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COMBINING ABILITY IN PIGEONPEA (*CAJANUSCAJAN* [L.]MILLSP)

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Abstract: Even though both additive and nonadditive gene effects were found to be important in the expression of the characters studied, the additive gene effects were having more influence than nonadditive gene effects. Number of primary branches was determined by additive and nonadditive genes, whereas number of secondary branches was influenced by additive genes. All the other nine characters were determined by additive genes. Among the five parents studied, PLA 550 was the best general combiner and among the crosses UPAS 120 x IC 15708 was having good sca for all the characters.

Key words: Additive gene effect, combining ability, nonadditive gene effect, pigeonpea.

INTRODUCTION

Pigeonpea is one of the important grain legumes in India. But its improvement by breeding has been mostly limited to pureline and progeny selections with the result that narrowly adapted varieties with limited genetic plasticity were evolved. Since the crop is grown under varied environmental conditions, varieties possessing greater adaptability along with high yield potential have to be evolved. Success of any breeding programme is largely dependent up on the choice of right parents. Though the performance of parents themselves gives some indication regarding their usefulness, their long term potentialities are not known at the beginning of the breeding programme. Combining ability analysis is one of the powerful techniques available, which gives the estimates of combining ability effects and also helps in selecting desirable parents and crosses for further exploitation. The present study was thus carried out to estimate the combining ability of pigeonpea cultivars for some quantitative characters.

MATERIALS AND METHODS

Five diverse cultivars of pigeonpea, namely, UPAS 120, PLA 550, PLA 600, PLA 345-1 and IC 15708 were crossed in all possible combinations excluding reciprocals in 1988. The resulting F1's and five parents were grown in a randomised block design replicated thrice at the farm attached to the College of Horticulture, Vellanikkara during 1989. Each entry was grown on ridges of 3 m long and 1 m apart with a plant spacing of 60 cm. Observations were recorded from all the individual plants in respect of eleven quantitative characters viz., height of plant at harvest, number of primary branches at harvest, number of secondary branches at harvest, days to first flowering, days to maturity, number of clusters per plant, number of pods per plant, length of pod bearing branches, number of seeds per pod, hundred seed weight and seed yield. Combining ability estimates of parents and crosses were estimated according to the Method-2, Model-1 of Griffing(1956).

RESULTS AND DISCUSSION

The variances due to both gca and sca were significant for all the traits indicating the importance of both additive and nonadditive gene effects (Table 1). However, gca variances were higher than sca variances in most of the characters showing the predominance of additive gene action. Number of primary branches was seen to be affected by both additive and nonadditive effects, whereas number of secondary branches was influenced by nonadditive effect alone. All the other nine characters were influenced by additive effect.

Variances due to gca and sca for number of primary branches were highly significant indicating the importance of both additive and nonadditive gene effects. Mehetre *et al.* (1988) also reported similar results of additive and non-additive gene effects for this trait in

Table 1. Estimates of components of variances (Griffings approach)

Sl.No	Characters	Additive genetic effect	Dominance deviations	Error	Heritability (Narrow sense)
1	Plant height	5469.91**	2856.98**	27.8	0.65
2	Number of primary branches	65.65**	57.41**	1.16	0.53
3	Number of secondary branches	227.78**	447.1**	6.91	0.33
4	Days to first flowering	64.01**	15.79**	2.18	0.78
5	Days to maturity	2507.43**	1460.02**	2.26	0.63
6	Number of clusters per plant	9239.08**	4569.65**	369.57	0.65
7	Number of pods per plant	46126.96**	15587.91**	2370.39	0.72
8	Length of pod bearing branches	402.96**	128.41**	6.58	0.75
9	Number of seeds per pod	3.09**	0.92**	0.03	0.77
10	Hundred seed weight	12.26**	4.69**	0.04	0.76
11	Seed yield per plant	1319.41**	396.04**	21.96	0.72

**Significant at 1% level

Table 2a. Estimates of gca effects and mean performance (in parenthesis) of parents

Parents	Plant height	Number of primary branches	Number of secondary branches	Days to first flowering	Days to maturity
UPAS 120	24.60** (153.16)	0.69 (13.50)	4.37** (14.33)	-4.26 (83.00)	19.52** (119.06)
PLA 550	37.27** (173.73)	4.69** (18.26)	16.07** (26.46)	-5.03** (81.66)	20.00** (121.32)
PLA 600	29.96** (194.66)	4.88** (28.66)	-0.49 (52.00)	2.83** (97.00)	23.71** (131.00)
PLA 345-1	-43.83** (190.33)	-4.95** (27.66)	-12.29** (28.50)	4.22** (99.33)	-32.04** (130.73)
IC 15708	-48.01** (141.50)	-5.31** (13.16)	-7.65 (10.80)	-2.24** (100.33)	-31.18** (131.00)
SE ± gi	1.78	0.36	0.88	0.49	0.50
CD (0.05)	3.65	0.74	1.82	1.02	1.04
CD (0.01)	4.92	1.01	2.45	1.38	1.40

**Significant at 1% level

pigeonpea. But, number of secondary branches was influenced by nonadditive effect as seen by the high magnitude of sca variance. Influence of nonadditive effect on number of

Table 2b. Estimates of gca effects and mean performance (in parenthesis) of parents

