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Studies on the Impact of Soil Factors on the Root Growth of Sugarcane in Rhizotrons

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ABSTRACT

An experiment was conducted at the Sugarcane Research and Training Institute (SRTI) farm during 1981-82 crop year to study the plausible effects of soil pathogen, soil compaction, placement of fertilizer and Heptachlor on the root and shoot development of sugarcane grown in Rhizotrons. Significant differences were obtained among the different treatments in respect of both root and shoot growth. The maximum shoot and root growth and weight of roots/Rhizotron were recorded with sterilized soil followed by Heptachlor free soil.

INTRODUCTION

A poor growth of sugarcane is often believed to be associated with a poor root development. It is impossible to get high yields without first giving the root system a favourable environment in which to grow (Humbert, 1968). Uunder field conditions, deficiency of viable roots often lead to stalks mortality prior to harvest. Although the rooting capability of any particular variety is apparently thought to be a varietal characteristic, the actual causes of inadequate root growth is poorly understood. The probable causes may be the soil pathogen, unfavourable soil composition, soil texture and structure, soil aeration, fertilizer placement etc. Fungi, viruses and nematodes are often contributing factors in the yield decline of sugarcane (BSES Annual Report, 1982). The buildup of unfavourable population of fungi and/or nematodes in a soil is often responsible for poor root growth (Martin *et. al.*, 1959). Many researchers reported residual action of Heptachlor on root growth of sugarcane and relate the soil physical characteristics to root development (SRTI Annual Report, 1981). Gomez and Pinto (1970) observed that root system is greatly affected by the type of sub-soil (texture).

Lee and Weller (1972) found no instance of a root changing its direction of growth towards the buried fertilizer. Their studies did show that if a root growing in the direction of band of fertilizer, passes into the band, it shows greater branching while in the fertilizer. Reduction of sugarcane yields due to soil compaction has been demonstrated by Cleasby (1964), Hare (1960) and Hill and Summer (1967). When the soil is compressed, its capacity to condense and retain heat, air and water changes affecting

plant growth (Parthasarathy, 1972). Trouse (1965) reports that compression usually occurs as a reduction in volume of the macropores of the soil which influences air and water permeability and moisture storage.

In order to identify the major causal factors for poor root growth, experiment was initiated at SRTI during the 1980-81 crop year. Preliminary results obtained from that experiment served as substratum for the present investigation undertaken during 1981-82 crop year with the objective of studying the plausible effects of soil pathogen, soil compaction, placement of fertilizer and Heptachlor on the root and shoot development of sugarcane grown in Rhizotrons.

MATERIALS AND METHODS

The experiment was conducted at the Sugarcane Research and Training Institute (SRTI) farm during 1981-82 crop year using Rhizotrons. The size of each Rhizotron was 40 cm x 30 cm x 80 cm. In one side of each Rhizotron there was a clear glass to observe the growth of roots in the soil contained in the Rhizotron. Being laid out in a randomized block design with three replications, the experiment involved the following treatments :

T_0—Control (SRTI top soil, fertilizer was placed just below the sett and mixed with the soil).

T_1—Fertilizer beside sett-a band of fertilizer mixed with the soil.

T_2—Sterilized soil (Sterilized with steam).

T_3—Soil compaction (Rhizotron, filled up with the soil layer about 15.2 cm below the final soil level, was made severely compact).

T_4—No Heptachlor (Soil from BARI, Ishurdi farm was used where no Heptachlor was used).

Sugarcane variety Co. 1158 was used in the experiment. The experiment was set up in mid January, 1982. In each Rhizotron three equally assorted three-eye budded setts were planted and recommended doses of fertilizers were used. Water was supplied to every Rhizotron as and when required. The length of living roots and shoot heights were measured at a regular interval of 15 days starting from mid February to last week of April, 1982. The experiment was harvested in early September, 1982 and data were taken on weight of roots and weight of canes. The collected data were statistically analysed and the significance of mean differences were adjusted as per LSD test.

RESULTS AND DISCUSSION

Significant differences were obtained among the different treatments in respect of both root and shoot growth at three weeks after planting. Compaction of soil appeared to have a depressing effect on root growth (Table 1). The maximum root growth was recorded with sterilized soil followed by Heptachlor free soil. This observation are in conformitory with those of Martin *et. al.* (1959) and the findings at SRTI (SRTI Annual Report, 1982). The probable causes for obtaining such highest result with sterilized soil

Table 1. Effects of different treatments on the mean root length (RL) and shoot height (SH) at different stages of cane growth and weight of roots and cane in the Rhizotron.

