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The Influence of Soil Physical Factors on Tapering Disease of Coconut in the Mapalana Research Farm

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INTRODUCTION

Although studies on the reason for tapering (Pencil Point) disease of coconut in various soils and climatological conditions are available (Cooke 1950; Jeganathan and Ramasami 1977; Bhaskaran et. al 1979), there is no clear evidence on its causative factors.

The common feature of this disease is the random distribution of affected palms in close association with non affected palms. There is no pathogenic organism or insect found as a causal agent for the disease (Cooke 1950). Affected Palms could be found under many environments: on good and bad soils; where there is regular cultivation and manuaring; close to sea and also for inland etc.

One of the important features of the disease is the extensive root destruction. This may be due to inhibited soil physical factors such as cracking of heavy clay soils caused by drought, hardening of certain soils due to the action of white ants, sudden rise in the water table resulting from flooding or neglected drainage etc.

Yellowing and subsequent necrosis of the lower and older leaves of tapering palm is one of the usual features of the disease which was explained as magnesium deficiency. (Cooke 1950). But later experiments by many authors didn't confirm this. The experiments of Jeganathan and Ramasami (1977) at Thambikkottai in India revealed that the deficiency of nitrogen, phosphorous, iron and manganese were associated with the disease. However Bhaskaran et. al (1979) found that there was no significant effect when the diseased palms were supplied with fertilizer alone.

It is evident, therefore, that further research should be undertaken to identify the causative factor of this disease. Such research has a particular interest for Sri Lanka as the disease is reported in a number of coconut plantations in Southern Sri Lanka.

MATERIALS AND METHODS

The study site where the present research was conducted is situated at Mapalana, Kamburupitiya, Matara (6.04 N lat 80. 34 E long.), approximately 50 m above mean sea level.

Soils of the area are Red yellow podzolic soils, Red yellow podzolic soils with strongly mottled sub soil and low humic glay soils. Mechanically soils of the research site can be classified as Sandy clay loam, well graded soil (Weerasinghe and Alwis 1985).

Mapalana is located in the Agroecological region WL2; rainfall distribution of the area is typically bimodal with an annual precipitation of 2380mm. Relative humidity is comparatively high in April to December while it is low in relatively dry months. Mean average relative humidity in April to Dscember is 74.4% and minimum average relative humidity in February is 60%. High mean monthly temperature (29.1° C) occurs in January and February. For the rest of the year average remains around 28° C. A detailed rainfall analysis of the research site is described elsewhere (Weerasinghe 1989).

Physical properties of the soils were studied under 12 randomly selected coconut palms of which 3 were healthy and 9 were affected by Pencil Point disease.

Soil profiles were opened under the palms 30 cm apart from the boll to the depth of 1.5 m. Soil samples were taken by 10 cm layers in 3 replicates for the laboratory analyses.

True density of the soil was determined by Picnometer method, mechanical composition by pipette method; macro aggregate composition of the soil by wet and dry sieving method, bulk density by core cutter method. Mean weight diameter of soil aggregates was calculated according to Van Bavel (1949).

Field infiltration rate of the soil was measured by double ring infiltrometer method; Drying pattern of the soil by Gravimetric method. Soils under the affected and non-affected palms were saturated with water and soil moisture loss was measured at two-day intervals. Root distribution pattern was studied according to Dospiehov (1972).

RESULTS AND DISCUSSION

According to the USDA criteria, soils of the research site could be classified as well graded sandy clay loams (Fig. 1). Clay fraction is comparatively high under the affected palms and its depth distribution shows distinct downward migration down through the soil profile, promoting a high degree of soil lessivage. This may cause inhibited drainage and high soil impedance, for roots penetration.

In general, soils of the research site are highly compacted (Table 1); the degree of compaction under the affected and non affected palms is appeared to be non significant (Table 1).

High compaction is closely associated with low perosity of the soil, which is around 36-38% in surface layers. Further reduction of pore space is true for the deeper horizons, which was more significant in the soils under the affected palms (table 1).

Mean weight diameter of dry aggregates in surface soils was comparatively high under the affected palms. (Table 2). But the stability of aggregates over the impact of water was less pronounced in soils under the affected palms.

The number of roots were significantly less in the affected palms than in the healthy palms (Fig. 2). In the top 30 cm soil layer, number of roots was more in the healthy palms than in the affected palms by 53.5%. In lower horizons this difference was reduced to 45%.

