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STUDIES ON SOIL CONDITIONS IN RELATION
TO THE "ROOT" AND "LEAF" DISEASES OF
COCONUTS IN TRAVANCORE-COCHIN

PART I

NITROGEN, ORGANIC MATTER CONTENT AND CARBON/NITROGEN RATIO
OF COCONUT SOILS

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Introduction

IN previous publications from these laboratories (Menon et al 1950, 1952) attention had been drawn to the fact that the root and leaf diseases of coconuts in Travancore-Cochin appeared to be associated with the nutritional status of the soil. Plant nutrients may become unavailable to coconut palms in optimum ratios either due to their total absence in soil or due to their inadequate release in assimilable forms. Soils from diseased areas appeared to be deficient in available potash and their clay contents and exchangeable bases were also low. Coconut palms in this State grow quite well in all the four main soil types and the diseases also are prevalent in areas belonging to all these soil types. It may be mentioned in this connection that in diseased areas there exist a number of healthy patches and in badly diseased gardens healthy trees may be found growing side by side with infected ones. These and other factors indicated the necessity for a more systematic study

of the soil profile for collection of comparative data and the results of this study are being presented in this series of papers.

Materials and Methods

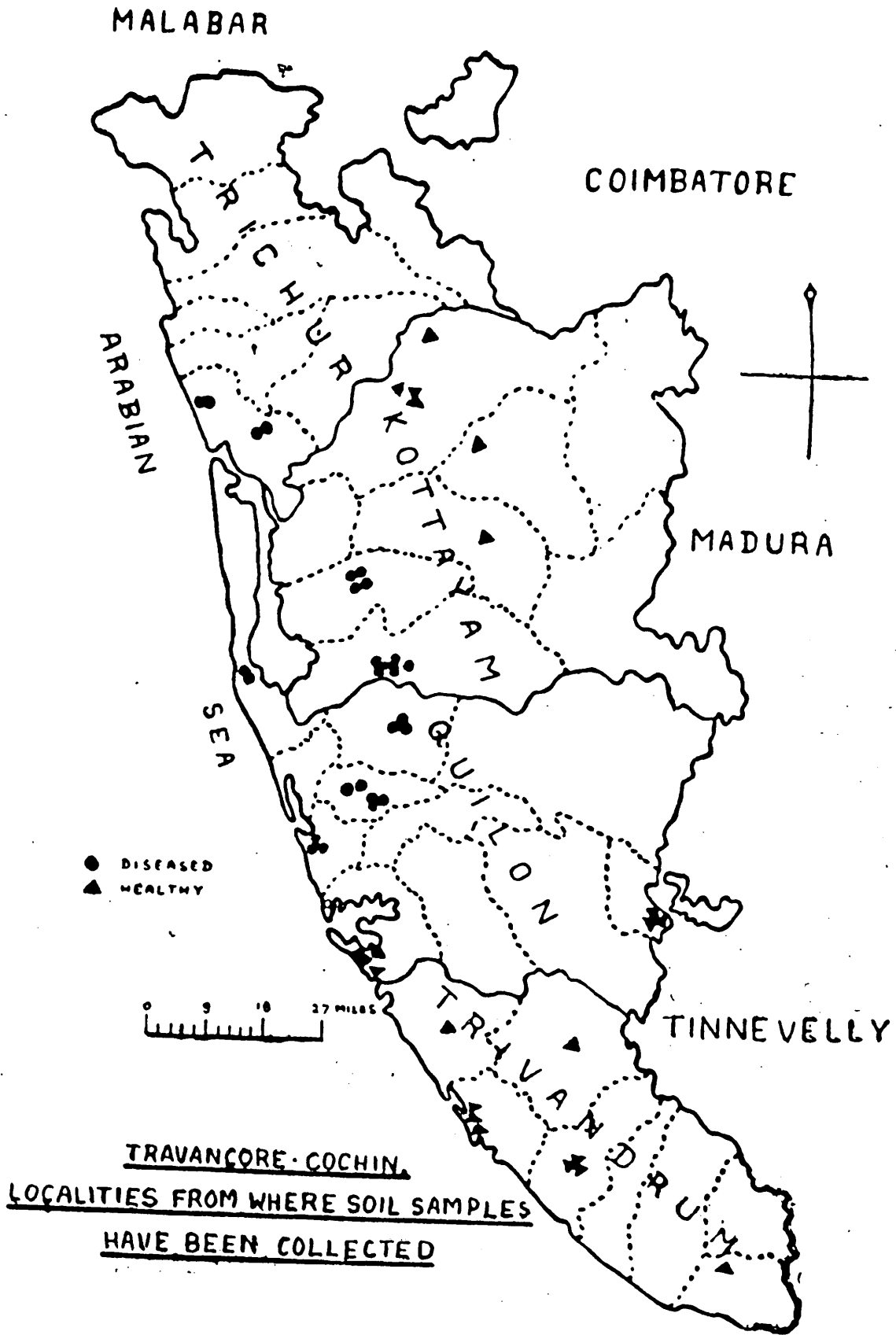
There are four main types of soil in this State. They are:—

1. The sandy or sandy loam soils of the coastal tracts;
2. The alluvial loam soils on the banks of rivers and backwaters;
3. The red loam soils which appear to be the products of weathering of laterite
- and 4. The laterite soils at the base of the Western Ghats.

