10	0.15	-0.05	0.01

* and ** are significant at P = 0.05 and P = 0.01 levels, respectively.

Table 2 Estimation of general combining ability (GCA) effects of parents in cowpea

Parents	Days to 50 % flowering	Days to first picking	Plant height (cm)	No. of branches per plant	Pod length (cm)	No. of seeds per pod	No. of pods per plant	Green pod yield per plant (g)	Protein content (%)	Crude fiber (%)
Pusa falguni	-1.08*	-1.44*	-2.56*	-0.10*	0.53*	0.28*	4.41*	21.67*	-0.09*	0.22*
GC-4	0.05*	0.181*	1.95*	0.02*	0.01*	-0.01*	3.41*	10.63*	0.09*	0.23*
CGD-370	0.86*	0.89*	-0.75*	0.12*	0.19*	0.65*	-0.67*	2.72*	0.46*	0.04*
CGD-352	-0.59*	-0.66*	-0.67*	0.23*	0.37*	0.48*	-3.02*	-7.55*	0.44*	0.14*
CGD-118	-1.15*	-1.25*	0.82*	0.09*	0.19*	0.34*	-0.21*	-3.02*	-0.08*	0.005*
CGD-77	1.23*	1.39*	3.56*	-0.18*	0.34*	-0.13*	-6.14*	-3.89*	-0.02*	-0.11*
CGD-402	0.13*	0.27*	-2.68*	-0.17*	-0.11*	0.02*	2.16*	1.61*	-0.71*	-0.23*
CGD-340	0.52*	0.65*	-0.75*	-0.02*	-0.69*	-0.74*	0.63*	-13.59*	0.06*	-0.21*
CGD-25	0.016*	-0.03*	1.09*	0.01*	-0.83*	-0.89*	-0.56*	-8.59*	-0.13*	-0.09*
S.E.(gi) ±	0.27*	0.29*	0.37*	0.08*	0.12*	0.12*	0.38*	1.24*	0.05*	0.02*

* and ** are significant at P = 0.05 and P = 0.01 levels, respectively.

Table 3 Estimation of specific combining ability (SCA) effects of hybrids in cowpea

