乾季におけるUSWB A級蒸発計を用いたサトウキビ生産の灌漑計画

Scheduling of Pre-monsoon Irrigation for Sugarcane Production using US Weather Bureau Class-A Open Pan

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INTRODUCTION

Water stress affects crop production and quality of yields, periodic droughts resulting from irregular rainfall distribution in the tropics causes sizeable reduction in sugarcane yield. The climate of Bangladesh, dominated by the Indian sub-continent monsoon system, causes such droughts in the western part of the country categorized as the Agro-Ecological Zone-11 (AEZ-11). This zone (AEZ-11), being used for large-scale sugarcane production, receives only 1200-1400 mm rainfall annually in comparison to over 5000 mm in the Northeast (Sylhet district) region. Ideally, this amount (1200-1400 mm) of rainfall is satisfactory to meet up the evaporative demand for sugarcane growth. However, only 10-20% of the total annual rainfall occurs from November to April and sometimes with no rainfall in some of these months. Seedling of sugarcane is done in November to December with the onset of moisture depletion from the field. The crop thus faces droughts in these months due to scanty and erratic rainfall. The depletion of soil moisture from the root zone seriously hampered the germination, tillering and the early elongation of sugarcane. Consequently, the germination and tillering combined with early grand growth (together known as the formative phase) has been identified as the critical water demand period and stress during this phase decreases the final yield of sugarcane (Naidu, 1976). On the other hand, 80-90% of the total rainfall occurring between July and September causes water stagnation in the field and results in ultimate loss of sugarcane yield and quality.

The application of supplemental water in the dry pre-monsoon period is a way to increase the productivity of sugarcane in the AEZ-11. However, the effect of such irrigation has not been studied in detail. A proper scheduling of irrigation for sugarcane is also important which is usually done on the basis of growth stages and soil moisture depletion studies. But, this method is time consuming and laborious. The method does not take into account the water use by the crop and often results in over- or under-estimation of irrigation requirement (Prihar et al., 1974). Also the farmers have no facilities for moisture determination in their fields.

The open pan evaporation method is considered as one of the best methods for scheduling of irrigation to crops (Robinson et al., 1963; Chang et al., 1968; Prihar et al., 1976; Jones, 1980; Rahman, 1983). This method indicates, at a glance, when to irrigate and how much water to apply for how long (Wolfe and Evans, 1964). A

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principal advantage of this method is that it requires minimum labor. Using the US Weather Bureau Class-A Pan, a judicious application of irrigation water may be made in the right way according to the need of the crop. This study was conducted in the AEZ-11 in Bangladesh during the 1996-1997 sugarcane growing season to identify a convenient way of irrigation scheduling for sugarcane on the basis of the ratio of Irrigation Water to Cumulative Pan Evaporation (IW: CPE), which incorporates soil-plant-atmospheric continuum in a better way. The objectives of this study were twofold: (1) to evaluate the response of different irrigation levels on the growth parameters and yield of sugarcane, and (2) to quantify the amount of irrigation water for optimum growth and yield of sugarcane at different growth stages which eventually provided the proper scheduling of irrigation.

MATERIALS AND METHODS

To accomplish the objectives of this study, a field experiment was conducted in Chuadanga district of Bangladesh. The experimental area was in the Agro-Echological Zone-11 (AEZ-11) having latitudes between 23° 29′ and 23° 88′ north and longitudes between 88° 20′ and 89° 20′ east. The land of the experimental area belongs to the High Ganges River Flood Plains. Texturally, the soil was sandy loam with low water holding capacity. The important physical properties of the experimental soil are given in Table 1.

The experiment was laid out in a Randomized Complete Block Design making 8m×10m individual plots with six irrigation levels and three replications. Individual plots were separated from each other by a 2.0 m buffer zone to prevent seepage from nearby plots. Irrigation levels were based on the ratio of irrigation water to the cumulative pan evaporation (IW: CPE) minus rainfall using the widely used standard (120 cm in diameter and 25 cm in depth) US Weather Bureau Class-A Open Pan. The irrigation levels were as follows:

I_0 = No irrigation (Control)

I_1 = Only one irrigation in the first week of plantation

$I_2 = I_1$+ late irrigation at $\frac{IW}{CPE}$ ratio of 0.25

$I_3 = I_1$ + late irrigation at $\frac{IW}{CPE}$ ratio of 0.50

$I_4 = I_1$ + late irrigation at $\frac{IW}{CPE}$ ratio of 0.75

$I_5 = I_1$ + late irrigation at $\frac{IW}{CPE}$ ratio of 1.00

Where, IW is the irrigation water applied (cm) and CPE is the cumulative pan evaporation (cm) from the USWB Class-A Open Pan minus rainfall since previous irrigation.

