SUBSURFACE DRAINAGE PERFORMANCE ON THE LOWLAND CANE FIELDS OF MUMIAS SUGAR COMPANY, KENYA

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Abstract

This study involved the performance analysis of various drainage materials installed in the lowland cane fields of the Mumias Sugar Company nucleus estate. This was in terms of water table control and crop response to drainage. Significant differences were observed in water table levels but not in cane and sugar yields. From the cane and sugar yield standpoint therefore, there appears to be no advantage among the various treatments, thus no material can be justifiably recommended at this stage. There is need to continue the experiment in order to cover a reasonable crop/seasonal weather interaction period.

Key words: drainage, subsurface, sugarcane.

Introduction

Drainage is considered important for commercial sugarcane production especially in the low lying areas of the humid tropics. High water tables adversely affect sugarcane especially when the crop has seed stalks and stubble. Sugarcane growing in poorly drained soils shows inhibited root formation, reduced growth rates, deficiency symptoms, shorter internodes and high incidence of disease. The installation of a drainage system aims at lowering the water table and thereby improving rooting conditions for the crop particularly during the wet season. The desirable end result is increased cane and sugar production.

The Mumias Sugar Company (MSC) nucleus estate, in particular, has 870 ha of poorly drained lowlands, from which production is generally low. The soils in these lowlands are mainly silt loams with an impermeable layer underlying the 0-50 cm topsoil, which is the cause of poor subsurface drainage in the area. However, these soils are suitable for sugarcane production if they are effectively drained (Home, 1991 quoting Bookers 1970). An experimental subsurface drainage system was designed and installed with the aim of establishing

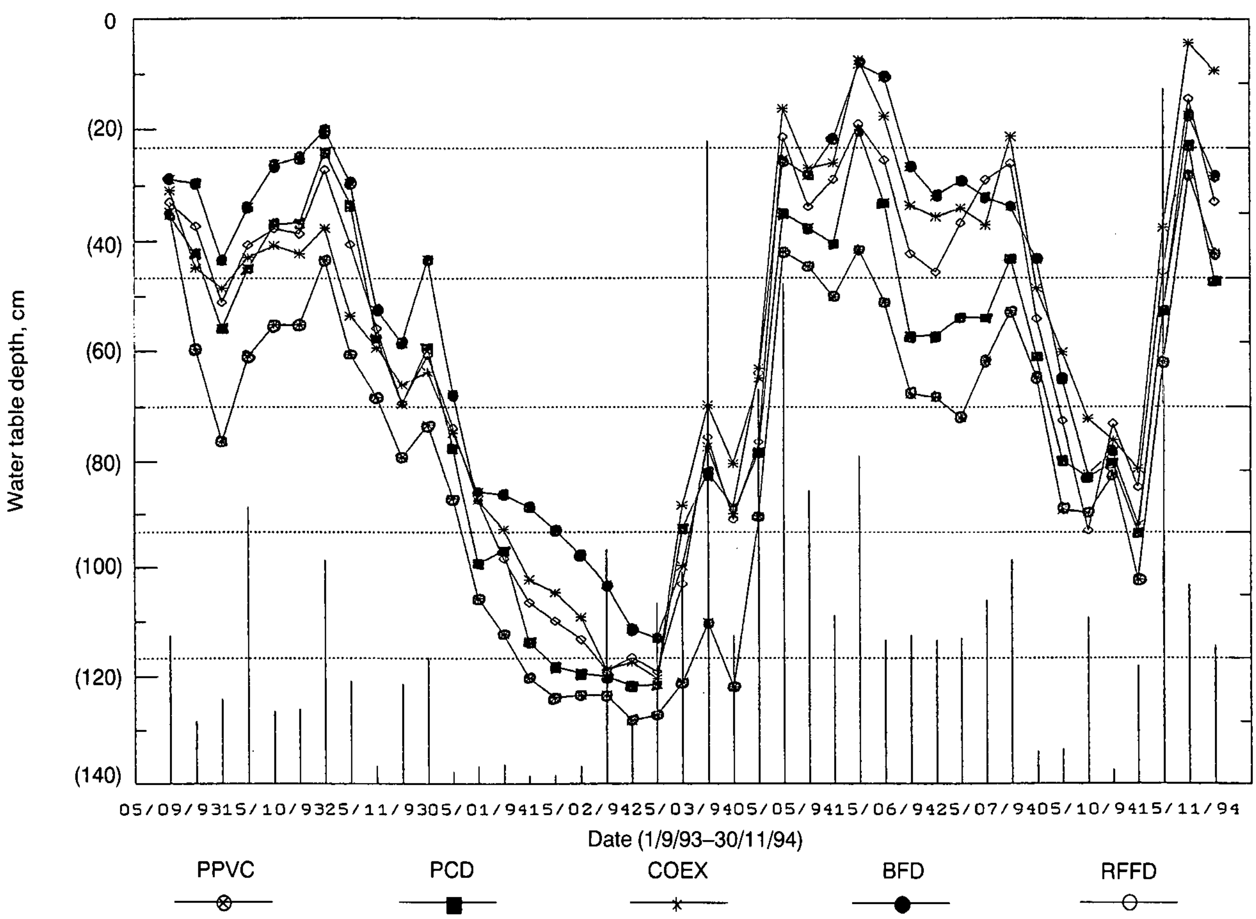

FIGURE 1: Water table fluctuations (advantages) for drained and undrained plots in relation to rainfall.

