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COMBINING ABILITY ANALYSIS OF PARENTS AND HYBRIDS USING GENIC MALE STERILITY IN PIGEONPEA

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ABSTRACT

The genetic analysis of sixty pigeonpea hybrids based on three genic male sterile lines and twenty pollinators revealed major role of additive genetic variance for days to maturity and 100-seed weight, and that of nonadditive genetic portion for seed yield/plant, branches/plant, pods/plant and seeds/pod. The parents were classified for their genetic worth in respect of different characters and prospects for use in hybrid programme. The hybrids showing significant positive sca effects mainly involved one good and the other poor combining parent and were associated with desirable sca effects for component traits especially pods per plant and branches per plant.

Key words: Pigeonpea, male sterility, combining ability.

Efforts are under way for commercial exploitation of heterosis in pigeonpea using the natural outcrossing coupled with the discovery of stable genic male sterility system and the development of technology for hybrid seed production [1, 2]. In this connection, information on quantitative inheritance and combining ability of parents and crosses is valuable for planning effective hybrid breeding programme. A study was undertaken to analyse combining ability of parents and hybrids in pigeonpea involving three genetic male sterile lines.

MATERIALS AND METHODS

Three genetic male sterile lines viz., MS 3A, MS 4A and MS Prabhat were crossed with twenty diverse pollinators. The resultant 60 hybrids were studied alongwith parents for six characters (Table 1) in randomised block design replicated thrice. The fertile sibs in the male sterile lines were used to represent female lines. The plot size for each entry was two rows of 3 m length spaced at 75 x 25 cm. Randomly selected five plants in each plot were selected

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for recording observations except days to maturity which was noted on plot basis. The mean values were subjected to combining ability analysis and estimation of variance components as per line x tester mating design [3].

RESULTS AND DISCUSSION

Significant differences were observed among the hybrids (Table 1). The lines (females) and testers (males) varied significantly for their general combining abilities for all the characters except females for pods per plant. The hybrids also showed significant variation in respect of specific combining ability as judged from lines x testers interaction mean squares for different traits. The variances due to general combining ability (σ^2 gca) were computed only for the males since the number of females was small. The estimates of σ^2 gca and σ^2 sca (variance due to specific combining ability) and their ratios (Table 1) have clearly shown additive genetic action to be predominent for days to maturity and 100-seed weight as has been reported earlier [4]. For rest of the traits substantial portion of total genetic variation was due to non-additive gene action. Such findings have been published for seed yield [4–6], for pods/plant, branches/plant and seeds per pod [4].

Table 1. Analysis of variance (mean squares) for combining ability for six characters in pigeonpea

Source of variation	d.f.	Yield per plant	Days to maturity	Branches per plant	Pods per plant	Seeds per pod	100-seed weight
Hybrids	59	480.2**	728.8**	12.83**	7171.6**	0.35**	2.28**
Line	2	2124.7**	11712.4**	120.97**	261.5	1.57**	1.01**
Testers	19	575.0**	738.7**	16.36**	7980.1**	0.47**	4.65**
Lines x Testers	38	346.3**	145.8**	5.37**	7131.1**	0.23**	1.17**
Error	118	13.7	2.6	0.86	255.8	0.10	0.23
σ^2gca		25.4	65.9	1.22	94.3	0.03	0.38
σ^2sca		110.9	47.7	1.50	2291.8	0.04	0.31
σ^2gca/σ^2sca		0.2	1.4	0.81	0.1	0.75	1.23

*, **Significant at P = 0.05 and 0.01 levels, respectively.

The gca effects for parents (Table 2) revealed that among the females, MS Prabhat was the best general combiner for early maturity and seeds per pod. MS 3A and MS 4A were good combiners for seed yield, prolonged maturity and branches/plant. The former had desirable gca effects for seeds/pod and 100-seed weight. Among the male parents, ICPL 8504 and ICPL 7979 were the best general combiners for all the six traits studied except days to maturity. Similarly, T 15-15, B 12 and ICPL 6997 were the most desirable parents for multiple traits like seed yield, branches and pods/plant, except T 15-15 only for

Table 2. Estimates of general combining ability effects for six characters of parents in pigeonpea