Hybrids	Days to 50 % flowering	Days to first picking	Plant height (cm)	No. of branches per plant	Pod length (cm)	Number of seeds per pod	Pod per plant	Green Pod yield per plant (g)	Protein content (%)	Crude fiber ontent (%)
Pusa falguni x GC-4	0.57	0.42	10.30**	-0.52	-2.54	-0.56	-0.25*	0.44	2.63**	0.83**
Pusa falguni x CGD-370	0.16	0.57	-1.21	-0.72*	2.31	2.40**	3.76**	26.72**	-1.63**	-0.59**
Pusa falguni x CGD-352	-0.60	-2.27*	-0.42	-0.10	0.93*	1.17**	2.97*	32.20**	1.42**	0.18**
Pusa falguni x CGD-118	0.45	1.18	-4.99**	0.27	1.04**	2.34**	4.40**	23.14**	0.94**	0.29**
Pusa falguni x CGD-77	2.46**	3.07**	-4.80**	1.21**	2.49**	0.35	0.46	5.14	-2.04**	0.31**
Pusa falguni x CGD-402	-1.4	-2.87**	3.58**	-0.09	1.74**	3.46**	-1.44	24.79**	-2.50**	-0.39**
Pusa falguni x CGD-340	2.40**	2.58**	-5.88**	0.45	-0.86*	0.10	-11.17**	-34.65**	-0.09	-0.38**
Pusa falguni x CGD-25	3.71**	3.80**	-1.69	-0.24	-1.19**	-1.77**	12..62**	-12.79**	-0.98**	-0.35**
GC-4 x CGD-370	-2.27*	-3.61**	-6.07**	0.71*	2.16**	0.16	-6.20**	-12.37**	0.25	0.47**
GC-4 x CGD-352	-0.44	0.13	4.44**	-0.20	3.18**	0.94*	8.74**	0.44	1.33**	0.08
GC-4 x CGD-118	-0.62	-0.43	-11.21**	-0.42	-2.36**	-1.55**	9.14**	11.24**	-2.24**	-0.50**
GC-4 x CGD-77	2.08*	2.07*	-8.19**	0.46	2.28**	1.88**	-5.86**	-13.85**	-4.21**	-0.50**
GC-4 x CGD-402	-0.33	0.09	-1.33	-0.19	0.53	-0.47	11.69**	10.50**	-1.54**	.034**
GC-4 x CGD-340	-0.3	0.22	0.08	0.99**	0.72	2.27**	8.09**	14.58**	-0.29	-0.46**
GC-4 x CGD-25	0.64	0.57	-2.78*	1.42**	-0.00	1.51**	5.75**	47.57**	0.81**	-0.61**
CGD-370 x CGD-352	-0.32	-0.10	-4.23**	1.03**	2.17**	2.20**	-1.30	16.41**	1.89**	0.91**
CGD-370 x CGD-118	-3.66**	-2.31*	-8.09**	1.44**	-1.61**	-0.12	10.15**	0.85	-0.51**	-0.25**
CGD-370 x CGD-77	4.31**	3.80**	-6.77**	0.78**	1.70**	3.21**	0.68	18.62**	0.25	-0.34**
CGD-370 x CGD-402	-2.28*	-0.71	-2.19	-0.02	-0.30	-2.54**	-5.42**	-2.75	1.06**	0.78**
CGD-370 x CGD-340	5.25**	2.97**	6.43**	-0.37	-1.78**	-0.32	8.87**	22.62**	-0.68**	-0.23**
CGD-370 x CGD-25	-1.63	-0.83	6.66**	0.69*	1.11**	-0.45	9.84**	29.65**	1.48**	0.66**
CGD-352 x CGD-118	0.16	-0.63	4.75**	1.43**	-2.32**	0.51	-1.64	-7.39	-0.47**	-0.62**
CGD-352 x CGD-77	5.30**	5.68**	-0.25	-0.73*	-0.84*	-2.37**	0.82	-4.39	1.20	0.44**
CGD-352 x CGD-402	-1.92*	-2.39*	8.09	-0.33	0.81*	-0.63	-0.27	14.22**	-1.91**	0.28**
CGD-352 x CGD-340	0.21	1.03	-4.07**	0.14	-0.10	-1.99**	-5.34**	-2.96	-0.61**	-0.22**
CGD-352 x CGD-25	-1.73	-1.14	-5.18**	0.54	-1.76**	1.95**	-0.94	-7.83	1.42*	0.40**
CGD-118 x CGD-77	-0.93	-1.12	13.14**	0.28	-0.49	2.10**	1.89	-4.05	0.70**	0.63**
CGD-118 x CGD-402	4.57**	4.13**	-5.99**	-0.72*	3.65**	1.63**	-9.28**	-24.26**	-1.3**	-0.43**
CGD-118 x CGD-340	-2.55**	-2.51**	-7.17**	0.89**	0.94*	-0.05	-4.68**	-14.89**	0.18	-0.05
CGD-118 x CGD-25	-0.38	-0.75	-0.94	0.55	0.08	-1.57**	-0.28	-20.89**	1**	0.31**
CGD-77 x CGD-402	-0.75	0.65	-7.57**	-1.11**	-2.52**	1.24**	-2.02	-1.56	1.63**	0.09
CGD-77 x CGD-340	-4.88**	-4.29**	-7.38**	-0.2	0.69	-1.24**	0.87	-1.35	2.74**	0.79**
CGD-77 x CGD-25	-2.53**	-2.97**	0.84	0.03	0.76	-0.69	-1.02	8.44*	-0.2	-0.38**
CGD-402 x CGD-340	3.25*	1.85*	1.27	0.59*	0.61	2.22**	12.40**	21.70**	2.49**	0.30**
CGD-402 x CGD-25	-2.07*	-2.38*	0.46	-0.11	-1.45**	0.04	1.80	-0.30	-2.4**	-0.07
CGD-340 x CGD-25	1.07	0.70	4.32**	0.90**	1.30**	0.18	-7.79**	-11.92**	0.86**	0.93**
S.Em.(±)	0.89	0.93	1.21	0.28	0.39	0.39	1.24	4.00	0.17	0.06