As far as the laterite type is concerned attention has been paid to only the soft or pistolitic laterite since there are practically no coconuts on the hard laterites.

Soil samples were collected from healthy and diseased areas representing all these four types. As far as possible only those

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areas where the soil had not been recently disturbed by manurial or cultural operations were selected. A trench 6 ft. by 3 ft. was dug going down to a depth of six feet, or up to the water table or up to any other impermeable bottom layer if this happened to be nearer the surface than six feet. One side of the trench was then made vertical using a clean shovel or mammaty. The profile thus exposed was examined and one sample was collected for each visibly distinct horizon of the profile. In tables 1 to 4 (see appendix) are given the descriptions of 104 soil samples thus collected from 50 sites. The map on page 6 shows the localities from where these samples have been collected.

The samples were collected over a period of three years, and each year the collection was made during the same months, viz., July and August, so that variations in nutrient status and such other factors due to variations in climatic conditions could be eliminated. The samples were brought to the laboratory and then air dried for a period of fifteen days. The lumps were broken up with a wooden pestle and the soil sieved through a 2 mm. sieve. The samples were then stored in air tight bottles. This material was used for all the analysis carried out unless otherwise stated.

The analysis of the soil samples included all those items generally looked for, in arable soils in different soil laboratories. The items looked for in their soil survey programme were also ascertained from workers at the Indian Agricultural Research Institute, New Delhi (Roy Choudhri, Private Commn.). In general details of procedures described by C. H. Wright (1939) and C. S. Piper (1944) were carefully adopted with regard to the different determinations.

It is well known that the fertility status of a soil influences to a considerable extent the growth and production of plants growing on it. From the point of view of fertility the nitrogenous portion of the soil is of paramount importance. Nitrogen is a component of most of the compounds associated with plants, e.g., protoplasm, proteins, chlorophyll, amides and alkaloids. Generally plants take up nitrogen from the soil in the form of nitrates which are formed in soils as a result of biological nitrification and fixation. Of course, other sources of nitrogen are also utilised. The coconut palm is one of the few perennial plants which bear throughout the year and consequently it can be expected to make a heavy demand on the soil for the supply of the different nutrients. Based on the analysis of fruits and leaves a number of estimates of the palms' requirement of nitrogen have been made by different workers in the field as shown in Table 5.

TABLE 5

1	Copeland (1921)	91.12 Kgms. per hectare (On the basis of 70 trees/acre and each tree producing 40 nuts per year)
2	Pillai (1919)	18.0 lb. per acre
3	Eckstein et al (1937)	90 kgms. per hectare
4	Jacob and Coyle (1926)	57 lb. per acre

Patel (1938) is of the opinion that an annual addition of at least 24 pounds of nitrogen is necessary to preserve the fertility of a soil on which coconuts are grown. These figures show such vast differences that one is lead to conclude that the composition of the parts of the palm examined to get these results was greatly influenced by the nutrient status of the soil on which they were grown;

palms growing on a rich soil giving high values and those growing on a poor soil giving correspondingly low values. This again provides further proof of the adaptable nature of the palm, in that, it is able to economise on the available plant foods and still grow and yield. However, there are threshold limits for each plant food ingredient, and when the quantity of nutrient available falls below this threshold value, it is attended with adverse effects on plant growth. This aspect has since been the subject of careful and systematic study. The position with regard to nitrogen and carbon/

nitrogen ratio which influence soil fertility factors to considerable extents are examined and discussed in this paper.

The values for nitrogen, carbon, organic matter and C/N ratio for the soils under examination are given in tables 6, 7, 8 and 9 (See appendix). In all the cases the oven dry soil has been chosen as the basis for expressing the percentages.

Discussion and Conclusion

A. *Nitrogen*.—In Table 10 are given the mean values for the percentage of nitrogen in the soil samples examined.

TABLE 10

Group	Horizon	Soil type			
		Sandy	All. Loam	Red loam	Laterite
Diseased	A	0.049	0.091	0.034	0.094
	B	0.038	0.088	0.033	0.090
	C	..	..	..	0.074
Healthy	A	0.030	0.069	0.070	0.107
	B	0.023	0.055	0.060	0.078
	C	..	..	..	0.046

The following conclusions may tentatively be drawn from the values presented above.

1. In the soil samples from diseased areas belonging to the sandy and alluvial loam types there is a higher percentage of nitrogen than in those from healthy areas.

2. The reverse is the case with the samples belonging to the red loam type; i. e., samples from healthy areas have a higher nitrogen status as compared with those from diseased areas.

3. In the case of laterite areas the samples from healthy localities have a

higher nitrogen status in the A horizons and a lower status in the B and C horizons when compared with those from diseased areas.

From these one has to assume that the nitrogen status of the soil does not exert appreciable influence in orientating the healthy or diseased conditions of the coconut palm. In this connection it is interesting to note that the results of analysis of leaves conducted by J. B. Hale (1947) at the Rothamstead Experimental Station to ascertain the cause of the chlorosis and bronzing of oil palms in W. Africa, revealed no correlation between nitrogen status of the leaves and incidence of the chlorosis and bronzing.

