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Original Research Article

Line x Tester Analysis in New Experimental CMS Based Pigeonpea Hybrids

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Pigeon pea, Combining ability, Line x Tester Analysis, Cytoplasmic male sterility

A B S T R A C T

The thirty six new experimental hybrids along with their parents were evaluated to estimate the combining ability effects and thereby to find out promising cross combinations using Line x Tester mating design during kharif 2011-12. Among the female parents only GT-290A was found to possess significant gca effects for maximum four characters *viz.*, grain yield per plant, number of branches, number of pods and days to 50% flowering. Among the male parents, AKPR-340 revealed highly significant gca effect for grain yield per plant.The cross AK-120-2A X AKPR-379 (6.40) recorded the highest significant positive sca effect for grain yield per plant followed by GT-290A X AKPR-17 (4.85).

Introduction

The pigeonpea crop grown widely in India particularly in the major states of Maharashtra, Karnataka, Andhra Pradesh, and Madhya Pradesh. Combining ability analysis help in identification of superior parents and cross combination. The gca effect reflects the breeding value of the parental genotypes and assists in identifying genotypes to be used for developing superior populations. Specific combining ability effects represent the non-reliable component of the genotypic value arising due to contribution from dominance deviation and interaction deviation. Hence, sca effect is the main cause for superiority of a cross.

Materials and Methods

The set of 13 parents, four females (cms lines) *viz.*, GT-33A, GT-290A, AK-120-1A, AK-120-2A and nine males (testers) *viz.*, AKPR-17, AKPR-100, AKPR-178, AKPR-224, AKPR-340, AKPR-344, AKPR-345, AKPR-376, AKPR-379 and their 36 crosses along with two checks AKT-8811 and Vipula were evaluated in randomized block design with three replications at the field of Pulses Research Unit, Dr. PDKV, Akola during *Kharif* 2011-2012. Each entry was grown in the two rows plot of 4 meter length with intra and inter row spacing of 20 cm and 60 cm respectively. Recommended crop management practices were followed during the crop growth period. The observations were recorded on five randomly selected plants on nine characters viz., days to 50% flowering, days to maturity, plant height, number of branches, number of clusters, number of pods, number of seed per pod,100 seed weight and grain yield per plant.The mean data were subjected to line x tester analysis to estimate combining ability (Kampthrone, 1957).

Results and Discussion

The mean squares due to genotypes were highly significant for all the traits studied (Table 1). This indicated the presence of substantial genetic variability among genotypes all the traits studied. Further partitioning of genotypic variance into components *viz.,* parents, crosses and parents vs. crosses revealed that the parents differed significantly among themselves for all the characters except for 100 seed weight. The mean square due to crosses also showed highly significant differences for all the traits except for days to 50% flowering and days to maturity. The mean squares due to parents vs. crosses were significant for all the characters except for number of seeds per pod indicating the significant differences between parents and crosses. Similar results were reported by Pawar and Tikka (2003), Sunilkumar *et al.,* (2003) and Aher *et al.,* (2006).

The estimates of general combining ability effects of the female and male parents are presented in (Table 2). Among female parents, GT-290A recorded significant gca effect for maximum four characters such as grain yield per plant, number of branches, number of pods and days to 50% flowering. The female parent AK-120-2A was found to possess highest gca effect for plant height and number of clusters. Among the male parents AKPR-345 was found to have highest gca effect for number of clusters and number of pods. The male parent AKPR-340 recorded highest significant gca effect for grain yield per plant. Hence, these genotypes were recognized as the best parental material among the available genotypes and can be used as parents in hybridization programmes. Similar results for these characters were reported by Sunilkumar *et al.,* (2003), Banu *et al.,* (2006) and Kumar *et al.,* (2009).

