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Establishment of Settlings and Yield of Spaced Transplanted Sugarcane as Influenced by Irrigation

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ABSTRACT

Polybag, single and two budded bed settlings of sugarcane were tested for establishment and its effect on yield and yield parameters under different methods of irrigation. Polybag and two budded bed settlings under single flood and spot life irrigation resulted better establishment. Number of tillers, millable canes, cane height and yield were significantly influenced by supplemental irrigations. But recovery percentage, number of internode and average stalk weight were found statistically insignificant. Average yield of three types of settlings tested under flood and spot irrigations were found to be 44. 6% and 21.8% higher over control. The highest economic benefit was obtained from Polybag and two budded bed settlings under flood irrigation.

INTRODUCTION

Sugarcane is a long duration crop usually requires 10-14 months from plantation to harvest. During this period 1500-1800 mm rainfall is necessary for optimum growth and yield (Rashid *et al.*, 1987). The annual rainfall in Bangladesh ranges from 1200-2500 mm which is unevenly distributed through out the year, around 70% of the total rainfall occurs during monsoon months July to September, while little rainfall occurs in the month of November to April during establishment and tillering phases. Establishment and tillerings of sugarcane crop sometimes badly affected due to drought during November to April which ultimately reduces cane yield. Ali *et al.* (1989) observed that adequate soil moisture is very essential during germination and tillering phases for maximising sugarcane yield. Imam *et al.* (1988) reported that the deficits in soil moisture during November to April may be supplemented to influence the higher establishment of settlings and sugarcane yield. But available informations on the method, number and amount of life and supplementary irrigation required for satisfactory establishment of settlings, and ultimate cane yield are still inadequate. In view of the above facts, the present investigation was conducted to determine the effect of irrigation on establishment of polybag, single and two budded soil bed sugarcane settlings, irrigation methods and amount of water for sustainable sugarcane cultivation.

MATERIALS AND METHODS

The experiment was conducted in farmers field at Darsana, Chuadanga during three subsequent cropping seasons. Fourty five days old settlings raised in three different methods were used in the experiment. The sugarcane variety Isd-16 was used as a test crop. The soil of the experimental plots belongs to the High Ganges River Calcareous brown flood plain of AEZ 11. The physical and chemical properties of the experimental plots are presented in the Table 1. The experiment was laid out in split-plot design with three replications. The irrigation treatments were allocated in the sub plots and the settlings were in the main plots. The treatments were as follows :

A. Sources of settlings :

S_1 = Polybag settlings,

S_2 = Single budded soil bed settlings,

S_3 = Two budded soil bed settlings.

B. Irrigation methods :

I_0 = Control (No irrigation/rainfed),

I_1 = Spot (Live) irrigation by pitcher for consecutive three days after transplanting,

I_2 = Flood (Live plus supplementary) irrigation.

Table 1. Some physical and chemical properties of the experimental plots.

Crop Year	Soil texture	Soil pH	Field Capacity	Bulk density (gm/cc)				Average Bulk density (gm/cc)
				15cm	30cm	45cm	60cm	
1st Year	Silty Loam	7.6	25.5	1.4	1.4	1.5	1.5	1.5
2nd Year	Clay Loam	7.8	29.5	1.4	1.4	1.3	1.3	1.3
3rd Year	Loamy	7.7	28.5	1.4	1.4	1.3	1.3	1.3
Average of three years	Loamy	7.7	27.8	1.4	1.4	1.4	1.4	1.4
Method of analysis	Hydrometer method	Lab. method	Field method	Core sampler method				

The settlings were transplanted at 5-6 leaves stage (7 week old) at row and plant spacing of 1m × 45 cm in the month of November. The size of the experimental sub plot was 7m × 10m. All the plots were isolated by inserting polythene sheets to a depth of 75 to 80 cm between two adjacent plots to prevent the seepage of irrigated water between the adjacent plots. Each plot was equally fertilized with recommended rates of 370 kg urea, 276 kg MP, 276 kg TSP, 185 kg Zypsum and 30 kg $ZnSO_4$ per hectare. Fertilizer was applied with one third of urea and MP as basal dose and one half of the rest as 1st and 2nd top dressing. The monthly soil moisture status of rainfed plots from plantation to harvest was monitored by soil moisture depletion studies at 15, 30, 45 and 60 cm depths. Also the soil moisture status of flood irrigated plots were determined gravimetrically just prior to irrigation and 24 hr after each irrigation from plantation to pre-monsoon rainfall.