Moisture losses of the soil under affected and control palms are shown in Fig. 3. Water losses of the soil under control was high compared to the affected palms. This difference was less pronounced in deeper layers, (Fig. 3), which is probably due to the communication of deeper soils with ground water.

The maximum water depletion layer in the soils, under control was extended to 40 cm, while under diseased palms this was at 20 cm depth. There was a considerable loss of moisture from surface layers in both cases which may be due to high evaporation from the surface soils.

It is evident from the foregoing that the red yellow podzolic soils under both the affected and healthy palms are highly compacted. High compaction decreases the porosity of the soil so created unfavourable physical environments for proper root functioning. Therefore the roots of the Palms which are physiologically and genetically strong enough to penetrate through the compacted barriers of the soil seems to survive while the weak palms are subjected to the tapering disease. This may be the reason why diseased palms appear randomly among healthy palms.

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ABSTRACT

The influence of soil physical environment on the tapering disease (Pencil point disease) of the coconut plants was studied in a field trial commenced in the Mapalana Research Farm since 1983.

It was revealed that the number of roots in the plants affected by the pencil point disease were significantly less and they were concentrated in the surface layers of the soil.

Probable reason for the disease in red yellow podzolic soils was identified as the physiological or genetical inabilitily of the root system to overcome the soil impedance.

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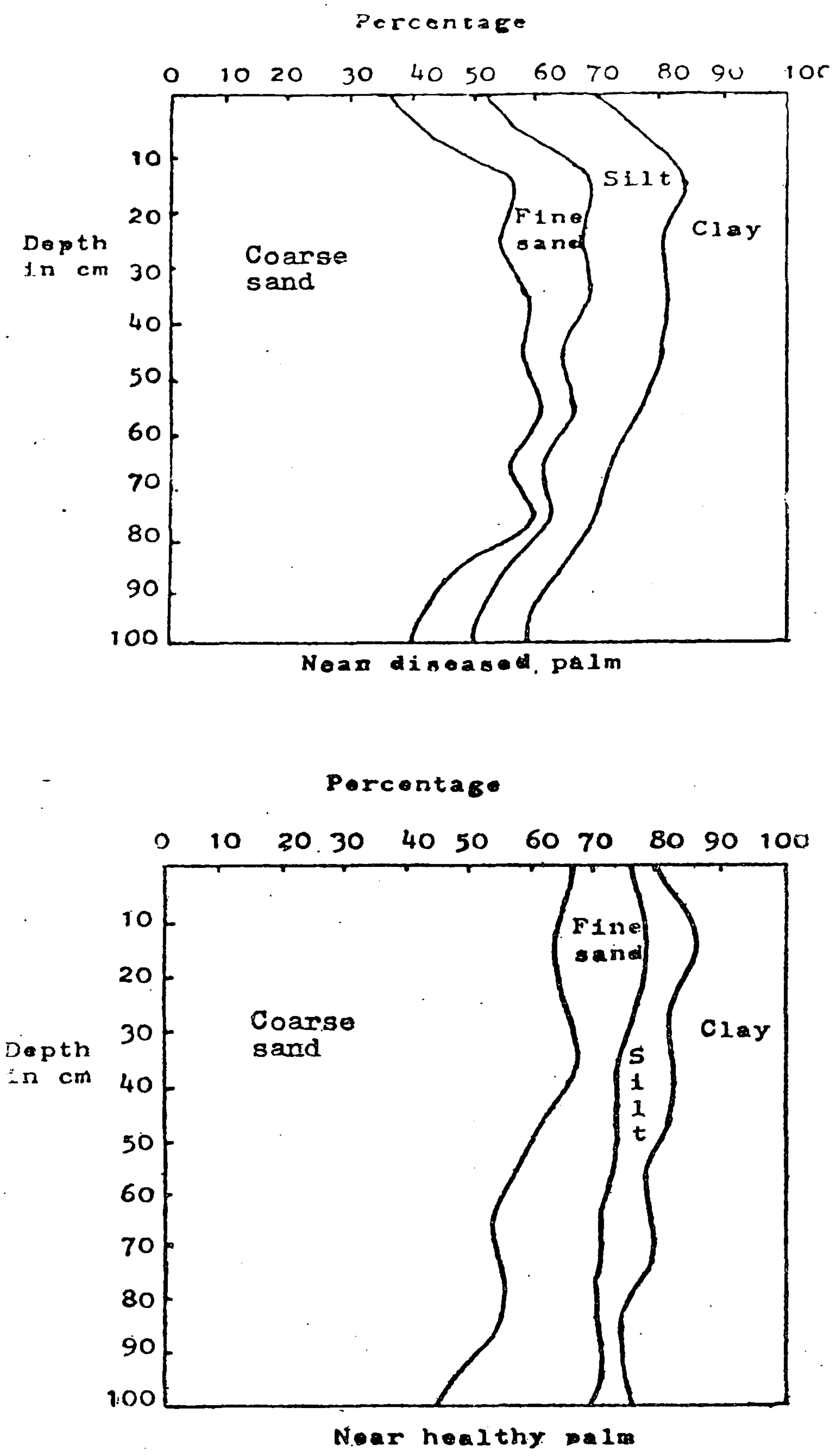