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B. Organic Matter. -- This confers on the soil its distinctive character as the seat of plant life. The organic matter content of a soil influences among other things the following physical properties of the soil *viz.* weight, cohesion, structure, absorptive power, porosity, colour, temperature and tilth. It is also known to contribute a good deal to the exchange capacity of the soils and many sandy soils owe their exchange capacity almost entirely to their organic matter content. Organic matter also makes a material contribution to the maintenance of the granular structure of soils. The organic acids produced during decomposition may serve to reduce the

amount of fixation of phosphoric acid and iron and keep them in forms available to the plants. Soil organic matter also helps to conserve soil moisture especially in sandy soils besides serving to release trace nutrients in available forms, to the plants, being a plentiful source of the latter. As a source of energy to the microflora of the soil the organic matter plays an important role in healthy plant growth. These considerations definitely point to the importance of soil organic matter in relation to healthy plant growth. Tables 11 and 12 give the mean values for the percentages of organic carbon and organic matter in the soil samples under examination.

TABLE 11
Shows the organic carbon content of the different soils

Group	Horizon	Soil type			
		Sandy	Alluvial loam	Red loam	Laterite
Diseased	A	0.236	0.847	0.179	0.792
	B	0.244	0.724	0.193	0.775
	C	..	..	..	0.439
Healthy	A	0.222	0.645	0.717	0.754
	B	0.125	0.745	0.681	0.769
	C	..	..	..	0.554

TABLE 12
Showing the organic matter content of the different soils

Group	Horizon	Soil type			
		Sandy	Alluvial loam	Red loam	Laterite
Diseased	A	0.408	1.461	0.308	1.348
	B	0.421	1.247	0.332	1.335
	C	..	..	..	0.759
Healthy	A	0.383	1.112	1.236	1.300
	B	0.216	1.284	1.174	0.982
	C	..	..	..	0.955

The following conclusions can be drawn from these results.

1. There is a higher content of organic matter in the samples belonging to (a) both the horizons of the sandy type (b) A horizon of the alluvial loam type and (c) A and B horizons of the laterite type in the diseased group, when compared with corresponding samples in the healthy group.

2. The organic matter content however is lower in the samples from the diseased areas belonging to (a) both the horizons of the red loam type and (b) the C horizons of the laterite type.

3. There is no difference between healthy and diseased areas as far as the B horizon of the alluvial loam type is concerned. There is thus no significant difference common to all the four soil types between healthy and diseased areas in the soil organic matter content. Hence it has to be concluded that the organic matter content of the soil appears to have no correlation with the incidence of

disease conditions or in predisposing the trees to disease attack. In all probability the disease conditions centre round aspects on which the soil organic matter content is not directly associated even though healthy plant growth is certainly definitely associated with the presence of it is the soil in appreciable quantities.

The Carbon Nitrogen Ratio of the Soils

The determination of the Carbon/Nitrogen ratio is considered to be helpful in assessing the influence of soil organic matter on plant growth. Normal agricultural soils are known to maintain a constant ratio and the decomposition in the soil of added organic material proceeds in such a way that this ratio is not altered much. Very little is known as to the actual influence of the Carbon/Nitrogen ratio upon plant growth. Mean values of the Carbon/Nitrogen ratio of the soil samples examined in this study are given in table 13.

TABLE 13
Giving the C/N ratio values of the soils

Group	Horizon	Soil type			
		Sandy	Alluvial loam	Red loam	Laterite
Diseased	A	5.0	9.6	5.7	8.6
	B	7.4	8.2	6.0	9.2
	C	..	..	..	5.5
Healthy	A	6.9	9.3	10.7	8.0
	B	4.9	8.5	10.2	7.1
	C	..	..	..	22.0

The following conclusions are possible from these results.

(i) The values of the C/N ratio are higher in the samples from diseased

areas belonging to the B horizons of the sandy type and the A & B horizons of the laterite type as compared with corresponding samples from healthy areas.

(ii) Samples of the diseased group belonging to (a) both the horizons of the red loam type (b) the A horizons of the sandy type and (c) the C horizons of the laterite type however have lower values for the ratio than corresponding samples of the healthy group; and

(iii) Samples from healthy and diseased areas of the alluvial loam type exhibit no significant difference.

As in the case of nitrogen and soil organic matter, it is thus seen that there is no significant difference in the C/N ratio value which is common to all soil types between healthy and diseased areas and this points to the conclusion that the incidence of the diseases of the coconut palm does not appear to be influenced by the C/N ratio of the soil organic matter. It is surprising but at the same time interesting to note that such important factors as the nitrogen and soil organic matter content of soil which are factors well known to influence soil fertility status and the healthy growth of plants are found to have no direct influence in the pathological conditions seen in the coconut palms in this State.

There have been numerous instances in literature, where, the addition of nitrogen or organic matter to the soil has corrected to a large extent disease conditions of crop plants. The classical work carried out in Britain on the control of

potato scab by incorporating large quantities of green manures with the soil is an instance of this fact. (E. Grossbard 1951). In Arizona and other cotton growing areas the serious cotton root rot disease (*Phymatotrichum omnivorum*) was successfully controlled by putting large quantities of hay and other manures into deep furrows. Canadian workers were able to eradicate strawberry root rot and scab of potatoes by ploughing in a crop of soyabeans, red clover and rye grass; all of which enrich the soil with both nitrogen and organic matter. The parasite *Ophiobolus graminis* responsible for a disease of cereals aptly named "Take all" can be eradicated by the use of manures of a high carbon but low nitrogen content. However in the case of the disease conditions of the coconut palm, these considerations do not have any significance, since, the results given in this paper do not point to any correlation between disease incidence and the nitrogen and organic matter content of the soil.