Irrigation water was supplemented each time when the soil moisture depletion reached to 50% of the total available water to raise the Soil moisture upto field capacity. In the present experiment irrigation was applied at the effective root zone (45-60 cm) to raise the soil moisture up to field capacity according to Ahmad and Heermann (1988). Furrow method of irrigation was used for applying flood irrigation to the experimental

Table 2. Amount of irrigation applied at different moisture levels and growth stages.

Stages of irrigation		Establishment stages with single live irrigation	Tiller stages with supplemental irrigation				
Date of Irrigation		Middle of November	Middle of December	Middle of January	Middle of February	Middle of March	Middle of April
Depth of Irrigation (mm)	Flood	60	70	85	100	120	140
	Spot	23	—	—	—	—	—
Cumulative amount of irrigation (mm)	Flood	60	130	215	315	435	575
	Spot	23	—	—	—	—	—
Number of irrigation	Flood	1	2	3	4	5	6
	Spot	1	—	—	—	—	—
Irrigation applied at DAP*	Flood	Just after plantation	25-30	55-60	85-90	120-125	150-155
	Spot		—	—	—	—	—

* DAP-Days after transplanting.

plots. By measuring the discharge rate during irrigation, the time required to irrigate each plot was calculated. Spot irrigation (2 litre per day) was applied by pitcher for three consecutive days after transplanting. The applied amount and time of irrigation applied at different moisture levels are presented in the Table 2. Data on settling establishment (%), tiller production, millable cane formation were taken at appropriate stages and yield of sugarcane per plot with other parameters were recorded, analysed and presented in the Tables 3 and 4. Relevant meteorological data were collected during three crop seasons and shown in Appendix 1a and 1b.

RESULTS AND DISCUSSION

The monthly soil moisture status of control plots from plantation to harvest were monitored by soil moisture depletion studies at 15, 30, 45 and 60 cm depths (Fig 1). The initial moisture percentage of the control plots during plantation (3rd week of November) at 15, 30, 45 and 60 cm depths were 18.0, 19.1, 21.6 and 22.9% respectively, and 17.3-20.0% soil moisture were available at harvest. The lowest moisture percentage (13.5-14.5%) was found at 15-60 cm soil depth during March and April. The soil moisture status of flood irrigated plots was determined gravimetrically just prior to irrigation and 24 h after each irrigation. The soil moisture fluctuation curve of irrigated plots from plantation to premonsoon rainfall was prepared and have shown in the Figure 2. The field capacity was 28%. The applied amount and time of irrigation to the irrigated plots at different moisture levels are presented in the Table 2. The available rainfall received and evapotranspiration are shown in the Appendix 1a. Only 184 mm rainfall was received during establishment and tillering phases in the month of November to April. But the actual water requirement for sugarcane was 650 mm before premonsoon rainfall. The average temperature ranges from 12-38°C through out the year and shown in the Appendix 1b.

