SOME OBSERVATIONS ON SHORT, FREQUENT IRRIGATION CYCLES IN SWAZILAND

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ABSTRACT

Harvest data from six fields on Tambankulu Estates are presented to illustrate the increase in yield obtained during the 1973/74 season. It is suggested that the increase in yield was partly due to the ability to apply 27 mm of water in 6 hours every 3 days. It is also suggested that the greatest response to short quick cycles of irrigation is obtained on shallow low water-holding capacity soils.

Introduction

The results discussed in this paper were obtained on Tambankulu Estates, which is an irrigated sugarcane and citrus estate situated in the north-eastern lowveld of Swaziland. The topography is flat and the altitude is approximately 180 m. The climate is sub-tropical with erratic summer rains. Soils are derived from basic rocks, giving rise to red and dark-coloured clays and clay loams. Sugarcane-growing commenced on the estate in the late 1950's.

The principle of applying "a little water often" is not new to agriculture, but only with the introduction of solid set systems of overhead irrigation did the principle become economically feasible in sugarcane agriculture. Tambankulu Estates experimented with various systems of semi-solid set irrigation, and the savings in labour and water soon became evident. The estate policy thus became one of converting fields to semi-solid set when they were replanted. The first fields were converted in 1970 and were irrigated on a 7-day cycle, applying 54 mm of water per cycle (12-hour stand time). During the 1972/73 season this was changed to a 3-day cycle, applying 27 mm of water per cycle (6-hour stand time).

Materials, soils and climate

Materials

The semi-solid set irrigation schemes commissioned on Tambankulu consist of PVC lateral pipes, 32 to 40 mm in diameter, spaced 18,3 metres apart and buried 15-23 cm below the ground surface. Rise-O-Matics are spaced 18,3 metres apart and consist of either flexible PVC hosing or galvanised domestic piping joined to the PVC lateral by means of a PVC tee-joint. These are fixed to iron standards driven into the ground to a depth of approximately 60 cm. The only movable attachment is the sprinkler stand-pipe.

Nutrition

Fertilizer applications are based on leaf and soil samples submitted to the Fertilizer Advisory Service (F.A.S.) of the S.A. Sugar Association Experiment Station, Mount Edgecombe. Any error in fertilizer application tends to be on the high side. Fertilizers are broadcast using a spinner type fertilizer distributor approximately one month after planting or immediately after cutting.

Weed control

A pre-emergence application of 5 litres Lasso e.c. plus 3,5 litres 2,4-D is applied immediately after the fertilizer has been applied. Subsequent weed control is by hand-weeding.

Irrigation control

The "profit-and-loss" system of irrigation control[2] which is based on daily evapotranspiration (Class A Pan), stage of crop canopy, and available soil moisture is used on the estate. To ensure that the soil profile is full, two 54 mm applications of water are applied immediately after planting or cutting. By ensuring that the profile is saturated immediately after planting or cutting, subsequent irrigations merely consist of replacing what is lost by evapotranspiration.

Climate

The mean monthly rainfall recorded on Tambankulu Estates is shown in Table 1. Mean monthly temperature (°C), solar radiation (ly/day) and Class A Pan evaporation (mm) recorded on the neighbouring Mhlume (Swaziland) Sugar Estate for the seasons 1970/71–1972/73 are shown in Table 2.

Soils

Field A: Approximately half the field is R-set (Rhebok series) and the other half T-set (Thorburn and Tambankulu series)

Field B: Mainly R-set (Rhebok and Rathbone series)

Field C: Mainly T-set (Tambankulu, Tshaneni and Thorburn series). About 20% of the field is R-set (Rhebok series)

Field D: About half is R-set (Rhebok and Rathbone series) and the other half T-set (Tambankulu and Tshaneni series)

Fields I and J: Mainly T-set (Tambankulu and Tshaneni series).

