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Research Notes

Heterosis for yield in Pigeonpea (*Cajanus cajan* L. Mill *sp.*)

R. Chandirakala, N. Subbaraman and Abdhul Hameed

Abstract

Three genic male sterile lines and ten testers were crossed in a line x tester mating design. The parents (for male sterile parents corresponding maintainer lines were used) as well as hybrids were evaluated for days to 50% flowering, plant height, number of branches/plant, number of clusters/plant, number of pods/plant, 100 grain weight and grain yield/plant. Among 30 hybrids, 13 hybrids exhibited significant and positive heterosis over all the three bases of estimation. The two hybrids *viz.,* MS Prabhat DT x ICPL 88009 (L_2 x T_3) and MS Prabhat DT x ICPL (L_1 x T_6) showed highly significant and positive heterosis over mid, better and standard parent. In general, the proportion of hybrids exhibiting significant heterotic effect for grain yield with genic male sterile line MS Prabhat DT was greater as compared to lines, MS Prabhat NDT and MS CO 5. The male parents *viz.,* ICPL 88009 (T_3), ICPL 89008 (T_4), ICPL 84023 (T_6) showed significant and positive heterosis with female lines MS Prabhat DT and MS Prabhat NDT for grain yield/plant.

Keywords:
Pigeonpea, genic male sterility, heterosis.

Hybrid breeding programmes based on genic male sterility (*gms*) had been successful in releasing about half a dozen pigeonpea hybrids in India. To study the extent of heterosis over mid parent (MP), better parent (BP) and standard variety, ICPL 87 (SP) in pigeonpea through line x tester analysis, the present study was carried out.

The experimental materials comprised three genic male sterile lines *viz.,* MS Prabhat DT (L_1), MS Prabhat NDT (L_2) and MS CO 5 (L_3) and ten testers *viz.,* ICPL 87104 (T_1), ICPL 85010 (T_2), ICPL 88009 (T_3), ICPL 89008 (T_4), ICPL 89020 (T_5), ICPL 84023 (T_6), ICPL 88039 (T_7), ICPL 90032 (T_8), ICPL 90012 (T_9) and ICPL 87 (T_{10}) and their resulting 30 hybrids obtained in a line x tester mating design. The parents (for male sterile parents corresponding maintainer lines were used) as well as hybrids were raised in a randomized block design and replicated thrice at the farm of Agricultural College and Research Institute, Madurai. The spacing was 60 x 30 cm with 3m length of each of 5 rows in each plot. Observations of five randomly selected plants were recorded for seven traits *viz.,* days to 50% flowering, plant height, number of branches/plant, number of clusters/plant, number of pods/plant, 100 grain weight and grain yield/plant from each entry of each replication. Relative heterosis, heterobeltiosis as well as standard heterosis were estimated and tested by working out the standard errors by Hays et al. (1955).

The value of percentage heterosis of hybrids for all the seven characters over mid, better and standard parent are given in the Table 1. Early flowering is a desirable feature of a genotype. Therefore, negative heterosis for days to 50% flowering was considered desirable. Heterosis for this trait ranged from –13.44 to 24.91 per cent, –18.09 to 12.91 per cent and –11.56 to 39.73 per cent over mid, better and standard parent respectively (Table 1). In this study, only one hybrid viz., MS Prabhat DT x ICPL 88009 (L_1 x T_3)

Dept. of Millets
Tamil Nadu Agricultural University, Coimbatore-641 003 (Tamil Nadu), India
Email: chandirakala2009@gmail.com

registered significant and negative heterosis on all the three bases of estimation. Similar findings were reported by Khorgada *et al*. (2000) and Patel and Tikka (2008) for this trait in pigeonpea.

Heterosis for plant height ranged from -24.43 to 34.38 per cent, -47.86 to 38.25 per cent and –35.92 to 56.14 per cent over mid, better and standard parent respectively. The negative heterosis in the context of breeding dwarf genotype will be desirable. Significant and negative heterosis for this trait on all the three bases of estimation was observed in four crosses viz., MS Prabhat DT x ICPL 87104 (L_1 x T_1), MS Prabhat DT x ICPL 89020 (L_1 x T_5), MS Prabhat DT x ICPL 90012 (L_1 x T_9) and MS CO 5 x ICPL 87104 (L_3 x T_1). This finding is in accordance with that of Pandey (2004).