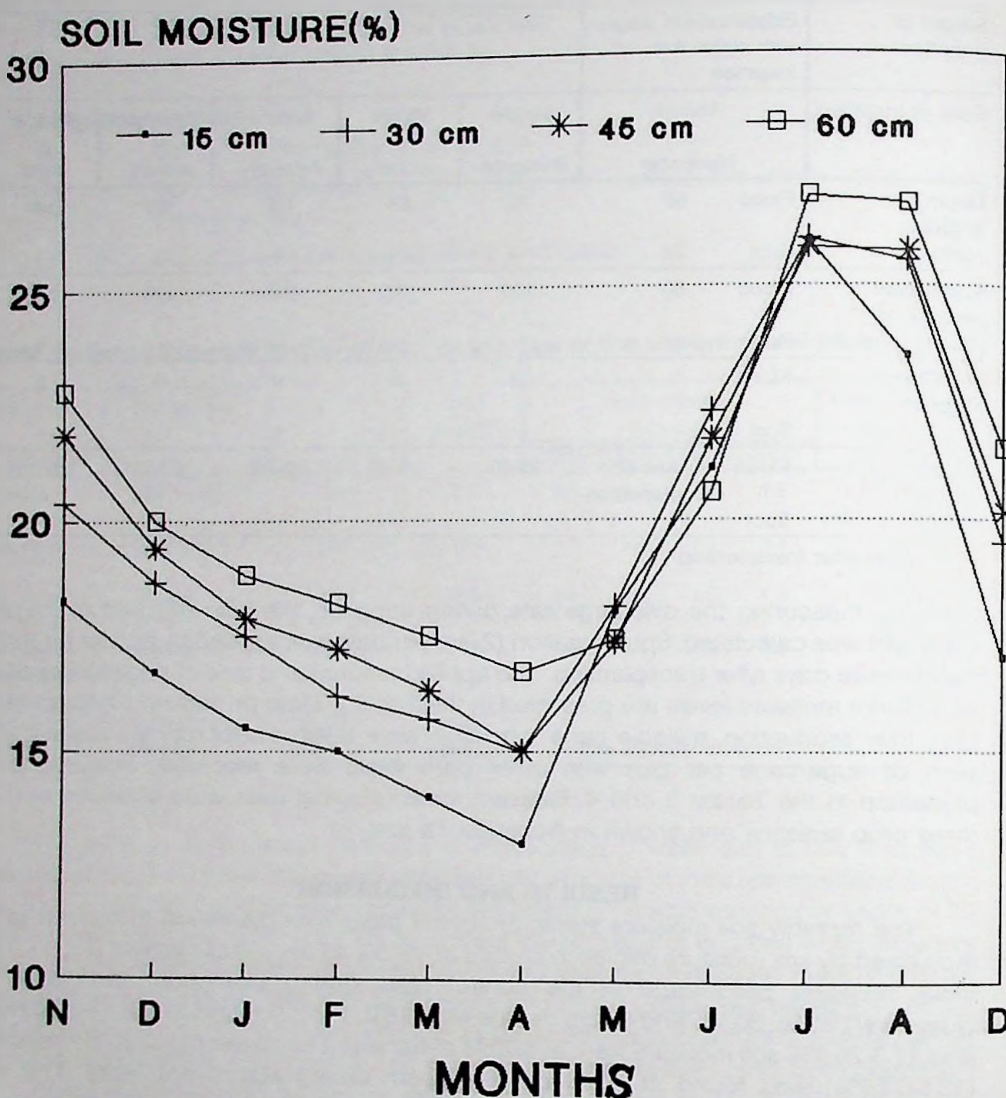


Figure 1. Average soil moisture status of non-irrigated/control plots.

