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HETEROSIS AND RECOMBINATION POTENTIAL IN PENNISETUM AMERICANUM (L.) LEEKE[1]

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ABSTRACT

The ear weight, grain yield and tiller number in pearl millet exhibited higher degree of heterosis. Inbreeding depression was higher for grain yield in BxB series than in RxR series. Heterosis for grain yield was retained to a great extent in the F_2 of cross L 111 B x J 126 D_2B. A few three-way crosses combining superior attributes were identified. Superiority of three-way crosses over single crosses were observed for important yield attributes indicating the possibility of deriving superior recombinants.

KEY WORDS : Pearl millet, Heterosis, Recombination.

Single crosses involving diverse parental genotypes were evaluated in their F_1 generation in pearl millet for expression of heterosis and combining ability. Three way crosses were also synthesised based on the *gca* of parents, *sca* of crosses and heterosis for yield and yield components. They were compared with the corresponding single crosses and F_2s for various character expressions. The inbreeding depression and the residual heterosis in single cross F_2s were recorded.

MATERIALS AND METHODS

Two sets of 27 three-way crosses in each were compared with the corresponding 10 parents, 9 F_1s and 9 F_2s for various character expressions. They were sown in 3 M row plots (replicated three times) in compact family block design to find out variance within and between the families. The parents and F_1s were sown in single row plots of 3 M length, while there were ten rows for F_2s and 3 rows for each three-way cross. Observations on six biometrical characters were recorded on five plants randomly chosen from each row and each replication. The mean values were used for statistical analysis appropriate for compact family blocks design (Panse and Sukhatme, 1967).

The heterosis exhibited by single and three-way crosses were estimated. The inbreeding depression and the residual heterosis in the single cross F_2s were calculated using the appropriate formulae and the significance worked out (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

The highest mean heterosis (over better parent) was exhibited for grain yield followed by tiller number (Table 1). All the progenies, except F_2s, recorded significant positive heterosis for grain yield. For tiller number, the three-way crosses from restorer series alone recorded significant positive heterosis.

The mean heterosis for plant height recorded by the non-restorer progenies was higher than in the restorers. Three-way crosses involving PT 1824 as third parent recorded the highest heterosis of 21.43 percent. The mean heterosis for panicle length both in non- restorers and restorers was almost same, but the heterosis for days to flowering was slightly higher in the non-restorers as compared to the restorer progenies. The three-way crosses involving PT 1921 as third parent were distinctly earlier than the rest. Significant positive

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Table 1. Mean heterosis (%) over better parent in the different progenies of families.

Progeny	Plant height		Panicle length		Tiller number		DAS		Grain yield		Grain weight	
	I	II	II	I	II	II	I	II	I	II	I	II
F_1 over	15.17**	6.69**	8.40*	9.54*	11.56	22.49	-5.03*	-2.97**	89.54**	50.12*	15.64	15.07
F_2 over	2.74	-5.54**	-5.08	-5.70	-	4.02	-2.33	-1.05	20.74	4.45	3.25	0.79
WC_1 over	21.43**	9.57**	9.75*	0.89*	29.03	30.54*	-1.02	-0.30	96.81**	83.51**	19.45*	6.96
WC_2 over	12.59**	8.96**	1.66	9.26	28.22	38.25*	-3.22*	-0.15	58.69	97.09**	5.47	22.37**
WC_3 over	19.29**	4.54**	6.46	6.89	29.36	30.54*	-8.64**	-0.15	63.06*	95.70**	9.34	10.95

(Non-restorers) II (Restorers)

WC_1 : F_1 x PT 1824 — F_1 X Tift 239 DB_2
WC_2 : F_1 x PT 560 — F_1 X J 126 D_2B
WC_3 : F_1 x PT 1921 — F_1 X PT 248 5B

DAS : Days to 50 percent flowering
*: Significant at 5% level
**: Significant at 1% level

eterosis for grain weight has been ecorded by the three- way crosses nvolving PT 1824 (19.45 perc ent) and 126D2B (22.37 percent) as third parents.