FIGURE - 1
Mechanical composition of soils under the affected and nonaffected palms.

Depth cm	Bulk density g/cm^3	true density	porosity (%)
0—30	1.65±0.11	2.62±0.08	36.73±2.19
30—60	1.68±0.11	2.55±0.10	32.54±3.56
60—100	1.73±0.11	2.52±0.21	31.58±3.36
0—100	1.71±0.12	2.56±0.30	33.42±3.92

I

Depth cm	Bulk density g/cm^3	true density	porosity (%)
0—30	1.66±0.08	2.69±0.22	38.38±1.8
30—60	1.73±0.09	2.68±0.16	34.84±1.45
60—100	1.73±0.12	2.61±0.32	33.42±3.11
0—100	1.70±0.13	2.77±0.18	36.45±3.72

II

TABLE I

Bulk density, True density and Porosity of Red Yellow Podzolic soils under affected and non affected Palms by Tapering disease

I — Affected palms

II — non affected palms

Depth cm	M.W.D. (dry seive) mm	M.W.D. (wet seive) mm	Aggregate stability (%)
0—30	1.65±0.01	1.40±0.05	84.08±4.13
30—60	1.85±0.08	1.52±0.09	81.41±5.46
60—100	2.24±0.13	1.54±0.23	60.39±12.84
0—100	1.95±0.28	1.49±0.19	77.01±11.9

I

Depth cm	M.W.D. (dry seive) mm	M.W.D. (wet seive) mm	Aggregate stability (%)
0—30	1.82±0.25	1.42±0.22	77.14±13.24
30—60	1.91±0.13	1.46±0.14	79.14± 4.98
60—100	2.10±0.16	1.50±0.19	72.22±11.74
0—100	1.96±0.29	1.49±0.23	76.94±12.48

II

TABLE II

Mean weight diameter (M.W.D.) and aggregate stability of Red Yellow Podzolic soils under affected and Non affected palms by Tapering disease