Table 1. Some physical properties of the experimental soil.

Parameter	Soil texture	Soil type	Bulk Density (g/cc)	Field Capacity (%)	WP (%)	pH
Value	Sandy loam	Calcareous Brown Flood Plain	1.38	27.65	11.20	7.6
Method used	Hydrometer method	SRDI*	Core Sampler method	Field method	Field method	Lab. method

*Soil Resource Development Institute (Bangladesh).

The pan was filled with water up to a depth of 20 cm. The water surface was measured daily by means of a hook gauge in a stilling well, and evaporation was computed as the difference between the observed levels adjusted for any precipitation measured with a standard rain gauge. Water was added each day to bring the level to a fixed point in the stilling well. To maintain the available soil moisture within the effective root zone (45 to 60 cm) at several specific levels, the experimental plots were irrigated by a fixed amount of water following the IW: CPE ratio. The amount of irrigation water, number and date of irrigation are furnished in Table 2. To replenish the depleted soil moisture one common irrigation of 10 cm was applied to all the irrigated plots at 5 Days After Planting (DAP) aiming at to ensure the higher rate of germination of the sugarcane eye buds. The subsequent irrigation was applied when the cumulative pan evaporation with subtracted rainfall value reached at 100, 133, 200 and 400 mm for the IW: CPE ratio of 1.0, 0.75, 0.50 and 0.25, respectively. The number of irrigation at the corresponding ratios were 8, 6, 4, 3 and 1, respectively at 5 DAP. During the rainy season (July through September) no irrigation was applied. Irrigation water was applied in the plots by furrow method and the quantity of irrigation water at different times was estimated (Table 2) by the following equation (Michael, 1978).

$$d = \frac{360 \times Q \times t}{W \times L} \tag{1}$$

where,

d = depth of irrigation water

t = elapsed time of irrigation (hr)

Q = discharge of water (lps)

W = furrow spacing (m)

L = furrow length (m)

Table 2. Applied irrigation amount, number of irrigation and irrigation interval as per IW : CPE ration during the dry pre-monsoon period.

Irrigation treatments	I_0	I_1	I_2	I_3	I_4	I_5
Total irrigation Water (cm)	0	10	30	40	60	80
Number of irrigation of applied irrigation (no.)	0	1	3	4	6	8
Irrigation applied at days after planting (DAP)	0	5	5 117 185	5 50 118 159	5 29 70 118 147 169	5 21 50 81 118 140 159 174

Plantation date was 20th November,1996.

Irrigation Levels: I_0 = No irrigation, I_1 = Irrigation at 5 DAP,

$I_2 = I_1$+IW:CPE ratio 0.25, $I_3 = I_1$ + IW:CPE ratio 0.5,

$I_4 = I_1$ + IW:CPE ratio 0.75, $I_5 = I_1$+IW:CPE ratio1.0 .

In this study L and W were known and the depth of irrigation water applied to the field was determined by gravimetric measurement just before the irrigation water was applied. By measuring discharge rate, the elapsed time of irrigation was calculated.

Three budded sugarcane setts of recently released high yielding variety ISD-21 was planted conventionally in trench following end to end method of sett placement at 1-m row spacing. Each plot was fertilized equally with recommended doses of commercial fertilizer of 376 kg urea (source of N), 276 kg TSP (source of P), 276 kg MP (source of K), 180 kg Gypsum (source of Ca) and 34 kg $ZnSO_4$ per hectare (BARC, 1989). Urea and potash were applied in three equal splits and other fertilizers were applied during plantation. Soil samples were collected during planting (20th November 1996) and at harvest (30th December 1997) to estimate the overall change of soil moisture during the entire growing season. Irrigation water was applied to the experimental plots from shallow tube well through lined canals. The crop water use or evapo-transpiration (ET) was calculated by the following water balance equation (Sammis et al., 1986).