The extent of inbreeding depression nd residual heterosis in single cross F_2s of on-restorers and restorers are given in ables 2 and 3. The values of inbreeding epression and residual heterosis were the highest for grain yield followed by tiller number, plant height and panicle length.

The three-way crosses involving Tift 239DB_2 and J 126D_2B recorded high degree of heterosis indicating that hybridisation followed by selection in later generations could improve height in the non-restorer lines. The inbreeding depression in the F_2s was almost similar in

Table 2. Inbreeding depression (%) and residual heterosis (%) in the single cross F_2s for six characters in non-restorer series of pearl millet

S. No.	Cross	Plant height		Panicle length		Tiller numbe	r Rh	DAS		Grain yield		Grain weight	
		ID	Rh	ID	Rh	ID		ID	Rh	ID	Rh	ID	Rh
1.	MS 5141B x PT 248/5B	6.97*	8.48*	9.60*	13.12*	-9.67	6.25	-4.49**	-3.18**	45.01*	25.98*	8.12	18.40*
2.	Tift 239DB_2 x PT 732/ 2B	24.28**	7.31**	25.33**	-9.53**	-2.44	42.37**	1.87	-9.56**	33.59**	36.39	2.24	2.25
3.	Tift 239DB_2 x MS 5141 B	6.11*	4.27*	10.52	-0.33	17.05	-21.70	4.36*	-6.60**	22.87	25.60	5.58	2.69
4.	ICMS 81B x L 111B	6.55*	18.16**	14.96**	6.06	4.91	-3.66	-0.90	-4.15*	35.57*	23.15	8.58	9.74
5.	ICMS 81B x Tift 239 DB_2	19.06**	6.82	12.15**	-1.75	30.00**	12.69	-0.69	-5.46	41.23**	39.67	6.51	11.62
6.	L 111B x Tift 239 DB_2	16.89	-8.54**	20.00**	14.23**	20.83	-17.58	1.94	-3.29	25.74**	33.92	23.04*	-1.30
7.	L 111B x MS 5141B	1.48	14.52**	4.04	9.00	33.64**	-20.39	-1.67	-1.74	36.33	5.79	11.06	-6.10
8.	L 111B x J 126 D_2B	13.81**	-12.09	9.32*	-6.23	24.67	7.29	13.07**	2.50	32.46**	61.73*	14.86**	11.32
9.	J 126D_2B x PT 248/5B	8.12*	2.36	10.07	-8.48	24.19	-9.25	-0.93	-0.12	43.30*	-7.24	13.43	-3.97
	Average inbreeding depression	11.47	3.43	12.89	-1.37	20.35	2.40	-1.51	-4.06	35.02	27.22	10.37	4.96

ID : Inbreeding depression (%) DAS : Days to 50 percent flowering
Rh : Residual heterosis (%)

Table 3. Inbreeding depression (%) and residual heterosis (%) in the single cross F_2s for six characte in restorer series of pearl millet

S. No	Cross	Plant height		Panicle length		Tiller number		DAS		Grain yield		Grain weigh	
		ID	Rh	ID	Rh	ID	Rh	ID	Rh	ID	Rh	ID	Rh
1.	PT 2598 x PT 2584	21.35*	-13.66*	23.38**	-9.59**	5.11	3.38	-1.61	-3.65*	32.98*	-8.57	3.89	-7.9
2.	PT 2598 x PT 1921	10.68**	-2.69**	10.99**	-1.74	15.85	21.66	-1.43	1.43	27.24	47.74*	24.34**	-6.3
3.	PT 2598 x K 560	3.99*	2.04*	18.76**	-7.40	9.80	-16.31	3.20**	-2.54	36.63	-17.97	14.41**	3.55
4.	PT 2584 x K 560	5.65*	0.35**	11.36**	-3.70	13.77	2.69	-1.29	-1.57	31.90	-0.03	12.86*	2.5
5.	PT 2584 x PT 1921	13.04**	0.45	26.80**	-5.47	8.08	16.60	-3.65**	-2.78*	13.19	26.58	14.92*	-12.1
6.	PT 1921 x PT 1824	13.19**	-10.16**	8.50	2.02	18.41*	17.12	0.80	-10.05*	29.08	26.83	7.96	-2.5
7.	J 104 x PT 1824	9.38**	-3.45**	5.67	-7.07	19.74	1.96	-4.03*	-4.15*	17.26	0.47	8.77	3.7
8.	J 104 x PT 2784	12.89**	-3.64**	11.32**	-7.64*	28.05	-1.89	-5.86**	-0.76	27.13*	68.56*	8.53	9.1
9.	J 104 x PT 2598	9.98**	-1.57	7.97	-1.68	15.25*	13.97	-1.45	2.53	35.42*	-17.88	14.63*	-2.4
	Average inbreeding depression	11.12**	-3.59	13.86	-5.88	14.89	2.73	-1.70	-2.28	27.87	13.67	12.28	-1.