The estimates of specific combining ability effects of the crosses are presented in (Table 3). The highest significant desirable sca effect was observed for days to maturity in GT-290A X AKPR-379 (-4.16), for plant height in GT-33A X AKPR-376 (10.87), for number of branches in GT-290A X AKPR-345(1.24), for number of clusters in AK-120-1A X AKPR-340 (4.48), for number of pods in AK-120-1A X AKPR-344 (22.20), for number of seed per pods in AK-120-1A X AKPR-345 (0.53), for 100 seed weight GT-290A X AKPR-344 (0.47) and for grain yield per plant in AK-120-2A X AKPR-379 (6.40).

The crosses viz., GT-33A X AKPR -178 (number of clusters, grain yield per plant) GT-290A X AKPR-340 (number of seeds per pod, grain yield per plant), AK-120-1A X AKPR-178 (number of branches, grain yield per plant) AK-120-2A X AKPR-224 (number of pods, grain yield per plant) and AK-120-2A X AKPR-379 (number of branches, grain yield per plant) revealed significant desirable sca effects simultaneously for more than one characters studied. Hence these crosses were found to be promising to exploit non-additive component breeding programme. It was observed that the crosses with high and significant specific combining ability for grain yield per plant had also high specific combining ability for one or more other yield components suggesting that the improvement in grain yield per plant could be obtained by improving its component characters. Similar results were reported by Pawar and Tikka (2003), Sunilkumar *et al.,* (2003), Banu *et al.,* (2006) and Gupta *et al.,* (2011).

Table.1 Analysis of variance for various characters

Sources of variation	d.f.	Mean sum of squares								
		Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of branches	Number of clusters	Number of pods	Number of seeds per pod	100 seed weight (g)	Grain Yield per plant (g)
		1	2	3	4	5	6	7	8	9
Replications	2	2.25	14.35	20.34	0.38	5.59	25.96	0.01	0.31	5.33
Genotypes	48	41.67**	14.36**	855.69**	4.38**	30.70**	936.64**	0.19**	0.87**	67.84**
Parents	12	102.39**	33.08**	714.93**	3.21**	51.07**	486.58**	0.31**	0.24	88.47**
Crosses	35	17.76	7.40	146.87**	3.67**	11.44**	564.66**	0.15**	0.39**	33.49**
Parents Vs Crosses	1	149.87**	34.03*	27353.58**	43.30**	459.99**	19356.90**	0.04	24.85**	1022.27**
Error	96	13.35	5.75	49.70	0.19	2.16	67.69	0.04	0.20	2.66

* - Significant over check at 5 % level of significance ** - Significant over check at 1 % level of significance

Table.2 Estimates of general combining ability effects of parents

Parents	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of branches	Number of clusters	Number of pods per plant	Number of seeds per pod	100 seed weight (g)	Grain yield per plant (g)
	1	2	3	4	5	6	7	8	9
Females (Lines)									
GT-33A	-0.45	0.39	-3.51*	0.88**	0.16	5.15**	0.04	0.09	-0.71*
GT-290A	-1.98**	0.58	-3.34*	0.38**	-0.08	8.00 **	-0.08*	0.09	1.37**
AK-120-1A	1.33	-0.36	2.31	-0.89**	-0.72*	-8.38 *	0.015	-0.04	0.24
AK-120-2A	1.10	-0.65	4.54**	-0.37**	0.64*	-4.75**	0.03	-0.14*	-0.89**
SE (gi) ±	0.72	0.42	1.39	0.07	0.28	1.29	0.04	0.07	0.33
SE(gi-gj) ±	1.02	0.59	1.97	0.10	0.40	1.83	0.05	0.10	0.46
CD AT 5 %	1.44	0.84	2.77	0.14	0.56	2.57	0.07	0.13	0.65
CD AT 1 %	1.91	1.11	3.68	0.18	0.75	3.41	0.09	0.17	0.86
Males (Testers)									
AKPR-17	0.45	0.84	- 9.08 **	-0.14	-1.42**	-2.93	0.03	-0.16	0.43
AKPR-100	-2.88**	-0.92	-0.55	-0.51 **	-0.66	-10.28**	0.02	-0.14	- 2.43**
AKPR-178	-1.38	0.08	3.65	0.11	-1.19**	5.41**	0.06	-0.07	-0.42
AKPR-224	1.21	-0.75	3.03	-0.08	-0.26	-3.84	0.01	0.42**	-0.69
AKPR-340	0.71	0.25	3.63	0.21	1.01*	5.36**	0.00	0.18	2.47**
AKPR-344	0.12	0.00	2.08	0.63**	0.14	-4.13	0.09	0.04	1.10*
AKPR-345	-0.38	0.25	1.53	0.09	2.30**	11.90**	-0.10	-0.17	-0.13
AKPR-376	0.54	1.17	-5.22*	-0.25*	0.75	-1.69	-0.16**	-0.02	-0.94
AKPR-379	1.62	-0.92	0.94	-0.07	-0.67	0.21	0.04	-0.08	0.61
SE (gj) ±	1.08	0.63	2.08	0.11	0.42	1.94	0.05	0.11	0.49
SE (gi-gj) ±	1.53	0.88	2.95	0.15	0.60	2.74	0.08	0.14	0.69
CD AT 5 %	2.16	1.25	4.16	0.21	0.84	3.86	0.11	0.20	0.97
CD AT 1 %	2.86	1.66	5.52	0.27	1.11	5.13	0.15	0.27	1.29