Treatment	Weeks after planting												Wt. of roots/ Rhizotron (gm)	Wt. of cane/ Rhizotron (kg)
	3		5		8		11		13		Mean			
	RL	SH	RL	SH	RL	SH	RL	SH	RL	SH	RL	SH		
T_0	9.03	4.6	16.73	9.5	23.60	10.6	54.60	20.8	41.76	29.2	30.16	15.3	316.5	1.00
T_1	15.10	4.6	17.00	8.0	31.23	10.5	54.06	19.4	42.53	31.1	32.16	14.9	280.6	1.26
T_2	15.80	5.9	27.60	9.9	40.36	12.1	61.80	24.9	40.26	34.2	38.50	17.6	318.7	1.18
T_3	10.50	4.6	28.83	7.7	26.40	9.9	58.56	22.1	26.40	30.2	31.53	15.1	234.8	0.88
T_4	18.20	5.4	21.36	8.7	34.16	11.2	60.60	17.5	40.50	24.3	37.29	13.4	245.3	0.87
LSD(0.05)	1.71	0.81	3.58	1.41	2.76	1.16	2.94	1.71	6.51	1.50	4.17	1.74	—	—

RL = root length (cm)
SH= shoot length (cm)

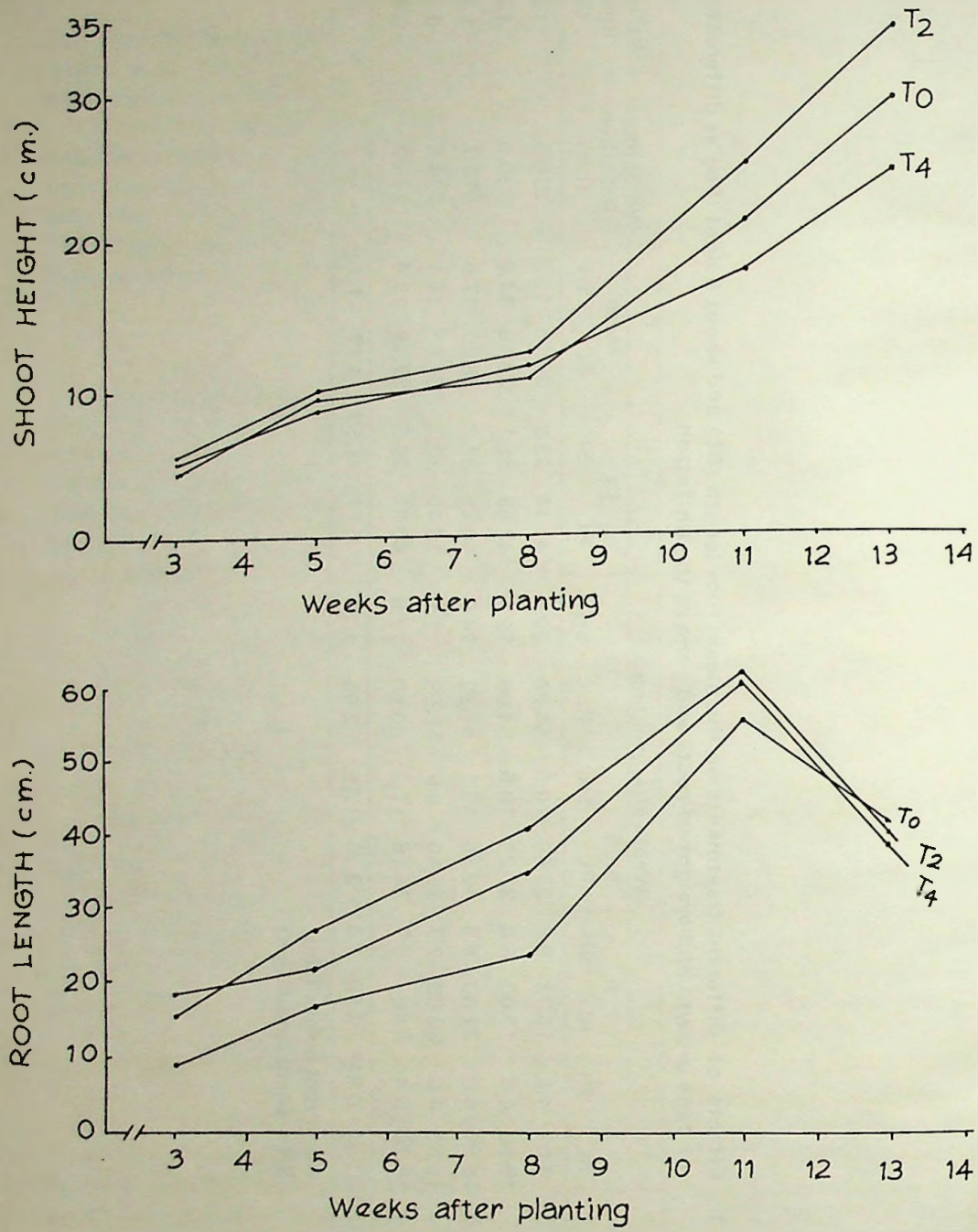

Figure 1. Shoot and Root growth in Patterns in Rhizotorns with different soil treatments.

might be due to the destruction of different soil pathogen on sterilization with steam. The effect of placing fertilizer in band beside sett (T_1) did not significantly influence root growth as compared to the control (T_0), which involves mixing of fertilizer with soil as normally practiced. The highest weight of roots/Rhizotron was obtained with sterilized soil; however, the result was not significantly different from other treatments. The maximum weight of cane/Rhizotron recorded at the termination of the experiment was observed with T_1 (fertilizer being placed in band beside sett) followed by sterilized soil. However, the effect was not significantly different from other treatments. Similar result was obtained by Miah *et. al.* (1982).

It appears that sterilized soil allowed roots to grow faster and further than other treatments upto at least 11 weeks after planting. Thereafter roots in all the treatments began to retreat to shallower depths (Fig. 1). Significantly higher shoot height was recorded with sterilized soil (Table 1 & Figure 1) throughout the experimental period. The results from this investigation indicate that at early stages of plant growth, a pathogen free soil offers better environment for root and shoot growth. The possible causes of poor root growth due to soil-borne pathogen can not thus be ruled out.