TABLE I

Monthly rainfall (mm) recorded on Tambankulu Estates for the seasons 1970/71–1972/73

Rainfall

	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	Total
70/71	56	4	2	32	18	80	91	69	24	8	47	19	450
71/72	12	29	1	5	25	120	158	177	294	317	211	63	1412
72/73	162	2	4	3	5	42	76	73	53	106	50	67	643

TABLE 2

Monthly temperature (°C), solar radiation (ly/day) and Class A Pan evaporation (mm/day) recorded on the Mhlume (Swaziland) Sugar Co. Estate for the seasons 1970/71–1972/73

Max. temperature, °C

	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April
1970/71	28,1	24,7	25,5	28,2	30,3	27,8	31,7	32,1	30,8	30,4	31,1	28,5
1971/72	25,0	23,4	25,3	27,5	—	28,4	27,1	29,1	30,5	28,0	28,6	28,2
1972/73	24,8	23,3	24,7	25,4	28,9	28,4	28,3	32,4	31,9	31,2	31,6	—

Min. temperature, °C

1970/71	13,2	9,5	9,9	12,9	15,1	15,6	19,5	20,3	20,7	19,2	19,8	17,8
1971/72	11,6	8,7	8,6	12,2	—	16,2	17,1	18,9	20,1	20,0	18,4	16,6
1972/73	11,7	6,3	8,5	10,9	13,4	16,4	15,7	20,0	20,2	19,5	19,9	—

Solar Radiation (ly/day)

1970/71	355	320	326	418	448	483	514	548	529	551	492	371
1971/72	336	332	359	415	—	494	459	552	529	487	421	408
1972/73	334	342	344	392	432	499	484	559	—	506	432	—

Evaporation — Class A Pan (mm/day)

1970/71	5,1	4,0	4,9	5,8	8,2	7,1	8,5	9,0	7,2	7,1	6,8	5,0
1971/72	3,7	3,4	4,4	4,9	—	6,6	6,0	7,2	6,7	6,2	5,2	5,2
1972/73	3,3	3,2	4,2	4,8	6,9	6,5	6,7	8,6	7,6	7,6	5,9	—

TABLE 3

Harvest results from six fields of NCo 376 on Tambankulu Estates during the three seasons from 1971/72 to 1973/74

Field	A			B			C			D			I		J	
Season	71/72	72/73	73/74	71/72	72/73	73/74	71/72	72/73	73/74	71/72	72/73	73/74	72/73	73/74	72/73	73/74
Crop	P	1R	2R	P	1R	2R	P	1R	2R	P	1R	2R	P	1R	P	1R
Age, months..	14,5	12,0	11,0	14,5	12,0	11,0	14,5	12,0	11,0	14,0	12,0	11,0	16,0	11,0	16,0	11,0
T.C./ha	120,4	98,3	120,7	135,4	117,1	133,0	119,2	92,7	136,5	114,0	96,2	120,0	119,7	143,7	98,2	126,6
Sucrose % ..	12,7	13,9	12,9	12,9	14,1	12,7	12,8	13,9	12,5	14,0	13,0	14,5	14,5	12,1	14,4	11,9
T.S./ha	15,37	13,75	15,57	17,59	16,58	16,89	15,35	12,97	17,05	14,41	13,51	15,60	17,39	17,46	14,21	15,11
T.C./ha/mth ..	8,3	8,2	10,9	9,3	9,8	12,1	8,2	7,7	12,4	8,1	8,0	10,9	7,5	13,1	6,1	11,5
T.S./ha/mth ..	1,06	1,15	1,55	1,21	1,38	1,53	1,06	1,08	1,55	1,03	1,13	1,41	1,08	1,58	0,88	1,37
% Increase T.C./ha/M* ..		32,9			23,5			61,0			36,2			74,7		88,5
% Increase T.S./ha/M* ..		34,8			10,9			43,5			24,8			46,3		55,7

* From 1972/73 to 1973/74

Months harvested: A, B, C, D: October 1971, October 1972, September 1973
I, J : September 1972, August 1973

Murdoch[1] classifies these soils as follows for irrigated sugarcane:

R-set: Best

T-set: Fair (Tambankulu) to poor (Tshaneni).

Harvest results

The harvest results from six fields on Tambankulu Estates, totalling 302,7 hectares, are tabulated in Table 3.

Observations

(i) All fields were extremely even in growth during the 1972/73 season. The variability in cane growth which had characterised these fields prior to the introduction of the 3-day cycle was absent.

