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COMBINING ABILITY ANALYSIS IN COWPEA *(VIGNA UNGUICULATA* [L] WALP)

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Abstract : Combining ability was studied in a 10 x 10 diallel cross in cowpea for nine important characters. The variance due to general combining ability and specific combining ability showed both additive and non-additive gene action for plant height, primary branches, days to flowering, pod length, *pod* weight, pods per plant, seeds per pod, 100 seed weight and yield per plant. Among ten parental lines, Arka Garima, VU-18, Selection 2-1, Section 263, Pusa Komal and Kanakamoni were good general combiners for most of the yield components. The hybrids VU-18 x Arka Garima and Selection 2-1 x VS 389 possessed high specific combining ability effects for yield per plant.

Key words : Combining ability, cowpea, gene action, genetic divergence.

INTRODUCTION

Cowpea (*Vigna unguiculata* [L.] Walp) is an important crop grown in homesteads and in rice fallows. In vegetable type cowpea, there is only limited work done especially in respect of vegetable pod yield and its yield contributing characters. Being a highly self pollinated crop, a programme of yield improvement should be based on selection and hybridisation between two or more selected parents.

The ability to accurately predict the parental combinations that produce superior hybrids is crucial to the success of such breeding programme. Therefore, the present investigation was carried out with a 10 x 10 diallel combination to provide the genetic information on yield and yield contributing characters.

MATERIALS AND METHODS

Ten parents of bush type vegetable cowpea viz., Pusa Komal (P1), Selection 2-1 (P2), VS 389 (P3), Kanakamoni (P4), Selection 263 (P5), VU-18 (P6), Amb-1 (P7), Arka Garima (P8), JBT 4/221 (P9) and Pusa De Fasli (P10) which were originally included in the variability studies were selected based! on genetic divergence. These diverse parental lines were selfed for one generation and crossed in all possible combinations excluding reciprocals in a 10 x 10 diallel to develop 45 F1 hybrids. These 45 F1 hybrids along with 10 parents were grown in a randomised block design with two replications during March-June 1994. The plot size was 2,4 x 1.8 m^2 with 32 plants per plot for each genotype. Seeds were sown at a spacing of 60 cm between rows and 30 cm within rows. Observations on five randomly selected plants from each plot were recorded for plant height, primary branches per plant, days to flowering, pod length, pod weight, pods per plant, seeds per pod, 100 seed weight and yield per plant.

The mean values of Fl hybrids for all the characters were analysed for combining ability using the method suggested by Griffing (1956).

RESULTS AND DISCUSSION

Analysis of variance for combining ability showed that the variance due to general combining ability (gca) and specific combining ability (sca) were significant for all the traits (Table 1). The significance of gca and sca variances indicated the role of additive as well as non-additive gene action for the control of these characters. The magnitude of gca variance was much higher than that of sca variance for all the characters indicating the preponderance of additive type of gene action.

Table 1. Analysis of variance for combining ability in a 10 x 10 diallel in cowpea

Source of variation	df	Plant height	Primary branches	Days to flowering	Pod length	Pod weight	P<xls / plant	Seeds / plant	100 seed weight	Yield / plant
gca	9	85.3**	1.4**	7.6**	70.1**	11.0**	185.2**	7.7**	11.0**	6442.9*
sca	45	27.3**	0.65**	2.2**	7.1**	1.3**	59.2**	3.4**	2.9**	2249.9**
Error	54	1.1	0.02	0.53	0.04	0.04	1.3	0.03	0.0	8.3

Table 2. Estimate of gca effects of 10 cowpea genotypes for yield and its components

Parental lines	Plant height	Primary branches	Days to flowering	Pod length	Pod weight	Pods / plant	Seeds / pod	100 seed weight	Yield / plant
Pusa Komal	-2.53**	-0.33	0.09	-1.30	-0.83	6.88**	0.12	-1.5	6.01**
Selection 2-1	-0.42	0.03	-0.84	3.1**	0.36	-0.98	1.4	1.5	19.7**
VS 389	-0.37	-0.60	1.16	1.8	0.28	-3.85**	-0.51	0.34	-3.7
Kanakamoni	-2.73*	0.20	0.85	-2.3*	-0.36	4.04**	-1.1	0.38	12.7**
Selection 263	-4.16**	0.01	-0.70	2.9**	0.48	-4.65**	0.46	0.11	-20.1**
VU-18	2.93**	-0.10	-0.55	0.22	0.51	-0.81	0.64	0.42	10.9**
Amb-1	2.64*	-0.08	-1.13	0.07	-0.26	-0.62	0.40	0.04	-6.8**
Arka Garima	1.6	-0.08	0.17	1.8	2.02	-4.55**	0.0	0.92	41.8**
JBT 4/221	-3.5**	0.62	-0.28	-3.95**	-0.82	0.57	-1.30	-0.87	-23.4**
Pusa De Fasli	1.47	0.33	1.04	-2.3*	-1.38	3.97**	-0.13	-1.3	-37.0**
Var (Gi)	0.09	0.001	0.04	0.003	0.003	0.10	0.002	0.001	0,62
Var (Gi-Gj)	0.18	0.003	0.09	0.006	0.006	0.22	0.004	0.002	1.4