Summary

1. Detailed studies on the soil conditions in relation to the diseases of the coconut palm in Travancore-Cochin have been undertaken and comparative analytical data of soils of representative diseased and healthy areas for nitrogen, soil organic matter and carbon nitrogen ratio with special reference to soil types have been presented.

2. There is no indication from the results that these factors have any significant influence in orientating the disease conditions of the palms, in spite of their intimate association with soil fertility.

3. The above does not preclude certain indirect ways in which these factors may exercise their influence as predisposing factors for disease attack.

Acknowledgment.

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APPENDIX

TABLE I

Description of the soil samples collected from healthy and diseased areas belonging to the type Sandy (Sandy loam)

Locality and Taluk	Whether diseased area and general condition of trees	Horizon	Depth of horizon	Details regarding water table	Description of the soil of each horizon as seen in the field	Laboratory No. of samples		
Krishnapuram, (Karunagapally)	Diseased area. Trees badly affected by both diseases. Very poor	A	0" 9"	..	White sandy soil with light patches of grey	1		
		B { I II	9" 27"	Water table at 37 in.	Reddish brown sandy soil	2 (a)		
			27" 72"		Yellowish brown sand	2 (b)		
		Block II	do.	A	0" 7"	Water table at 37 in.	Light grey sand	3
				B	7" 37"		Greyish brown sand	4
		Block III	do.	A { I II	0" 9"	Water table at 60 in.	Sandy soil greyish brown in colour	5 (a)
9" 21"	Brownish grey sandy soil				5 (b)			
Alleppey (Ambalapuzha)	Diseased area. Trees badly affected by both diseases. Extremely poor	B { I II	21" 37"	Water table at 24 in.	Grey sandy soil	6 (a)		
			37" 53"		Sandy soil coloured dark brown: probably due to some accumulation of organic matter	6 (b)		
		Block I	do.	III	53" 60"	Water table at 24 in.	Brownish grey sand	6 (c)
					0" 24"		Dark grey sandy soil	7
		Block II	do.	A	0" 24"	Water table at 24 in.	Dark grey sand	8
				A	0" 12"		Light grey sandy soil	9
Edappally (Kunnathunad)	Diseased area. Trees affected mainly by leaf disease. Very poor	B	12" 72"	..	Dark grey sand	10		
		Block I	do.	0" 12"	..	Light grey sand	11	
Block II	12" 72"			Grey sandy loam		12		
Thazhakkara (Mavelikkara)	Diseased. Trees badly affected mainly by root disease. Poor palms.	A	0" 12"	..	Grey sandy loam	13		
		B	12" 72"		Reddish brown sandy loam	14		

TABLE I—(cont.)

Locality and Taluk	Whether diseased area and general condition of trees	Horizon	Depth of horizon	Details regarding water table	Description of the soil of each horizon as seen in the field	Laboratory No. of samples
Mudemveli (Cochin-Kannur) Block I Block II	Diseased. Both root and leaf diseases. Poor palms do.	A	0" 16"	Water table at 32 in.	Grey sand	15
		B	16" 32"		Brown sand	16
Quilon (Quilon) Block I Block II	Healthy. Trees average bearers. do.	A	0" 21"	..	Grey sand	17
		B	26" 46"	Water table at 46 in.	Light grey sand	18
		A	0" 21" 21" 72"		Dark grey loam Light red sandy loam	19 20
		B	0" 12" 12" 24" 24" 72"		White sand with light brown patches Brown sand Greyish brown sand Grey sand coloured dark by organic matter	21 22 (a) 22 (b) 23
Pettah (Trivandrum) Block I Block II	Healthy. Trees rather poor Healthy. Very good and heavy yielders	A	0" 12"	..	Grey sand coloured dark by organic matter	24
		B	12" 72"		Reddish brown sand	25 (a)
Neendakara (Quilon)	Healthy. Very good and heavy yielders	A	0" 8" 8" 28"		Reddish grey sandy loam Dark grey sandy loam	25 (b)
		B	28" 72"		Brown sandy loam	26
		A	0" 24" 24" 43" 43" 49" 49" 62" 62" 72"		Light grey sand Greyish brown sand Mixture of black and white sand Black sand Mixture of black and white sand	27 (a) 27 (b) 28 (a) 28 (b) 28 (c)
Paravoor (Quilon)	Healthy. Trees are good yielders	A	0" 12"	..	Grey sandy loam	29
		B	12" 24" 24" 72"		Grey brown sand Light red sand	30 (a) 30 (b)

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TABLE 2
Description of soil samples collected from healthy and diseased areas belonging to the type *Alluvial loam*