Parent	Yield per plant	Days to maturity	Branches per plant	Pods per plant	Seeds per plant	100-seed weight
Females:						
MS Prabhat	-6.35**	-16.13**	-1.58**	2.41	0.09**	0.02
MS 3A	5.44**	7.71**	0.41**	-1.15	0.10**	0.11**
MS 4A	0.91	8.42**	1.17**	-1.26	-0.19**	-0.14**
SE ±	0.33	0.15	0.08	1.43	0.03	0.04
Midlate males:						
T 15-15	10.25**	1.59**	0.41	31.46**	0.13	0.27*
B 12	10.71**	0.92**	1.14**	49.10**	-0.04	-0.03
ICPL 6997	8.68**	4.37**	0.50**	35.40**	0.09	0.17
ICPL 8504	119.06**	7.81**	1.62**	68.40**	0.49**	0.35**
ICPL 7979	11.84**	7.48**	1.75**	21.88**	0.32**	1.10**
BDN 2	-7.23**	2.37**	-1.92**	-25.05**	-0.09	-0.04
Hy 3A	0.58	6.14**	-2.33**	-43.43**	0.19*	1.06**
AGS 498	1.67	3.26**	0.05	7.57	0.04	0.50**
AGS 521	-8.01**	10.81**	0.01	-40.50**	0.16	-0.06
AGS 579	-4.68**	7.81**	-0.39	0.72	-0.57**	0.80**
ICPL 384	1.97	13.48**	2.05**	-8.43	-0.21	-0.48**
Early males:						
S 5	-3.51**	-7.74**	-0.57*	10.28**	-0.14	-0.67**
ICPL 87	-2.25*	-10.30**	-1.91**	2.43	0.22**	-0.60**
ICPL 6	-6.50**	-4.63**	-1.28**	-9.86**	-0.06	-0.22
GAUT 82-53	-3.38**	-5.59**	1.23**	-36.57**	-0.16	1.29**
GAUT 82-55	-8.88**	-3.74**	1.94**	-22.64**	-0.30**	0.16
T 21	-4.98**	-4.74**	-0.55*	-2.43	0.04	-0.98**
DL 78-1	-1.81	-20.52**	0.04	-2.78	-0.03	-1.16**
Hy 6	-6.79**	-1.86**	-0.22	-22.76**	-0.08	-0.47**
UPAS 120	-6.75**	-18.08**	-1.57**	-12.79**	-0.001	-1.03**
SE ±	1.02	0.45	0.26	4.42	0.09	0.13

*, **Significant at P = 0.05 and 0.01 levels, respectively.

branches/plant. T 15-15 and B 12 were already reported to be good combiners for seed yield [6]. All the early males had desirable gca effects for days to maturity but were poor combiners for seed yield. However, some of them were good general combiners for certain specific traits, e.g. GAUT 82-53 and GAUT 82-55 for branches/plant, S 5 for pods/plant, ICPL 87 for seeds/pod, and GAUT 82-53 for 100- seed weight.

The sca effects of hybrids for seed yield (Table 3) indicated that 23 and 25 hybrids depicted significantly positive and negative estimates, respectively. The highest value was obtained in the cross MS Prabhat x Hy 3A (15.30). In general, 15 hybrids with desirable sca effects for seed yield involved medium duration male parents. As regard the component traits, desirable and significant sca effects (Table 3) could be seen for days to maturity,

Table 3. Estimates of specific combining ability effects for seed yield in the crosses and desirable sca effects for component traits in pigeonpea

Male parent	Seed yield/plant			Component traits with desired sca effects @		
	MS Prabhat	MS 3A	MS 4A	MS Prabhat	MS 3A	MS 4A
T 15-15	11.06**	-15.95**	4.88	1, 3	—	2
B 12	-3.32**	-3.29**	8.61**	2	—	1, 3, 5
ICPL 6997	2.99*	3.40*	-6.39**	1, 2, 4, 5	3	—
ICPL 8504	-4.36**	12.27**	-7.91**	—	1, 3, 4, 5	1
ICPL 7979	-9.93**	-2.22	12.15**	1, 2	—	2, 3
BDN 2	2.77**	5.47**	-8.24**	1	1, 2, 3	—
HY 3A	15.30**	-3.97**	-11.33**	2, 3	—	1
AGS 498	11.50**	-18.24**	6.75**	3	5	2, 3
AGS 521	-2.85**	-13.41**	16.27**	—	1	1, 2, 3
AGS 579	0.80	-1.60	0.80	4	3	5
ICPL 384	14.68**	4.16*	-18.84**	3	—	—
S 5	-3.03*	1.67	1.37	1, 5	2	1, 3
ICPL 87	-6.78**	8.76**	-1.98	—	5	1, 3, 4
ICPL 6	-5.25**	2.95*	2.30	1, 2	1	3
GAUT 82-53	-0.54	-10.21**	10.75**	—	—	1, 2, 3
GAUT 82-55	-3.13*	10.51**	-7.38**	1, 3	2	5
T 21	-2.99**	10.15**	-7.15**	1	2, 3, 5	1
DL 78-1	-9.67**	11.47**	-1.80	2, 5	1, 3	1, 4
HY 6	3.41*	2.03	-5.45**	1, 2, 5	2	—
UPAS 120	-10.64**	-1.96	12.61**	—	1, 2, 3	1, 3
S.E. ±	1.45					

@ 1—days to maturity, 2—branches per plant, 3—pods per plant, 4—seeds per pod, and 5—100-seed weight.

*, **Significant at P = 0.05 and 0.01 levels, respectively.

branches and pods/plant in 25, 18 and 21 crosses, respectively. The hybrids MS Prabhat x ICPL 6997 and MS 3A x ICPL 8504 exhibited significant and useful sca effects simultaneously for five traits. Eight hybrids showed significant sca effects in desirable direction for four characters including seed yield. The hybrids with desirable sca effects for yield also had desirable sca effects for branches per plant and pods per plant.

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