# NUTRIENT INDEXING IN COCONUT LEAVES AND SOILS OF LAKSHADWEEP ISLANDS : II—MICRONUTRIENT ASPECTS

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## INTRODUCTION

A systematic nutrient indexing in coconut leaves and soils of Lakshadweep islands was undertaken in the wake of occurrence of medium to severe chlorosis of many intercrops (banana, chillies, beans, brinjal and grasses) grown in coconut gardens. The results reported in Part I indicated the need for stepping up K and N nutrition of coconut palms. The status of micronutrients in soils and leaf in relation to the requirements of coconut are discussed in this report.

## MATERIALS AND METHODS

One hundred coconut leaf samples from 14th frond leaf from different sites, 77 bulk soil samples upto 30 cm depth near the coconut base were collected from 10 islands of Lakshadweep. The determination of total Fe, Mn, Zn and Cu was carried out in diacid digest (10 ml $HNO_3$ + 5 ml $HclO_4$) of the samples. Sodium acetate, pH 8.2 (Hesse 1972) and EDTA plus $(NH_4)_2$ $CO_3$ (Trierweiler and Lindsay, 1969) were used to extract exchangeable and available nutrients respectively. These nutrients were determined by using atomic absorption spectrophotometer.

## RESULTS AND DISCUSSIONS

### Iron

The results presented in Table 1 reveal that the total, sodium acetate and EDTA plus ammonium carbonate extractable Fe ranges from 143 to 2469, 0.31 to 4.00 and 1.5 to 23.00 ppm; the average values among the islands are 222 to 1802; 1.62 to 3.56, and 2.5 to 15 ppm respectively. High amount of total and sodium acetate extractable Fe were observed in surface layer with a general decrease in sub soil. The organic carbon showed a significant positive correlation with total iron (0.76**) and EDTA plus ammonium carbonate extractable iron (0.77**). Takkar and Randhawa (1978) also reported similar significant relation between organic matter and available Fe and significant negative correlation with $CaCO_3$. If 15 ppm is taken as critical value (Randhawa *et al* 1967), almost all the soils were found to be deficient in available Fe content which is quite obvious in view of high soil pH (7.4 to 8.9), $CaCO_3$ (63 to 96%) and Na (0.60 to 0.65%) content. The high correlation coefficient between organic carbon and Fe indicates that the organic carbon may be the main source of the total and available Fe in the soil.

The concentration of Fe in coconut leaves listed in Table 2 shows that the Fe content in coconut leaves ranges from 101 to 200 ppm as against an optimum level of 115 ppm. This indicates that marginal cases of Fe deficiency are prevalent in the islands.

### Manganese

The total, sodium acetate and EDTA plus ammonium carbonate extractable Mn ranges from 3 to 172, 0.010 to 0.80; and 0.80 to 14.5 ppm and the average value among islands ranged from 12 to 78, 0.23 to 0.50 and 1.6 to 7.6 ppm respectively. The higher concentration of total and available Mn was invariably observed in surface layer with general decrease in sub-soil. A significant positive correlation was found between total Mn and organic carbon (0.62**) and EDTA plus ammonium carbonate extractable Mn (0.73**). Working on the Mn availability of calcareous soils of Lebanon, Khan and Ryan, 1978, reported that Mn increases with organic matter content but decreases with $CaCO_3$ content. The exchangeable Mn extracted by NaOAC was lower than the critical value of 5 ppm postulated by Toth (1951). The EDTA plus $(NH_4)_2$ $CO_3$ extract value is also low in spite of its ability to dissolve the carbonate and organo metallic complexes. The result reveals that soil is not having sufficient total and exchangeable Mn for healthy growth of plants.

The results presented in Table 2 shows that average value of Mn in coconut leaves ranges between 12 and 35 ppm which is less than the critical limit (66 ppm).

The chlorosis in grasses and beans at Minicoy was successfully controlled by spraying 0.2% each of Fe So4 and Mn So4. No chlorosis was found when banana, papaya, tapioca and sweet potato were planted in moist region in pits after breaking the hard pan and filling the pits with top soil, organic waste and normal doses of N, P and K. In case of banana, 100 gram MnSo4 and FeSo4 each were also added.

### Zinc

The total, sodium acetate, and EDTA plus $(NH_4)_2$ $CO_3$ extractable Zn in soil ranges between 8 and 190, 0.01 and 1.18 and 1.3 and 8.8 ppm whereas average among the islands ranges between 15 and 71, 0.21 and 0.40, and 2.1 and 6.7 ppm respectively. A positive correlation coefficient was found between organic

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carbon and total Zn (0.51*) and organic carbon and EDTA plus ammonium carbonate extractable Zn (0.72*). Misra *et al* (1975) & Takkar and Randhawa (1978) also reported significant positive correlation between organic matter and available Zn. If 1.5 ppm Zn is taken as critical limit (EDTA + ammonium carbonate extractable Zn, Katyal and Ponnamperuma, 1974), all the soils were found to be sufficient in available Zn.

