This finding also agrees with Kenchiah et al (1983) and Biswas at al (1983). Almost a similar trend was noticed for the other yield components like number of filled grains per panicle, length of panicle and thousand grain weight (Table 3).

In *Kharif* ,anilofos at 0.4 kg ha^{-1} recorded the highest grain yield of 5008 kg ha^{-1} and was on par with piperophos at 0.75 kg ha^{-1}, thiobencarb at 1.5 kg ha^{-1}, hand-weeding twice, piperophos at 1.0 kg ha^{-1} and butachlor at 1.5 kg ha^{-1} in order.

In summer crop, piperophos at 1.0 kg ha^{-1} recorded the highest grain yield with 7034 kg ha^{-1} and was on par with other herbicides applied and hand weeded plots as in *Kharif* (Table 3). In general, the yield of summer crop was higher than in *Kharif*. This may be due to the increased weed control efficiency coupled with bright sunshine hours favouring increased photosynthetic activity leading to efficient grain filling.

REFERENCES

CHANG. W.L. 1970. The effects of weeds on rice in paddy yield, weed species and population density. J. Taiwan Agric Res. 19: 18-36.

BISWAS.K P.A. SARKAR and A.K. GHOSH. 1983. Competition of barnyard grass in transplanting rice hills. Abstract of papers. Ann. Conf. of ISWS. Varnashi. India. pp. 13.

PARK.J.K. and D.S.KIM. 1971. Distribution of weeds and their competition with rice in Korea. Proc. 3rd Asian Pacific Weed Sci. Conf. Kualalumpur. P: 1- 12.

GILL.H.S. and S.P. MEHRA. 1981. Tolerance of rice cultivar to butachlor and benthiocarb. Oryza. 18: 24-26.

KENCHAIAH. K., B.N. SHIVANAJE GOWDA.B. RAJU and K. KRISHNAMURTHY. 1980. Screening of slow release herbicide formulations in paddy. Abstract. ISWS. OUAT Weed Sci.Conf. Bhubaneswar. India. pp.39-40.

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COMBINING ABILITY FOR YIELD AND ITS COMPONENTS IN COWPEA

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ABSTRACT

Combining ability analysis, involving four lines and three testers was made in cowpea and studied for ten quantitative characters. The variance due to g.c.a. and s.c.a. showed that gene action was predominantly non-additive for days to 50 per cent flowering, days to maturity, plant height, pod length, seeds per pod, 100 grain weight and yield per plant and primarily additive for primary branches per plant, clusters per plant and pods per plant. The genotypes Co 4, C 87, C,152 and CoVu 4 were found to be the good general combiners. The crosses co 3 x C 152, Co 3 x CoVu 4, Co 4 x C 152, V 87 x C 152 and KC 199 x KC 195 were observed to have higher s.c.a effects for some of the yield components.

Cowpea (*Vigna unguiculata* (L.) Walp.) is one of the major pulse crops of our country. Genetical studies in cowpea are far from adequate in the literature (Kheradnam and Niknejad, 1971; Singh and Jain, 1972; Lal *et al.*, (1975). To isolate high yielding genotypes, an understanding of genetic architecture of the crop is obligatory to the plant breeder. Combining ability analysis is useful to assess the ability of the parents in selfpollinated crops and at the same time to elucidate the nature of gene action involved. Therefore,

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able 1. Analysis of variance for combining ability