the most effective drainage material for these lands. This paper reports on the results of a performance analysis of the various materials, in terms of water table control and crop response to drainage.

Materials and methods

An experimental subsurface drainage system was designed and installed in the MSC lowland cane fields. The experimental drainage system consisted of different drainage materials applied as five treatments, ie perforated PVC pipes (PPVC), porous concrete drains (PCD), rock filled french drains (RFFD), bagasse filled drains (BFD) and a control (COEX) – without any drains, in three replicates. The experimental design used was a randomised complete block design. Each replicate consisted of three drains installed at a depth of 0,9 m and spaced 12,8 m apart. The PVC pipes were two inches in diameter while the concrete drains were four inches in diameter.

Water table and discharge data were collected over a two year period. Instrumentation involved observation wells for measuring water table fluctuations with time and a measuring cylinder and stop watch for discharge measurements. Rainfall data were based on records from the nearby MSC central meteorological station. Water table data were analysed by means of a hydrograph and the summation of excess water (SEW) index, ie the total number of daily values by which ground water table exceeded a threshold of 45 cm below the surface (cm-days).

Cane yields were determined by weighing all the cane within the plots. A 24 whole stalk sample was taken from each plot and analysed at the MSC agronomy laboratories for sugar content. The tonnage of cane per hectare (TCH), tonnes of extractable sugar per tonne of cane (TEST) and tonnage of extractable sugar per hectare (TESH) were then obtained and analysed statistically.

Results

It was found that PPVC and PCD lowered water tables faster and to relatively lower depths than the other drained treatments (Figure 1). Annual SEW values (Table 1) also show the magnitude of the treatment differences in water table levels. Results from the cane response data are shown in Table 2.

Table 1

Average annual SEW values in relation to drainage treatments

Treatment	PPVC	BFD	PCD	RFFD	COEX
Annual SEW (cm-days)	940,2	2975,8	1703,8	2608,0	3167,1

In general, cane and sugar yields were good for all treatments. Differences observed in the various cane response data were, however, not statistically significant. The water table problem was not as serious during this experiment as it had been in the past. This was thought to be because the rainfall during the experimental period was unusual, being relatively dry when at least some rainfall was expected and at times being unexpectedly wet, eg November 1994. A comparison of the rainfall experienced during the crop season with the long term monthly medians for MSC show that the rainfall was somewhat lower than the long term medians. However water table and discharge measurements made during this period were sufficient for the performance analysis of the trial drains.

Table 2

Average crop response values in relation to treatments

TRT	PPVC	BFD	PCD	RFFD	COEX	Fcal	Significance	
							5%	1%
A	125/1.1*	135/1.5	139/2.0	118/1.8	140/1.3	1.023	NS	NS
B	14.9/0.1	16.3/0.8	15.2/0.8	14.6/0.5	16.7/0.7	0.546	NS	NS
C	.119/.04	.119/05	.118/0.5	.124/.04	.119/.05	0.354	NS	NS

Fcal = calculated F statistic, table values are 3,84 and 7,01 at the 5% and 1% levels respectively
NS = not significant, A, B, C = TCH, TESH, TEST respectively (t/ha)
* = first value represents the average value for TCH, TESH or TEST, second value represents the standard error of the mean

Discussion

In terms of water table control, PPVC and PCD seem to have been more efficient than the other drained treatments. Lowering of the water table to an acceptable level would mean preventing crop damage from waterlogging (Yang *et al.*, 1977). However, despite the fact that many experimental results have shown an increase in cane and sugar yields after the installation of subsurface drainage (Carter and Floyd, 1973; Yang and Wang, 1980; Gayle *et al.*, 1987), no significant differences were found in this case. Results obtained from the crop response data could be explained by the fact that the experiment had been affected by a dry spell that occurred in the region shortly after planting. This implied that the cane in all treatments experienced approximately similar drainage conditions in the initial stages of the crop's establishment. However it is expected that future stands and stand longevity are likely to be affected provided the crop does not again undergo a dry period. Further monitoring of ratoon crops and stand longevity and a cost benefit analysis thereafter would be necessary to allow the making of sound recommendations where subsurface drainage for sugarcane production is concerned.

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