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DISTRIBUTION OF MICRONUTRIENT CATIONS IN SOILS OF AMARAVATHY RIVER COMMAND AREA OF TAMIL NADU

D. GOWRI SANKAR and V. MURUGAPPAN

Department of Soil Science and Agricultural chemistry
Agricultural College and Research Institute
Tamil Nadu Agricultural University
Coimbatore 641 005

ABSTRACT

Among the four micronutrient cations, deficiency of Zn (98%) was found to be widespread in Amaravathy River Command area. Fe deficiency was found to be in 36 per cent of calcareous soils and 14 per cent of non-calcareous soils, 28 per cent of the samples showed Cu deficiency and 4 per cent Mn deficiency. The mean contents of DTPA Zn, Cu, Fe and Mn were 0.38, 2.23, 19.17 and 7.34 ppm respectively. The total Zn had positive relationship with clay, fine sand, organic carbon, CEC, EC and $CaCO_3$ and negative relationship with coarse sand. The DTPA Zn had a positive relationship with organic carbon. The total Cu and total Fe failed to show any dependence with any of the soil properties studied. But the DTPA Cu was found to positively correlate with clay, organic carbon, CEC and total Cu while the DTPA-Fe showed negative relationship with soil pH. Positive significant relationship of total Mn was seen with clay, silt, pH, EC and $CaCO_3$ while a negative correlation between DTPA-Mn and course sand was observed.

KEY WORDS : Micronutrients, Distribution, Deficiency, Soil Properties

In intensive agriculture, the micronutrient deficiencies are emerging in a big way in Indian soils. Farmers' option to apply high analysis fertilizers and application of organic manures in insufficient amounts have further aggravated the micronutrient deficiencies in soils. Therefore, information on micronutrient status is a prerequisite for forecasting micronutrient deficiencies before sowing of crops. So far no systematic survey was conducted to assess the micronutrient status of soils of Amaravathy River Command Area, (ARCA). The present study was aimed to generate such information which will be of use in forecasting the micronutrient deficiencies for the major crops like rice and sugarcane grown in this tract.

MATERIALS AND METHODS

Two hundred and ten surface (0-15 cm) soil samples were collected from ARCA, Tamil Nadu which represented the eight soil series of this command area, *viz.*, Irugur (Igr), Kallivalasu (Klv), Suryanallur (Snr), Dasarapatti (Dpt), Syamalakavundanpudur (Skp), Tulukkanur (Tlk), Vannapatti (Vpt) and Manupatty (Mpy). Texture (by feel), pH, EC and lime status were determined in these samples. In order to make detailed analysis, the sample size was reduced to 35 duly ensuring in them a possible range in these properties. These samples were analysed for pH (Jackson, 1973) organic carbon (Walkley and Black 1934), the mechanical fractions (International pipette method) and free CaCO3 content (rapid titration method) (Piper 1966), cation exchange capacity (Schollenberger and Dreibelbis, 1930), total Zn (Pratt, 1965), and DTPA extractable Zn (Lindsay and Norvell, 1978). Simple correlations between soil properties and total as well as available (DTPA) were computed (Snedecor and Cochran, 1968).

RESULTS AND DISCUSSION

Micronutrient status

The range and mean values of various physico-chemical properties of 35 samples and total and DTPA extractable micronutrient contents of the 210 samples are presented in Table 1. the DTPA-Zn content in soil of the study area showed a wider variation (cv = 96.17%) with a mean value of 0.38 ppm. The DTPA-Cu content was found to range from 0.30 to 9.36 ppm (cv= 66.43%) with a mean value of 2.23 ppm. The DTPA-Fe content ranged from 1.28 to 58.20 ppm (cv = 84.91%) with a mean of 19.17 ppm. The DTPA-Mn content was found to range from 0.88 to 27.72 ppm (cv : 69.18%) with a mean content of 7.34 ppm.

Mircronutrient deficiencies

Critical levels with respect to Zn (1.2 ppm of DTPA-Zn), Cu (1.2 ppm of DTPA-Cu), Fe (6.3 and 3.7 ppm of DTPA-Fe for calcareous and non

Table 1. Range, mean and co-efficient of variation of various physio-chemical properties and total as well as DTPA extractable micro nutrient contents