REFERENCES

BSES Annual Report - 1982. Bureau of Sugar Experiment Stations, Queensland, Australia, pp. 24-25.

Cleasby, T. G. 1964. Symposium on soil compaction. *Proc.* South African Sugar Technol. Assoc., **38** : 144-153.

Gomez, A. F. and Pinto, M. R. 1970. Root development of the sugarcane cultivars H32-8560 and H57-5174 under normal conditions of cultivation and irrigation in the Chicama Valley, *Proc. ISSCT. 17* (1) : 534-539.

Hare, C. J. 1960. Some observations on various soil physical properties and their bearing on yield of sugarcane on a Berbice sugar estate. *Proc.* British West Indies Sugar Technol., pp. 80-86.

Hill, J. N. S. and Sumner, M. E. 1967. Effect of bulk density on moisture characteristics of soils. *Soil Sci.*, **103** : 234-238.

Humbert, R. P. 1968. The growing of sugarcane. Elsevier Publishing Co., London, p. 779

Lee, H. A. and Weller, D. M. 1972. The progress of sugarcane roots in the soil at different age. *Proc.* Hawaiian Sugar Technol., **31** : 69-72.

Martin, J. P., Wismer, C. A. Koike, H. and Apt, W. J. 1959. Some biological factors associated with yield decline of sugarcane varieties in Hawaii. *Proc. ISSCT.*, **10** : 70.

Miah, M. A. H., Khuda, A. K. M. Q. E. and Shahjahan, M. 1982. Studies on the effect of some factors on the development of sugarcane roots and plants. *Bangladesh J. Sugarcane, 4* : 63-66.

Parthasarathy, S. V. 1972. Sugarcane in India. K. C. P. Ltd., Madras - 6. India, p. 804.

SRTI Annual Report - 1981. Sugarcane Research and Training Institute, Ishurdi, Pabna, p. 78.

SRTI Annual Report - 1982. Sugarcane Research and Training Institute, Ishurdi, Pabna, pp. 44-45.

Trouse, A. C. 1965. Erfect of soil compression on the development of sugarcane roots. *Proc. ISSCT. 12* : 137-152.