* - Significant over check at 5 % level of significance

** - Significant over check at 1 % level of significance

Table.3 Estimates of specific combining ability effects for crosses

Sr.No.	Crosses	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches	Number of clusters	Number of pods	Number of seeds per pod	100 seed weight (g)	Grain yield per plant (g)
		1	2	3	4	5	6	7	8	9
1	GT -33A X AKPR-17	0.62	0.28	-9.13 *	0.85 **	-0.92	-1.72	-0.19	0.08	1.6
2	GT -33A X AKPR -100	-1.71	-0.97	-5.38	0.58 **	0.39	-7.08	-0.312 **	0.31	-2.21 *
3	GT -33A X AKPR -178	-1.88	-0.97	2.03	-0.19	2.15 *	3.69	0.22	0.38	2.76 **
4	GT -33A X AKPR -224	2.54	1.53	2.54	0.42 *	0.84	6.09	0.10	0.13	-2.15 *
5	GT -33A X AKPR - 340	-1.63	-0.14	-1.98	-0.55 **	-1.51	9.57 *	0.05	0.07	1.30
6	GT -33A X AKPR -344	1.287	0.78	0.36	-0.39	-1.11	-0.05	-0.01	-0.02	1.32
7	GT -33A X AKPR -345	-2.21	-1.81	1.53	-0.62**	-0.03	-11.24 **	-0.24 *	-0.58**	-2.30 *
8	GT -33A X AKPR -376	1.54	-0.72	10.87 *	-0.05	0.27	1.06	0.19	-0.298	-0.32
9	GT -33A X AKPR -379	1.45	2.03	-0.82	-0.06	-0.10	-0.28	0.21	-0.07	-1.39
10	GT -290A X AKPR-17	1.47	0.09	2.63	-0.76**	-0.89	0.14	-0.25 *	0.17	4.85 **
11	GT -290A X AKPR-100	-2.19	0.17	3.45	-0.13	2.73 **	7.06	0.20	-0.31	-2.59 **
12	GT -290A X AKPR-178	-1.69	1.51	1.24	0.32	-1.01	2.25	-0.28 *	-0.88 **	-0.87
13	GT -290A X AKPR-224	-1.94	0.01	5.07	1.18**	1.21	21.92 **	0.18	0.19	1.42
14	GT -290A X AKPR-340	1.22	0.34	-2.94	-0.21	-2.47 **	-13.17 **	0.26 *	-0.10	2.01 *
15	GT -290A X AKPR-344	-0.86	-1.07	-2.92	0.04	-0.66	2.25	-0.03	0.47 *	-0.31
16	GT -290A X AKPR-345	2.31	2.34	-7.84	1.24**	-0.89	-9.92 *	-0.13	0.18	-3.13 **
17	GT -290A X AKPR-376	1.40	0.75	-1.22	0.28	0.98	10.65 **	-0.18	-0.01	-0.87
18	GT -290A X AKPR-379	0.31	-4.16 **	2.55	-1.96 **	1.01	-21.16 **	0.22*	0.29	0.93
19	AK-120-1A X AKPR-17	-1.16	-1.02	-2.98	0.28	1.32	3.61	0.13	-0.09	-1.17
20	AK-120-1A X AKPR-100	3.51	1.73	-1.66	0.64**	-1.60	-1.34	0.01	0.05	1.11