I — Affected palms
II — Healthy palms

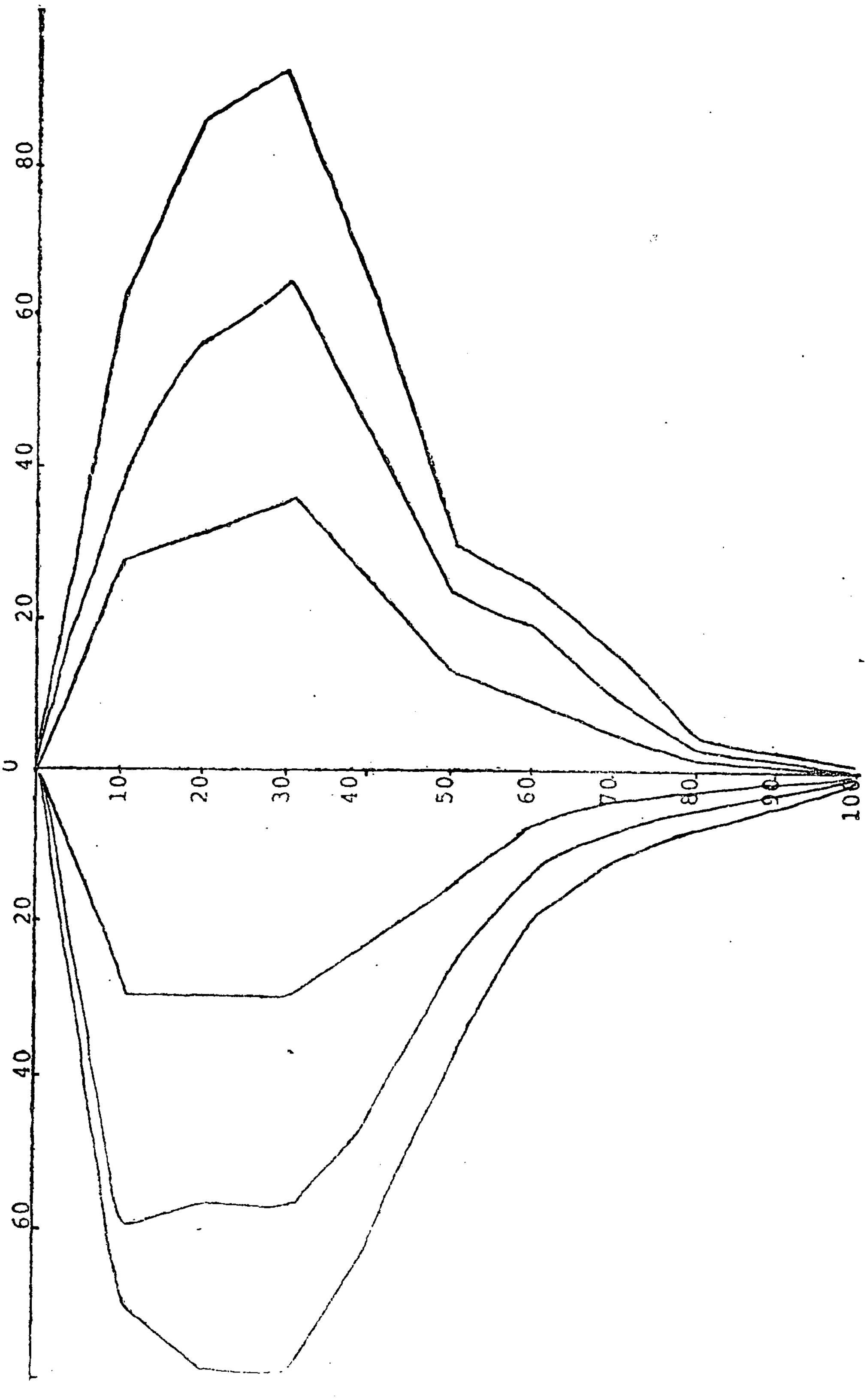


Fig 2B Root distribution pattern of the Healthy coconut palms.