$$ET = I + R - D \pm \Delta SM \quad (2)$$

Where,

ET = Water requirement of the crop assumed to be equal to the evapo-transpiration (mm)

I = Depth of irrigation water applied in the field (mm)

R = Amount of rainfall (mm)

D = Amount of drainage and deep percolation (mm)

ΔSM = Change of soil moisture in the experimental plots within the root zone during the entire growing season. (mm)

The amount of drainage was calculated from Barlow table for flat, cultivated absorbent soils with low average or varying rainfall and no continuous downpour (Khushalani, 1984). All the necessary intercultural operations were done as and when needed. The weather data in the study area were recorded, which are shown in Fig. 1. Statistical analysis of yield and yield parameters were done by Duncan's Multiple Range Test.

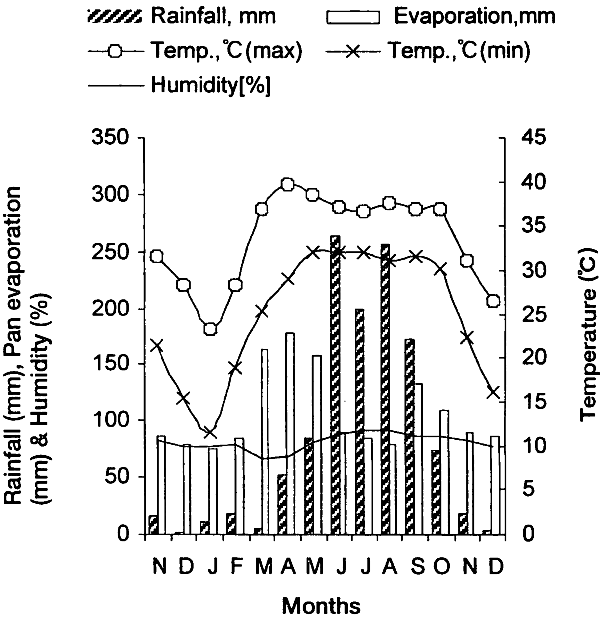

Fig.1 Monthly average rainfall, pan evaporation, humidity and temperature (maximum and minimum) of the experimental site.

RESULTS AND DISCUSSION

The effect of different irrigation levels on sugarcane yield and growth parameters was found to be significant over the rainfed or non-irrigated sugarcane (I_0) and the results are listed in Table 3. During germination the moisture content in the sett bears a critical importance than the soil moisture, but the effect of soil water in conserving the sett-moisture is also important (Srivastava and Johari, 1979). During plantation soil moisture of 15 to 60 cm effective root zone was within a range of 18 - 24% (wb), which was far below the field capacity (26.7%). The common irrigation of 10 cm applied to all irrigated plots at 5 DAP and enhanced the germination rate. The germination rates of sugarcane eye buds showed that germination was initiated from 15 DAP and continued rapidly up to 45 DAP. Under different moisture levels the germination rate of sugarcane buds was found to be significantly higher than that in the non-irrigated plots and the germination continued sometimes even up to 60 DAP (Fig.2). At 60 DAP, the three levels of irrigation (IW:CPE ratio of 0.5, 0.75 and 1.0)receiving 2 irrigations amounting 20 cm recorded significantly ($P<0.01$) higher germination rate (28 - 33.5%) over the plots with only one irrigation and no irrigation (Table 3). The IW: CPE ratio of 0.75 resulted in the highest germination rate (56.6%) whereas in the non-irrigated plot 37.9% germination was recorded. The high rate of germination of the plots irrigated twice over the plots with only one irrigation or control was due to the adequate moisture supply within 60 DAP (germination phase). Optimum germination of sugarcane requires ample soil moisture, warm temperature and long day length (Anon, 1981b). Irrigation at or after 60 DAP could not influence germination of sugarcane buds because the germination phase was already over.

