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Short Scientific Reports

Available Micronutrient Status of the Coconut-tract of Kasaragod District, Kerala*

Large stretches of soil in Kerala state are acidic (Mandal, Sinha and Sinha, 1975) and highly leached acid soil of the humid tropical regions are known to be deficient in micronutrients such as Zn, Mo and B (Aubert and Pinta, 1977). Deficiencies of some or all of these micronutrients are commonly encountered in plantation crops such as cocoa and cashew grown in these soils (Chandra Mohanan et al., 1981; Subbaiah Manikandan and Joshi - unpublished). Simulated leaching studies in a red sandy loam soil revealed a heavy secondary loss of Cu, Zn and Mn owing to application of N, P and K fertilizers (Anonymous, 1985). Studies on phosphorus nutrition of coconut in a red sandy loam soil have shown that phosphorus can be omitted (Hameed Khan et al., 1983) from the fertilizer schedule for adult coconut palms for a continuous period of seven years where the available P status of the 25–50 cm in the coconut basin is adequate. Dispensing of superphosphate application, which is a good carrier of micronutrients, on one hand coupled with the heavy leaching of micronutrients on the other (annual rainfall being 3250 mm) is likely to make these soils deficient in micronutrients in course of time. Considering the above, a survey was undertaken during May 1984 to assess the micronutrient status of soils of Kasaragod District, Kerala. The present communication deals with the results of this survey.

The Kasaragod district has an area of 1961.3 sq. km with a coastal line running up to 60 km in length. Laterite and coastal sands are two major soil groups on which coconut is extensively grown in this area. Fifteen locations each for laterite and coastal sandy soils were selected, representing the area of the district. Soil samples were collected from coconut gardens at three locations around the palm at 1.2 m away from the bole from three depths, *viz.*, 0–25, 25–50 and 50–100 cm each and pooled to get a single sample for each depth. Samples (2 mm fraction) were analysed for pH and organic carbon by standard methods (Jackson, 1967). Available Cu, Zn, Mn and Fe were extracted with DTPA following Lindsay and Norvel (1969). Leaf samples taken from 14th frond (Prevot and Bachy, 1962) of each palm were washed with 0.1 per cent teepol solution, tap water and then

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distilled water, and dried at 65±5°C for 48 hours in a forced air oven. The leaf samples were powdered in a Wiley mill, and digested in 1:2 perchloric-nitric acid mixture and analysed for Cu, Zn, Mn and Fe. The elements were estimated by Varian Techtron Atomic Absorption Spectrophotometer model AA 6.

The pH of the soils ranged from 4.0 to 5.6 for laterite and 4.8 to 7.2 for coastal sand. Table I shows the range and mean of available nutrient contents of laterite and coastal sandy soils. Excepting Zn, the laterite soils had higher available micronutrients than coastal sandy soils. The lower available micronutrient contents of coastal sandy soils might be due to its very low clay (<1%) and organic matter (0.14%) contents. As majority of coconut roots were observed to be below 30 cm around a palm (Kushwah et al., 1973), the available nutrients present in 25-50 cm layer are expected to be taken up more by coconut. Hence the nutrient content of this layer is considered for assessing the deficiency/sufficiency levels of these soils.

The average content of Cu in laterite soils was 0.84 ppm, the range being 0.48 to 1.63 ppm. For coastal sand the mean value for available Cu was 0.34 ppm and the values ranged from 0.17 to 0.76 ppm. Considering 0.4 ppm DTPA extractable Cu as the critical limit (Anonymous, 1976), the laterite soils were found to be adequate in their Cu content whereas 80 per cent of coastal sandy soils were deficient.

The available Zn content of laterite soils was 0.40 ppm (range: 0.13-0.80 ppm) whereas for coastal sandy soils it was 0.48 ppm (range: 0.13-1.25 ppm). Judging from the critical level of 0.5 ppm Zn suggested by Follet and Lindsay (1970), 64.3 per cent of laterite soils and 66.7 per cent of coastal sandy soils were found to be deficient.

