Table 1. Effect of underground tile drain on the yield of ADT-36 rice

	Yield (kg/ha)					
	1986-87			1987-88		
(M)	$d_1$60	$d_2$90	M	$d_1$60	$d_2$90	M
S_1	3276	4759	4017	3766	5099	4433
S_2	2477	2872	2674	2999	3666	3333
M	2876	3815		3383	4383	
	SE	CD (5%)		SE	CD (5%)	
L	29	88		31	94	
D	29	88		31	94	
L x D	41	124		44	134	

depth registered the highest yield of 4759 kg ha^{-1} during the year 1986 - '87 and 5100 kg ha^{-1} during the year 1987 - '88 respectively which differ significantly from other treatments. The highest yield may be due to the fact that, the lesser spacing with deeper depth facilitated good drainage in problem soils. This result is in conformity with the findings of lassondiere and Martin (1974) that in under ground drainage in problem soil, the system with 80 cm depth with 10 m lateral spacing was better performance compared to 55 cm depth with 10 m lateral spacing. Kumbhare and Rao (1985) also observed that the deep cultivation considerably reduced the soluble salts in problem soil and this would ultimately lead to higher yield. The lowest yields were recorded in the treatment having 15 m lateral spacing with 60 cm depth in both the seasons probably the water would not have drained fully intime through the shallow depth of 60 cm drain. The results revealed that the under ground tile drainage of 10 m lateral spacing with 90 cm depth of laying was found to be effective in increasing the yield of ADT 36 rice in wet land sodic soil.

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EVALUATION OF SINGLE AND THREEWAY CROSS HYBRIDS OF PEARL MILLET

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ABSTRACT

Hybrids of five altered male sterile lines with 0.5 transferred genome (TG)(81A x 3383B, 81AxPb305B, 3383A x 81B, Pb 302A x Pb 305B, Pb 403A x Pb 405B) and four altered made sterile lines with 0.75 TG level (81A x $3383B^2$, 3383A x $81B^2$, Pb 302A x $Pb\ 305B^2$, Pb 403A x $Pb\ 405B^2$) along with single cross hybrids of respective inbred male sterile lines and checks were evaluated during 1988-89 *kharif and rabi*. Significant differences were observed among the entries for all the characters in both the seasons. The three way cross (81A x Pb305B) x PIB 2231P out yielded the check X.5. The hybrids (3383A x 81B) x PIB 2231P and (Pb403A x Pb405B) x PIB 2231P recorded significantly higher yield than single crosses of their respective original A lines. The hybrids of altered A lines with 0.5 TG were found to be superior than the hybrids of respective altered A lines with *0.75 TG*. Superiority of three way crosses over single crosses was observed which offered scope for the production of three way hybrids.

KEY WORDS : Single and Three Way Crosses, Altered A lines

In general, single cross hybrids because of theor uniformity, have been more vulnerable than [illegible] and diseases. To obviate this type of problem, Harinarayana (1987) suggested to breed for heterogeneous and heterozygous, three way or

multicross hybrids. Hence an attempt was made to develop three way cross hybrids of pearl millet in this study.

MATERIALS AND METHODS

Six male sterile lines *viz.*, 81A, 3383A, Pb 302A, Pb 305A, Pb 403A and Pb 405A, five altered A lines with 0.50 TG level (81A x 3383B, 81A x Pb 305B, 3383A x 81B, Pb 302A x Pb 3305B, Pb 403A)xPb 405 B and four altered A lines with 0.75 TG level (81A x $3383B^2$, 3383A x $81B^2$, Pb 302A x Pb $305B^2$, Pb 403A x Pb $405B^2$) were crossed with the restorer PIB 2231P. These 15 hybrids along with six B lines, one R line and X.5 and Co.7 checks were raised in a randomised block design replicated thrice during 1988-89 *kharif and rabi*, at the Regional Research Station, Vridhachalam. For each entry, 20 per row were raised in each replication. Observation on six traits *viz.*, days to fifty per cent flowering, plant height, number of productive tillers per plant, length of panicle, girth of panicle and grain yield per plant were recorded on ten plants selected at random.