Parents	No. of clusters per plant	No of pods per plant	Length of pod bearing branches	No. of seeds per pod	Hundred seed weight	Seed yield per plant
UPAS 120	22.44** (109.66)	79.05** (292.16)	2.05** (29.10)	0.57** (3.20)	1.14** (7.96)	11.25** (53.83)
PLA 550	64.76** (158.33)	143.69** (340.30)	12.00** (43.40)	0.98** (3.00)	1.74** (8.80)	25.40** (64.10)
PLA 600	27.67** (236.60)	18.62 (449.66)	8.16** (36.63)	0.49** (3.50)	1.32** (6.53)	2.80 (61.93)
PLA 345-1	-56.69** (199.50)	-118.06** (385.66)	-8.11** (48.10)	-0.97** (3.46)	-2.08** (7.33)	-19.77** (63.90)
IC 15708	-58.18** (139.00)	-123.30** (229.33)	-14.11** (26.53)	-1.07** (3.96)	-2.12** (8.46)	-19.69** (52.96)
SE ± gi	6.50	13.87	0.86	0.06	0.07	1.58
CD (0.05)	13.41	33.70	1.78	0.12	0.14	3.24
CD (0.01)	17.96	45.47	2.39	0.16	0.19	4.37

** Significant at 1 % level

Table 3a. Estimates of sca effects of the ten crosses

Cross No:	Combinations	Plant Height	No. of primary branches	No. of secondary branches	Days to first flowering	Days to maturity
1	UPAS 120 x PLA 550	-17.69**	-5.05**	-17.41**	5.20**	-14.24**
2	UPAS 120 x PLA 600	-19.05**	-0.30**	2.85**	2.96**	-19.62**
3	UPAS 120 x PLA 345 - 1	50.70**	6.36**	20.57**	1.52	41.30**
4	UPAS 120 x IC 15708	62.76**	7.56**	46.67**	-6.70**	33.28**
5	PLA 550 x PLA 600	-34.22**	-3.46**	5.15**	-4.19**	-21.77**
6	PLA 550 x PLA 345 -1	49.23**	9.20**	-3.88*	-1.75**	30.99**
7	PLA 550 x IC 15708	63.08**	12.89	11.64**	-2.59**	41.80
8	PLA 600 x PLA 345-1	59.88**	3.52**	10.01**	2.72**	-37.15**
9	PLA 600 x IC 15708	17.23**	-2.79**	-13.03**	1.87**	38.09**
10	PLA 345 - 1 x IC 15708	-50.48**	-6.12**	-11.99**	-4.18**	-37.15**
S E ± (Sij)		2.82	0.58	1.40	0.79	0.80**
C D (0.05)		5.77	1.18	2.88	1.62	1.65**
C D (0.01)		7.79	1.59	3.88	2.18	2.22**

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

secondary branches in chickpea had been reported by Katiyar *et al.* (1988). The high magnitude of gca for all the other nine characters suggested that additive genetic effect had played a predominant role in the expression of these characters. These results are in agreement with those of Chaudhari *et al.* (1980) in pigeonpea. But conflicting reports

Table 3b. Estimates of sca effects of the ten crosses

Cross No.	Combinations	No. of clusters per plant	No. of pods per plant	Length of pod bearing branches	No. of seeds per pod	Hundred seed weight	Seed yield per plant
1	UPAS 120 x PLA 550	-6.79	17.12	-2.62	0.26 *	-1.16 **	4.46
2	UPAS 120 x PLA 600	46.22 **	104.02 **	-2.62	0.35 **	-2.01 **	4.46
3	UPAS 120 x PLA 345-1	68.58 **	107.21 **	12.42 **	1.12 **	2.08 **	7.18 **
4	UPAS 120 x IC 15708	102.07 **	71.12 **	10.26 **	0.78 **	2.14 **	25.06 **
5	PLA 550 x PLA 600	-42.43 **	-162.79 **	-13.01 **	-0.72 **	-0.31 *	-31.44 **
6	PLA 550 x PLA 345-1	51.43 **	151.24 **	13.28 **	0.84 **	1.69 **	24.80 **
7	PLA 550 x IC 15708	60.16 **	95.48 **	6.71 **	0.64 **	0.71 **	2.35
8	PLA 600 x PLA 345-1	47.85 **	29.31	15.71 **	0.93 **	2.29 **	11.09 **
9	PLA 600 x IC 15708	-0.32	0.21	0.45	1.09 **	3.06 **	15.98 **
10	PLA 345-1 x IC 15708	-54.96 **	-92.43 **	-9.81 **	-0.90 **	-1.99 **	-14.41 **
	SE ± (Sij)	10.27	26.02	1.37	0.09	0.11	2.50
	CD (0.05)	21.04	53.29	2.81	0.19	0.23	5.13
	CD (0.01)	28.39	71.90	3.79	0.26	0.31	6.92

*Significant at 5% level

had been made on the importance of additive and nonadditive gene effects for various characters in redgram by different scientists. These differences might have resulted from different methods employed by various authors for estimating genetic parameters, genotypic differences among parents and high G x E interactions (Reddy *et al.*, 1981).

Out of the five parents studied, PLA 550 was found to be the best general combiner, followed by UPAS 120 and PLA 600, which showed that these genotypes could be used as parents in hybridization programme (Table 2a and 2b). PLA 345-1 and IC 15708 were having negative gca effects for all characters. It was found that the parents showing significant gca effects were also having medium to high *per se* performance values for the respective traits in most of the cases.

Among the ten crosses effected, UPAS 120 x IC 15708 was having good sca for all the characters, the next being PLA 550 x PLA 345-1 (Table 3a and 3b). Both these crosses involved one good general combiner and one negative combiner. Similar result was reported by Venkateswarlu and Singh (1982) in redgram and Katiyar *et al.* (1988) in chickpea. Such crosses could produce desirable transgressive segregants if the additive genetic system operated in the good combiner and the complementary epistatic effects in the F1's acted in the same direction to maximise the desirable plant attributes (Venkateswarlu and Singh, 1982).

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