The trend of tiller and millable cane formations are visualized in Fig. 3. Under all the irrigation levels tiller production started from 75 DAP and increased rapidly with a significant bearing up to 150 DAP. The highest number of tillers ($149.29 - 212.58 \times 10^3$ ha^{-1}) was produced under all the irrigation levels at 150 DAP following 105 DAP ($68.00 - 99.04 \times 10^3$ ha^{-1}), and 90 DAP ($32.50 - 32.79 \times 10^3$ ha^{-1}). The lowest number of tillers ($22.76 - 29.17 \times 10^3$ ha^{-1}) was produced at 75 DAP. The effect of irrigation on tiller production was thus highly significant ($P<0.01$) over the non-irrigated sugarcane

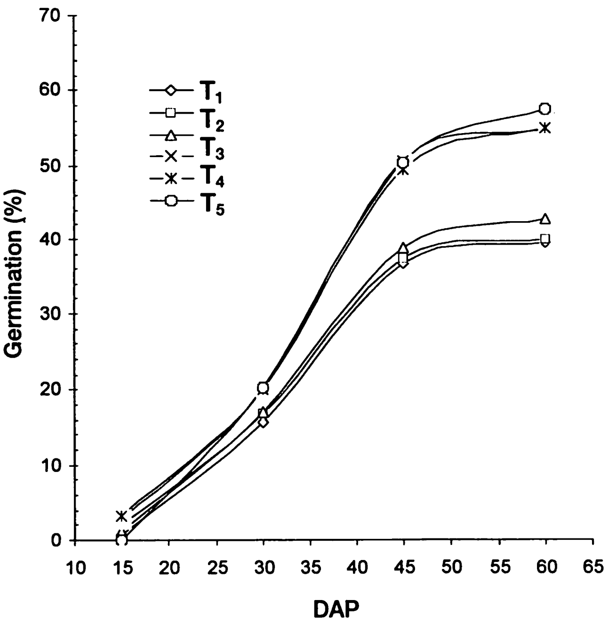

Fig.2 Germination of sugarcane eye buds under different moisture regims.

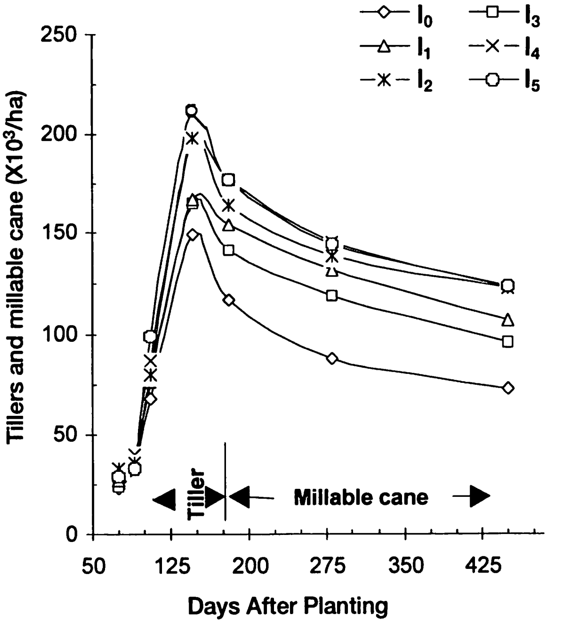

Fig.3 Effect of irrigation on tiller and millable cane production of sugarcane.

Table 3. Growth parameters and yield response of sugarcane to different irrigation levels.

Irrigation treatments	Total Irrigation (cm)	Germination (%)	Tiller Production ('000'/ha)	Millable Cane ('000/ha)	Sucrose (%)	Sugarcane Yield (t/ha)	Sugar Production (t/ha)
I_0	0	37.91 b*	149.29 d	72.22 c	11.37	56.72 d	7.07 d
I_1	10	42.87 b	165.60 c	87.67 b	11.26	68.85 c	8.08 c
I_2	30	43.31 b	167.42 c	106.08ab	11.05	96.52 b	10.67 b
I_3	40	52.94 a	196.21 b	122.21 a	10.72	106.80 ab	11.29 ab
I_4	60	56.60 a	199.63 b	122.58 a	10.76	114.42 a	12.32 a
I_5	80	56.17 a	212.00 a	119.66 a	10.73	111.25 a	11.92 a
S_x	-	2.31	3.199	5.116		2.070	0.2869
Significane Level	-	0.01	0.01	0.05	NS	0.01	0.01

*Similar letters are not significant as per as DNMR test.

