

Available Micronutrient Status of Major Soil Types Under Coconut in Healthy and Root (Wilt) Affected Tracts of Kerala, India

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Abstract

A survey of coconut plantation in Kerala State was carried out. In this, 733 surface soil samples were collected at about 6.5 km intervals and analyzed for available micronutrients in five major soil types. Because of the low values encountered in a majority of cases, the following soil types are more likely to be deficient of certain elements: coastal sandy and reclaimed marshy soils for Mn, sandy loam soils for Zn, sandy loam and coastal sandy soils for Mo, and coastal sandy soils for B. The distribution of available Cu was uniform in the different soil types excepting coastal sandy soils.

The root (wilt) disease affected tracts showed a significant reduction in the levels of the following micronutrients as compared to healthy tract: Fe, Mn, and Zn in laterite, reclaimed marshy, and coastal sandy soils; Zn in alluvial soils; and Mn and Zn in sandy loam soils. The variation in Cu, B, and Mo content in the different soil types between healthy and disease affected tract was negligible.

The intensity of deficiency of Mo, Zn, and Mn was 83, 48, and 48 per cent, respectively. The intensity of deficiency of Zn was above 47 per cent in all soil types in only the disease affected tract and that of Mo above 60 per cent in both healthy and disease affected tracts.

Introduction

The root (wilt) disease is the most serious malady of coconut in Kerala state. Though considerable work has been done in the past three decades, the nature of the disease has not yet been determined. In the present study, a comprehensive survey of the micronutrient status of Kerala was undertaken in all the coconut soil types having diseased and healthy palms. In the past, Rajagopal (1969), Deb, Sachdev, and Wahid (1973), and Mohapatra, Bhat, and Devaraju (1975) have studied the Kerala soils, but their sample numbers were too small to draw general conclusions.

Materials and Methods

The survey of the coconut growing areas of the State was carried out in 1971. It covered five different soils, laterite, alluvial, reclaimed marshy, coastal sandy, and sandy loam. Soil samples were collected at about 6.5 km intervals. Each sample was collected from the basins of five palms at 1.5 m from the bole and 0.50 m depth. Altogether, 733 samples were collected of which 268 were from laterite soils, 128 from alluvial, 95 from reclaimed marshy, 83 from coastal sandy, and 159 from sandy loam soils. The samples from different soil groups were categorized into three groups, viz., (1) healthy (soil samples collected from basins of healthy palms in healthy areas); (2) foliar yellowing (samples collected from root (wilt) affected palms showing foliar yellowing); and (3) foliar yellowing + rubbery kernel (samples collected from basins of root (wilt) affected palms having foliar yellowing associated with rubbery kernel). Air-dried samples were analysed for available micro-nutrients using the method employed by the All India Coordinated Scheme on Micro-nutrients of Soils 1969) for Cu and Mo and Jackson (1967) for Fe, Mn and B, and Shaw and Dean (1951) for Zn.

Results and Discussion

General characteristics of the soils. The physico-chemical properties of the soils are given in Table 1. The reclaimed marshy soils include the *kole* lands of Trichur district, *kaipad* lands of Cannanore district, *pokkali* soils of Ernakulam district, and peaty or *kari* soils of Alleppey and Kottayam districts (Koshy and Verghese, 1972). These are acid soils with a very low pH. Addition of varying amounts of silt and clay is often done to the coastal sand to improve its physical characteristics. Sandy loam soils include the red sandy loam of Cannanore, Calicut, Malappuram, and Trivandrum districts.

Available micronutrient status. The micronutrient status of different soils is presented in Tables 2 and 3. The exchangeable Fe content of different soils can be considered to be satisfactory, though instances of deficiencies were noticed. The high content of exchangeable Fe in reclaimed soils, almost twice that of laterite, may probably be due to increased solubility of Fe under seasonal submergence. Variation in exchangeable Fe content was particularly high in reclaimed soils. Alluvial, coastal sandy, and sandy loam soils did not vary much in their Fe content. In the case of available Cu, all the soils were found to contain sufficient quantities. Though the mean values indicated that the level of Zn was sufficient in all the five soils, nearly half the samples had less than the critical level of available Zn. Most of the deficient areas belonged to the root (wilt) affected treats of South and Central Kerala.

B was sufficient in all soils. As many as 83% samples contained less

TABLE 1. Physico-chemical properties of the soils

Soil group	Mechanical compositions (%)*			pH* (1 : 2.5 soil : water)
	Clay	Silt	Sand	
Laterite	17 (10 - 39)	11 (2 - 20)	64 (49 - 87)	4.0 - 6.8
Alluvial	18 (9 - 32)	7 (1 - 18)	75 (50 - 89)	4.2 - 7.1
Reclaimed marshy	15 (9 - 26)	4 (0 - 14)	79 (64 - 91)	3.7 - 6.5
Coastal sandy	7 (4 - 11)	1 (0 - 8)	92 (87 - 95)	5.2 - 8.3
Sandy loam	17 (9 - 30)	4 (1 - 14)	79 (69 - 90)	4.8 - 8.6

* Each value is the mean of 20 samples. Figure in parentheses denote range.