Locality from where samples have been collected	Whether locality is an affected area and condition of trees	Horizon	Depth of Horizon	Details re-water table and other impermeable layers	Description of the soil of each horizon as seen in the field	No. of samples Laboratory
Mannakkanad (Meenachil)	Diseased. Trees affected mainly by leaf disease. Poor	A B	0" 24" 24" 36"	Pebbles of granite at 36"	Grey alluvial loam Brown loam, rather sticky	31
						32
Thazhakkara (Mavelikara) Border of river	Diseased. Trees in the early stages of both the diseases. Average yielders	A B	0" 12" 12" 72"	..	Greyish black alluvial loam Black stiff clayey soil	33
						34
Mepral (Thiruvella) Block I	Diseased. General prevalence of leaf disease and a few cases of root disease. Average yielders	A B	0" 20" 20" 30"	Water table at 30"	Brown sticky alluvium Black stiff clayey soil	35
						36
Block II	do.	A { I II	0" 12" 12" 18"	Water table at 36"	Brown alluvial loam Brown alluvium with small patches of clay	37(a)
						37(b)
Block III	do.	B { I II	18" 36" 0" 8" 8" 15"	Water table at 27"	Mixture of black silt and clay Brown alluvium Mixture of brown alluvium and a little black clay	38
						39(a)
Changanacherry (Changanacherry)	Diseased. Trees affected by both root and leaf diseases. Poor	B A B	15" 27" 0" 18" 18" 46"	Water table at 46"	Sandy loam and brown alluvium Greyish brown alluvial loam Brown loam with a good proportion of clay	40
						41
Aymanam (Kottayam) Block I	Diseased. Trees affected by leaf disease and sporadic cases of root disease. Average yielders	A B	0" 9" 9" 30"	Water table at 30"	Grey alluvial loam Brown loam with a good proportion of clay	43
						44
Block II	do.	A	0" 14"	do.	Dark grey alluvium. Appears to have a good content of organic matter	45
		B	14" 30"		Reddish brown alluvial loam rather compact	46

TABLE 2—(cont.)

Locality from where samples have been collected	Whether locality is an affected area and condition of trees	Horizon	Depth of Horizon	Details re-water table and other impermeable layers	Description of the soil of each horizon as seen in the field	No. of samples Laboratory
Muvattupuzha (Muvattupuzha) Bank of river	Healthy. Trees healthy and good yielders	A	0" 30"	..	Black alluvial loam, rather compact	47
		B	30" 55" 55" 72"			Reddish brown alluvium, very compact Reddish alluvium and black stiff clay	48(a) 48(b)
Nedumangad (Nedumangad) Bank of river	Healthy. Trees healthy and heavy bearers	A	0" 7"	..	Greyish brown loam	49(a)
		B	7" 21" 21" 51" 51" 72"			Mixture of sticky brown loam & sand Brownish yellow sticky loam Mixture of yellow clayey loam & sand	49(b) 50(a) 50(b)
Karamanai (Trivandrum)	Healthy. Trees healthy and heavy bearers	A	0" 3"	..	Brown loam	51(a)
		B	3" 8" 8" 10"			Dark grey alluvium Brown loam with streaks of dark grey alluvium	51(b) 51(c)
Puliyara (Shencottah) Block I Block II Block III	Healthy. Trees healthy though poor bearers	A	10" 14"	Granite rock at 60"	Brown grey loam	52(a)
		B	14" 72"			Brown clayey loam and sand	52(b)
	do.	A	0" 12"	do.	Black sticky alluvial loam	53
		B	12" 60"			Grey alluvium	54
	do.	A	0" 12"	Granite rock at 62"	Grey alluvial loam	55
		B	12" 60"			Black compact clayey loam	56
	do.	A	0" 12"	Granite rock at 62"	Black sticky alluvial loam	57
		B	12" 62"			Very black and compact clayey loam	58

STUDIES ON SOIL CONDITIONS IN RELATION TO THE "ROOT" AND "LEAF" DISEASES OF COCONUTS IN TRAVANCORE-COCHIN

TABLE 3
Description of soil samples collected from healthy and diseased areas belonging to the type Red Loam

Locality from where samples have been collected	Whether locality is an affected area and condition of the trees	Horizon	Depth of horizon	Details re-water table or other impermeable layer	Description of the soil of each horizon as seen in the field	Laboratory Number of samples
Changanacherry, (Changanacherry) Block I	Diseased. A number of trees suffering from leaf disease and a few from root disease. Poor bearers	A	0"72"	..	Only one horizon of reddish yellow loam	59
Block II	do.	A	0"34"	..	Red loamy soil coloured rather dark by organic matter	60
Mavelikara (Mavelikara) North	Diseased. Only a few cases of infection. Trees are average bearers	B { I	34"55"	..	Light red sandy loam	61 (a)
		II	55"72"	..	Reddish yellow loam	61 (b)
		A { I	0"31"	..	Reddish brown loamy soil rather light textured	62 (a)
		II	31"50"	..	Dark brown sandy loam	62 (b)
South Block I	do.	B	50"72"	..	Bright red loam	63
Block II	do.	A	0"16"	..	Greyish red loam; light textured	64
		B	16"72"	..	Bright red loam	65
Quilon (Quilon)	Healthy area. Trees healthy and average bearers	A	0"15"	..	Brownish red loam; light textured	66
		B { I	15"35"	..	Yellowish red loam	67 (a)
		II	35"72"	..	Bright red loam	67 (b)
Nagercoil (Agastheeswaram)	Healthy area. Trees healthy and good bearers	A	0"30"	..	Greyish red sandy loam	68
		B	30"72"	..	Bright red loam	69
		A { I	0"8"	..	Grey sandy loam	70 (a)
		II	8"20"	..	Light red loam; light texture	70 (b)
		B { I	20"26"	..	Bright red loam; light textured	71 (a)
		II	26"72"	..	Bright red loam; rather heavy	71 (b)

TABLE 3—(cont.)