The concentration of Zn in coconut leaves presented in Table 2 shows that Zn content in coconut leaves ranges from 6 to 71 ppm and the average among the islands ranged from 10 to 41 ppm. It was also noticed from the data that Zn content was more than the critical limit (11 ppm) in 95% of the samples.

### Copper

The total, exchangeable and EDTA + $(NH_4)_2\ Co_3$ extractable Cu in the Lakshadweep soil ranges from 8 to 41, 0.10 to 2.55 and 1.0 to 4.8 ppm, whereas on an average among the islands it ranges from 14 to 25, 0.45 to 1.89 and 1.5 to 2.6 ppm respectively. The Cu content was found to be comparatively higher in surface soil than sub soil. The higher accumulation of Cu at the surface may be due to concentration by vegetation.

On the basis of classification given by Grewal *et al* (1969), 40% samples fall under low (<0.5 ppm exchangeable Cu), 35% under medium (0.5 to 1 ppm) and only 25% under high (>1 ppm) categories. However, the available copper content in 1 N NaOAc extract was adequate in most of the samples except a few according to the critical limit of 0.2 ppm (Fiskell 1965).

The data presented in Table 2 shows that Cu content in coconut leaves ranges from 4 to 17 ppm with an average ranging from 5 to 11 ppm among the Islands, as against an optimum concentration of 12.5 ppm.

In conclusion, this study has shown that organic matter is the major source of reserve as well as available Fe, Mn and Zn. Despite high pH, high $CaCo_3$ levels most of the soils of Lakshadweep contain adequate levels of available Zn and Cu as measured by the two extracting procedures. Available Fe and Mn in soils were found lower than critical levels. Mn in coconut leaves was found lower than critical level. Next in order of deficiency was due to Fe.

## AMELIORATION OF MICRONUTRIENT DEFICIENCY

To overcome problems due to micronutrient deficiencies, in addition to supply of micronutrients certain cultural practices are also advisable, (Velayutham and Singh, 1978), since the soils have not only inadequate quantity of reserve Fe, Mn, Zn and Cu but also have many adverse factors (Sandy in texture, lack of clay, very high content of $CaCo_3$ and sodium very high and fluctuating water table, high pH and low water and nutrient retention capacity) limiting their availability to crops. These are:

(a) Organic manure (20 to 25 kg) should be added with 100 g ferrous and manganese sulphate each in addition to major nutrients per palm per year.

(b) As far as possible, coconut should be planted in deep pit (after breaking the hard pan) filled with coconut husk, pith, other organic waste and top soil.

(c) Similar practice should be followed in case of banana, papaya and other fruit trees.

(d) Minimum tillage is advisable to minimise the organic matter decomposition as it is the major source of nutrients in the soil.

(e) As the soil is highly calcareous with high sodium content, most of the leguminous crops tried have failed. Therefore selection of leguminous crops suitable for this soil is badly needed to maintain the soil fertility.

(f) Introduction of poultry and Livestock and recycling of all organic wastes should be given top priority to increase the fertility status of soil.

(g) Spraying with neutralised 0.5% $MnSo4$, $FeSo4$ each at intervals of 10 to 15 days when chlorosis is noticed in annual crops and grasses.