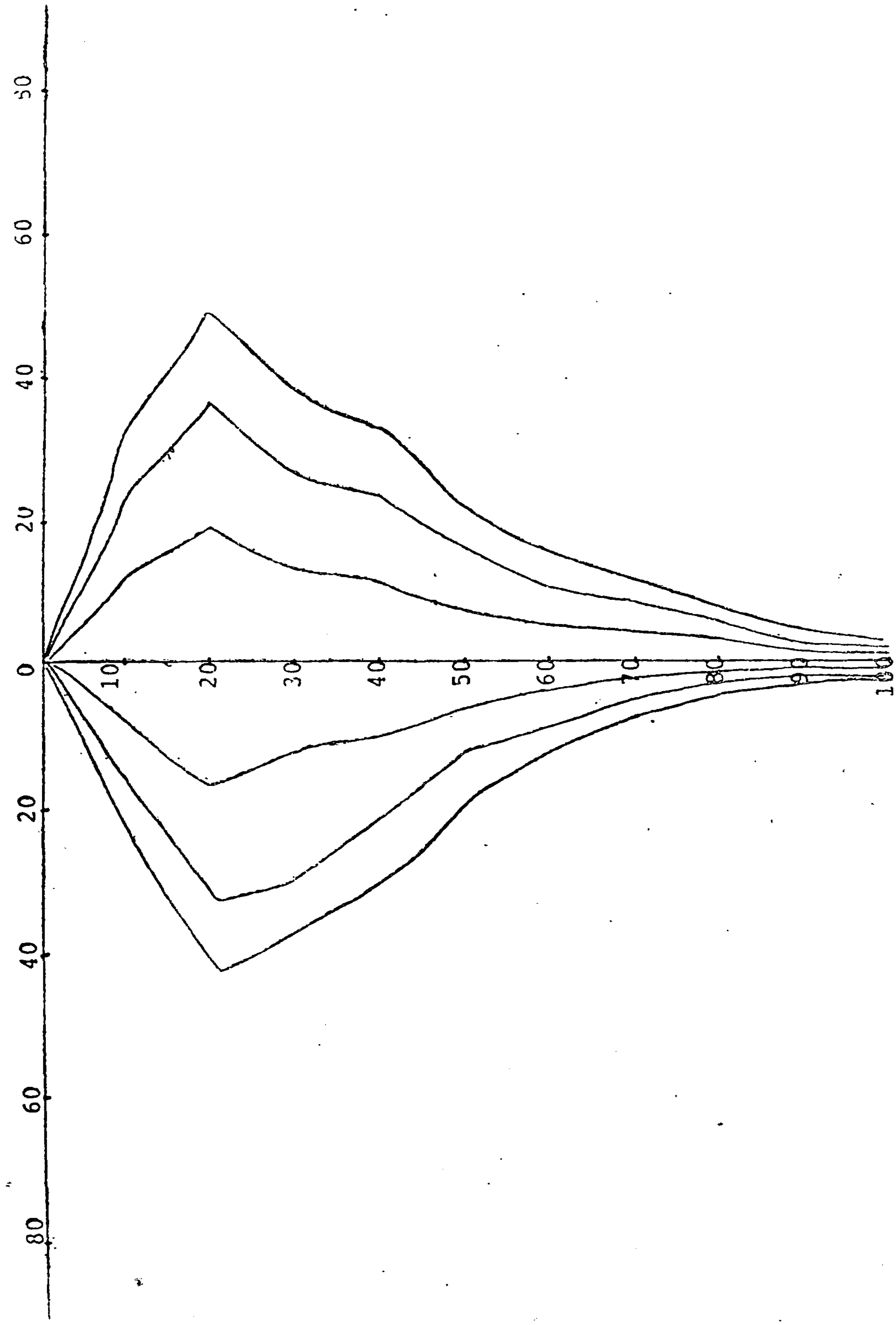
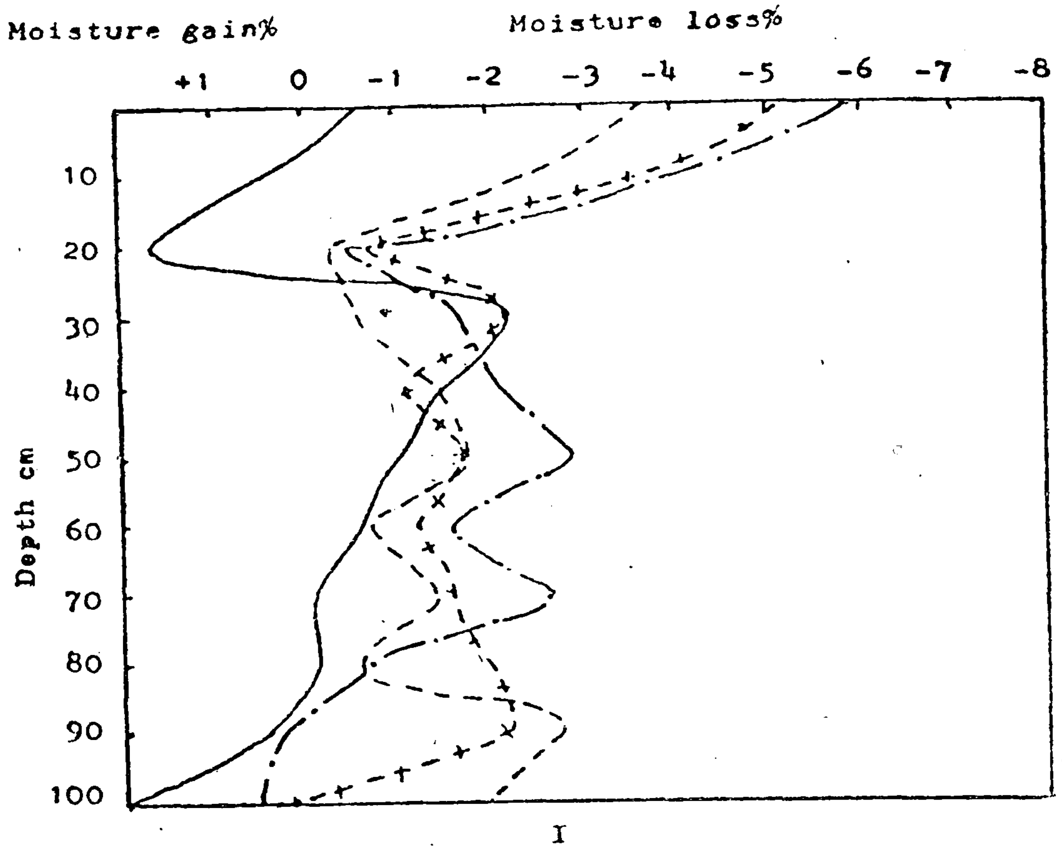


Fig 2A Root distribution pattern of the coconut palm affected by tapering disease.