* Significant at 5 per cent level

** Significant at 1 per cent level

Thyagarajan *et al.* (1990) reported additive and non-additive gene action for yield. The variation in estimates of general combining ability effects (Table 2) of parents can be attributed to genetic as well as geographic diversity in the material. Among the parents, the good general combiners were VU-18 (P6) and Amb-1 (P7) and Selection 2-1 (P2) for days to flowering, Selection 2-1 (P2) and Selection 263 (P5) for pod length, Arka Garima (P8) for pod weight, Pusa Komal (P1) for pods per plant, Selection 263 (P5) and VU-18 (P6) for seeds per pod, Selection 2-1 (P2) for 100 seed weight and Arka Garima (P8) for yield per plant.

Examination of the specific combining ability effects of 45 F1 hybrids (Table 3) showed that the crosses with high sca effects were Pusa Komal x Kanakamoni (plant height), Arka Garima x JBT 4/221 (primary branches), Amb-1 x Arka Garima (earliness), Selection

Table 3. Estimate of sca effects of 45 F_1 hybrids of cowpea for yield and its component characters

Genotypes	Plant height	Primary branches	Days to flowering	Pod length	Pod weight	Pods / plant	Seeds / pod	100 seed weight	Yield / plant
1 x2	-2.51**	0.56	0.08	-2.82**	0.04	-2.79**	1.78*	1.84**	-17.57**
1 x 3	-3.26**	0.02	-0.67	1.67**	0.12	9.93**	-1.64*	0.98	48.41**
1 x 4	13.61**	-0.86	-0.37	-0.86	0.66	2.94**	0.40	2.94**	9.41**
1 x 5	-5.87**	-0.25	-0.87	-1.56	-0.35	-0.28	-1.70*	-0.79	8.27**
1 x6	2.59**	0.69	0.59	-0.24	-1.56	14.38**	-0.29	-0.10	3.18**
1 x 7	0.83	0.66	-0.02	-0.18	-0.19	2.19**	0.95	-0.72	2.16**
1 x 8	-2.63**	-1.33	0.82	-3.88**	1.05	-13.37**	1.35	1.40	-33.70**
1 x 9	3.97**	-0.32	-1.98**	1.95*	-0.25	14.50**	0.82	-1.81*	79.24**
1 x 10	-2.75**	-1.26	2.45**	2.61**	-0.21	-5.90**	-0.51	-1.35	-25.78**
2 x 3	3.19**	0.93	0.16	1.48	-0.51	8.54**	1.60	-1.00	122.37**
2 x 4	-3.35**	0.01	0.61	-2.54**	-1.86**	7.25**	-1.11	-1.04	-7.64**
2 x 5	-1.04	0.93	0.16	-3.76**	1.60	2.08**	2.62**	0.98	30.64**
2 x 6	2.27**	-0.05	0.42	0.06	-0.61	-0.51	0.69	1.93*	7.00
2 x 7	2.91**	0.53	-0.76	2.71**	0.19	-13.20**	2.69**	2.25**	-86.51**
2 x 8	-4.27**	-0.24	-0.58	5.33**	0.28	2.01**	1.41	-0.50	24.82**
2 x 9	-0.63	-0.56	-0.59	-0.89	0.38	0.62	-0.60	-4.79**	0.93
2 x 10	-1.68	0.19	-0.32	-3.09**	-0.53	10.16**	-2.91**	0.68	27.72**
3 x 4	-7.28**	0.53	-2.56**	-3.44**	0.42	-3.33**	3.61**	0.10	-53.77**
3 x 5	9.65**	0.51	-0.22	2.66**	-2.22**	-1.99	1.14	1.38	-87.99**
3 x 6	-4.82**	0.96	-0.45	0.64	1.04	-8.76**	0.66	-1.93**	-29.27**
3 x 7	-3.52**	0.81	1.67	-2.61**	-0.42	11.82**	-2.59**	1.44	48.81**
3 x 8	0.84	-0.22	-0.71	2.16**	-0.43	-3.31**	1.23	-0.44	-38.88**
3 x 9	5.61**	-0.76	-0.47	-1.06	0.19	2.36**	0.09	2.35**	19.19**
3 x 10	-3.11**	0.00	-1.27	3.14	1.22	-10.59**	0.23	0.82	8.73**
4 x 5	-3.74**	0.82	-0.45	-0.69	0.55	-3.60**	1.30	1.83*	10.62**
4 x 6	-6.50**	-0.19	-0.23	1.82*	0.58	5.89**	1.28	-0.97	80.18**
4 x 7	-6.12**	-0.99	-1.00	4.90**	0.58	-8.47**	0.62	0.40	-23.00**
4 x 8	3.70*	0.62	-0.03	0.42	-1.03	8.97**	-0.58	1.52	39.08**
4 x 9	1.97*	-0.87	2.36**	-1.15	0.33	-2.53**	-2.42	-0.69	-0.72
4 x 10	7.17**	1.14	1.02	-0.83	-0.15	2.11**	0.27	-0.22	-1.79
5 x 6	-4.02**	-0.01	0.87	1.07	2.12**	-12.84**	3.36**	1.30	-23.59**
5 x 7	-6.98**	-0.67	-1.00	-3.23**	0.37	3.97**	-139	0.67	60.82**
5 x 8	3.47**	-0.79	-0.67	-4.22**	-1.25	2.15**	0.36	-0.21	-11.99**
5 x 9	5.66**	-0.08	1.71*	2.79**	1.37	-8.12**	0.19	1.08	8.20**
5 x 10	-4.94**	-0.50	0.73	4.60**	0.35	6.63**	-2.24**	-1.45	80-53**