Source	d.f.	Days to 50 flowering	Days to maturity	Plant height	Primary branches/ plant	Clusters per plant	Pods per plant	Pod length	Seeds per pod	100 grain weight	Yield per plant
Replications	2	1.473	4.228	272.906	3.955**	45.037**	95.938*	0.026	0.127	1.021*	196.835*
Treatments	18	16.676**	30.243**	1967.818**	1.295**	17.331**	38.022*	1.944**	3.550**	4.257**	107.961*
arents	6	18.111**	36.634**	3677.488**	2.541**	25.345**	70.180**	3.530**	6.083**	6.033**	126.893*
arents Vs rosses	1	54.536**	57.142**	61.671	0.020	23.916	43.886	0.184	3.897**	6.712**	29.011
rosses	11	12.452**	19.333**	1208.557**	0.731	12.362	19.949	1.240**	2.136**	3.064**	104.813*
ines	3	10.842	9.851	802.732	0.943	20.093*	15.991	2.075	2.374	1.577	94.099
esters	2	38.694*	76.333**	4294.087**	1.421	25.823*	55.51*	0.832	4.821	11.806**	159.017
ines X esters	6	4.509**	5.074	382.959	0.395	4.009	10.074	0.958**	1.123*	0.895*	92.101
rror	36	0.658	2.191	268.328	0.401	6.967	18.570	0.235	0.421	0.286	47.704
CA		0.342	0.615	35.614	0.014	0.360	0.429	0.012	0.043	0.093	0.548
A		1.283	0.961	38.210	-0.002	-0.986	-2.832	0.241	0.234	0.203	14.799

* Significant at 5% level   ** Significant at 1% level.

ble 2. **General combining ability effects of 7 parents for different characters**

rents	Days to 50% flowering	Days to maturity	Plant height	Primary branches/ plant	Clusters per plant	Pods per plant	Pod length	Seeds per pod	100 grain weight	Yield per plant
males										
3	1.138** (44.44)	0.666 (64.00)	-4.650 (122.17)	0.411 (6.13)	1.677 (14.71)	1.911 (22.97)	-0.463** (16.64)	-0.372 (15.00)	-0.521** (11.99)	-0.386 (31.41)
4	-1.194** (42.11)	-0.777 (62.55)	11.016* (137.84)	0.077 (5.80)	-0.766 (12.26)	-0.133 (20.93)	0.699** (17.77)	0.716** (16.08)	0.499** (13.01)	4.602* (36.40)
87	-0.638* (42.66)	-1.000* (62.33)	4.038 (130.86)	-0.344 (5.37)	-1.655 (11.37)	-1.088 (19.97)	-0.041 (17.06)	-0.372 (15.00)	-0.033 (12.47)	-2.863 (28.93)
C 199	0.694* (44.00)	1.111* (64.44)	-10.405 (116.42)	-0.144 (5.57)	0.744 (13.77)	-0.688 (20.37)	-0.163 (16.94)	0.027 (15.40)	0.055 (12.56)	-1.352 (30.44)
.E.	0.270	0.493	5.460	0.211	0.879	1.436	0.161	0.216	0.178	2.302
Males										
152	1.861** (45.16)	2.000** (65.33)	6.155 (132.98)	0.394* (6.11)	1.366 (14.40)	2.466* (23.53)	0.025 (17.13)	0.711** (16.08)	-1.143** (11.36)	4.077* (35.87)
195	-1.722** (41.58)	-2.833** (60.50)	-21.227** (105.60)	-0.238 (5.48)	0.183 (13.21)	-0.983 (20.08)	-0.275 (16.83)	-0.505** (14.86)	0.521** (13.03)	-2.922 (28.87)
CoVu 4	-0.138 (43.16)	0.833 (64.16)	15.072** (141.90)	-0.155 (5.56)	-1.55 (11.48)	-1.483 (19.58)	0.250 (17.35)	-0.205 (15.16)	0.621** (13.13)	-1.155 (30.64)
S.E.	0.234	0.427	4.728	0.182	0.761	1.243	0.139	0.187	0.154	1.993

Figures in parenthesis are parental means.