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**Table 1**

*Range of Micronutrients (ppm) in soils*

| Nos. of samples/ Nutrient | | LOCATION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kalpeni | Minicoy | Kiltan | Kavaratti | Cheriam | Chetlat | Agatti | Kadamath | Amini | Androth |
| | | 7 | 6 | 4 | 11 | 4 | 4 | 7 | 10 | 8 | 16 |
| 1 | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Fe | (i) | 269-1013 (483) | 143-1054 (589) | 300-1194 (603) | 550-2356 (1057) | 150-338 (222) | 419-2263 (1008) | 350-1306 (705) | 1213-2231 (1802) | 756-2344 (1328) | 250-2469 (1488) |
| | (ii) | 0.31-3.35 (2.00) | 2.00-4.00 (3.36) | 0.63-3.44 (2.90) | 0.63-3.75 (2.25) | 0.49-2.06 (1.62) | 0.63-3.75 (2.29) | 1.55-3.44 (2.50) | 0.31-3.75 (2.15) | 0.94-5.64 (2.22) | 0.33-3.75 (2.36) |
| | (iii) | 2.8-9.9 (5.5) | 2.6-9.4 (6.0) | 2.9-9.3 (7.5) | 3.0-16.1 (11.1) | 1.5-8.6 (2.5) | 3.6-23.0 (11.6) | 5.4-14.5 (7.6) | 8.0-23.0 (15.0) | 5.0-20.0 (12.8) | 4.9-19.0 (14.03) |
| Mn | (i) | 4.43 (19) | 3.25 (12) | 14-54 (27) | 14-172 (55) | 20-34 (28) | 32-100 (78) | 14-60 (31) | 48-144 (84) | 26-86 (47) | 30-134 (30) |
| | (ii) | 0.25-0.60 (0.38) | 0.10-0.50 (0.46) | 0.10-0.60 (0.37) | 0.20-0.60 (0.43) | 0.10-0.50 (0.23) | 0.20-0.60 (0.37) | 0.20-0.80 (0.50) | 0.20-0.60 (0.33) | 0-.20.0.60 (0.28) | 0.20-0.60 (0.39) |
| | (iii) | 1.4-3.8 (2.9) | 0.8-2.6 (1.6) | 1.5-4.0 (3.4) | 1.9-13.9 (6.8) | 1.5-2.4 (2.0) | 2.5-9.7 (5.9) | 2.6-4.2 (3.5) | 3.0-11.9 (7.6) | 2.9-8.4 (5.7) | 3.0-14.5 (7.5) |
| Zn | (i) | 11-58 (26) | 8-45 (16) | 12-19 (15) | 22-85 (35) | 18-24 (21) | 24-100 (63) | 21-63 (35) | 20-50 (34) | 39-190 (71) | 11-189 (58) |
| | (ii) | 0.11-1.18 (0.43) | 0.10-0.60 (0.24) | 0.04-0.63 (0.21) | 0.11-0.88 (0.33) | 0.07-0.51 (0.32) | 0.07-0.40 (0.24) | 0.07-0.44 (0.26) | 0.07-0.55 (0.36) | 0.01-0.74 (0.32) | 0.04-0.77 (0.40) |
| | (iii) | 1.6-.3.2 (2.8) | 1.3-2.9 (2.31) | 1.6-2.4 (2.1) | 2.2-6.5 (3.4) | 2.0-2.3 (2.1) | 2.4-7.5 (5.4) | 2.0-3.6 (2.6) | 1.8-4.0 (3.1) | 2.5-8.8 (6.7) | 1.8-8.6 (5.8) |
| Cu | (i) | 14-41 (27) | 16-41 (24) | 10-22 (15) | 10-22 (14) | 16-26 (21) | 18-38 (25) | 12-28 (15) | 8.24 (15) | 14-24 (20) | 14-32 (28) |
| | (ii) | 0.62-2.34 (1.55) | 0.83-2.55 (1.89) | 0.18-1.04 (0.55) | 0.10-0.93 (0.64) | 0.42-0.73 (0.55) | 0.33-0.84 (0.49) | 0.31-1.04 (0.60) | 0.21-1.45 (0.48) | 0.10-1.61 (0.87) | 0.10-1.15 (0.50) |
| | (iii) | 1.4-4.3 (2.8) | 1.7-4.9 (2.3) | 1.1-3.3 (1.6) | 1.0-2.4 (1.5) | 1.4-4.6 (2.3) | 1.6-4.8 (2.6) | 1.2-4.2 (2.5) | 0.90-3.2 (2.6) | 1.1-3.2 (1.8) | 2.1-4.5 (2.5) |

(i) Total (ii) Exchangeable (iii) $(NH_4)_2 CO_3$ + EDTA extractable
Figures under parenthesis is average value.

**Table–2**

*Fe, Mn, Zn and Cu Content of Coconut Leaves*

| Location | No. of samples | Iron (Fe) ppm | Manganese (Mn) ppm | Zinc (Zn) ppm | Copper (Cu) ppm |
|---|---|---|---|---|---|
| Kalpeni . . . . . . . | 11 | 67-209 (144) | 14-42 (23) | 23-46 (30) | 8-19 (11) |
| Kiltan . . . . . . . | 7 | 115-240 (168) | 17-44 (29) | 13-42 (27) | 5-11 (6) |
| Agatti . . . . . . . | 7 | 88-181 (127) | 18-52 (31) | 15-34 (20) | 5-10 (8) |
| Minicoy . . . . . . . | 10 | 120-273 (177) | 10-49 (18) | 11-39 (19) | 5-10 (6) |
| Cheriyam . . . . . . . | 6 | 167-242 (202) | 12-24 (23) | 8-14 (10) | 4-8 (6) |
| Chetlat . . . . . . . | 4 | 88-119 (101) | 10-13 (12) | 12-27 (18) | 4-8 (6) |
| Androth . . . . . . . | 21 | 120-317 (196) | 15-37 (24) | 16-56 (32) | 4-12 (7) |
| Kadmath . . . . . . | 9 | 92-222 (145) | 14-35 (23) | 10-30 (21) | 4-8 (6) |
| Kavaratti . . . . . . . | 15 | 88-270 (151) | 15-70 (27) | 12-41 (20) | 4-7 (5) |
| Amini . . . . . . . | 10 | 72-272 (155) | 15-34 (23) | 21-72 (41) | 6-11 (8) |