RESULTS AND DISCUSSION

Significant differences were observed among the entries for all the characters in both the seasons. The pooled analysis revealed that there was significant seasonal effects on all the characters barring the number of productive tillers per plant. Interaction effects were significant for all the characters (Table 1). The seasonal influence on the expression of traits in pearl millet was reported by Appa Rao et al. (1989). When compared with superior check X.5, all the hybrids proved their superiority for earliness and dwarf stature in both the seasons. For grain yield per plant, the single cross hybrid 81A x PIB 2231P and three way cross (81A x Pb 305B) x PIB 2231 P recorded significant *per se* performance over X.5 (X.5 yield=24.6 g and 17.3 g per plant in *kharif and rabi*, respectively) in both the seasons. The percentage of increase was 31.3 and 16.3 in *kharif* and 16.2 and 13.9 in *rabi*, respectively.

The test of significance on the comparative *per se* performance of single and three way crosses involving original and altered (0.5 TG and 0.75 TG) A lines for six traits in *kharif and rabi* seasons are given in Table 2. All the hybrids of altered A lines of 81A were significantly earlier in flowering during *kharif*, whereas one hybrid was earlier in *rabi* over single cross hybrids of 81A. In *kharif*, all the hybrids of altered A line produced significantly higher number of tillers per plant than the single cross hybrid of 81A. The hybrids of altered A lines of 3383A were late in flowereing and hybrid with 0.5 TG in *kharif* and hybrids with both genome level in *rabi* were taller and recorded significantly higher grain yield (Table 3) than single cross hybrid of 3383A. During *kharif*, the hybrids of altered A line with 0.5 TG showed significant superiority for number of productive tillers per plant over single cross hybrids of Pb 302A, whereas hybrid of altered A lines with 0.75 TG was earlier with long panicle during *rabi* than the single cross hybrid.

The hybrids of altered A lines of Pb 403A were significantly earlier and taller with more panicale girth in *kharif* than single cross hybrid of Pb 403A. The hybrid of altered A line with 0.5 TG recorded significantly higher grain yield in *kharif* (Table 3). A critical examination of the hybrid

Table 1. Pooled analysis of variance

Source of variation	DF	Mean squares					
		Days to 50 percent flowering	Plant height	Numbre of productive tillers	Panicle length	Panicle girth	Grain yield
Seasons (S)	1	488.9632**	3353.125**	0.3008	40.3332**	9.4519**	370.1854**
Genotype (G)	23	20.6091**	1000.9585**	0.7775*	22.0595**	0.8058**	43.9902**
G x S	23	4.4516**	121.0617**	0.2874**	4.0781**	0.1223**	4.8396**
Pooled error	92	0.2568	7.2781	0.0336	0.4798	0.0338	1.0827

* Significant at P = 0.05 ** Significant at P = 0.01

combinations indicated that the hybrids of altered A lines of 3383 A and Pb 403A were proved to be superior to the hybrids of respective original A lines. The reason for recording higher grain yield by the hybrid of altered A line of 3383A might be due to slight increase in panicle length and girth and also due to the interaction genome of alternate B line 81B. When the genome of 3383B was transferred to 81A the expression of traits in hybrids of altered A line was lesser than the single cross hybrid of 81A. The reaction was *vice versa* when 81B was used as alternate B line for 3383A. This indicated the high potential of the genome of 81A\81B.

