



Studies on Combining ability in pearl millet (*Pennisetum glaucum* (L) Lecke)

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Abstract: A total of 30 crosses was obtained by crossing five male sterile lines with six restorers in line x tester mating design. Crosses and parents were studied for their combining ability in five characters in pearl millet. Based on mean performance and *gca* effect male sterile line ICMA 92333 and the restorers PT 5567, PT 5590 were identified as the best general combiners for yield contributing characters. Hybrids *viz.* ICMA 92333 X PT 5595, 405A x PT 5590 and ICMA 91777 X PT 5590 were screened as best for grain yield per plant based on *per se* performance and *sca* effects.

Key words: Combining ability, *gca* effect, *sca* effect

Introduction

The concept of combining ability plays a significant role in crop improvement as it helps in determining the nature of gene action involved in the expression of quantitative traits. Combining ability studies help in the identification of parents having *gca* hybrids with high *sca*. The present investigation, therefore, was carried out in pearl millet to identify superior cross combinations for commercial exploitation.

Materials and Methods

A total of 30 crosses was obtained by crossing five male sterile lines *viz.* 405A(L1), 732A(L2), ICMA 91777(L3), ICMA 92111(L4) and ICMA 92333(L5) with six restorers *viz.* PT 5567(T1), PT 5568(T2), PT 5569(T3), PT 5570(T4), PT 5590 (T5) and PT 5595(T6) in a line x tester mating system. These 30 hybrids along with their five isogenic maintainers and six restorers were studied for their combining ability in randomised block design with three replications during *Kharif* 1995 at Agricultural College and Research Institute, Killikulam. Observations were recorded on five characters *viz.* days to first flowering, plant height, total number of tillers, grain yield per plant and protein content. Combining ability analysis was done following Kempthorne (1957) model.

Results and Discussion

The combining ability analysis (Table 1) indicated the importance of both additive and non-additive gene action for all characters. The

ratio of *gca* : *sca* variance revealed the predominance of additive gene action for three characters *viz.* days to first flowering, plant height and total number of tillers, while non-additive gene action for grain yield per plant and protein content was observed. This is in consonance with the findings of Navale and Harinarayana (1992) and Kandasamy and Sethupathi Ramalingam (1995).

The results of mean performance of parents indicated the high *per se* performance with three parents *viz.* ICMA 92333, PT 5568 and PT 5590 (grain yield per plant), PT 5567 (days to first flowering, total number of tillers) and PT 5590 (plant height, grain yield, protein content). Among the crosses hybrids *viz.* ICMA 92333 x PT 5567, ICMA 92333 x PT 5595, ICMA 92333 x PT 5568, ICMA 92333 x PT 5569, 732 A x PT 5567 and ICMA 92111 x PT 5567 exhibited superior mean performance for grain yield per plant and most of the yield contributing characters (Table 3).

The *gca* effects showed that lines ICMA 92111 and ICMA 92333 were good combiner for days to first flowering, plant height, total number of tillers, grain yield per plant and protein content. Among the restorers PT 5567 was a good general combiner for days to first flowering, plant height and total number of tillers, while PT 5590 was superior general combiner for plant height, grain yield per plant and protein content (Table 2). The estimates of *sca* effects revealed that the crosses 405A x PT 5570, 405A x PT 5595, 732A x PT

Table 1. Mean squares for *gca* variance

Characters	Source			
	<i>gca</i>	<i>sca</i>	Error	<i>gca</i> : <i>sca</i>
Days to first flowering	1.69	1.41	0.55	1.20:1
Plant height	175.07	151.64	5.98	1.51:1
Total number of tillers	0.13	-0.01	0.15	-13.0:1
Grain yield per plant	6.24	20.02	7.25	0.31:1
Protein content	0.04	0.08	0.02	0.50:1

Table 2. Mean performance and *gca* effects of parents

Characters	Days to first flowering		Plant height		Total number of tillers		Grain yield per plant		Protein content	
	mean	<i>gca</i>	mean	<i>gca</i>	mean	<i>gca</i>	mean	<i>gca</i>	mean	<i>gca</i>
Lines										
405A	53.00	1.49**	179.50	25.42**	3.13	-0.42**	23.80	-2.50**	4.68	-0.03
732A	48.33	-0.51**	66.24	-20.45**	4.27	-0.14**	16.07	-2.69**	4.48	-0.23**
ICMA91777	49.67	1.43**	118.8	8.31**	2.47	-0.38**	14.00	-1.54**	3.88	-0.29**
ICMA92111	46.33	-1.34**	113.5	-9.78**	4.67	0.53**	18.80	2.28**	3.96	0.26**
ICMA92333	44.67	-1.07**	113.4	-3.50**	5.20	0.41**	28.00	4.45**	3.77	0.29**
Testers										
PT5567	44.33	-1.23**	84.37	-1.53**	4.67	0.46**	11.13	-0.42	4.82	-0.28**
PT5568	46.00	-0.70**	116.60	-0.54	3.33	0.00	24.67	0.26	5.06	-0.07**
PT5569	44.33	-0.77**	138.90	-0.61	3.27	-0.04	23.53	-3.04**	5.11	-0.13**
PT5570	46.67	0.37*	108.30	-0.21	3.27	-0.02	16.93	-3.43**	5.89	0.33**
PT5590	48.33	2.77**	97.52	-12.05**	2.73	-0.35**	25.20	5.43**	5.99	0.11**
PT5595	47.00	-0.43**	157.90	14.94*	3.40	-0.06	22.33	1.19**	5.14	0.04
SE (<i>gca</i>)		0.14		0.465		0.075		0.515		0.03
CD	1.20		4.44		0.60		4.09		0.27	

*, ** - significant at $p = 0.05$ and $p = 0.01$ respectively

5567, ICMA 9177 x PT 5568, ICMA 91777 x PT 5590, ICMA 91777 x PT 5595 and ICMA 92333 x PT 5597 had significant and desirable *sca* effects for most of the characters.

