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DISTRIBUTION OF COPPER IN SOIL

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ABSTRACT

The distribution of total and available copper and their relationship to different soil properties were studied in twenty three soil profiles representing seven major soil series of Namakkal Taluk in Tamil Nadu. The total copper content varied from 12.6 to 105.5 ppm and increased with depth. Laterite soils contained more of total copper than black, alluvial and red soils and the total copper was closely related to available copper, clay, silt, calcium carbonate, fine and coarse sand.

The available copper content varied from 0.20 to 1.13 ppm and the content showed an irregular distribution with reference to depth. Alluvial soils contained more of available copper than others.

Key words: Copper distribution soil

In Tamil Nadu work on trace elements was started only very recently. Mostly the investigations concern the distribution of various elements in surface soils and in a few selected profiles of broad soil groups (Balasundaram *et al*., 1973; Rajendran, 1974; Velayutham, 1974). In the present study the depthwise distribution of total and available copper was made with reference to availability and their interaction with each other.

MATERIALS AND METHODS

Soil samples collected from twenty three profiles representing seven major soil series namely Peelamedu, Upparapatti, Thiruchengodu, Thulukkanur, Thondipatti, Vellalur and Kolli Hills were analysed for their mechanical composition, pH, organic carbon and calcium carbonate content (Jackson, 1967). Samples have been collected based on the morphological features of the profiles and wherever the horizon differentiation was not clear the samples have been collected on depthwise basis. Total copper was determined in sodium carbonate fusion extract of the soil by using spectrophotometer (Varian-Techtron A.A. 120). Available copper was estimated by Cheng and Bray (1953) method using normal ammonium acetate (pH 4.8) as an extractant.

RESULTS AND DISCUSSION

Analytical data on mechanical composition, pH, organic matter and calcium carbonate are given in table 1 along with total available copper content.

Total Copper:

The total copper content varied from 12.6 ppm in Thiruchangodu series to 105.5 ppm in Peelamedu series with a mean value of 46.5 ppm. Among the black calcareous soil profiles (Peelamedu series) examined, the total copper content increased with depth in two profiles which may be due to increasing clay content with depth. Similar pattern was observed by Fateh Lal and Biswas (1974) in deep black soils of Rajasthan. In another profile the total copper content decreased with depth possibly due to the removal of copper by plants as these samples were collected from an area under continuous cropping under irrigated condition while the previous ones were under dry land cropping.

In alluvial calcareous soils (Upparapatti series) generally there was an increase in total copper content with depth. As the profile soil samples were collected from deltaic areas, it might have been leached from surface layer to

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Table 1. Forms and distribution of copper

Depth (cm)	Copper (ppm)	
	Total	Available
Aniapuram		
0-15	64.8	0.54
15-30	67.7	0.52
30-60	81.6	0.61
60-82.5	67.2	0.67
82.5-97.5	105.5	0.60
Eramapatti		
0-15	66.8	0.36
15-30	67.8	0.52
30-60	68.6	0.68
60-75	55.2	0.62
75-90	79.3	0.70
Ernapuram		
0-15	40.3	0.56
15-30	54.0	0.67
30-60	40.7	0.52
60-75	54.1	0.51
75-90	40.1	0.47
Nallipalayam		
0-15	68.4	0.46
15-30	68.7	0.53
30-60	40.4	0.43
60-75	13.6	0.32
Ellakkator		
0-15	39.2	0.75
15-30	65.7	1.09
30-60	78.4	1.13
60-90	66.3	0.70
E.N.Palayam		
0-15	39.6	1.05
15-30	39.8	0.91
30-60	39.6	0.59
60-90	26.3	0.90
Vellur		
0-15	39.1	0.65
15-30	39.6	0.64
30-75	52.4	0.50
75-95	80.3	0.51

Depth (cm)	Copper (ppm)	
	Total	Available
Unchapalayam		
0-15	25.7	0.64
15-25	24.1	0.77
25-30	25.6	0.50
30-60	25.4	0.30
60-90	38.8	0.46
90-120	51.9	0.35
Paramapathi		
0-15	12.6	0.20
15-30	38.1	0.45
30-52.5	38.1	0.41
52.5-60	25.4	0.53
60-90	38.0	0.53
90-112.5	50.6	0.40
Marapalayam		
0-10	12.6	0.20
10-25	38.4	0.41
25-47.5	38.9	0.46
47.5-60	63.9	0.31
60-90	63.3	0.41
Nallur		
0-15	12.6	0.34
15-22.5	12.7	0.24
22.5-30	12.7	0.20
30-60	25.4	0.45
Rasampalayam		
0-15	25.5	0.69
15-22.5	38.3	0.43
22.5-30	38.3	0.43
30-60	38.3	0.61
Anangur		
0-15	12.6	0.34
15-30	25.4	0.43
30-60	35.8	0.31
60-90	50.4	0.60
Sellappampalayam		
0-15	25.4	0.55
15-30	38.2	0.43
30-60	38.2	0.96

Table 1. (Contd.)