(ii) There was almost a complete absence of lodging in 1973/74. It is interesting that where sprinklers had been left in position by mistake for 12 hours, lodging occurred.

(iii) An inspection of sugarcane roots in 1973/74 revealed prolific ramification throughout the profile to the depth of the impervious (iron concretion) layer in T-set soils. This layer varied from 15 cm to 61 cm. In the deeper R-set soils, prolific root growth was found throughout the top 60 cm of soil.

(iv) An inspection of these fields after a short cycle irrigation revealed an increasing degree of wetness from the centre of the interrow to the sugarcane stool. This showed that the irrigation water was being intercepted by the cane foliage and that it tended to run down the stalk. This was confirmed by placing a small can in the centre of the interrow during a subsequent application of irrigation water. Virtually no water (1 mm) was collected.

(v) Leaf samples submitted for analysis from these fields showed nutrition to be "very satisfactory".

Discussion

It might be misleading to draw definite conclusions from field results, particularly when comparisons are made over a number of seasons. This shortcoming in the data presented here is acknowledged, but the results are nevertheless interesting and might contribute to better planning of future irrigation and research projects.

The harvest data reveal that cane yields during the 1972/73 season were lower than those from the 1971/72 season, but this was probably due mainly to the age factor. The mean tons sucrose per hectare per month data for fields A, B, C and D were, in fact, quite comparable (1,09 in 1971/72 and 1,19 in 1972/73). In contrast, the mean results for all six fields show that the yields in 1973/74 were clearly superior to those of 1972/73 (1,50 compared with 1,12 tons sucrose/ha/month). Since the 1971/72 and 1972/73 results were so similar it is difficult to imagine that the 1973/74 results were better mainly because of possible reasons for low yields in 1972/73 alone, e.g. wet conditions, extensive leaching of N, or low amounts of radiation. However, the younger age at time of harvest did favour the 1973/74 crop consistently, and particularly so in fields I and J. The inference may nevertheless be drawn that small amounts of irrigation applied frequently cause yields to be higher than they are when larger amounts are applied less frequently.

The absence of lodging in 1973/74 may also have been associated with the age of the crop. Had cutting been delayed another month, then lodging may well have occurred. It is worth noting, however, that on a neighbouring estate where cane was also grown under the semi-solid set system of irrigation, but on a 9-day cycle (12-hour stand time), applying 64,5 mm of water, lodging was severe at 9 months of age. What was of particular interest was the evenness in growth in fields where soil depth and available soil moisture (TAM) varied greatly.

By adopting the semi-solid set system of irrigation, the following advantages have become apparent:

(1) A 75 per cent saving in labour required for irrigation. This has also eased the amount of supervision required.

(2) Increased output per cane cutter because the cane was erect.

(3) More even topping of cane and consequently less wastage in the field.

(4) The ability to start irrigating immediately the soil is able to accept a small amount of water after a soaking rain.

(5) The ability to vary the time a stand-pipe stays in one position to suit soil requirements.

(6) Constantly high soil moisture content ensures no "stop-start" in crop growth.

(7) No wastage of water through leaking seals and uncoupling of pipes filled with water.

(8) A 60 per cent saving on in-field sub-surface drainage. (Drainage problems on Tambankulu are associated with a rising water table.)

(9) Ideal conditions can be maintained for the application of herbicides.

The main disadvantage which has become apparent is the amount of maintenance required. In-field equipment damages Rise-O-Matics and pipes become blocked. The estate intends overcoming these problems as well as the increase in capital costs by installing the dragline system in future conversions.

Conclusion

The Swaziland Sugar Industry is beset with problem soils, e.g. Somerling series (shallow, low TAM); Zwide, Habelo and Hlunya series (duplex soils, freely draining shallow sandy loam topsoil overlying a heavy impervious clay); Kwezi and Valumgwaco series (heavy black clays with a high salinity hazard); and T-set soils (imperfectly drained). It is suggested that by adopting the principle of "a little water often", which is now feasible through the use of semi-solid set systems of irrigation, the productivity of these soils can be raised and maintained at a high level.

REFERENCES

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