Crop Improv. 23(1), 66-70 (1996)
ISSN0256-0933

IDENTIFICATION OF SUPERIOR PARENTS AND HYBRIDS FOR IMPROVING PIGEONPEA

P.S. SIDHU, M.M. VERMA, R.S. SARLACH, R.S. SEKHON AND DEVINDER SANDHU.
Department of Plant Breeding, Punjab Agricultural University, Ludhiana-141004

ABSTRACT

A study involving three male-sterile lines and 11 diverse pollinators of pigeonpea exhibited preponderance of additive genetic effects for plant height, number of primary and secondary branches and pods per plant; non-additive gene effects for days to flowering and maturity, seeds per pod and 100 seed weight; and equal importance of both additive and non-additive gene effects for pod bearing length of the main stem and grain yield per plant. PMS1, a determinate male sterile line was a good combiner for earliness, number of secondary branches, pod bearing length, pods per plant and grain yield. Three top yielding hybrids, PMS 1 x AL 688, ms Prabhat (DT) x AL 101 and ms Prabhat(DT) x AL 259 depicted highest SCA effects for seed yield and out yielded the check hybrid PPH 4 by a margin of 67.9, 34.9 and 17.5 per cent respectively.

INDEX WORDS : *Cajanus cajan,* pigeonpea, male-sterility, line x tester analysis.

The exploitation of heterosis in pigeonpea is in its infancy stage and todate, only three hybrids have been released for general cultivation. Besides, the experimental hybrids produced, till now, are based on a very limited number of available male-sterile lines and pollinators. The identification of additional superior combiners and F1 hybrids will certainly augment the progress made on hybrid breeding in this crop. The present study was, therefore, taken up with two objectives, (i) to assess general (GCA) and specific (SCA) combining ability for different characters, and (ii) to determine the efficiency of parental performance as an indicator of the progeny performance via line x tester analysis in pigeonpea.

MATERIAL AND METHODS

Three genetic male-sterile lines. Ms Prabhat (DT), PMS 1, and IMS 1, used as females, were crossed with 11 diverse pollinators. The resultant 33 hybrids along with 14 parents were planted in randomized complete block design with three replications during *kharif* 1992 at Punjab Agricultural University, Ludhiana. The data recorded on five random effective plants, for ten quantitative characters, were used for statistical analysis. Fertile male sibs were used to collect data on male-sterile lines. The combining ability analysis was done following Kempthorne, 1957.

RESULTS AND DISCUSSION

Highly significant difference were observed among the hybrids for all the traits studied. The lines (females) and tester(males) varied significantly for their GCA for all the characters except the females for number of primary branches and seeds per pod, and the males for seeds per pod. The hybrids also exhibited significant variation with respect to SCA as judged from line x tester interaction mean squares for different traits.

Because of small number of female lines used in this study, the estimates of variance components due to GCA were computed only for the pollinators and have been used here for further interpretations. The variance components due to GCA and SCA have clearly indicated preponderance of additive gene effects for plant height, number of primary branches and pods per plant. Similar results have been reported by Saxena *et al.*, (1981) and Patel *et al.*,(1987) for plant height and pods per plant and by Ready *et al.*, (1981) for primary branches in pigeonpea. For rest of the traits non-additive gene effects were observed to be more predominant except for grain yield and pod bearing length of the main stem, where both additive and non-additive gene effects were almost equally important. Predominance of non-additive gene effects for days to maturity (Patel *et al.*, 1987) and both additive and non-additive gene effects for grain yield (Reddy *et al.*, 1981) have also been indicated in pigeonpea.

The GCA effects of the parents (Table 1) revealed that among the females, PMS I was a good general combiner for earliness, number of secondary branches, pod bearing length, pods per plant, 100-seed weight and grain yield. Similarly, ms Prabhat (DT) was observed to be good general combiner for earliness, plant height, number of primary branches and grain yield. Another, early maturing and short-statured male-sterile line IMS I, was good combiner for early flowering and dwarfness. In an earlier study, the male sterile line ms Prabhat (DT) was also observed to be good general combiner for earliness and short plant height (Omanga *et al.*, 1992).