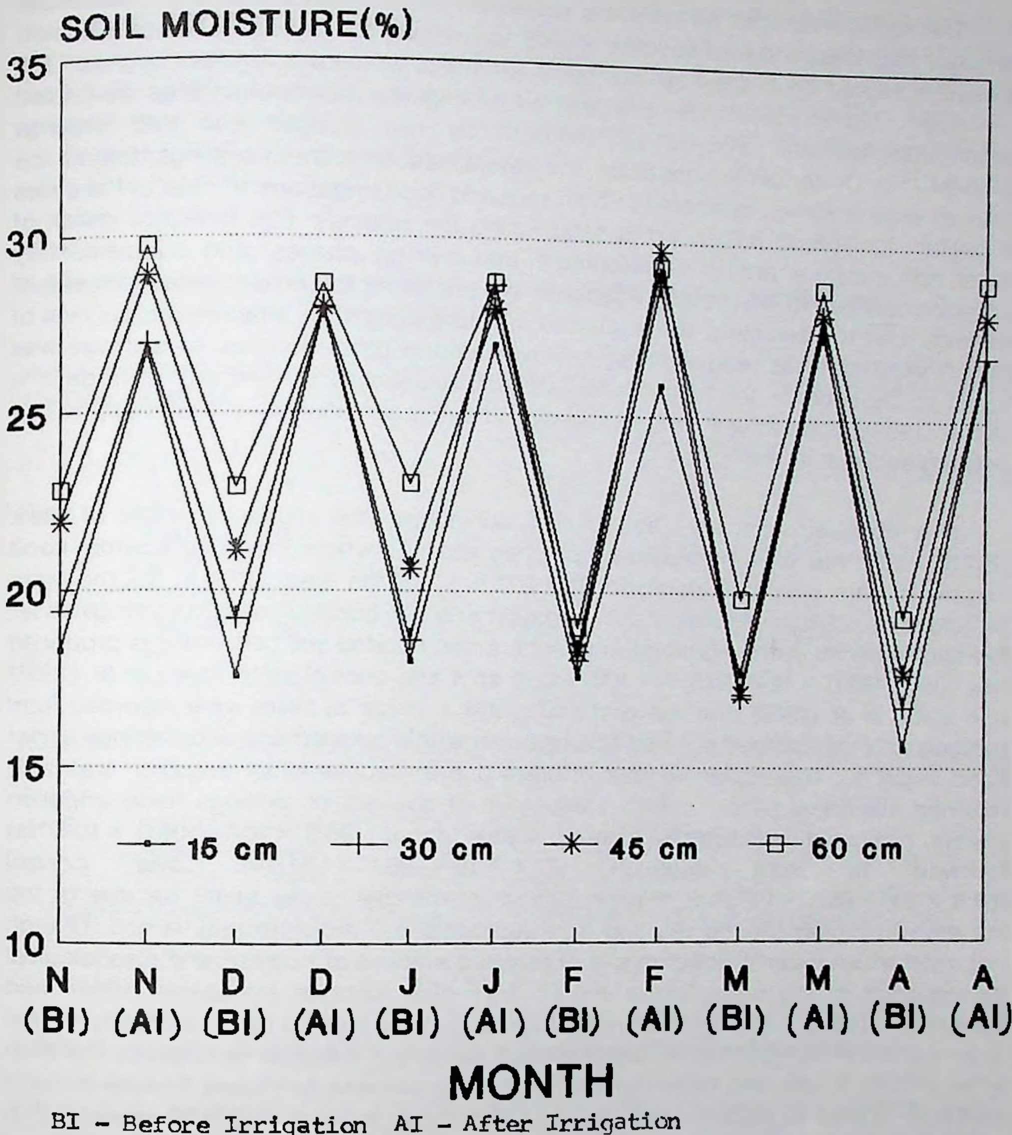


Figure 2. Average soil moisture fluctuation of irrigated plots.

The salient research findings are presented in the Tables 3 and 4. The results revealed that irrespective of sources of settlings, single life irrigation as flood (60 mm) always produced the highest establishment (81.1-99.1%) followed by spot irrigation (23 mm depth, 72.5-98.5%). Under any method of irrigation polybag settlings performed better establishment (96.5-99.1%) followed by two budded soil bed settlings (93.6-94.7%). Under rainfed condition, the lowest establishment of settlings from all the sources were observed compared to both spot and flood irrigations. In most of the cases irrigation significantly influenced in establishing the settlings. This indicates deficit of initial soil moisture during establishment and tillering phases, and supplementary irrigation is needed to provide adequate soil moisture for proper establishment of settlings after transplanting. Adequate soil moisture played the vital role for survival of transplanted settlings, and polybag settlings among other sources of settlings was found to be superior for higher establishment irrespective of methods of irrigations (Anon., 1987). Flood as well as spot irrigations have great influence on establishment of polybag settlings in the field.