ID : inbreeding depression (%) DAS : Days to 50 percent flowering
Rh : Residual heterosis (%)

both the series and the residual heterosis was also negative. This indicates the role of dominant genes in determining plant height as earlier observed by Lal and Singh (1969), Ravindran (1982) and Shinde *et al.* (1984).

In general, higher panicle length was observed in three-way crosses of restorer series than that of non-restorers. Higher inbreeding depression was recorded in the restorers (13.86 percent) than in the non-restorers (12.89 percent). Lal and Singh (1969), Shinde *et al.* (1984) and Rai *et al.* (1985) also reported similar results. Although the average expression of three-way crosses was not superior to the mean values of single crosses, a few three way crosses exceeded the corresponding single cross F_1s and showed potentiality for producing superior segregants for panice length.

For tiller number, the average expression of heterosis was higher in the three-way crosses as compared to the respecti single cross F_1s both in the maintainer ar restorer series. The three-way crosses fro the restorer series could prove useful increasing the tiller number to considerable degree. For inducing earliness the genotype PT 1921 which recorded th highest negative heterosis offers scope fc generating early maturing genotypes Significant inbreeding depression for tille number and days to flowering was see which were earlier reported by Lal and Sing (1969) and Shinde *et al.* (1984).

The three-way crosses in the RxI (restorers) series expressed higher mea heterosis than BxB's (non-restorers). Th three-way crosses, involving PT 1824 and $126D_2B$ as third parents, exhibited th highest degree of heterosis of 96.91 an 97.09 percent over their better parent respectively as against 89.54 and 50.1

ercent in the corresponding single cross is.

Sprague *et al.* (1962) reported that the ifferences between expected and bserved expressions for biometrical traits n the three-way crosses in maize could be nterpreted to be due to epistatis. The equency of three-way crosses that xceeded the corresponding single crosses as higher in RxR series than in BxB series ndicating that improvement of grain yield ould be effected with much facility in the estorers as compared to the maintainers Jayamohana Rao *et al.*, 1982).

The inbreeding depression recorded in ie F_2s of maintainers was 35.02 as against 7.87 percent in the restorers. Similar sults on inbreeding depression in grain eld were reported by Singh and Lal (1969), Balyan and Gupta (1980), Govil and Rana 1983), Shinde *et al.* (1984) and Rai *et al.* 1985). This inference is further strengthened by the presence of non-significant residual heterosis in many F_2s. Improvement for seed yield therefore could be achieved by initial hybridization followed by recurrent selection procedures.

The three-way crosses in the BxB series have expressed more or less a similar degree of heterosis for grain weight as compared to the respective single cross F_1s. Higher inbreeding depression was recorded in non-restorers (12.28 percent) as compared to the restorers (10.37 percent). Inbreeding depression for grain weight has been earlier reported by Lal and Singh (1969), Shinde *et al.* (1984) and Rai *et al.* (1985). The three-way crosses involving PT 1824 and J $126D_2B$ as third parents, which recorded higher grain weight than the corresponding F_1s could be utilised for improving this trait by adopting recurrent selection procedures following hybridisation.

The three-way crosses involving K 560 and PT 248/5B recorded high heterosis values in the non-restorer and restorer series respectively, in addition to other desirable attributes such as tiller number and grain weight. The three-way crosses with improved potentiality could be directly utilised for generating superior inbred derivatives to be used as parents for future hybrids.

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