The available iron content of both laterite soils (range: 11.7-111.3 ppm;

Table I. *Available micronutrient status (20–25 cm) of soils of Kasaragod District*

Soil	Micronutrients			
	Cu	Zn	Fe	Mn
Laterite				
Range (ppm)	0.48-1.63	0.13–0.80	11.7–111.3	2.32–55.1
Mean (ppm)	0.84	0.40	39.2	18.5
Deficient (%)	0.0	64.3	0.0	14.3
	(7.1)*	(78.6)	(0.0)	(14.3)
Coastal sand				
Range (ppm)	0.17–0.76	0.13–1.25	8.3–35.5	0.32–2.42
Mean (ppm)	0.34	0.48	17.1	1.07
Deficient (%)	80.0	66.7	0.0	100.0
	(86.7)	(80.0)	(0.0)	(100.0)

* Figures in parentheses represent per cent soils showing deficiency when available nutrient of 25–100 cm is considered

Table II. *Leaf nutrient content of coconut (Frond 14)*

Soil	Micronutrients			
	Cu	Zn	Fe	Mn
Laterite				
Range (ppm)	4.8–13.0	12.2–47.6	101.3–240.5	187.9–577.5
Mean (ppm)	7.0	22.1	130.8	329.4
Deficient (%)	20.0	13.3	0.0	0.0
Coastal sand				
Range (ppm)	1.7–13.1	7.1–30.7	107.6–746.8	53.2–264.7
Mean (ppm)	7.1	19.4	209.7	136.4
Deficient (%)	20.0	20.0	0.0	13.3

mean – 39. 2 ppm) and coastal sandy soils (range: 8.3–35.5 ppm; mean– 17.1 ppm) were found to be sufficient based on the suggested critical level of 4.5 ppm (Lindsay and Norvel, 1978).

Considering 4.7 ppm of DTPA extractable Mn as the critical limit (Anonymous, 1976), only 14.3 per cent of laterite soils (with a mean value of 18.5 ppm) showed deficiency range whereas all the samples from coastal sandy soils (with a mean value of 1.07 ppm) were found to be deficient.

On the other hand, the leaf analysis (Table II) showed only 20 per cent of the palms to be deficient in Cu for both laterite and coastal sandy soils; 13.3 and 20 per cent for Zn in laterite and coastal sandy soils respectively. While 13.3 per cent of palms growing in coastal sandy soils had Mn content in the deficiency range, no deficiency was observed in palms growing in laterite soils.

Several factors affect the availability and extractability of nutrients from the soil, and also the plant uptake. According to Lindsay and Norvel (1969 a), DTPA extractable micronutrients are considered available as it extracts mainly water soluble, exchangeable, adsorbed, and chelated or complex forms. A deep rooted perennial crop like coconut might be mining its nutrients from different layers of the soil; also from different forms of nutrient, some of which might not have been extracted by DTPA. This is more so for a nutrient like Mn, the forms of which are more redox dependent (Lindsay and Norvel, 1978; Norvel and Lindsay, 1972). This is corroborated by the studies of Shuman and Anderson (1974) wherein the best measure of plant available Mn was obtained with DTPA for soils of pH 5.8 and 6.8 while for soils with pH 4.8 water extraction gave the best results. Again, deficiency levels in soils were assessed by taking the nutrient contents of 25–50 and 25–100 cm layers; however, mining from the top layers, which contain higher quantities of nutrients, cannot be ruled out. As a result, soil analysis could have given an over-estimate of deficiency levels.

On the other hand, the lower percentage of deficiency indicated by leaf analysis in comparison to that of soil can be attributed to the following: i) the critical limits of micronutrients in the 14th leaf (Cu – 5 to 7 ppm; Zn – 15 ppm; Fe–50 ppm and Mn–60 ppm), suggested by Manciot, Ollagnier and Ochs, (1979) are only the proposed values and the critical levels have so far not been established experimentally. The critical nutrient levels themselves are dependent on a number of environmental and plant characters, and they do not reflect the nutrient supplying capacity of the soil (Nair, 1979); ii) though a crop responds by yielding more following the application of one or more nutrients, upon chemical analysis the average concentration of that particular nutrient in some or all plant tissue is actually lower than that in the control plant (Jarrel and Beverly, 1981). Hence it is likely that the palms growing under nutrient stress conditions show higher nutrient content due to "concentration effect" (Jarrel and Beverly, 1981), as it possesses a smaller canopy / lesser biomass and consequently mislead in judging deficient palm / palms under deficient range as per the suggested critical levels of leaf nutrient content.