It is observed from the Table 3 that significantly the highest number of tillers ($292.5l \times 10^3$/ha) were produced by polybag settlings where five supplemental flood irrigations were provided. Identical tillers 271.4×10^3/ha and 272.9×10^3/ha were produced by polybag settlings at spot irrigation and two budded soil bed settlings under five supplemental flood irrigations. In general single budded soil bed settlings produced less tillers (182.8×10^3—245.7×10^3/ha) in spot and control plots. Imam *et al.* (1988) and Matin *et al.* (1989) also reported that higher number of tillers were recorded from polybag and two budded soil bed settlings over single budded soil bed settlings under flood irrigation. The higher number of tillers due to supplemental irrigation was also reported elsewhere (Anon., 1981). Irrespective of sources of settlings flood irrigation always produced significantly higher millable canes (96.3×10^3—105.0×10^3/ha) followed by spot irrigation (77.4×10^3—96.1×10^3/ha) over control (64.4×10^3—85.1×10^3/ha). Higher number of millable canes might be due to the initiation of higher tillering resulted from adequate soil moisture maintained through irrigation which inturn helped uptake of required amount of nutrient and phonological development of the crop. Similar results were also reported by Kakde (1985), and Banwarilal (1988). It is evident from the Table 3 that the highest tillers ultimately helped to produce the highest millable canes. Similar behaviour was also reported by Rahman *et al.* (1987). It has also been reported that irrigated cane produced heavier millable stalks compared to rainfed cane (Anon., 1987). Data on yield (Table 3) revealed that polybag and two budded soil bed settlings under flood irrigation, significantly produced higher yield 129.1 t/ha and 128.8 t/ha respectively compared to polybag and two budded soil bed settlings under spot irrigation and control as well as single budded soil bed settlings under any methods of irrigation. Similar performance in cane yield from polybag and two budded soil bed settlings under flood irrigation was also reported by Anon. (1987). The average percentage of yield increase due to flood and spot irrigations over control, among the sources of settlings were 44.6% and 21.8% respectively. All the sources of settlings under flood irrigation showed significantly higher cane yield. Banwarilal (1988) and Imam *et al.* (1988) reported that irrigation always played a vital role for increasing cane yield at tillering stage. Table 3 shows that the highest recovery (9.4%) was obtained from polybag settlings under flood irrigation. Irrigation slightly increased the sugar recovery over control agrees with the result of Banwarilal (1988). Average Cane height and diameter were found to be statistically insignificant (Table 4). The number of internode was significantly higher for polybag settlings under flood irrigation compared to control. In general mean stalk weight was found to be identical in irrigated cane and irrespective of sources of settlings flood irrigation always significantly produced higher cane yield (Table 4).

Table 3. Effects of irrigation on yield and different yield contributing parameters of sugarcane.

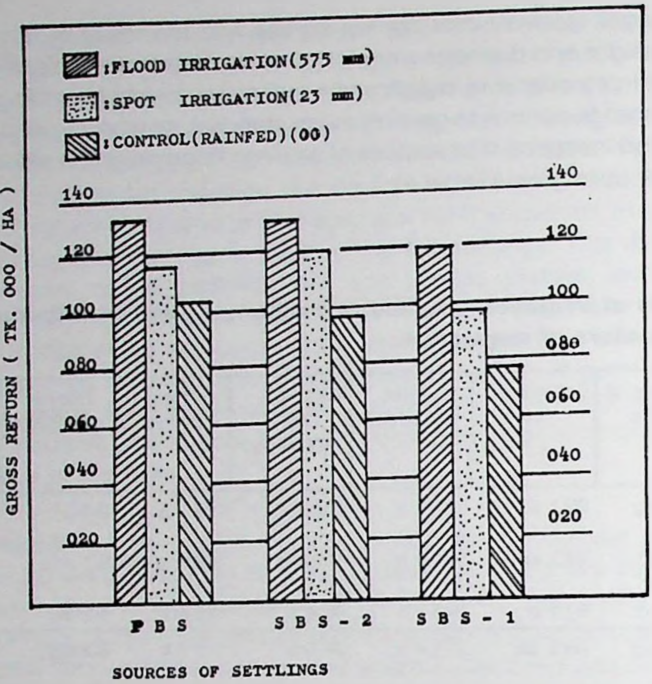
Method of irrigation	Sources of settlings	Establishment (%)	Tiller (000/ha)	Millable cane (000/ha)	Yield (t/ha)	Recovery (%)	Average yield increase over control due to irrigation (%)
Flood	Polybag	99.1 a*	292.5 a	105.0 a	129.1 a	9.4 a	
	Two budded	94.7 cd	272.9 b	102.4 a	128.8 a	9.1 abc	44.6
	Single budded	81.1 e	245.7 c	96.4 b	118.6 ab	9.2 ab	
Spot	Polybag	98.5 ab	271.4 b	96.1 b	111.7 b	9.2 ab	
	Two budded	94.5 cd	249.3 c	93.2 b	111.4 b	8.5 c	21.8
	Single budded	72.5 f	191.5 d	77.4 d	94.1 c	9.0 ab	
Control	Poly bag	96.5 bc	251.8 c	85.1 c	98.8 c	8.8 abc	
	Two budded	93.6 d	246.5 c	74.9 d	89.1 c	8.7 bc	—
	Single budded	63.59	189.8 d	64.4 e	72.4 d	8.6 bc	

* Figures accompanied by the same letters do not significantly differ at 5% level as per DNMR Test.