For number of branches/plant, the range of heterosis over mid, better and standard parent was from –23.69 to 29.33 per cent, -42.83 to 28.87 per cent and –24.89 to 47.49 per cent respectively. The estimates of heterosis for this trait revealed that eight crosses showed significant positive heterosis over standard parent. Number of pods/plant, a principal component of yield exhibited higher magnitude of heterosis as compared to other traits. Out of 30 hybrids, 19 expressed significant positive heterosis on all the three bases of estimation. Heterosis for this trait ranged from 3.34 to 48.86 per cent, -3.88 to 32.84 per cent and 5.41 to 98.26 per cent over mid, better and standard parent respectively. Hybrid MS CO 5 x ICPL 88009 (L_3 x T_3) showed highest significant and positive heterosis of 42.06, 25.45 and 98.26 per cent on all the three bases of estimation *viz.*, mid parent, better parent and standard parent respectively. Similar findings were also reported in pigeonpea by Patel and Tikka (2008) for number of branches/plant and number of pods/plant.

The magnitude of heterosis for number of clusters/plant showed that only five crosses recorded significant and positive heterosis on all the three bases of estimation. The range of heterosis for this trait over mid, better and standard parent was from –7.37 to 44.74 per cent, -28.02 to 23.93 and –10.02 to 51.00 per cent respectively. Among 30 hybrids, 10 crosses showed significant and positive heterosis over mid, better and standard parent for 100 grain weight. Heterosis for this trait ranged from –25.30 to 26.57 per cent over all the three bases of estimation. These results are in agreement with the results of Deshmukh *et al.* (2001).

For grain yield/plant, a complex character, the range of heterosis over mid, better and standard parent was from –2.30 to 82.74 per cent, -23.94 to 63.13 per cent and –8.61 to 71.22 per cent respectively. Among 30 hybrids, 13 hybrids exhibited significant and positive heterosis over all the three bases of estimation. The two hybrids *viz.,* MS Prabhat DT x ICPL 88009 (L_2 x T_3) and MS Prabhat DT x ICPL (L_1 x T_6) showed highly significant and positive heterosis over mid, better and standard parent. Similar observations have been reported earlier by Pandey (2004) and Patel and Tikka (2008) in pigeonpea.

In general, it was observed that positive and high magnitude of heterosis for grain yield/plant was noticed and this may be due to the heterosis contributed by one or more yield contributing characters. The positive heterosis could be useful for further exploitation (Wanjari *et al.,* 2007). In pigeonpea, heterosis in yield/plant was positively associated with heterosis in number of branches/plant, number of pods/plant, number of clusters/plant and 100 grain weight indicating relative merit of these traits.

It would be thus evident that the traits, number of branches/plant, number of clusters/plant and 100 grain weight in addition to earliness should be given priority for selecting the parents to be involved in a hybridization programme aimed at yield improvement in pigeonpea. It is interesting to note that the proportion of hybrids exhibiting significant heterotic effect for grain yield with genic male sterile line MS Prabhat DT was greater as compared to lines, MS Prabhat NDT and MS CO 5. The male parents *viz.,* ICPL 88009 (T_3), ICPL 89008 (T_4), ICPL 84023 (T_6) showed significant and positive heterosis with female lines MS Prabhat DT and MS Prabhat NDT for grain yield/plant.

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Table1. Heterosis for mid, better and standard parent for different characters in pigeonpea