TABLE 2. Available micronutrient status (ppm) of different soils

Micronutrient	Laterite	Alluvial	Reclaimed marshy	Coastal sandy	Sandy loam
	Mean and range	Mean and range	Mean and range	Mean and range	Mean and range
Exchangeable Fe	7.47 Trace—37.20	5.96 Trace—24.60	14.23 Trace—102.00	3.66 Trace—17.40	4.71 0.9—22.80
Cu	3.27 Trace—20.00	2.71 Trace—11.66	2.08 Trace—9.00	1.25 Trace—2.44	2.47 Trace—24.60
Zn	1.20 Trace—3.70	1.20 Trace—3.80	0.90 Trace—2.88	0.97 Trace—2.44	0.61 Trace—3.60
B	0.28 0.04—0.66	0.26 0.02—1.60	0.27 0.02—0.83	0.18 0.02—0.46	0.22 0.03—0.69
Mo	0.05 Trace—0.76	0.04 0.01—0.08	0.04 Trace—0.07	0.01 Trace—0.02	0.02 Trace—0.07
Water soluble Mn	0.82 Trace—8.64	1.29 Trace—8.64	0.94 Trace—7.20	0.08 Trace—1.26	1.39 Trace—7.20
Exchangeable Mn	11.81 Trace—48.24	9.67 Trace—39.00	3.38 Trace—36.00	0.38 Trace—5.76	7.16 Trace—52.20
Available Mn	12.63 Trace—53.30	10.88 Trace—42.80	4.32 Trace—41.60	0.45 Trace—7.90	8.48 Trace—52.70
Easily reducible Mn	36.72 Trace—144.00	33.94 Trace—144.00	8.66 Trace—61.40	1.56 Trace—22.32	18.27 Trace—109.80
Active Mn	49.73 Trace—162.30	44.81 1.10—176.20	8.66 Trace—59.80	2.01 Trace—30.20	26.38 Trace—140.70

TABLE 3. Percentage of soil samples falling below critical limits*

Micronutrient	Laterite		Alluvial		Reclaimed marshy		Coastal sandy		Sandy loam		Total %
	Healthy	Diseased†	Healthy	Diseased†	Healthy	Diseased†	Healthy	Diseased†	Healthy	Diseased†	
Fe	0.0	16.0	5.9	23.8	0.0	10.0	0.0	31.9	0.0	12.2	13.6
Cu	12.2	4.0	10.4	3.5	16.7	3.9	25.9	46.9	35.3	25.2	14.8
Zn	15.8	54.0	5.9	47.6	5.9	51.3	0.0	57.4	9.0	60.9	47.9
B	9.8	6.9	5.9	7.1	6.0	11.9	29.3	3.5	15.1	18.2	12.3
Mo	97.5	59.2	95.8	66.7	94.4	67.5	100.0	100.0	97.0	99.9	83.1
Exchangeable Mn	8.5	29.2	29.4	40.5	87.9	75.0	93.9	100.0	3.0	99.9	47.7
Easily reducible Mn	79.5	97.6	85.3	88.3	88.3	100.0	100.0	100.0	96.9	100.0	98.0
Active Mn	2.4	31.2	17.6	27.8	83.3	93.4	93.5	100.0	6.0	79.1	46.0

* The critical limits (threshold values) are 2 ppm for Fe (Olsen and Carlson, 1950), 0.6 ppm for Cu (Bear, 1965), 0.5 ppm for Zn, 0.1 ppm for B (Eaton and Wilcox, 1939), 0.05 ppm for Mo (Grigg, 1953), 3 ppm for exchangeable and 100 ppm for reducible Mn (Sherman and Harmer, 1943) and 20 ppm for active Mn (Jones and Leepers, 1951).

† 'Diseased' includes all samples from root (wilt) affected areas and consists of the two categories, foliar yellowing and foliar yellowing + rubbery kernel.