Table 3 (contd.)

Genotypes	Plant height	Primary branches	Days to flowering	Pod length	Pod weight	Pods / plant	Seeds / pod	100 seed weight	Yield / plant
6 x 7	4.88**	0.72	-2.85**	1.93	0.32	-1.46	-1.15	0.36	10.66**
6 x 8	-1.46*	0.61	-0.42	0.68	-0.02	8.19**	1.16	0.48	88.39**
6 x 9	-1.90*	-0.39	2.57**	0.36	0.02	-10.53**	0.39	2.28**	-51.17**
6 x 10	-2.83**	0.15	-1.46	-0.98	1.88**	-6.59**	2.36	0.69	-17.76**
7 x 8	0.96	0.54	-3.62*	2.21**	1.21	2.77**	1.82*	1.86*	48.98**
7 x 9	-0.39	0.71	-0.29	2.28**	-0.80	-1.85*	2.26*	-1.35	-42.05**
7 x 10	13.44**	0.17	0.46	-1.73*	-0.55	5.85	1.45	-0.39	3.92**
8 x 9	-0.36	1.87*	-0.43	-4.00	-2.24**	6.26**	-2.22	-1.23	-37.07**
8 x 10	-1.00	-0.59	0.36	-2.98**	-2.23**	-4.30**	-1.90	1.23	-83.69**
9 x 10	2.60**	-0.86	-0.76	-0.29	-0.06	3.91	-0.18	1.03	16.46**
Var (Sij Sik)	0.926	0.0147	0.454	0.0321	0.036	0.913	0.0217	0.0010	7.04
Var (Sij Sik)	2.001	0.0138	0.981	0.0694	0.066	2.455	0.0440	0.0022	15.22
Var (Sij Sik)	1.819	0.0289	0.892	0.631	0.060	2.232	0.0427	0.0020	13.84

* Significant at 5 per cent level

** Significant at 1 per cent level

2-1 x Arka Garima, Kanakamoni x Amb-1 and Selection 263 x Pusa De Fasli (pod length), Selection 263 x VU-18 and VU-18 x Pusa De Fasli (pod weight), Pusa Komal x JBT 4/221 and Pusa Komal x VU-18 (pods per plant), VS 389 x Kanakamoni and Selection 263 x VU-18 (seeds per pod), Selection 2-1 x VS 389 and VU-18 x Arka Garima (yield per plant). Perusal of the values of sca effects revealed that in all the crosses with higher sca effects either one or both of the parents were good general combiners for the characters. Reports of Patil and Shettee (1986) supported the present findings.

The results revealed that the parents Arka Garima, VU-18, Amb-1, Selection 2-1, Selection 263, Pusa Komal and JBT 4/221 which were good general combiners for yield and its component characters could be utilized in hybridization programme and the selection of desirable segregants from the segregating generation could be employed for exploiting additive genetic variance.

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