* Significant at 5% level ** Significant at 1% level.

able 3. Specific combining ability effects

rosses	Days to 50% flowering	Days to maturity	Plant height	Primary branches/ plant	Clusters per plant	Pods per plant	Pod length	Seeds per pod	100 grain weight	Yield per plant
o 3 X C 152	0.027	0.333	-0.900	5.555**	0.322	-0.444	0.636*	-0.577	-0.109*	-2.622
o 3 X KC 195	0.277	0.833	6.116	-0.027	0.172	0.205	0.030	0.105	0.054	0.877
o 3 X CoVu 4	-0.305	-1.166	-5.216	0.022	-0.494	0.238	0.605*	0.472	0.654*	1.744
4 X C 152	-0.972*	-1.888*	5.666	-0.127	-0.566	0.133	0.197	0.266	0.699*	1.322
4 X KC 195	0.944	0.611	1.516	-0.227	-1.250	-2.083	-0.102	-0.583	-0.266	-6.277
ͻ 3 X CoVu 4	0.027	1.277	-7.183	0.355	1.816	1.950	-0.094	0.316	-0.433	4.955
87 X C 152	-0.861	0.666	-1.955	-0.172	0.455	1.488	0.641*	0.622	-0.133	4.955
87 X KC 195	0.388	-0.500	-15.172	0.527	-0.027	-0.461	-0.458	0.105	0.200	-1.344
87 X CoVu 4	0.472	-0.166	17.127	-0.355	-0.427	-1.027	-0.183	-0.727	-0.066	-3.611
199 x C 152	1.805**	0.888	-2.811	0.294	-0.211	-1.177	-0.202	-0.311	0.143	-3.655
199 X KC 195	-1.611**	-0.944	7.538	-0.272	1.105	2.338	0.530	0.372	.011	6.744
199 x CoVu 4	-0.194	0.055	-4.727	-0.022	-0.894	-1.161	-0.327	-0.061	-0.155	-3.088
	0.468	0.854	9.457	0.365	1.523	2.487	0.279	0.374	0.308	3.987

* Significant at 5% level ** Significant at 1% level.

the present investigation was carried out with four lines and three testers to provide the above genetic information.

MATERIALS AND METHODS

Three male parents (C 152, KC 195 and CoVu 4) and four female parents (Co 3, Co 4, V 87 and KC 199) were selected on the basis of their past performance in field experiments. The seven parents and their 12 F_1's obtained by crossing each female with each of the male parent were grown in randomized block design with three replications at the National Pulses Research Centre, Pudukkottai, Tamil Nadu during the Kharif season. Each genotype was sown in 1.5 m long two-row plots spaced 45 cm apart and distance between plants within rows being 15 cm. Observation on five randomly selected competitive plants from each plot was recorded for plant height, primary branches per plant, clusters per plant, pods per plant pod length, seeds per pod, 100 grain weight and yield per plant. Days to 50 per cent flowering and days to maturity were recorded on plot basis.

Mean value of the five plants of each genotype in each replication was used for statistical analyses following the methods developed by Kempthorne (1957).

RESULTS AND DISCUSSION

Analysis of variance (Table 1) revealed that the hybrids differed for most of the characters. Significant differences were obtained between males for many of the characters except primary branches per plant, pod length, seeds per pod and yield per plant, indicating sufficient variability in the testers selected for the study. The differences between females were not significant for all the characters except clusters per plant. The line x tester interaction was significant for days to 50 per cent flowering, pod length, squares due to testers were of larger magnitude in comparison with those due to lines or line x tester for days to 50 per cent flowering, days to maturity, primary branches per plant, clusters per plant, pods per plant, seeds per pod, 100 grain weight and yield per plant. The results indicated the existence of more diversity in males for these characters. For the characters plant height and pod length, mean squares due to lines exceeded those for the testers indicating that for these characters there was more scope of exploitation in the female parents.

The general combining ability (g.c.a.) variances and specific combining ability (s.c.a.) variances were also estimated and are presented in Table 1. The s.c.a. variances were more than g.c.a. variances for days to 50 per cent flowering, days to maturity, plant height, pod length, seeds per pod, 100 grain weight and yield per plant, whereas the g.c.a. variances were more for primary branches per plant, clusters per plant and pods per plant. These estimates indicate a preponderance of non-additive gene action for the first set of characters and additive for the second. Similar results have been reported by Gupta and Ramanujam (1974) for yield per plant and Bhatt and Singh (1980) for pods per plant and yield per plant in chickpea. Lal *et al.*, (1975) and Jatasra (1979) have reported preponderance of additive gene action governing 100 grain weight in cowpea.