Irrigation Levels:

I_0 = No irrigation, I_1 = Irrigation applied at 5 DAP,

I_2 = I_1+IW:CPE ratio of 0.25, I_3 = I_1+IW:CPE ratio of 0.5,

I_4 = I_1+IW:CPE ratio of 0.75, I_5 = I_1+IW:CPE ratio of 1.0 .

at 105 and 150 DAP. Table 3 shows that significantly ($P<0.01$) large number of tillers (212.58×10^3 ha^{-1}) was produced in I_5 following the I_4 and I_3 which was 10.92 - 42.00% higher than that in I_0 (149.29×10^3 ha^{-1}). The tiller number increased with increasing frequency of irrigation. A similar differential effect of irrigation on the pick tiller production was also noticed up to 150 DAP due to relatively less amount of rainfall (Prasad et al., 1990).

A depression of the number of tillers was observed (Fig.3) after 150 DAP and this trend continued up to 450 DAP (harvesting period). This might be due to the strong inter-competition between the tillers to survive as a millable cane. The establishment of tillers as a millable cane was higher under the irrigation treatments than over the non-irrigated cane. At the harvesting time (450 DAP), millable cane was significantly ($P<0.05$) influenced by the frequency of irrigation. The highest millable cane (124.46×10^3 ha^{-1}) was obtained with I_4 following I_3 and I_5 (Table 3) but the millable canes of these levels (IW: CPE ratio of 0.5, 0.75, 1.0) were statistically identical and were significantly ($P<0.05$) higher (41.9%) over I_0 (72.22×10^3 ha^{-1}). Tiller mortality was higher (51.8%) in the control (I_0) than that in the irrigated canes (36.6-40%). The frequent use of irrigation reduced the tiller mortality and resulted in the maximum millable cane as well as the sugarcane yield. These results are in conformity with that of Banwarilal et al. (1988), Prasad et al. (1990) and Hossain et al. (1994).

Irrigation levels did not significantly influence the sucrose content of the cane. The sucrose percentage in the non-irrigated cane was found to be slightly higher than that in the irrigated canes (Table 3). A possible reason for this might be that the frequent irrigation diluted the sucrose content in the cane. Prasad et al. (1990) and Singh et al. (1986) also reported similar reasons for sucrose content. There was a favorable influence of irrigation on the cane yield (Table 3). The increase in yield was recorded up to IW: CPE ratio of 0.75 receiving 6 pre-monsoon irrigation totaling 60cm. The highest cane yield (114.42 t ha^{-1}), which is 40%

Table 4. Water use and water use efficiency of sugarcane under different soil moisture regimes.

Irrigation treatments	Total Irrigation (cm)	Total Rainfall (cm)	Drainage (cm)	Δ SM (cm)	Water use (cm)	WUE (t/ha/cm)
I_0	0	128.87	19.98	5.19	114.08	0.47
I_1	10	128.87	19.98	5.04	123.93	0.55
I_2	30	128.87	19.98	5.28	144.17	0.66
I_3	40	128.87	19.98	5.98	151.98	0.70
I_4	60	128.87	19.98	6.01	175.01	0.66
I_5	80	128.87	19.98	7.18	196.18	0.57

Irrigation Levels:
I_0 = No irrigation, I_1 = Irrigation applied at 5 DAP,
$I_2 = I_1$ + IW: CPE ratio 0.25, $I_3 = I_1$ + IW: CPE ratio 0.5,
$I_4 = I_1$ + IW: CPE ratio 0.75, $I_5 = I_1$+IW: CPE ratio 1.0 .

higher than that with no irrigation (72.22 t ha^{-1}) was produced by IW: CPE ratio of 0.75 receiving 60-cm irrigation water. The results follow a statistically identical cane weight of 106.08 - 111.25 t ha^{-1} among the IW: CPE ratios of 0.5 and 1.0. These results are in well agreement with the findings of Fogliata (1974), Yates et al. (1986), Banwarilal et al. (1988), Prasad et al. (1990), and Hossain et al. (1994). The irrigation level with IW: CPE ratio of 0.75 produced significantly the highest quantity of sugar (12.32 t ha^{-1}), which was 42.6 % higher over the I_0 (7.07 t ha^{-1}). Though the recovery percent at this level (IW: CPE ratio of 0.75) was slightly low but all the growth parameters (such as germination %, millable cane) were high which finally raised the total cane yield as well as the sugar yield.