Locality from where samples have been collected	Whether locality is an affected area and condition of the trees	Horizon	Depth of horizon	Details re-water table or other impermeable layer	Description of the soil of each horizon as seen in the field	Laboratory Number of samples
Neyyattinkara (Neyyattinkara) Block I	Healthy area. Trees healthy and average bearers	A	0"12"	..	Bright red loam coloured a bit dark by organic matter	72
		B { I II	12"24" 24"72"	.. ..	Bright red loam: light textured Heavier red loam	73 (a) 73 (b)
Block II	do.	A	0"12"	..	Red loam, coloured dark by organic matter	74
		B { I II	12"24" 24"72"	.. ..	Bright red loam: light texture Heavier red loam	75 (a) 75 (b)
Block III	do.	A	0"12"	..	Red loam, coloured dark by organic matter	76
		B { I II	12"24" 24"72"	Bright red loam: light textured Heavier red loam	77 (a) 77 (b)

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TABLE 4
Description of the soil samples collected from healthy and diseased areas belonging to the type *Laterite*

Locality from where samples have been collected	Whether locality is an affected area, and conditions of the trees	Horizon	Depth of horizon	Details re-water table or other impermeable layer	Description of the soil of each horizon as seen in the field	Laboratory Number of samples
Changanacherry (Changanacherry) Block I	Diseased area. Trees affected by both root and leaf diseases. Poor bearers	A	0"16"	Hard laterite rock at 54"	Reddish brown loam with a few pebbles of laterite	78
		B	16"34"	..	Greyish brown clayey loam with a good amount of laterite pebbles	79
		C	34"34"	..	Soft red laterite	80
Block II	do.	A	0"29"	Hard laterite rock at 51"	Red loam with a good amount of gravel	81
		B	29"51"	..	Soft yellowish red laterite	82
Block III	do.	A	0"21"	Hard laterite rock at 63"	Grey clayey loam with a small quantity of small laterite pebbles	83
		B	21"48"	..	Red loam mixed with a good quantity of big pebbles	84
Kottayam (Kottayam) Block I	Diseased area. A few cases of root disease only. Trees medium bearers	C	48"63"	..	Semi hard yellowish red laterite	85
		A	0"15"	..	Red loam mixed with small laterite pebbles	86
Block II Kothamangalam (Muvattupuzha)	do.	B	15"24"	..	Greyish red loam with small pebbles	87
		C I	24"45"	..	Soft red laterite	88(a)
		C II	45"72"	..	Soft yellowish red laterite	88(b)
		A	0"72"	..	Only one horizon of soft red laterite	89
Muvattupuzha (Muvattupuzha) Block I	Healthy area. Trees healthy and medium bearers	A	0"4"	..	Brown clayey loam	90
		B	4"38"	..	Sticky stiff red loam	91
		C	38"72"	..	Yellowish red loam mixed with friable laterite	92
	do.	A	0"23"	..	Red loam mixed with fine pebbles of laterite	93
		B	23"66"	..	Red loam and soft yellow laterite	94
		C	66"72"	..	Soft friable yellow laterite	95

TABLE 4—(cont.)

Locality from where samples have been collected	Whether locality is an affected area, and condition of the trees	Horizon	Depth of horizon	Details re-water table or other impermeable layer	Description of the soil of each horizon as seen in the field	Laboratory Number of samples
Block II	Healthy area. Trees healthy and medium bearers	A	0'6"	Hard laterite rock at 54"	Black clayey loam	96
		B	6'48"	..	Red loam and soft red laterite	97
Attingal (Chirayinkil)	Healthy area. Trees healthy and good bearers	C	48'54"	..	Soft friable red laterite	98
		A	0'31"	..	Red loam mixed with small laterite pebbles	99
Thodupuzha (Thodupuzha)	Healthy area. Trees healthy and medium bearers	B	31'60"	..	Brown clayey loam and laterite pebbles	100
		C	60'72"	..	Reddish yellow soft laterite	101
		A	0'9"	..	Red loam coloured dark by organic matter	102
		B	9'18"	..	Red loam and laterite pebbles	103
		C	18'72"	..	Soft red laterite	104

STUDIES ON SOIL CONDITIONS IN RELATION TO THE "ROOT" AND "LEAF" DISEASES OF
COCONUTS IN TRAVANCORE-COCHIN

TABLE 6

Percentage of nitrogen, organic carbon, organic matter and C/N ratio in the soil
samples belonging to the type *Sandy* (*Sandy loam*)