Notwithstanding the variability in the pattern of deficiency, as indicated by soil and leaf analysis data, the results of the present study point out that there is a prevalence of deficiency of Cu, Zn and Mn in coconut and coconut growing soils of Kasaragod District; the coastal sandy soils being more deficient than laterite soils with respect to Cu, Zn and Mn.

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REFERENCES

ANONYMOUS. 1976. *Annual Report.* All India Co-ordinated Scheme on Micronutrients in Soils and Plants (ICAR).

ANONYMOUS. 1985. *Central Plantation Research Institute, Annual Report for 1984,* Kasaragod, India, pp. 211.

AUBERT, H. and PINTA, M 1977. *Trace Elements in Soils.* Elsevier Scientific Publishing Company, Amsterdam. pp. 395.

CHANDRA MOHANAN, R., MENON, M. A., YADU KUMAR, N. and NAIK, B.G. 1981. Zinc deficiency in cacao: Diagnosis and correction. *Planter* (Kuala Lumpur). 57: 120–124.

FOLLET, R. H. and LINDSAY, W. L. 1970 *Tech. Bull. Colorado. St. Univ. Exp. Stn.* 110.

HAMEED KHAN, H., SANKARANARAYANAN, M.P., GEORGE, M. V. and NARAYANAN, K.B. 1983. Effect of phosphorus skipping on the yield and nutrition of coconut palm *(Cocos nucifera* L.). *J. Plant. Crops.* 11: 129–134.

JACKSON, M. L. 1967. *Soil Chemical analysis.* Prentice Hall of India Pvt. Ltd., New Delhi. pp. 498.

JARRELL, W. M. and BEVERLY R. B. 1981. The dilution effect in plant nutrition studies. *Adv. Agron.* **34:** 197–224.

KUSHWAH, B. L., NELLIAT, E. V., MARKOSE, V. T. and SUNNY, A. F. 1973. Rooting pattern of coconut. *Indian J. Agron.* **18:** 71–74.

LINDSAY, W. L. and NORVELL, W. A. 1969. Development of a DTPA micronutrient soil test. *Agron. Abstr.* **69:** 84.

LINDSAY, W. L. and NORVELL, W. A. 1969 a. Equillibrium relation-ships of zn^{2+}, Fe^{3+} Ca^{2+} and H^{+} with EDTA and DTPA in soils. *Soil Sci. Soc. Am. Proc.* **33:** 62–68.

LINDSAY, W. L. and NORVELL, W. A. 1978. Development of a DTPA soil test for Zinc, iron, manganese and copper. *Soil Sci. Soc. Am. J.* **42:** 421–428.

MANCIOT, R., OLLAGNIER, M. and OCHS, R. 1979. Nutrition minerale et fertilisation eu cocotier dans le monde. *Oleagineux.* **35:** 23–27.

MANDAL, S. C., SINHA, M. K. and SINHA, H. 1975. *Acid Soils of India and Liming.* ICAR Technical Bulletin (Agric.) No. 51. pp. 126.

NAIR, P. K. R. 1979. *Intensive Multiple Cropping with Coconuts in India. Principles, Programmes, Prospects.* Verlaug Paul Parey Berlin and Hamburg, pp. 147.

NORVELL, W. A. and LINDSAY, W. L. 1972. Reactions of DTPA chelates of iron, zinc, copper and manganese with soils. *Soil Sci. Soc. Am. Proc.* **36:** 778–783.

PREVOT, P. and BACHY, A. 1962. Leaf analysis of coconut palm. Influence of the leaf rank and vegetative development on elemental contents. *Oleagineux.* **17:** 451–458.

SHUMAN, L. M. and ANDERSON, O. E. 1974. Evaluation of six extractants for their ability to predict manganese concentrations in wheat and soyabeans. *Soil Sci. Soc. Am. Proc.* **38:** 788–790.