TABLE 4. Mean values of available micronutrient status (ppm)

	Fe	Mn	Zn	Cu	B	Mo
<i>Critical Limits</i>	2.0	3.0	0.5	0.6	0.1	0.05
Laterite						
1. Healthy	11.33	14.15	1.70	2.42	0.22	0.07
2. Foliar yellowing	7.54	8.54	1.02	4.45	0.28	0.05
3. Foliar yellowing+Rubbery kernel	3.10	6.31	0.55	2.97	0.24	0.04
Alluvial						
1. Healthy	7.23	10.33	2.44	2.14	0.33	0.02
2. Foliar yellowing	5.90	8.55	0.88	3.44	0.21	0.05
3. Foliar yellowing+Rubbery Kernel	8.50	9.81	0.75	3.49	0.27	0.05
Reclaimed marshy						
1. Healthy	17.75	6.82	2.15	2.20	0.24	0.04
2. Foliar yellowing	9.69	1.81	1.09	1.91	0.26	0.04
3. Foliar yellowing+Rubbery kernel	8.63	0.99	1.19	3.40	0.25	0.04
Coastal sandy						
1. Healthy	5.32	0.72	1.97	1.23	0.15	0.01
2. Foliar yellowing	3.07	0.16	0.28	1.29	0.20	0.01
3. Foliar yellowing+Rubbery kernel	2.29	0.36	0.49	0.57	0.33	0.00
Sandy loam						
1. Healthy	4.45	14.63	0.88	2.62	0.20	0.02
2. Foliar yellowing	4.78	5.33	0.35	3.02	0.22	0.02
3. Foliar yellowing+Rubbery kernel	4.29	5.33	0.04	3.29	0.29	0.02

Mo than the critical limit. This must be because the soils are generally acidic. Similarly, nearly half the samples were deficient in exchangeable Mn and almost all in reducible Mn.

Micronutrient status in relation to root (wilt) disease. About half of the samples collected from diseased trees were deficient for Zn and all soils showed deficiencies for Mo and easily reducible Mn (Table 3). When the micronutrient content in different soils is considered against the three categories, viz., healthy from healthy tract, foliar yellowing, and foliar yellowing+rubbery kernel from disease affected tract (Table 4), we again find that though certain soils and certain disease categories show deficiencies for certain micronutrients, no really consistent and universal relationship is noticed between any micronutrient deficiency and incidence of root (wilt) disease, based on the threshold values. However, healthy areas had comparatively higher status of Zn and Mn.

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References

- All India Coordinated Scheme on Micronutrients of Soils (1969). Annual Progress Report for 1968-69. 89 pp. Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur.
- Deb, D.L. Sachdev, M.S., and Wahid, P.A. (1973). Some aspects of soil fertility problems of major coconut growing acid soils of Kerala. Paper presented at the Symposium on Acid Sulphate and Other Acid Soils of India, Trivandrum, February 1973. Indian Society of Soil Science, New Delhi.
- Eaton, P.M. and Wilcox L.V. (1939). The behaviour of boron in soils. *Tech. Bull.* 596. U.S. Dept. Agric., Washington, DC.
- Grigg, J.L. (1953). Determination of available molybdenum in soils. *N.Z.J. Sci. Technol. A.* 34 : 405-414.
- Jackson, M.L. (1976). *Soil Chemical Analysis*. 485 pp. Prentice Hall, New Delhi.
- Jones, L.P.M. and Leeper, G.W. (1951). Available manganese in acid, natural and alkaline soils. *Plant and Soil* 3 : 154.
- Koshy, M.M. and Verghese, T. (1972). 'Soils of Kerala'. pp. 144-157, in *Soils of India* 296 pp. Fertilizer Association of India, New Delhi.
- Mitchell, R. L. (1965). Trace elements in soils. pp. 320-368. in Bear, F.E. (Ed.) : *Chemistry of the Soil*. 515 pp. Reinhold Publishing Corp., New York.
- Mohapatra, A.R., Bhat, N.T., and Devaraju, C. (1975). Evaluation of micronutrient status of soils from healthy and yellow leaf disease affected arecanut gardens. *J. Indian Soc. Soil Sci.* 23 : 71-75.
- Olsen, R.V. and Carlson. C.W. (1950). Iron chlorosis of sorghums and trees as related to extractable soil iron and manganese. *Proc. Soil Sci. Soc. Am.* 14 : 109-112.

- Rajagopal, V. (1969). Distribution of manganese and molybdenum in the soils of Kerala and the effects of molybdenum on the growth of cowpea. M. Sc. (Ag.) Thesis. University of Kerala, Trivandrum.
- Shaw, E. and Dean, L. A. (1951). Use of dithizone as an extractant to estimate the zinc status of soils. *Soil Sci.* 73 : 341-347.
- Sherman, C.D. and Hasmer, P.H. (1943). The manganous-manganic equilibrium of soils. *Proc. Soil Sci. Sec. Am.* 7 : 398-405.

Discussion

Thomas : You have found that some trace elements are deficient in disease affected areas. What is the practical significance of this observation ? Do you say that the disease can be prevented by correcting the deficiency ? Do you contemplate carrying out any studies in this line ?

Pillai : Our study has established the consistently low status of Zn, Mn, and Fe in certain soil types in only the disease affected tracts as against the healthy areas. The possibilities of correction or prevention of the disease are under experimentation.