Diseased areas					Healthy areas				
Lab. No. of sample	N	Org. C	Org. matter	C/N ratio	Lab. No. of sample	N	Org. C	Org. matter	C/N ratio
1	0.066	0.232	0.400	3.5	19	0.055	0.583	1.005	10.6
2 a	0.054	0.268	0.462	5.0	20	0.051	0.372	0.641	7.3
2 b	0.036	0.102	0.176	2.8					
					21	0.032	0.076	0.131	2.1
3	0.084	0.376	0.648	4.5	22 a	0.020	0.102	0.176	5.0
4	0.060	0.292	0.504	4.9	22 b	0.024	0.102	0.176	4.3
5 a	0.057	0.434	0.748	7.6	23	0.022	0.065	0.112	3.0
5 b	0.063	0.382	0.659	6.1	24	0.018	0.084	0.145	4.7
6 a	0.059	0.173	0.298	2.9					
6 b	0.061	0.182	0.314	3.0	25 a	0.036	0.389	0.671	10.8
6 c	0.055	0.251	0.433	4.6	25 b	0.028	0.251	0.433	9.0
					26	0.018	0.112	0.193	6.2
7	0.051	0.082	0.141	1.6					
8	0.038	0.050	0.086	1.3	27 a	0.020	0.117	0.202	5.9
					27 b	0.011	0.071	0.122	6.5
9	0.041	0.444	0.765	10.8	28 a	0.008	0.033	0.057	4.1
10	0.021	0.370	0.638	17.6	28 b	0.010	0.037	0.064	3.7
					28 c	0.014	0.014	0.025	1.0
11	0.038	0.184	0.317	4.8					
12	0.050	0.437	0.753	8.7	29	0.021	0.195	0.336	9.3
					30 a	0.017	0.056	0.097	3.3
13	0.035	0.344	0.593	9.8	30 b	0.013	0.047	0.081	3.6
14	0.021	0.260	0.448	12.4					
15	0.041	0.121	0.209	3.0					
16	0.025	0.084	0.145	3.4					
17	0.031	0.123	0.212	4.0					
18	0.024	0.121	0.209	5.0					

ABSTRACT OF TABLE 6

Factor		Diseased areas		Healthy areas	
		A Horizon	B Horizon	A Horizon	B Horizon
Nitrogen	Mean	0.049	0.038	0.030	0.023
	Range	0.031—0.084	0.021—0.060	0.016—0.055	0.011—0.051
Org. Carbon	Mean	0.236	0.244	0.222	0.125
	Range	0.050—0.444	0.084—0.437	0.065—0.583	0.028—0.372
Organic matter	Mean	0.408	0.421	0.383	0.216
	Range	0.086—0.765	0.145—0.753	0.112—1.005	0.049—0.641
C/N Ratio	Mean	5.0	7.4	6.9	4.9
	Range	1.3—10.8	3.4—17.6	2.1—10.6	2.9—7.3
No. of values	..	10	8	6	6

TABLE 7

Percentage of nitrogen, organic carbon, organic matter and C/N ratio values of the soil samples belonging to the type *Alluvial loam*

Diseased areas					Healthy areas				
Lab. No.	N	Org. C.	Org. matter	C/N ratio	Lab. No.	N	Org. C.	Org. matter	C/N ratio
31	0.162	1.237	2.132	7.6	47	0.082	0.884	1.524	10.8
32	0.119	1.125	1.939	9.5	48a	0.074	0.465	0.802	6.3
					48b	0.050	0.512	0.883	8.5
33	0.144	1.395	2.405	9.7	49a	0.078	0.716	1.234	9.2
34	0.178	1.404	2.419	7.9	49b	0.060	0.539	0.929	9.0
35	0.056	0.884	1.524	15.8	50a	0.034	0.432	0.745	12.7
36	0.073	1.237	2.132	16.9	50b	0.025	0.391	0.674	15.6
37a	0.098	1.107	1.907	11.3	51a	0.046	0.409	0.705	8.9
37b	0.080	1.004	1.731	12.6	51b	0.083	0.735	1.267	8.9
38	0.164	0.865	1.491	5.3	51c	0.045	0.437	0.753	9.7
					52a	0.048	0.428	0.738	8.9
39a	0.083	0.837	1.443	10.1	52b	0.039	0.298	0.514	7.6
39b	0.087	1.079	1.865	12.3					
40	0.060	0.623	1.074	10.4	53	0.078	0.670	1.155	8.6
					54	0.071	0.576	0.993	8.1
41	0.043	0.335	0.578	7.8					
42	0.039	0.214	0.369	5.5	55	0.062	0.488	0.841	7.9
					56	0.056	0.200	0.345	3.6
43	0.070	0.470	0.810	6.7					
44	0.035	0.079	0.136	2.3	57	0.066	0.674	1.162	10.2
					58	0.059	0.553	0.953	9.4
45	0.077	0.442	0.762	5.7					
46	0.032	0.242	0.417	7.6					

STUDIES ON SOIL CONDITIONS IN RELATION TO THE "ROOT" AND "LEAF" DISEASES OF
COCONUTS IN TRAVANCORE-COCHIN

ABSTRACT OF TABLE 7

Factor		Diseased areas		Healthy areas	
		A. Horizon	B. Horizon	A. Horizon	B. Horizon
Nitrogen	Mean Range	0.091 0.043—0.162	0.088 0.032—0.178	0.069 0.058—0.082	0.055 0.030—0.071
Org. Carbon	Mean Range	0.847 0.335—1.395	0.724 0.079—1.404	0.645 0.488—0.884	0.745 0.200—0.576
Org. matter	Mean Range	1.461 0.578—2.405	1.247 0.136—2.419	1.112 0.841—1.524	1.284 0.345—0.993
C/N ratio	Mean Range	9.6 5.7—15.8	8.2 2.3—16.9	9.3 7.9—10.8	8.5 3.6—14.2
No. of values		8	8	6	6

