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Combining ability analysis in long duration Pigeonpea [*Cajanus cajan* (L.) Millsp.]

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ABSTRACT

The combining ability analysis for yield and yield traits was done in long duration pigeonpea using five lines (MA 98 PTH 1, MAL 8, Pusa 9, MA 98 SD 74 and DA 11) and three testers (Bahar, ICPL 7035 and ICPL 84023). The fifteen crosses were made in Line x tester fashion. Among females, Pusa 9 and MA 98 PTH 1 and among males, ICPL 7035, ICPL 84023 and Bahar were identified as good general combiners for yield traits. The two crosses (MAL 8 x Bahar and Pusa 9 x ICPL 7035) for number of pods per plant and three crosses (MA 98 SD 74 x ICPL 84023, MAL 8 x ICPL 7035 and MA 98 PTH 1 x ICPL 7035) for seed yield per plant were found to be superior on the basis of *per se* performance and desirable specific combining ability.

Key words : Pigeonpea, Combining ability analysis, Line x tester.

INTRODUCTION

Pigeonpea is an often cross pollinated crop and out-crossing has been observed upto 70 per cent (Saxena *et al.*, 1990) which may be useful for the production of hybrid seed. In a hybrid breeding programme, the objective is to identify a new line that when crossed with other parents, may produce hybrids with superior performance. Combining ability analysis is frequently employed to identify the desirable parents and crosses. Therefore, it is urgently required to identify the best combiners and desirable crosses. Line x tester analysis is an extension of top cross method in which several testers are used (Kempthorne, 1957) which provides information about general and specific combining ability of parents and at the same time, it is helpful in estimating various types of gene effects, besides identifying best heterotic crosses.

MATERIALS AND METHODS

The experimental materials comprised of five lines (MA 98 PTH 1, MAL 8, Pusa 9, MA 98 SD 74 and DA 11) and three testers (Bahar, ICPL 7035 and ICPL 84023) were obtained from the All India Co-ordinated Pulse Improvement Project, Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Fifteen crosses were made in a line x tester fashion in *kharif*, 2002-03 and corresponding 15 F_1's along with 8 parents were grown in Randomized Block Design with three replications during *kharif*, 2003-04. Each of the parents and F_1's were grown in single row of 4m length and row to row and plant to plant distances being 75 and 25 cm, respectively. All recommended agronomic practices were followed to raise a good crop. The general combining ability (gca) and specific combining ability (sca) variances were worked out as per the method given by Kempthorne (1957).

RESULTS AND DISCUSSION

Analysis of variance for combining ability showed that variances among females and males genotypes in respect of general combining ability were found to be highly significant for different traits except for number of primary and secondary branches and seed yield per plant (Table 1).

Table 1: Analysis of variance for combining ability for nine characters in line x tester analysis in pigeonpea

Source of variation	d.f.	Mean sum of squares								
		Days to 50 % flowering	Days to maturity	Plant height	Number of primary branches/plant	Number of secondary branches/plant	Number of pods / plant	Number of seeds /pod	100 seed weight	Seed yield / plant
Replication	2	0.60	0.86	761.26	0.28	2.18	19.28	0.03	0.03	5.48
Female (Lines)	4	248.75**	352.70**	917.83*	5.64**	6.18**	3155.72**	0.44**	1.61**	251.50**
Males (Testers)	2	510.47**	171.80**	3199.26**	0.94	0.18	3864.68**	0.53**	7.90**	213.91**
Females x males	8	52.35**	18.80**	656.93*	2.07	3.08*	997.52**	0.04**	0.22	227.71**
Error	28	0.17	1.44	239.50	0.97	1.29	41.45	0.007	0.12	30.00

* and ** indicates significance of values at P =0.05 and 0.01, respectively

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Table 2 : Estimates of specific combining ability effects for 15 crosses of nine characters in pigeonpea