Hybrids	Days to 50% flowering			Plant height			Number of branches/plant			Number of pods/plant		
	Heterosis per cent over			Heterosis per cent over			Heterosis per cent over			Heterosis per cent over		
	Mid parent	Better parent	Standard parent	Mid parent	Better parent	Standard parent	Mid parent	Better parent	Standard parent	Mid parent	Better parent	Standard parent
L1 x T1	14.40**	11.84**	20.75**	-9.03**	-18.42**	-30.51**	-9.64	-15.18	-24.89**	22.53**	4.12	8.6
L1 x T2	0.95	-1.35	6.52**	-1.59	-10.96**	-24.14**	2.56	-0.66	-12.09**	16.31**	15.5**7	22.10**
L1 x T3	-13.44**	-18.09**	-11.56**	-2.87	-7.42**	-12.97**	4.89	-1.12	-1.16	35.50**	26.11**	52.70**
L1 x T4	-2.34	-3.89	3.78	13.53**	-4.84**	19.84**	0.62	-5.19	-5.1	9.50*	7.52	16.36**
L1 x T5	-4.76	-6.87**	0.55	-13.98**	-24.78**	-35.92**	7.13	5.72	-6.45	3.34	2.69	8.47
L1 x T6	3.67	3.39	11.63**	14.24**	12.02**	-4.57*	1.35	-4.88	-4.03	25.36**	21.38**	26.60**
L1 x T7	-5.73*	-7.07**	0.33	-3.35	-8.53**	-12.72**	29.33**	23.02**	8.86	5.53	1.06	5.41
L1 x T8	-7.10**	-8.07**	1.39	6.89**	-2.58	0.86	9.39	1.32	-10.3	13.63**	9.68*	14.39**
L1 x T9	-4.62	-6.81**	5.46*	-6.64**	-14.91**	-11.90**	12.24	3.9	-8.06	34.27**	22.57**	27.84**
L1 x T10	-0.32	-4.00	3.66	16.67**	8.03**	8.03	4.23	-1.75	-1.79	34.11**	31.34**	36.99**
L2 x T1	7.89**	4.02	15.57**	2.09	-22.61**	1.33	-11.55	-26.08**	-14.5	21.07**	-3.88	19.26**
L2 x T2	-0.98	-4.57	6.02*	12.00**	-14.50**	11.95**	-3.4	-17.07**	-4.03	21.74**	12.70*	39.83**
L2 x T3	-5.09**	-11.38	-1.54	3.74*	-10.89**	16.68**	11.61	4.03	20.32*	34.46**	32.84**	64.82**
L2 x T4	5.18*	2.08	13.40**	7.44**	5.39**	37.98**	-2.47	-9.06	5.19	21.97**	14.18**	41.66**
L2 x T5	10.39**	6.45**	18.26**	-1.31	-26.61**	9.39**	2.51	-10.57	3.49	16.93**	8.24*	34.29**
L2 x T6	14.03**	12.12**	24.56**	15.77**	-5.91**	23.19**	1.9	-4.61	10.38	31.80**	17.78**	46.14**
L2 x T7	9.49**	6.44**	18.25**	21.31**	4.86**	37.30**	-15.84	28.87**	-17.73*	16.62**	3.17	28.01**
L2 x T8	8.92**	8.52**	20.57**	29.19**	15.68**	51.46**	16.23	-3.99	11.1	16.39**	3.71	28.69**
L2 x T9	8.02**	7.04**	21.13**	25.73**	12.57**	47.39**	3.68	-14.4	-0.98	40.13**	18.70**	47.27**
L2 x T10	16.75**	10.91**	23.22**	34.38**	18.50**	55.16**	2.22	-4.72	10.21	12.36**	1.46	25.89**
L3 x T1	15.62**	6.00**	31.18**	-24.43**	-47.86**	-7.22**	-3.61	-28.46**	14.68	42.10**	6.85	64.12**
L3 x T2	23.03**	12.73**	39.52**	-14.85**	-40.92**	5.13**	12.15	-14.91	36.44**	20.05**	0.15	58.28**
L3 x T3	8.83**	-3.21	19.78**	-9.14**	-22.42**	38.06**	13.24*	-8.04	47.49**	42.06**	25.45**	98.26**
L3 x T4	14.25**	5.39*	30.43**	-11.38**	-32.29**	20.50**	1.58	-17.54**	32.23**	26.32**	6.41*	68.17**
L3 x T5	20.60**	10.57**	36.84**	-6.96**	-36.80**	12.42**	11.84	-14.02**	37.87**	29.71**	8.20**	71.00**
L3 x T6	12.05**	4.64*	29.49**	-15.42**	38.25**	9.88**	-16.92**	-32.31**	8.5	36.21**	10.20**	74.16**
L3 x T7	13.76**	5.10*	30.01**	3.23*	20.71**	41.11**	-23.69**	-42.84**	-8.33	46.16**	17.22**	85.27**
L3 x T8	11.08**	5.04*	30.00**	8.02**	14.57**	52.03**	2.32	-24.77**	20.60**	27.69**	3.05	62.87**
L3 x T9	16.97**	11.97**	38.56**	2.95*	18.58**	44.78**	6.54	-21.70**	25.51**	48.86**	14.99**	81.74**
L3 x T10	24.91**	12.91**	39.73**	12.42**	12.20**	56.14**	-6.33	-23.96**	21.93**	43.01**	16.75	84.52**