TABLE 8

Percentage of nitrogen, organic carbon, organic matter and C/N ratio values of
the soil samples belonging to the type *Red Loam*

Diseased areas					Healthy areas				
Lab. No.	N	Org. C	Org. matter	C/N ratio	Lab. No.	N	Org. C	Org. matter	C/N ratio
59	0.028	0.214	0.369	7.6	68	0.116	1.072	1.848	9.2
60	0.049	0.102	0.176	2.1	69	0.069	0.678	1.169	9.8
61a	0.032	0.167	0.288	5.2	70a	0.086	0.897	1.546	10.4
61b	0.029	0.158	0.272	5.4	70b	0.107	1.004	1.731	10.0
62a	0.021	0.214	0.369	10.2	71a	0.128	1.324	2.282	10.3
62b	0.027	0.065	0.112	2.4	71b	0.147	1.572	2.710	10.7
63	0.025	0.195	0.336	7.8	72	0.046	0.539	0.929	11.7
64	0.036	0.242	0.417	6.7	73a	0.038	0.456	0.786	12.0
65	0.039	0.223	0.384	5.7	73b	0.036	0.409	0.705	11.4
66	0.035	0.195	0.336	5.6	74	0.043	0.493	0.850	11.5
67a	0.038	0.205	0.353	5.4	75a	0.043	0.539	0.929	12.5
67b	0.036	0.177	0.305	4.9	75b	0.043	0.446	0.769	10.4
					76	0.048	0.530	0.914	11.1
					77a	0.049	0.349	0.602	7.1
					77b	0.045	0.358	0.617	8.0

ABSTRACT OF TABLE 8

Factor		Diseased areas		Healthy areas	
		A. Horizon	B. Horizon	A. Horizon	B. Horizon
Nitrogen	Mean	0.034	0.033	0.070	0.067
	Range	0.024—0.049	0.025—0.039	0.043—0.116	0.037—0.138
Org. Carbon	Mean	0.179	0.193	0.717	0.681
	Range	0.102—0.242	0.163—0.222	0.493—1.072	0.354—1.448
Org. matter	Mean	0.308	0.332	1.236	1.174
	Range	0.176—0.417	0.280—0.384	0.850—1.848	0.610—2.496
C/N. Ratio	Mean	5.7	6.0	10.7	10.2
	Range	2.1—7.6	5.2—7.8	9.2—11.7	7.6—11.7
No. of values		5	4	5	5

TABLE 9

Percentage of nitrogen, organic carbon, organic matter and C/N ratio of the soil samples belonging to the type *Laterite*

Diseased areas					Healthy areas				
Lab. No.	N	Org. C	Org. matter	C/N ratio.	Lab. No.	N	Org. C	Org. matter	C/N ratio.
78	0.112	0.781	1.347	7.0	90	0.098	0.856	1.476	8.7
79	0.126	0.837	1.443	6.6	91	0.044	0.167	0.288	3.8
80	0.102	0.581	1.002	5.7	92	0.040	0.484	0.834	12.1
81	0.119	0.832	1.435	7.0	93	0.059	0.572	0.986	9.7
82	0.055	0.712	1.227	12.9	94	0.065	0.484	0.834	7.4
					95	0.053	0.540	0.931	10.2
83	0.076	0.851	1.467	11.2					
84	0.085	0.758	1.307	8.9	96	0.115	0.846	1.458	7.4
85	0.039	0.135	0.233	3.5	97	0.098	0.934	1.610	8.5
					98	0.012	0.874	1.507	12.8
86	0.081	0.865	1.491	10.7					
87	0.094	0.791	1.363	8.4	99	0.073	0.763	1.315	10.5
88 a	0.097	0.786	1.355	8.1	100	0.070	0.837	1.443	12.0
88 b	0.062	0.414	0.714	6.7	101	0.057	0.660	1.136	11.6
89	0.080	0.581	1.002	7.3	102	0.189	0.735	1.267	3.9
					103	0.111	0.425	0.733	3.8
					104	0.066	0.213	0.367	3.2

STUDIES ON SOIL CONDITIONS IN RELATION TO THE "ROOT" AND LEAF" DISEASES IN COCONUTS IN TRAVANCORE-COCHIN

ABSTRACT OF TABLE 9

Factor	Diseased areas			Healthy areas		
	A. Horizon	B. Horizon	C. Horizon	A. Horizon	B. Horizon	C. Horizon
Nitrogen	0.094 0.076—0.119	0.090 0.055—0.126	0.074 0.039—0.102	0.107 0.059—0.180	0.078 0.044—0.111	0.046 0.012—0.066
Organic carbon	0.792 0.581—0.882	0.775 0.712—0.837	0.439 0.135—0.600	0.754 0.572—0.856	0.569 0.167—0.934	0.554 0.213—0.874
Og. matter	1.348 1.002—1.491	1.335 1.227—1.443	0.757 0.233—1.035	1.300 0.986—1.476	0.982 0.288—1.610	0.955 0.367—1.507
C/N Ratio	8.6 7.0—11.2	9.2 6.6—12.9	5.5 3.5—7.4	8.0 3.9—10.5	7.1 3.8—12.0	22.0 3.2—72.8
No. of values	5	4	3	5	5	5