Study conducted at ICRISAT (1989) revealed that the hybrid of F1 male sterile line (altered A line with 0.5 TG level) yielded ten per cent lesser at ICRISAT centre and 25 per cent lesser at Bhavanisagar than the single cross hybrids. But it yielded six per cent more than the single cross hybrids at Hissar. But in the case of earliness, the hybrids were slightly earlier in flowering and shorter in height which was desirable. The reason

Table 2. Test of significance on the comparative *per se* performance of single and three way crosses involving original and altered (0.5 TG and 0.75 TG) A lines in *kharif*

Hybrids	Days to 50 per cent flowering (Early)		Plant height (Tall)		Number of productive tillers		Panicle length		Panicle girth		Grain yield per plant	
	K	R	K	R	K	R	K	R	K	R	K	R
@ 81A x PIB 2231P												
(81A x 3383B) x PIB 2231P	S	-	-	-	S	I	I	I	I	I	I	I
(81A x 3383B^2) x PIB 2231P	S	S	I	I	S	-	I	I	I	-	I	I
(81A x Pb 305B) x PIB 2231P	S	-	I	-	S	-	I	I	I	S	I	-
@ 3383A x PIB 2231P												
(3383A x 81B) x PIB 2231P	I	I	S	S	I	I	I	-	-	-	S	S
(3383A x 81B^2) x PIB 2231P	I	-	-	S	I	I	I	-	-	-	-	S
@ Pb 302A x PIB 2231P												
(Pb 302A x Pb 305B) x PIB 2231P	-	-	-	-	S	I	-	-	-	-	-	-
(Pb 302A x Pb 305B^2) x PIB 2231P	-	S	-	-	-	-	-	S	-	-	-	-
@ Pb 403A x PIB 2231P												
(Pb 403A x Pb 405B x PIB 2231P	S	-	S	I	I	-	-	-	S	S	S	-
(Pb 403A x PB 405B^2) x PIB 2231P	S	I	S	S	I	-	S	-	S	-	-	-

@ Single Crosses
S = Significantly superior than respective single cross
I = Significantly inferior than respective single cross
- = Differences between hybrids of altered A lines and single cross of respective original A lines non-significant
K and R denote *kharif* and *rabi* seasons, respectively

Table 3. Superior hybrids of altered A lines for grain yield per plant (g)

Entry	Grain yield		Increase over single cross* (in per cent)	
	Kharif	*Rabi*	*Kharif*	*Rabi*
*338A x PIB 2231P	20.8	11.3	-	-
(3383A x 81B) x PIB 2231P	25.0	17.0	20.2	50.4
(3383A x 81B^2) x PIB 2231P	-	16.9	-	49.6
* Pb 403A x PIB 2231P	16.4	-	-	-
Pb 403A x Pb 405B) x PIB 2231P	20.9	-	27.4	-

Table 4. Test of significane showing the superiority/inferiority of the hybrid of altered A line with 0.5 TG over the hybrid with 0.75

Hybrids	Days to 50 per cent flowering (Early)		Plant height (Tall)		Number of productive tillers		Panicle length		Panicle girth		Grain yield per plant	
	K	R	K	R	K	R	K	R	K	R	K	R
(81A x 3383B) x PIB 2231P	-	I	-	S	-	I	S	-	-	I	-	-
@ (81A x $3383B^2$) x PIB 2231P												
(3383A x 81B) x PIB 2231P	-	I	S	S	S	-	-	-	-	-	S	-
@ (3383A x $81B^2$) x PIB 2231P												
(Pb 302A x Pb 305B) x PIB 2231P	-	-	S	-	S	I	-	-	I	-	S	-
@ (Pb 302A x $Pb\ 305B^2$) x PIB 2231P												
(Pb 403A x Pb 405B x PIB 2231P	-	S	I	I	-	-	-	I	-	-	-	-
@ (Pb 403A x $PB\ 405B^2$) x PIB 2231P												

@ = Hybrids of altered A lines with 0.75 TG
S = Significantly superior than respective hybrids of altered A lines with 0.75 TG
I = Significantly inferior than respective hybrids of altered A lines with 0.75 TG
- = Differences not significant
K and R denote *kharif* and *rabi* seasons, respectively

attributed for low yield was one of the A lines involved was much poorer combiner that had clearly contributed this character to the F1. Hence it is suggested to use good combining inbred A lines for development of altered male sterile lines to obtain good hybrids. In sorghum, Sivasamy (1988) also reported the possibility of developing superior hybrid combinations by using altered A lines than hybrid of original A lines.