Table 4. Effects of irrigation on different yield parameters of sugarcane.

Method of irrigation	Sources of settlings	Average cane height (m)	Average number of internode	Average stalk weight (kg)	Average cane diameter (cm)
Flood	Polybag	3.4 a*	30.7 a	1.2 ab	2.5 a
	Two budded	3.3 a	28.7 ab	1.3 a	2.4 a
	Single budded	3.4 a	29.3 ab	1.2 ab	2.5 a
Spot	Polybag	3.3 a	28.7 ab	1.2 ab	2.3 a
	Two budded	3.1 a	28.7 ab	1.2 ab	2.4 a
	Single budded	3.1 a	28.3 b	1.2 ab	2.4 a
Control	Polybag	3.1 a	28.0 b	1.2 ab	2.3 a
	Two budded	2.9 a	28.3 b	1.2 ab	2.4 a
	Single budded	3.1 a	28.0 b	1.1 c	2.4 a

* Figures accompanied by the same letters do not significantly differ at 5% level as per DNMR test.



IRRIGATION COST (TK.'000/ HA.):
FLOOD IRRIGATION - 5.50
SPOT IRRIGATION - 1.75
CONTROL - 0.00

Figure 3. Economic analysis of spaced transplanted settlings of sugarcane under different irrigation levels.

An economic analysis of the irrigation treatments (Figure 3) showed that the gross return was the highest for polybag settlings (Tk. 133.00×10^3/ha) followed by two budded soil bed settlings (Tk. 132.60×10^3/ha) under flood irrigation cost of Tk. 5.50×10^3/ha. Cost-benefit ratio of flood irrigation to polybag and two budded soil bed settlings comes to 1 : 5.0 and 1 : 6.7 respectively. Lower gross return was recorded from spot irrigated cane. From Figure 3 it is evident that sugarcane cultivation in STP method using single budded soil bed settlings, maximum economic benefit can be derived through irrigation. However the highest sale proceed can be obtained from polybag and two budded soil bed settlings under flood irrigation. From the overall result discussion it is seen that irrigation always plays the vital role for increasing the establishment and yield of spaced transplanted sugarcane. Single flood irrigation (60 mm) and spot irrigation (23 mm) may be applied as life irrigation for the establishment of settlings just after plantation. At the tillering stage four to five irrigations may be applied to a depth of 70, 85, 100, 120, 140 mm at 25-30, 60-65, 85-90, 120-125, 150-155 d after planting (DAP). Therefore the present findings suggest that polybag and two budded soil bed settlings may be cultivated under flood and spot irrigation for obtaining economic sugarcane yield.

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REFERENCES

Anonymous, 1981. Hand Book on Sugarcane Growing. Philipine Sugar Commission, Research and Development Office, North Avenue, Diliman, Quezon City. Philippine, pp. 4-92.

Anonymous, 1987. Annual Report 1987. Sugarcane Research & Training Institute, Ishurdi, Pabna, Bangladesh. pp. 24-30.

Ali, M.Y.; Imam, S.A. and Ali, M.K. 1989. Ropa Akh Chash (in Bengali). Sugarcane Research & Training Institute, Ishurdi, Pabna, Bangladesh. SRTI Pub. No. 45. pp. 1-12,51.

Ahmad, S. and Heermann, D.F. 1988. Management strategies for scheduling irrigation : Sugarcane. *Pakistan J. Agric. Res.*, **9**(4) : 516-517.

Banwarilal 1988. Effect of pre-monsoon irrigation on sugarcane varieties under north Indian conditions. *Indian J. Agron.*, **33**(2) : 202-203.

Imam, S.A.; Uddin, S.M.A.; Ali, M. and Ali, M.Y. 1988. Spaced transplanting (STP) technique of cane planting. BASS, 13th Annual Bangladesh Science conference, 1988. p. 9.