Sr. No	Crosses	Days to 50 % flowering		Days to maturity		Plant height		Number of primary branches/ plant		Number of secondary branches/ plant		Number of pods / plant		Number of seeds /pod		100 seed weight		Seed yield / plant	
		SCA effect	Mean	SCA effect	Mean	SCA effect	Mean (cm)	SCA effect	Mean	SCA effect	Mean	SCA effect	Mean	SCA effect	Mean	SCA effect	Mean (g)	SCA effect	Mean (g)
1.	MA 98 SD 74 x Bahar	-0.27	148.67	3.27**	252.00	-14.24	176.33	-0.12	9.33	0.11	7.96	1.91	130.00	-0.07	4.27	-0.03	12.20	2.00	67.33
2.	MA 98 SD 74 x ICPL 7035	4.47**	142.33	-1.13	243.00	10.69	177.33	-0.84	9.03	-0.02	7.66	-11.42**	85.00	0.05	4.60	-0.07	13.43	-9.28**	49.56
3.	MA 98 SD 74 x ICPL 84023	-4.20*	136.00	-2.13**	240.00	3.56	167.67	0.96	11.33	-0.09	7.56	9.51*	126.33	0.02	4.20	0.10	12.37	7.27*	66.00
4.	MAL 8 x Bahar	2.84	154.67	-2.07**	260.00	21.42*	209.67	-0.46	9.73	0.10	9.23	-3.64	145.00	-0.10	3.89	0.12	11.87	-1.79	65.76
5.	MAL 8 x ICPL 7035	-5.42**	135.33	1.53*	259.00	-20.31*	144.00	1.31*	11.33	0.50	9.46	17.69**	134.66	0.09	4.30	-0.22	12.80	8.45**	69.53
6.	MAL 8 x ICPL 84023	2.58	145.67	0.53	256.00	-1.11	160.67	-0.84	9.66	-0.59	8.33	-14.04**	123.33	0.01	3.84	0.09	11.87	-6.60*	54.30
7.	Pusa 9 x Bahar	-0.27	140.00	0.93	254.00	-14.47	191.00	0.03	9.33	1.05	10.40	9.91*	166.00	0.02	3.93	0.07	11.47	4.85	73.00
8.	Pusa 9 x ICPL 7035	3.80*	133.00	0.53	249.00	12.80	194.33	-0.37	8.76	-1.57*	7.60	-22.42**	102.00	0.07	4.20	-0.10	12.57	-9.00**	52.66
9.	Pusa 9 x ICPL 84023	-3.53*	128.00	-1.47*	245.00	1.67	180.67	0.34	9.96	0.52	9.66	12.51**	157.33	-0.09	3.67	0.04	11.47	4.15	65.70
10.	MA 98 PTH-1 x Bahar	-2.27	138.00	0.93	254.00	9.09	194.00	-0.17	11.33	0.20	10.33	-14.09**	96.66	0.10	4.33	0.22	12.47	-5.14	49.90
11.	MA 98 PTH-1 x ICPL 7035	-2.20	127.00	-0.47	248.00	-0.98	160.00	0.33	11.66	0.38	10.33	25.91**	105.00	-0.22**	4.23	0.18	13.70	11.93**	60.50
12.	MA 98 PTH-1 x ICPL 84023	4.47**	136.00	-0.47	246	-8.11	150.33	-0.16	11.66	-0.58	9.33	-11.82**	87.66	0.12*	4.20	-0.41*	11.87	-6.78*	41.66
13.	DA 11 x Bahar	-0.04	143.00	-3.07**	260.00	-1.80	176.33	0.72	11.00	-1.46*	8.00	5.91	155.00	0.04	3.85	-0.39*	11.00	0.08	64.00
14.	DA 11 x ICPL 7035	-0.64	131.33	-0.47	258.00	-2.20	152.00	-0.43	9.66	0.71	10.00	-9.75*	107.66	0.02	4.05	0.21	12.87	-2.10	55.33
15.	DA 11 x ICPL 84023	0.69	135.00	3.53**	260.00	4.00	155.67	-0.29	10.30	0.74	10.00	3.84	141.66	-0.06	3.60	0.18	11.60	2.01	59.33
	XF_1	-	138.26	-	252.26	-	172.66	-	10.31	-	9.06	-	124.22	-	4.07	-	12.23	-	59.64
-	S.E. (S_{ij}) ±	1.55		0.68		8.12		0.63		0.62		4.04		0.05		0.18		2.87	
	S.E. ($S_{ij} - S_{kl}$)	2.19		0.96		11.48		0.89		0.88		5.72		0.07		0.25		4.05	

* and ** indicates significance of values at P=0.05 and 0.01, respectively

Table 3 : Estimates of general combining ability effects for 8 parents from a line x tester design in respect of nine characters in pigeonpea