The total water used by sugarcane increased linearly as the irrigation frequency increased. However, cane yield did not increase linearly with increasing water use (Tables 3 & 4). Water Use Efficiency (WUE) was generally higher under the critical moisture or drier regimes than under the frequently irrigated (wetter) plots (Table 4). Such observation is in conformity with that reported by Yoshinaga et al. (1999). The highest WUE (0.70 t $ha^{-1}cm^{-1}$) was obtained from the irrigation treatment I_3 (IW: CPE ratio of 0.5) and the lowest (0.47 t $ha^{-1}cm^{-1}$) was obtained in I_0.

The water use efficiency (WUE) varied non-linearly with the total applied irrigation water(IW) (Fig. 4). This non-linear relationship is best represented by a second-degree polynomial as

$$WUE = 0.4677 + 0.0097IW - 0.0001IW^2 \quad (3)$$

where *WUE* and *IW* represent the water use efficiency (decimal) and total irrigation water applied (cm), respectively. The coefficient of determination was very high (R^2=0.992), which showed a very highly significant correlation between the irrigation levels and water use efficiency (WUE). The highest WUE (0.70 t $ha^{-1}cm^{-1}$) in this study corresponded to the application of 48.5 cm of water. The same WUE was reported else where by Leverington et al. (1970) in Queensland, Anon. (1973) in Jamaica, Fogliata (1974) in Australia and Yoshinaga et al. (1999) in Japan.

The quantity of irrigation water (IW) and cane yields (Y_C) were fitted for regression analysis to

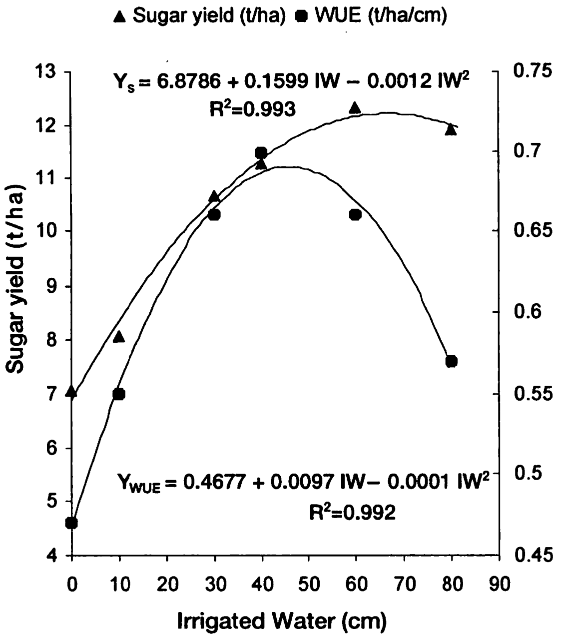

Fig.4 Quadratic irrigation response curve estimated form sugar yield and WUE.

determine the logical cane yield at IW=48.5 cm (Figure are not shown). The correlation showed the polynomial relationship

$$Y_C = 54.797 + 1.821IW - 0.0139IW^2 \quad (4)$$

with significant coefficient of determinant (R^2=0.996). For the highest WUE (0.70 t ha^{-1}cm^{-1})) the application of maximum irrigation water (48.5 cm) resulted 110.42 t ha^{-1} which was identical to the higher yield 106.80-114.42 t ha^{-1} (Table 3).

The sugar yield data was also correlated by a second-degree polynomial with the total irrigation water applied (Fig. 4). The governing equation was

$$Y_S = 6.8786 + 0.1599IW - 0.0012IW^2 \quad (5)$$

(Y_S = sugar yield, t ha^{-1} and IW = total irrigation water applied, cm) with a significantly higher coefficient of determination (R^2=0.993). From Figure 4, it is evident that WUE was the function of irrigation water (IW) following the highly correlated (R^2=0.992) second-degree polynomial epuation.

$$Y_{WUE} = 0.4677 + 0.0097\,IW - 0.0001\,IW^2 \quad (6)$$

The highest WUE (0.70 t ha^{-1}cm^{-1}) obtained at IW = 48.5 cm water application resulted in 11.82 t ha^{-1} sugar yield. This yield was significantly identical to the higher range of sugar yield (11.29 - 12.32 t ha^{-1}) as reported in Table 3.