Depth (cm)	Copper (ppm)	
	Total	Available
P.N.Patti		
0-15	76.8	0.76
15-30	63.6	0.55
30-60	64.1	0.76
60-90	38.4	1.03
90-97.5	38.5	0.82
Kalangani		
0-15	50.6	0.75
15-30	51.1	0.96
30-45	76.6	0.73
Eachavari		
0-15	37.8	0.82
15-30	38.0	1.08
30-45	38.4	0.89
45-60	38.4	0.83
60.75	38.5	1.09
Bodupatti		
0-15	12.7	0.35
15-30	25.9	0.56
30-60	39.2	0.56
60-67.5	38.9	0.70
Kandampalayam		
0-15	37.9	0.49
15-30	25.3	0.42
30-60	25.2	0.48
60-70	38.1	0.43
70-85	88.1	0.43
Ponnaripatti		
0-15	25.3	0.48
15-30	38.3	0.29
30-60	38.7	0.29
60-70	51.7	0.50
70-85	19.9	0.44
Vettambadi		
0-15	38.4	0.76
15-30	38.5	0.55
30-45	38.7	0.50
45-60	38.6	0.76
60-75	50.8	0.55
75-90	102.7	1.09
Karaiyangadu		
0-15	39.8	0.45
15-30	39.0	0.23
30-60	52.5	0.44
60-90	39.0	0.50
90-120	91.1	0.50
120-150	77.4	0.29
150-180	89.8	0.43
Semmedu		
0-15	52.1	0.28
15-30	65.2	0.29
30-60	65.6	0.38
60-90	65.0	0.29
90-120	90.4	0.50
120-135	38.4	0.43

subsurface layer due to continuous flooding and accumulated in lower layers.

In red soil profiles (except one profile in Thondipatti series), the total copper content increased with depth. This might be due to light texture of the surface that could have facilitated in leaching of copper from surface to sub-surface horizons and got accumulated in lower horizons and also due to increased clay content in lower horizons and appearance of calcium carbonate in lower depths (Rajendran, 1974).

In laterite soils (Kolli Hills series) the total copper content increased with depth although the increase was not uniform. This could be attributed to the translocation of copper to lower layers of the profile, due to non-calcareous nature of soil, heavy rainfall, presence of illite type of clay minerals and comparatively low pH of the soil. This was in agreement with the work of Fateh Lal and Biswas (1974) in the red foot hill soils of Rajasthan.

Considering all the soils as broad soil groups, the total copper content was maximum

Table 2.Simple correlation coefficients between forms of copper and soil properties

S. No.	Soil properties	Total copper	Available copper
1.	pH	-0.195*	0.109N.S.
2.	Clay	0.478**	0.022N.S.
3.	Silt	0.349**	0.021N.S.
4.	Fine sand	-0.479**	-0.051N.S.
5.	Coarse sand	-0.305**	-0.062N.S.
6.	Organic matter	0.028N.S	-0.116N.S.
7.	Calcium carbonate	0.251**	0.185 N.S.
8.	Total copper	-	0.205*

* Significant at 5 per cent level
** Significant at 1 per cent level
N.S. Not significant.

in laterite soils followed by black, alluvial and red soils. Higher copper content in laterite soils might be attributed to higher clay content. Moreover the clay content of different soil groups studied also followed the same pattern as that of total copper. As could be seen from the present study, the total copper content was mainly dependent on finer rather than coarser fractions of the soil since positive correlations were obtained between clay content and total copper (Table 2) ($r=0.478^{**}$), silt and total copper content ($r=0.349^{**}$). Similarly negative relationship was obtained between fine sand and total copper ($r=-0.345^{**}$), calcium carbonate content exhibited a positive association with total copper content ($r=0.251^{**}$).

Available Copper:

Though the partial regression coefficient for organic matter and available copper was significant when independent variables were considered in predicting the total copper, the fit cannot be considered as a best one since the R^2 value was very low and because of the low contribution to the R^2 this equation cannot be used successfully for projection purposes.

Available copper varied from 0.20 to 1.13 ppm in all the soils studied. Generally there was no regular pattern of distribution of available copper with depth. Similar result was reported by Velayutham (1974) in Coimbatore soils of Tamil Nadu.

When the soils were grouped into broad soil groups the available copper content was found to be higher in alluvial soils followed by red, black and laterite soils. This trend is quite expected as these alluvial soils were normally in a reduced state than the other soil types due to submergence. Similar results have been reported by Lodha and Baser (1971) and Balasundaram *et al.* (1973).

In the present study no significant correlation was found to exist between available copper and pH, mechanical fractions of the soil, organic matter and calcium carbonate content of the soils. The available copper was positively influenced by total copper content ($r=0.206^{*}$). Multiple correlation studies clearly indicate that total copper is mainly responsible for the available copper in these soils.

REFERENCES

BALASUNDARAM, C.S., LAKSHMI NARASIMHAN, C.R. and RAJAKANNU, K. 1973. Evaluation of different methods of measuring available copper in soils of Tamil Nadu. *Madras agric. J.*, **60**: 924-30.

CHENG, K.L. and BRAY, P.H. 1953. Two specific methods of determining copper in soil and plant materials. *Anal. Chem.*, **25**: 655.

FATEH LAL, and BISWAS, T.D. 1974. Factors affecting the distribution and availability of micronutrient elements in major soil groups of Rajasthan. II. Soil profiles. *J. Indian Soc. Soil Sci.*, **22**: 333-346.

JACKSON, M.L. 1967. Soil Chemical analysis. Asia Publishing House, Madras.

LODHA, P.S. and BASER, B.L. 1971. Available copper, boron and iron status of Rajasthan soils. *J. Indian Soc. Soil Sci.*, **19**: 407-13.

RAJENDRAN, G. 1974. Categorization of Red soil series of Coimbatore District (Tamil Nadu). M.Sc.(Ag.) dissertation submitted to and approved by Tamil Nadu Agricultural University.

VELAYUTHAM, K.S. 1974. Studies on the nature and properties of salt affected soils and their improvement. M.Sc. (Ag.) dissertation submitted to and approved by Tamil Nadu Agricultural University.