* and ** are significant at P = 0.05 and P = 0.01 levels, respectively.

and GCD-370 were also observed good general combiners for yield and other pod related character in the desired direction In case of days to first picking pusa falguni, CGD-352 and CGD-118 recorded as good general combiner.

An overall appraisal of GCA effects indicated pusa falguni, GC-4 and CGD-370 appeared to be good GCA for green pod yield and other contributing characters. The high GCA effects are releated to additive gene and additive x additive interaction effect (Griffing, 1956a) which fixable genetic component of variation.

The parent with high GCA is effective for a particular component breeding programme, seeking improvement in yield through that particular component.(Buhecha, 1981 and Patil and Shete, 1986)

The estimates of SCA effects,(Table 3) revealed that none of the crosses were consistently superior for all the characters. (Patil and Bhapkar 1986 and Thiyagaragin 1993) The cross GC-4 x CGD-25 possessed highest sca effect for green pod yield(g) and also recorded significant sca for other characters like number of branch per plant, number of seeds per pod, and number of pods per plant followed by pusa falguni x CGD-352 and CGD-370x CGD-25 for green pod yield. The cross CGD-77x CGD-340 showed high SCA effect for days to 50 percent flowering and first picking, cross CGD-118x CGD-402, pusa falguni x CGD 402 and pusa falguni x CGD-425 showed high SCA effect for nos. of pod/plant. The crosses exhibited high positive and negative SCA effects involved either good x good, good x average, good x poor, average x average combining parent.

In a situation where predominance of additive and non-additive gene effects observed for most of the traits, it is better to follow the biparental mating and diallel selective mating to exploit both additive and non-additive gene effects.

Jatasra (1979) and Aravindum and Vijendra Das(1996) suggested that it would be desirable to follow cyclic method of breeding for combining superior recombinants and their interse crosses which will simultaneously exploit additive and non additive gene effect for the improvement of economic yield in cowpea.

REFERENCES

Aravindhan, S. and Vijendra Das, L.D. 1996. Heterosis and combining ability in fodder cowpea for green fodder and seed yield. *Madras Agricultural Journal*, **83** (1) : 11-14.

Ayanaba, A. and Dart, D.T. 1997. Biological nitrogen fixation in farming system of the tropics. John Willey and Sons, New York. pp. 209.

Buhecha, K.V. 1981. A genetics study of yield and its components in cowpea. M.Sc. (Agri.) Thesis, Gujarat Agricultural University, Sardarkrushinagar.

Jatasara M.L. 1979. "Combining ability for green and dry matter yield in cowpea [*Vigna unguiculata* (L.) Walp.]. *Forage Research*, **5** : 165-168.

Griffing, B. 1956a. The concept of general and specific combining ability in relation to diallel crossing system. *Assiut Journal Agriculture Science*, **9** : 463-493.

Patil, R.B. and Bhapkar, D.G. 1986. Combining ability in cowpea. *Journal of Maharastra Agricultural University*, **11**(3) : 303-306.

Patil, R.B. and Shete, M.M. 1986. Combining ability analysis in cowpea [*Vigna unguiculata* (L.) Walp.]. *Journal of Maharastra Agricultural University*, **11**(3) : 293-295.

Sawant, D.S. 1995. Combining ability studies in cowpea. *Annals of Agricultural Research*, **16** (2) : 206-211.

Thiyagarajan, K., Natrajan, C., Rathnaswamy, R. and Rejasekaran, S. 1990. Combining ability and inheritance studies in cowpea. *Madras Agricultural Journal*, **76** (10) : 564-567.