A linear regression analysis conducted between the irrigation water (IW) and IW: CPE ratio provided the appropriate pan ratio (IW: CPE) for obtaining economic sugar yield (Fig. 5). The resulting regression equation was

$$IW = 4.7 + 74 \times (IW: CPE) \quad (7)$$

again with high coefficient of determination (R^2= 0.969). Such a correlation implies that irrigation water was well correlated with the pan ratio (IW: CPE). Therefore, pre-monsoon irrigation of sugarcane with 48.5 cm water at IW: CPE ratio 0.6 resulted in the highest cane yield 110.42 t ha^{-1} and sugar production (11.82 t ha^{-1}) with WUE 0.70 t ha^{-1}cm^{-1} and the total crop water use was 157.75 cm for the tropical dry western regions of Bangladesh. For the humid sub-

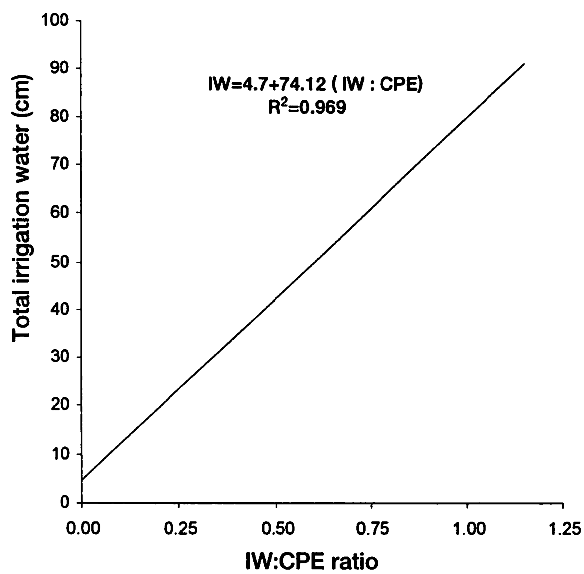

Fig.5 Relationship between IW:CPE ratio and irrigation water.

tropic regions (Okinawa, Japan) the crop water use for sugarcane is 147.6 cm reported by Yamashiro et al. (1994), 135.2 - 169.2 cm in Argentina reported by Fogliata (1974), 140.0 - 250.0 cm in India reported by Srivastava and Johari (1979).

ABSTRACT:

The effect of pre-monsoon irrigation for sugarcane production in Bangladesh was studied using six water regimes (irrigation treatments) with three replications. Irrigation water was calculated based on the ratio of irrigation water (IW) to cumulative pan evaporation (CPE) measured with USWB Class - A Open pan. The six treatments were: I_0 (no irrigation /control), I_1 (only one irrigation in the first week of plantation), I_2 (I_1+ late irrigation at IW:CPE = 0.25), I_3 (I_1 + late irrigation at IW:CPE = 0.50), I_4 (I_1 + late irrigation at IW:CPE = 0.75), and I_5 (I_1 + late irrigation at IW:CPE = 1.00).

The germination rate of sugarcane eye buds in the irrigated plots was significantly higher than that in the non-irrigated/controlled plots. At 60 days after planting (DAP), I_3, I_4, and I_5 receiving 2 irrigation amounting 20 cm recorded significantly ($P<0.01$) the 28 - 34% higher germination rate over the plots receiving only one irrigation/no irrigation. Treatment I_4 resulted in the highest germination rate (56.6%) and I_0 resulted in the lowest rate (37.91%). Treatment I_5 produced significantly ($P<0.01$) large number of tillers (212.58×10^3 ha^{-1}) following I_4 and I_3 which was 10.9-42.0% higher over I_0 (149.29×10^3 ha^{-1}). The highest millable cane (124.46×10^3 ha^{-1}) was obtained from I_4 following I_3 and I_5 but the millable canes of these treatments were statistically identical and were significantly ($P<0.05$) higher (41.9%) over I_0 (72.22×10^3 ha^{-1}). Tiller mortality was higher (51.80%) in the control (I_0) than that in the irrigated canes (36.6 - 40%). However, irrigation did not significantly influence the sucrose content of the cane.