Contd…

Sr. No.	Crosses	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of branches	Number of clusters	Number of pods	Number of seeds per pod	100 seed weight (g)	Grain yield per plant (g)
		1	2	3	4	5	6	7	8	9
21	AK-120-1A X AKPR-178	1.34	-0.60	-0.17	0.56 **	-1.75*	-15.58 **	0.17	-0.21	3.81 **
22	AK-120-1A X AKPR-224	-0.90	-0.10	-1.03	-0.11	-0.53	-12.91 **	-0.12	0.34	3.93 **
23	AK-120-1A X AKPR-340	-0.74	0.57	4.67	0.29	4.48**	6.92	-0.42**	-0.49 *	-2.63 **
24	AK-120-1A X AKPR-344	0.51	0.48	2.98	0.22	-0.17	22.20 **	0.08	0.05	-5.11 **
25	AK-120-1A X AKPR-345	0.01	0.56	2.28	-1.78 **	1.94*	-8.77 *	0.53**	0.07	0.06
26	AK-120-1A X AKPR-376	-1.24	-1.35	-2.80	-0.91 **	-1.78 *	12.19 **	-0.01	0.13	-1.37
27	AK-120-1A X AKPR-379	-1.32	-0.27	-1.34	0.81 **	-1.89 *	-2.04	-0.35**	-0.16	0.08
28	AK-120-2A X AKPR-17	-0.94	0.65	9.43*	-0.37	0.49	1.36	0.32 **	-0.05	1.22
29	AK-120-2A X AKPR-100	0.40	-0.94	3.60	-1.10**	-1.53	0.43	0.10	0.39	-4.82 **
30	AK-120-2A X AKPR-178	2.23	0.07	-3.10	-0.69 **	0.60	-12.45 **	-0.10	-0.11	-3.59 **
31	AK-120-2A X AKPR-224	0.32	-1.44	-6.57	-1.49 **	-1.51	16.52 **	-0.16	-0.30	5.57 **
32	AK-120-2A X AKPR-340	1.15	-0.77	0.25	0.47 *	-0.49	-9.12 *	0.12	0.04	2.85 **
33	AK-120-2A X AKPR-344	-0.94	-0.19	-0.41	0.13	1.94*	-1.03	-0.04	0.35	-1.11
34	AK-120-2A X AKPR-345	-0.10	-1.10	4.04	1.16**	-1.01	-2.93	-0.16	0.23	-5.88 **
35	AK-120-2A X AKPR-376	-1.69	1.32	-6.84	0.67 **	0.53	9.25*	-0.01	-0.34	0.59
36	AK-120-2A X AKPR-379	-0.44	2.39	-0.39	1.22 **	0.98	-15.58 **	-0.08	-0.21	6.40 **
	SE (Sij) ±	2.15	1.25	4.16	0.21	0.84	3.87	0.11	0.21	0.98
	SE (Sij-Skl) ±	3.05	1.76	5.89	0.28	1.19	5.47	0.16	0.29	1.39
	SE (Sij-Sik) ±	2.27	1.31	4.39	0.21	0.88	4.08	0.12	0.22	1.03
	CD AT 5 %	4.30	2.49	8.31	0.41	1.68	7.72	0.30	0.40	1.94
	CD AT 1 %	5.71	3.31	11.04	0.54	2.23	10.26	0.29	0.54	2.59

* - Significant over check at 5 % level of significance ** - Significant over check at 1 % level of significance

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