Table 1. (Contd…)

Hybrids	Number of clusters/plant			100 grain weight			Grain yield/plant		
	Heterosis per cent over			Heterosis per cent over			Heterosis per cent over		
	Mid parent	Better parent	Standard parent	Mid parent	Better parent	Standard parent	Mid parent	Better parent	Standard parent
L1 x T1	11.38*	8.61	-10.02**	8.99**	7.04*	-4.27	52.88**	33.09**	13.00**
L1 x T2	33.98**	22.20**	1.23	-5.85*	10.53**	11.10**	-2.3	-10.56**	-8.61*
L1 x T3	26.87**	6.55**	29.86**	21.36**	8.51**	23.16**	35.34**	13.67**	41.98**
L1 x T4	44.74**	23.93	6.81	18.21**	12.79**	11.10**	59.47**	56.69**	33.03**
L1 x T5	8.52	-3.41	2.57	21.15**	11.03*	19.21**	32.18**	20.74**	23.95**
L1 x T6	33.00**	20.19**	25.40**	13.05**	12.95**	1.07	82.74**	63.13**	38.49**
L1 x T7	24.08**	13.53**	13.31**	18.22**	12.86**	10.99**	68.11**	54.78**	31.39**
L1 x T8	29.87**	16.94**	20.96**	20.87**	9.67**	20.28**	25.67**	19.26**	12.73**
L1 x T9	26.47**	9.05*	24.67**	19.92**	15.85**	11.21**	37.40**	34.36**	19.36**
L1 x T10	17.29**	7.23	7.21	16.39**	10.25**	10.25**	0.28	-7.29	-7.3
L2 x T1	-1.66	-18.64**	-2.18	-0.31	-7.74**	-6.51	23.02	-7.60*	15.75**
L2 x T2	21.11**	-5.07	14.15**	11.81**	10.69**	12.17**	22.74**	11.42**	39.56**
L2 x T3	8.71*	7.98*	31.59**	10.96**	12.03*	19.21**	30.04**	29.65**	62.65**
L2 x T4	23.29**	-5.16	14.04**	2.94	1.47	-2.13	30.78**	8.16**	35.48**
L2 x T5	-5.0	-10.55**	7.55	-23.14**	-25.30**	-19.74**	-16.40**	-23.94**	-4.72
L2 x T6	13.8	6.28	27.78**	24.69**	17.27**	18.89**	52.42**	16.77**	46.26**
L2 x T7	7.31	-1.8	18.07**	-7.80**	-9.16**	-7.90**	22.42**	-3.89	20.40**
L2 x T8	-1.34	-8.24*	10.34*	-4.04	-7.73**	1.28	12.11**	-1.65	23.22**
L2 x T9	-0.65	-3.09	16.51**	7.33**	4.48	5.87*	19.08**	1.77	27.47**
L2 x T10	1.68	-6.87	11.97*	3.58	2.9	4.27	21.46**	9.20**	36.78**
L3 x T1	-6.49	-26.50**	1.53	-7.74**	-21.63**	-3.31	12.72**	-22.14**	28.41**
L3 x T2	-3.78	-28.02**	0.93	-12.39**	-20.38**	-2.45	11.22**	-9.94**	48.51**
L3 x T3	15.44**	8.83**	49.78**	6.67**	2.38	26.36	18.16**	3.83	71.22**
L3 x T4	23.17**	-9.44**	24.64**	-8.73**	-17.95**	1.28	26.96**	4.98*	56.68**
L3 x T5	-7.31	-17.90**	13.00**	9.71**	2.6	26.57**	23.08**	-0.14	64.66**
L3 x T6	-7.15	-18.38**	12.33**	-9.41**	-21.93**	-3.63	21.12**	-14.95**	40.23**
L3 x T7	12.85**	-2.66	33.97**	-1.9	-11.85**	8.75**	23.85**	-11.26**	46.33**
L3 x T8	13.3	-0.78	36.56**	-13.25**	-18.04**	1.17	23.94**	-2.51	60.77**
L3 x T9	11.44	2.01	40.39**	11.83**	-0.61	22.62	28.50**	-1.14	63.02**
L3 x T10	26.76	9.42**	51.00**	-2.25	-11.51**	9.18**	22.22**	-1.84	61.88**

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