There was a favorable influence of irrigation on the cane yield. The highest cane yield (114.42 t ha^{-1}), which is 40% higher than that with no irrigation (72.22 t ha^{-1}) was produced by I_4 receiving 60 - cm irrigation water. I_4 also produced significantly large quantity of sugar (12.32 t ha^{-1}), which was 42.6 % higher than that of the I_0 (7.07 t ha^{-1}). The total water used by the sugarcane increased linearly as the irrigation frequency increased. However, cane yield did not increase linearly with increasing water use. The highest WUE (0.70 t $ha^{-1}cm^{-1}$) was obtained from the irrigation treatment I_3 and the lowest (0.47 t $ha^{-1}cm^{-1}$) was obtained in I_0. Pre-monsoon irrigation of sugarcane with 48.5 cm water at IW: CPE ratio of 0.6 resulted in the highest cane yield (110.42 t ha^{-1}) and sugar production (11.82 t ha^{-1}) with WUE of 0.70 t ha^{-1} cm^{-1} and total crop water use of 157.74 cm.

乾季におけるUSWB A級蒸発計を用いたサトウキビ生産の潅漑計画

要　旨

バングラディッシュのサトウキビ生産における雨期前の潅漑効果について，６つの水管理方法（潅漑方法）の実験を３回行った．潅水量の計算は，潅水量とA級開口式蒸発計(USWB)を用いて測定した累積蒸発散量との比を基に行った．潅漑方法は次の６水準である．

I_0（潅水なし）

I_1（植え付け１週間後に一度だけ潅水する）

I_2（I_1+IW:CPE=0.25に達した時に潅水する）

I_3（I_1+IW:CPE=0.50に達した時に潅水する）

I_4（I_1+IW:CPE=0.75に達した時に潅水する）

I_5（I_1+IW:CPE=1.00に達した時に潅水する）

サトウキビの発芽率は，潅漑を行わなかった場合

よりも，灌漑を行った方が明らかに高かった．植え付け60日後において，2度にわたって20cmの灌漑を行った I_3, I_4, I_5 では，1度だけ灌漑したものや，灌漑なしのものよりも発芽率が28.0%から33.5%高かった(P<0.01)．発芽率が最も高いのはI_4で56.6%，最も低いのはI_0で37.91%であった．

萌芽した芽の数が多いのは I_5(212.58×10^3ha)で，次いで I_4, I_3 となり，これらは I_0(149.29×10^3/ha)よりも10.92%から42.00%多い(P<0.01)．

また，最大茎数は I_4(124.46×10^3ha)で得られ，次いで，I_3, I_5 となる．しかし，これらの茎数は，統計学的な差はないといえる．また，I_0のそれ(72.22×10^3/ha)と比べると41.9%多かった(P<0.01)．

萌芽の枯死率は，I_0(51.8%)の方が，灌漑区(36.6%から40.0%)よりも高かった．しかし，灌漑によるショ糖量への影響は明らかにできなかった．

灌漑がサトウキビの収量に対して，有利に影響していることが分かった．合計60cm灌漑されたI_4で収量(114.42 t ha^{-1})は最大となり，灌漑しなかった区域の収量(72.22 t ha^{-1})よりも40%多かった．また，I_4で得られた砂糖の量は多く(12.32 t ha^{-1})，これはI_0で得られた砂糖の量(7.07 t ha^{-1})よりも42.6%多かった．

また，サトウキビが消費した総潅水量は，潅水回数が増えるにしたがって直線的に増加した．しかしながら，サトウキビ収量は，消費水量の増加に伴って直線的な増加は示さなかった．

有効水利用率はI_3で最も高く(0.70 t $ha^{-1}cm^{-1}$)，I_0で最も低い(0.47 t $ha^{-1}cm^{-1}$)結果が得られた．サトウキビの雨期前の灌漑では，潅水量48.5cm，IW:CPE=0.6の条件下で，最大収量(110.42 t ha^{-1})と砂糖収量(11.82 t ha^{-1})が得られ，その時の有効水利用率は，0.7 t ha^{-1} cm^{-1}で，総消費水量は157.75cmであった．

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