Among the testers, AL 688, AL 101 and AL 259 were the best general combiners for earliness, plant height , higher number of branches, pods per plant and grain yield. AL 201 was also good general combiner for higher number of branches, pods per plant, seeds per pod, and grain yield per plant. Similarly , AL 31, AL 600, AF 98 and ICPL 84023 were found to be good general combiners for earliness and dwarfness whereas AL 15 was observed to be good combiner for short plant height only.

It was interesting to note that the first three highest yielding hybrids, in the present study, were those involving AL 688, AL 101 and AL 259 as pollinators. AL 688 was also the male parent of the first early maturing pigeonpea hybrid PPH 4 released for general cultivation in Punjab. In view of the predominance of additive gene effects for number of branches and pods per plant in the present study, lines selected on the basis of their superior GCA for these component traits should be crossed among

Table 1. General combining ability effects of lines and testers for various quantitative traits in pigeonpea.

Lines/ maturity	Days to height Flowering	Days to branches	Plant branches per	Primary per per plant	Secondary bearing per plant	Pod per plant	Pods seed length	Seeds yield pod	100 weight	Grain	testers	50%
Lines												
ms Prabhat (DT)	5.02**	-0.41**	6.44*	0.88*	0.30	6.90	-1.38	0.02	0.14**	5.35**		
PMS 1	-1.01**	-1.02**	1.84	-0.39	1.46*	18.84**	3.37**	0.06*	0.60**	3.87**		
IMS 1	-4.01**	1.43**	-8.28**	-0.48	-1.76**	-25.74**	-1.99*	-0.08**	-0.74**	-9.22**		
S.E. (±)	0.09	0.10	2.57	0.42	0.67	6.96	0.78	0.03	0.02	1.15		
Testers												
AL 201	10.63**	0.73**	28.04**	3.89**	-0.32	55.24**	11.26**	0.18**	0.18**	7.81**		
AL 101	5.74**	-0.72**	26.71**	4.11**	8.78**	99.24**	12.48**	0.08	0.58**	20.59**		
AL 259	-2.82**	1.51**	19.15**	2.78**	4.50**	7.35	7.60**	0.00	-0.27**	14.92**		
AL 31	-9.04**	-3.61**	-25.18**	-2.89**	1.10	-35.65*	-10.74**	-0.10	0.59**	-11.53**		
AL 15	-4.15**	2.06**	-31.18**	-5.33**	-9.89**	-97.98**	-16.85**	-0.09	0.41**	-21.75**		
AL 230	3.63**	1.73**	7.26**	2.00*	4.01**	7.80	-1.96	0.09	-0.39**	3.14		
AF 100	11.96**	4.84**	35.71**	2.67**	-6.79**	-7.98	3.37	0.60**	-0.60**	-5.86*		
AF 98	-3.60**	-1.61**	-8.74	-5.33*	-2.03	-42.42**	-6.85**	-0.04	-0.18**	-19.08**		
AL 600	4.07**	-0.72**	-5.96	-1.33	1.78	10.35	3.26	0.00	-0.47**	2.59		
ICPL 84023	-21.93**	-4.50**	-70.63**	-3.78**	-3.65*	-107.54**	-11.74**	-0.10	0.34**	-19.41**		
AL 688	5.52**	-0.16	24.82**	3.22**	2.50	105.58**	10.15**	-0.07	-0.18**	28.59**		
S.E. (±)	0.19	0.23	5.75	0.93	1.49	15.55	1.75	0.07	0.04	2.57		

*,** Significant at 5% and 1% levels respectively.

themselves as well as with other superior genotypes. Such crosses are likely to throw away superior inbred lines in the segregating generations as earlier reported by Omanga *et al.*, (1992). Genotypes such as AL 688, AL 101, AL 201 and AL 259, exhibiting high GCA for seed yield should also be converted into male-sterile background for use as female parents for developing superior F1 hybrids. Efforts in this direction are going on and AL 688 and AL 201 are in the final stages of conversion into genic male-sterile background.

The SCA effects of hybrids for seed yield (Table 2) revealed that 13 hybrids recorded significantly positive and eight hybrids significantly negative estimates.