Goyal and Sudhirkumar (1991) and Ramalingam *et al.* (1993) observed a high correlation between *per se* performance and *gca* effects of parents. So selection of superior parents and combinations was based on *per se* performance and combining ability. Hence ICMA 92333 was considered to be the best male sterile line and restorers PT 5567 and PT 5590 were selected based on *per se* and *gca* effects. They can be used in the hybridization programme with CMS lines for the development of superior crosses. The hybrids *viz.* 405A x PT 5590, ICMA 91777 x PT 5590 and

ICMA 92333 x PT 5595 were identified as the best, based on their high *per se* performance for grain yield per plant as well as most of yield associated characters. They can be further studied for exploiting heterotic breeding.

References

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Table 3. Mean performance and *sca* effects of parents for five characters

Characters	Days to first flowering		Plant height		Total number of tillers		Grain yield per plant		Protein content	
	mean	<i>sca</i>	mean	<i>sca</i>	mean	<i>sca</i>	mean	<i>sca</i>	mean	<i>sca</i>
Hybrids										
L1 x T1	42.33	-0.16	181.59	1.22	3.67	-0.10	29.87	-1.39	4.62	0.28**
L1 x T2	43.33	0.31	188.37	7.01**	3.07	-0.23	27.93	-4.01**	4.60	0.06
L1 x T3	42.00	-0.96**	157.47	-23.83**	3.27	0.00	21.93	-6.71**	4.29	-0.20**
L1 x T4	44.33	0.24	170.00	-11.70**	3.40	0.12	33.00	4.75**	4.95	0.00
L1 x T5	48.33	1.84**	199.13	29.28**	3.13	0.18	43.40	6.29**	4.61	-0.12*
L1 x T6	42.00	-1.29**	194.87	-1.97*	3.27	0.02	33.93	1.06	4.64	-0.02
L2 x T1	40.67	0.18	143.04	8.53**	4.33	0.29	38.27	7.20**	4.64	0.49**
L2 x T2	42.00	0.98**	134.41	-1.09	3.73	0.15	37.07	5.32**	4.37	0.02
L2 x T3	41.00	0.04	145.21	9.77**	3.57	0.02	30.13	1.68	4.27	-0.02
L2 x T4	39.00	-3.09**	128.37	-7.46**	3.47	-0.10	24.73	-3.32**	4.66	-0.09
L2 x T5	45.00	0.51	108.55	-15.44**	2.87	-0.37**	29.80	-7.12**	4.40	-0.13*
L2 x T6	42.67	1.38**	156.66	5.68**	3.53	0.01	28.93	-3.75**	4.18	-0.28*
L3 x T1	42.33	-0.10	165.66	1.79**	3.47	-0.34*	29.13	-3.09**	4.17	0.09
L3 x T2	42.00	-0.97**	173.37	9.11**	3.33	-0.01	38.00	5.10**	4.12	-0.17*
L3 x T3	42.33	-0.57	167.70	2.98**	3.20	-0.11	32.63	3.03**	4.17	-0.06
L3 x T4	46.67	2.63**	166.01	1.42	3.33	0.01	24.00	-5.21**	4.75	0.06
L3 x T5	45.67	-0.77*	141.67	-11.08**	3.13	0.14	39.67	1.59	4.48	0.01
L3 x T6	43.00	-0.23	175.51	-4.23**	3.60	0.31*	32.40	-1.43	4.49	0.08
L4 x T1	39.67	0.01	144.29	-0.89	4.87	0.15	32.93	-3.10**	3.79	-0.85**
L4 x T2	40.33	0.14	137.73	-8.45**	4.20	-0.05	36.13	-0.58	4.83	-0.01
L5 x T3	41.33	1.21**	158.16	12.05**	4.27	0.05	34.73	1.32	4.90	0.12*
L6 x T4	40.67	-0.59	153.72	7.22**	4.13	-0.11	32.80	-0.22	5.64	0.40**
L4 x T5	43.00	-0.66**	133.97	-0.69	3.93	0.03	43.93	2.04	5.41	0.39**
L4 x T6	40.33	-0.12	152.41	-9.24**	4.13	-0.07	38.20	0.55	4.91	-0.05
L5 x T1	40.00	0.07	140.82	-10.64**	4.60	0.00	38.60	0.39	4.65	-0.01
L5 x T2	40.00	-0.47	145.87	-6.58**	4.27	0.14	33.07	-5.83**	4.97	0.10
L5 x T3	40.67	0.27	151.41	-0.98	4.13	0.04	36.27	0.67	4.97	0.16**
L5 x T4	42.33	0.80**	163.30	10.52**	4.20	0.08	39.20	4.00**	4.90	-0.37**
L5 x T5	43.00	-0.93**	138.87	-2.07*	3.80	0.02	41.27	-2.80*	4.90	-0.15*
L5 x T6	41.00	0.27	177.68	9.75**	3.80	-0.28	43.40	3.57**	5.26	0.27**
SE (<i>sca</i>)		0.30		0.99		0.15		1.09		0.06
CD	1.20		4.44		0.60		4.09		0.27	

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