General combining ability effects for lines as well as testers are given in Table 2. It can be seen that among the lines, Co 4 and V 87 were good combiners for days to 50 per cent flowering, V 87 for days to maturity, Co 4 for plant height, pod length, seeds per pod, 100 grain weight and yield per plant. Among the testers C 152 was a good combiner for primary branches per plant, pods per plant, pod length and yield per plant, KC 195 for days to 50 per cent flowering, days to maturity and 100 grain weight, and CoVu 4 for plant height and 100 grain weight.

The parents showing higher mean performance for a particular character were generally good general combiners for that character. Bhatt and Singh (1980) also reported similar results in chickpea. Jatasra (1979) in cowpea and Jatasra and Paroda (1979) in wheat reported that there existed positive association between g.c.a effects and array means.

The values for specific combining ability effects for all characters and crosses have been presented in Table 3. There were only two cross combinations that flowered significantly early. These involved Co 4 and KC195 as one of their parents which were good general combiners for days to 50 per cent flowering. There was only one cross with significant value for days to maturity. The s.c.a. effects were not significant for the characters plant height, clusters per plant, pods per plant, seeds per pod and yield per plant for all the crosses. For primary branches per plant the cross Co 3 x C 152 showed significant s.c.a. effects, which involved C 152 which was a good general combiner for this character. Two crosses exhibited significant positive s.c.a. effects for pod length. These crosses did not involve good general combiners as their parents. For 100 grain weight two crosses namely, Co 3 x CoVu 4 and Co 4 x C 152 have high s.c.a. effects, and one of their perents was good general combiner for 100 grain weight.

The s.c.a effects represent dominance and expistatic actions and it can be related to heterosis. The crosses Co 4 x KC 195 and KC 199 x KC 195 showed high s.c.a effects for days to 50 per cent flowering, Co 4 x C 152 for days to maturity, Co 3 x C 152 for primary branches per plant and Co 3 x CoVu 4 and Co 4 x C 152 for 100 grain weight. The above crosses were having one of their parents as good general combiners for the specific character. Such crosses may be expected to throw good segregants, only if the epistatic effects in the cross act in the same direction so as to maximize the desirable plant characteristics. The results reveal that the genotypes Co 4, V 87, C 152, KC 195 and CoVu 4 were good general combiners for different component characters. The use of the above good general combiners in hybridization programme and selecting desirable segregants from the segregating generations by adopting progeny selection technique for exploiting additive genetic variance would lead to rapid improvement in cowpea.

REFERENCES

BHATT, D.D and SINGH, D.P. 1980. Combining ability in chickpea. **Indian J. Genet.**, **40**: 456 - 460.

GUPTA, V.P. and RAMANUJAM, S. 1974. Cumulative gene effects and genetic parameters of heterosis in F_1 and F_2 generations of chickpea (*Cicer arietinum* L.) **Genetica Yugoslavia** 6: 263 - 275.

JATASRA, D.S. and PARODA, R.S. 1979. Heterosis and combining ability analysis for synchrony traits in wheat. **Indian J. Genet.**, 39: 528 - 535.

KEMPTHORNE, O. 1957. **'An Introduction to Genetic Statistics'** John Wiley and Sons, New York. pp. 468-471.

KHERADNAM, M. and NIKNEJAD, M. 1971. Combining ability in cowpea. **Z. pflanzucht.** 66: 312 - 316.

LAL, S. SINGH, M. and PARHAK, M.M. 1975. Combining ability in cowpea. **Indian J. Genet.**, **35**: 375 - 378.

SINGH, K.B. and JAIN, R.P. 1972. Heterosis and combining ability in cowpea. **Indian J. Genet.**, **32**: 62 - 66.