Table 2. Specific combining ability effects and mean performance (in parentheses) for yield (g/plant) of different crosses in pigeonpea.

Sr No.	ms lines/ pollinators	ms Prabhat (DT)	PMS 1	IMS 1
1	AL 201	-3.69	-5.20	8.89*
		(62.67)	(59.67)	(60.67)
2	AL101	18.87**	-29.98**	11.11
		(98.00)	(47.67)	(75.67)
3	AL259	19.20**	-0.98	-18.22**
		(92.67)	(71.00)	(40.67)
4	AL31	-2.35	-6.87	9.22*
		(44.67)	(38.67)	(41.67)
5	AL15	-6.13	-2.65	8.78*
		(30.67)	(32.67)	(31.00)
6	AL230	13.31**	8.13*	-21.44*
		(75.00)	(68.33)	(25.67)
7	AF100	-6.69	-5.20	11.89**
		(46.00)	(46.00)	(50.00)
8	AF98	-6.46	-10.98**	17.44**
		(33.0)	(27.00)	(42.33)
9	AL600	4.87	16.69**	-21.56**
		(66.00)	(76.33)	(25.00)
10	ICPL 84023	-16.46**	0.69	15.78**
		(22.67)	(38.33)	(40.33)
11	AL688	-14.46**	36.35**	-21.89**
		(72.67)	(122.00)	(50.67)

S.E. for sca of hybrids = ± 3.81

*,** Significant at 5% and 1% levels respectively.

The results further indicated that 13 hybrids with significant desirable SCA effects for seed yield involved six high x high, two high x low and five low x low cross combinations. In the present study, three top yielding hybrids, PMS 1 x AL 688, ms Prabhat (DT) x AL 101 and ms Prabhat (DT) x AL 259 also depicted highest SCA effects for seed yield and two of its most important components namely, number of branches and pods per plant. These three experimental hybrids have outyielded the check hybrid PPH 4 (ms Prabhat-DT x AL 688) by a margin of 67.9, 34.9, and 17.5 percent respectively. The performance of such crosses needs to be evaluated in large scale trials to confirm their superiority over the standard check hybrid/cultivar as also suggested by Giriraj *et al.*, (1987). The crosses IMS 1 x AL 101 and IMS 1 x AL 201 which cannot be exploited commercially but involved high x low combiners and recorded significant desirable SCA effects for seed yield and its important components, may be used for identifying desirable transgressive segregants. The potential of such high x low crosses in providing useful transgressive segregants has already been reported (Singh *et al.*, 1993) in pigeonpea.

REFERENCES

Giriraj, K., Hiremath, S.R. and Seenappa (1987). Combining ability of converted male-sterile lines of sunflower (*Helianthus annuus*). *Indian J. Genet.*, 47: 315-317.

Kempthorne, O. (1957). *An Introduction to Genetic Statistics.* John Wiley and Sons, Inc. New York.

Omanga, P.A., Faris, D.G., and Saxena, K.B. (1992). Genetic analysis of grain yield in pigeonpea using male sterile lines. *Indian J. Pulses Res.*, 5: 9-14.

Patel, J.A., Pathan, D.R., Zaveri, P.P. and Shah, R.M. (1987). Combining ability analysis in pigeonpea (*Cajanus cajan* (L.) Millsp.) *Indian J. Genet.*, 47: 182-187.

Reddy, L.J., Saxena, K.B., Sharma, D. and Green, J.M. (1981). Some combining ability analyses in pigeonpea (*Cajanus cajan* (L.) Millsp.). Pages 93-104. Proceedings of the international workshop on pigeonpea. 15-19 December 1980, ICRISAT, Patancheru, India, Vol. 2.

Saxena, K.B., Byth, D.E., Wallis, E.S. and De Lacy, I.H. (1981). Genetic analysis of diallel cross for early flowering pigeonpea lines. Pages 81-92, Proceedings of the international workshop on pigeonpea, 15-19 December 1980.

Singh, N.B., Ariyanayagam, R.P. Gupta, S.C., Rao, A.N. and Singh, Laxman. (1993). Evaluation of pigeonpea crosses involving parents with high and low general combining abilities (GCA). *International Pigeonpea Newsletter* 18: 17-18.