Comparison of the mean performance of three way cross hybrids with 0.5 TG and 0.75TG revealed the following. The hybrids of altered A line of 81A with 0.5 TG recorded significantly longer panicle (in *kharif)* and tall stature (in *rabi)* than the hybrid of altered A line of 81A with 0.75 TG. Regarding hybrid of altered A line of 3383 A with 0.5TG, it recorded significant superiority for plant height, number of productive tillers and grain yield per plant in *kharif* and for plant height in *rabi.* Superiority of the hybrid of altered A line of Pb 302A with 0.5 TG over 0.75 TG was observed for plant height, number of productive tillers per plant and grain yield per plant in *kharif.* The hybrid of altered A line of Pb 403A with 0.5 was earlier than the hybrid with 0.75 TG in *rabi* (Table 4).

In general, low yield was obtained almost in all the three way hybrids of altered A lines with 0.75 TG level when compared with three way hybrids

Table 5. Mean performance of three way cross hybrids with 0.5 TG and 0.75 TG

Hybrid combination	Grain yield per palnt (g)			
	Kharif		*Rabi*	
	0.5 TG	0.75 TG	0.5 TG	0.75 TG
(81A x 3383B) x PIB 2231P	20.0	16.7	14.5	13.1
(3383A x 81B) x PIB 2231P	25.0*	19.8	17.0	16.9
(Pb302A x PB305B) x PIB 2231P	17.4*	13.8	13.0	12.3
(PB403A x PB405B) x PIB 2231P	20.9	18.2	9.8	9.8

* Significant at P = 0.05

of respective altered A line with 0.5 TG level (Table 5). This may be due to the interaction of the genome of the altered male sterile line at 0.5 TG level, since the altered A line at 0.5 TG level itself is a hybrid (F1 male sterile line).

From this study, it is observed that the existing male sterile lines may be utilised for production of three way cross hybrids by introducing genomes from alternate B lines. Diversification of A lines at 0.5 TG level is found to be adequate. Inbred male sterile lines produce more uniform hybrids than the three-way hybrids produced by altered A line with 0.5 TG (F1 male sterile seed parents). However, with the wide acceptance of more variable open-pollinated varieties by farmers, it is unlikely that the variability of a three way hybrid on an altered male sterile seed parent will be a significant barrier to its adoption.

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EFFECT OF SOIL MOISTURE STRESS ON SEED YIELD AND QUALITY OF COTTON CV. MCU 7

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ABSTRACT

Seed yield and quality attributes were studied in MCU 7 summer seed cotton crop raised under different levels of soil moisture stress treatments. Irrigation below 0.6 IW/CPW ratio registered significant reduction in seed cotton yield, seed yield, 100-seed weight, germination, vigour index and storability. The seed crop of MCU 7 should be irrigated prior to 0.6 IW/CPW ratio.

KEYWORDS : Soil Moisture Stress, Cotton, Yield, Quality

Soil moisture plays an important role on seed yield and quality (Austin, 1972). Moisture stress at different levels and different growth periods affect the crop growth, yield and seed quality. Studies on this aspect is available for limited seed crops like sorghum (Krishnasamy, 1982) and maize. In cotton the information on the effect of soil moisture stress in relation to seed germination and crop growth are available (Sankaran, 1975) However, its influence on seed quality, vigour and storability of the resulting seeds is meagre. Hence, the present study was taken up to determine the optimum soil moisture for the production of quality seeds in cotton.

MATERIALS AND METHODS

The summer cotton crop of MCU 7 was raised during March 1984-85 under irrigated condition with the recommended package of practices except desired irrigation frequencies. The stress treatments were imposed after weeding and earthing up. Single plant per hill was maintained. The following soil moisture regimes were monitored through IW/CPE (irrigation water/cumulative pan evaporation) ratio with five replications.

T_1 - Irrigation at 0.4 IW/CPE ratio
T_2 - Irrigation at 0.5 IW/CPE ratio
T_3 - Irrigation at 0.6 IW/CPE ratio
T_4 - Irrigation at 0.7 IW/CPE ratio