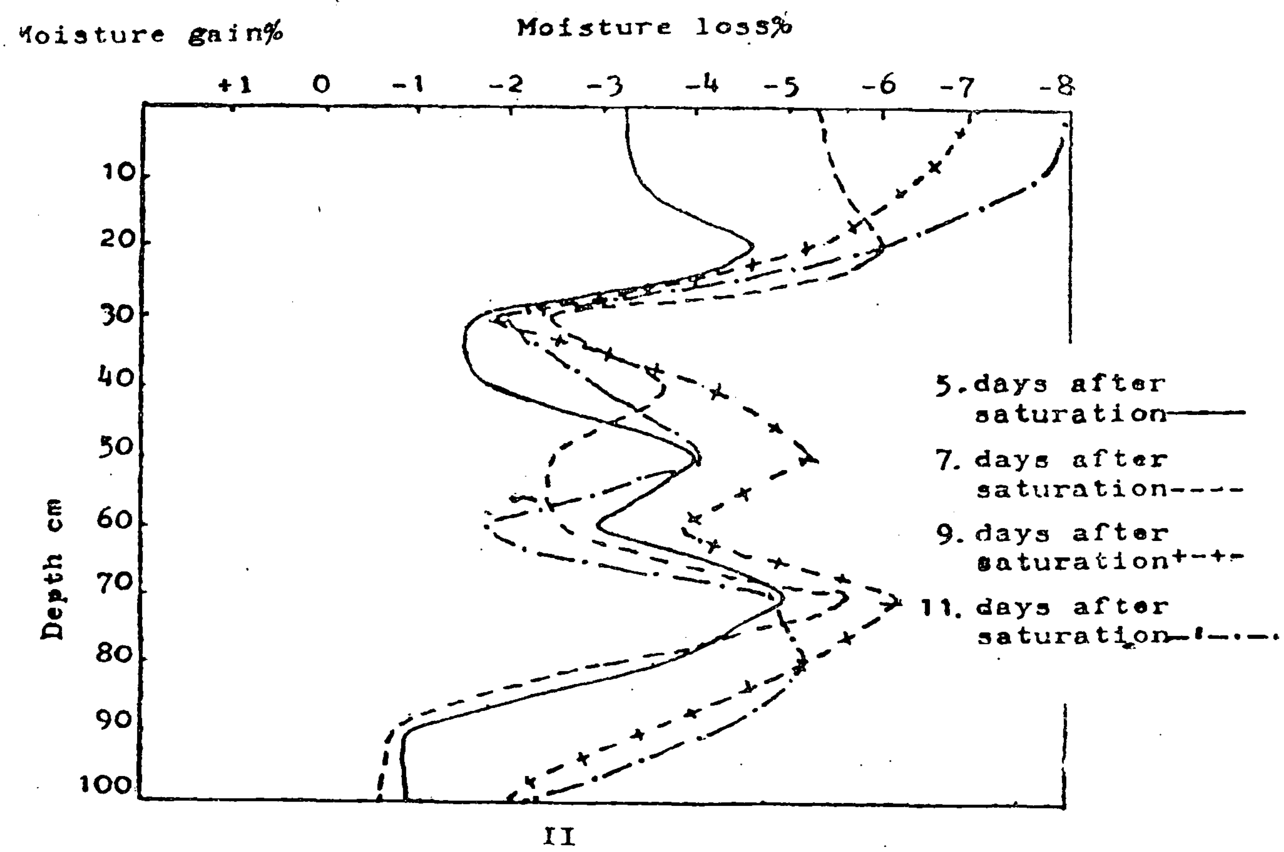


FIGURE 3

Moisture Extraction curves of the Soil under diseased and healthy palms

I Diseased palm II Healthy palm