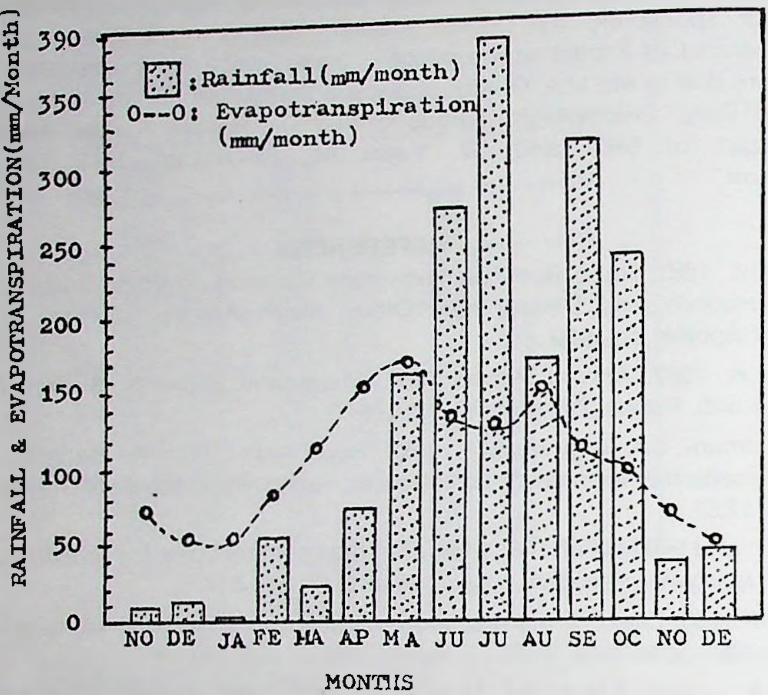
Kakde, J. R. 1985. Sugarcane Production. Metropolitan Book Co. Pvt. Ltd., 1, Netaji Subhash Marg, New Delhi-110002, India. pp. 62-67.

Matin, M.A.; Hossain, M.A. and Miah, M.A.S. 1989. Tiller dynamics in sugarcane variety Isd 16. *Bangladesh J. Sugarcane*, **11** : 1-6.

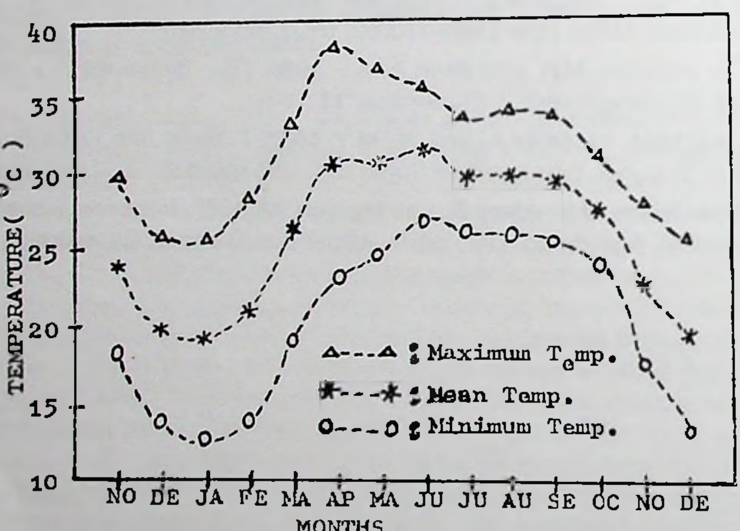
Rahman, A.B.M.M.; Matin, M.A. and Ali, M.Y. 1987. Tillering and Productivity of Autumn and Summer Transplanted Sugarcane. *Bangladesh J. Sugarcane*, **9** : 1-8.

Rashid, M.H.; Islam, M.S.; Alam, Z. and Hassan, M. 1987. Irrigation water Measurement Manual. Agri. Engg. Div., BARI, Joydebpur, Gazipur, Bangladesh. p. 20.

APPENDIX-1



a) Monthly rainfall & evapotranspiration pattern at Darsana, Chuadanga.



b) Monthly maximum, minimum & mean temperature at Darsana, Chuadanga.