Parents	Days to 50 % flowering		Days to maturity		Plant height		Number of primary branches/plant		Number of secondary branches/plant		Number of pods / plant		Number of seeds /pod		100 seed weight		Seed yield / plant	
	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean (cm)	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean (g)	GCA effect	Mean (g)
Lines																		
MA 98 SD 74	4.07**	144.67	-7.26**	245	1.11	177.33	-0.22	8.30	-1.32**	7.00	-10.44**	69.06	0.28**	4.35	0.43**	16.23	1.33	47.67
MAL 8	6.96**	158.00	6.07**	261	-1.22	201.33	-0.07	7.86	-0.05	8.00	10.11**	96.43	-0.07*	3.83	-0.06	11.00	3.56*	41.66
Pusa 9	-4.60**	133.00	-2.93**	248	16.00**	200.67	-0.96*	11.00	0.16	7.33	17.55**	117.66	-0.14**	3.53	-0.40**	10.53	4.15*	42.83
MA 98 PTH-1	-4.60**	131.00	-2.93**	250	-4.56	182.00	1.24**	8.00	0.94*	5.20	-27.77**	45.70	0.18**	4.00	0.44**	14.60	-8.95**	26.77
DA 11	-1.82	136.00	7.07**	260	-11.33*	209.00	0.007	9.23	0.27	5.03	10.55**	117.66	-0.25**	3.51	-0.41**	10.20	-0.08	42.00
Testers																		
Bahar	6.60**	146.00	3.73**	257	16.80**	185.67	-0.05	7.60	0.13	5.60	14.31**	109.13	-0.02	3.85	-0.44**	11.10	4.36**	47.00
ICPL 7035	-4.47**	133.00	-0.87**	243	-7.13	119.00	-0.22	5.36	-0.05	4.83	-17.35**	14.33	0.20**	4.47	0.84**	16.50	-2.12	11.08
ICPL 84023	-2.13**	125.33	-2.87**	240	-9.67*	159.33	0.27	5.66	-0.08	3.33	3.04	56.66	-0.18**	3.47	-0.40**	11.17	-2.24	20.90
S.E (g_i) Lines ±	0.89		0.39		4.68		0.36		0.36		2.33		0.03		0.10		1.65	
S.E (g_j) Tester ±	0.69		0.31		3.63		0.28		0.28		1.81		0.02		0.08		1.28	
S.E (g_i - g_j) Lines ±	1.26		0.55		6.63		0.51		0.51		3.30		0.04		0.14		2.34	
S.E (g_i - g_j) Testers ±	0.98		0.43		5.13		0.39		0.39		2.56		0.03		0.11		1.81	

* and ** indicates significance of values at P=0.05 and 0.01, respectively

Variances due to interaction of females x males in respect of specific combining ability exhibited highly significant values for all the traits except for number of primary branches per plant and 100 seed weight (Table 2).

Isolation of desirable parents having higher proportion of additive gene effect as indicated by the significance of GCA effect for yield and its components is of practical value to the plant breeder especially for developing high yielding varieties. In the present investigation, Bahar, Pusa 9, MAL 8, MA 98 PTH 1, ICPL 7035 and ICPL 84023 were identified as good general combiners for yield and / or few yield traits. For example, Pusa 9 was found to be good general combiner for days to 50 % flowering, days to maturity, pods per plant and seed yield per plant whereas Bahar and MAL 8 were good general combiner for pods per plant and seed yield per plant. However, MA 98 PTH 1 for days to 50 % flowering, days to maturity, primary and secondary branches, seeds per plant and 100 seed weight, ICPL 7035 for days to 50 per cent flowering, days to maturity, seeds per pod and 100 seed weight and ICPL 84023 for plant height, days to maturity and days to 50 per cent flowering exhibited desirable GCA effect (Table 3). Srinivas *et al.* (2000) and Banu *et al.* (2006) also studied general combining ability of several genotypes of pigeonpea for yield and yield traits and observed that few parents were good general combiners for yield and yield traits whereas others parents were only desirable for few yield components only.

It may be concluded that single, three way or even complex crosses involving Bahar, Pusa 9, MAL 8, ICPL 7035, MA 98 PTH 1 and ICPL 84023, should be produced and resulting materials may be handled through intermating of selects in early segregating generations *i.e.* F_2, a sort of population improvement approach would be more efficient for isolating desirable segregates in advanced generations.

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