Properties	Range	Mean	Co-efficient of variation (%)
Clay (%)	7.23 - 44.32	23.63	41.90
Silt (%)	4.50 - 32.32	14.34	48.68
Fine sand (%)	6.85 - 36.45	22.75	29.99
Coarse sand (%)	21.50 - 55.38	36.98	21.88
pH	5.2 - 9.2	7.66	13.05
EC (d Sm^{-1})	0.04 - 1.00	0.18	105.55
CEC C.mol (P^{+})kg^{-1})	3.40 - 48.00	12.76	71.87
$CaCO_3$ (%)	0.30 - 5.10	1.65	80.61
Organic carbon (%)	0.12 - 0.99	0.14	43.90
Total Zn (ppm)	12.00 - 43.25	27.36	31.58
Total Cu (ppm)	11.00 - 36.50	22.67	45.61
Total Fe (ppm)	774.00 - 824.50	788.86	1.42
Total Mn (ppm)	42.75 - 300.75	193.46	37.07
DTPA-Zn (ppm)	0.08 - 1.36	0.40	75.00
DTPA-Cu (ppm)	0.62 - 5.84	2.04	64.71
DTPA-Fe (ppm)	1.36 - 56.36	18.71	94.60
DTPA-Mn (ppm)	2.10 - 19.58	7.43	59.62

calcareous soils, respectively) and Mn (2.0 ppm of DTPA-Mn) had been reported for Tamil Nadu soils by Savithri and Vijayalakshmi (1991). With these critical levels, it was observed that nearly 98 per cent of the soil samples of this command area were found to be deficient in Zn and 28 per cent in Cu. About 36 per cent of the calcareous soils were found to be deficient in Fe and only 14 per cent in non calcareous soils. Mn availability was not a major problem because only 4 per cent of the soils were found to be deficient.

Relationship of micronutrient availability with soil properties

Simple correlation analysis

The various soil parameters estimated in the samples were correlated with total and DTPA extractable micronutrient levels (Table 2). The total Zn content of the soils was found to correlate significantly and positively with clay ($r = 0.528^{**}$), fine sand ($r = 0.338^{*}$), organic carbon ($r = 0.495^{**}$), CEC ($r = 0.422^{*}$), EC ($r = 0.355^{*}$) and $CaCO_3$ ($r = 0.495^{**}$) whereas its correlation with coarse sand was negative ($r = -0.531^{**}$). The positive association of total Zn with clay was also reported by Vourinen (1958) and Frank *et al*. (1976) and with lime content by Throne *et al.* (1942). The positive association of organic carbon on total Zn agreed with the results of Frank *et al* (1976), Jalali *et al* (1989) and Katyal and Sharma (1991). The DTPA-Zn was found to correlated significantly and positively with organic carbon ($r = 0.369^{*}$) which was in agreement with the findings of Malewar and Randhawa (1978), Rajkumar *et al* (1990), Veeraiah (1990) and Jalali *et al* (1989).

The total Cu content of soil did not show any dependence with any of soil properties considered. However, the DTPA-Cu was found to positively correlate with clay content ($r = 0.379^{*}$), organic carbon ($r = 0.721^{**}$), CEC ($r = 0.494^{**}$) and total Cu ($r = 0.373^{*}$). Whereas its association with fine sand was negative ($r = -0.372^{*}$). Several past studies have also revealed the positive effect of clay on Cu availability (Jalali *et al* 1989; Veeraiah, 1990; Singh *et al.*, 1990; Katyal and Sharma, 1991). The positive relationship of organic matter and DTPA-Cu indicated that more dissolved Cu in soil solution occurred due to chelation and complexation of Cu by soil organic matter (Tisdale *et al.*, 1990). Similar results were also reported by Joshi *et al* (1983), Jalali *et al* (1989), Gupta and Srivastava (1990), Singh *et al* (1990) and Veeraiah (1990). The relationship of DTPA-Cu with fine sand fraction of soil validated the widespread appearance of Cu deficiency in sandy soils (Arora and Sekhon, 1980). The positive relationship of DTPA-Cu with CEC was also reported by Singh *et al.* (1990). Karim *et al.* (1976) and Katyal and

Table 2. Simple correlations between soil properties and total/DTPA micronutients

Soil properties	Zn (ppm)		Cu (ppm)		Fe (ppm)		Mn (ppm)	
	Total	DTPA extractable	Total	DTPA extractable	Total	DTPA extractable	Total	DTPA extractable
Clay (%)	0.528**	0.250	0.262	0.379*	-0.224	0.029	0.353*	0.072
Silt (%)	0.321	0.044	-0.008	0.179	-0.110	-0.193	0.329*	-0.301
Find sand (%)	0.338*	-0.174	-0.116	-0.372*	0.245	-0.054	-0.219	0.111
Coarse sand (%)	-0.531**	-0.196	-0.210	-0.287	0.202	0.206	-0.520**	0.079
Organic carbon (%)	0.495**	0.369*	0.260	0.721**	-0.134	0.258	0.101	0.052
CEC Cmol (P^+) kg^{-1}	0.422*	0.180	0.306	0.494**	0.097	0.225	0.092	0.432**
pH	0.318	0.087	0.218	-0.217	0.048	-0.730**	0.613**	-0.313
EC (dSm^{-1})	0.355*	0.065	0.014	-0.027	-0.193	-0.243	0.336*	-0.001
$CaCO_3$ (%)	0.495**	-0.137	-0.045	-0.057	-0.279	-0.284	0.486**	-0.226
Total amount of respective nutrient (ppm)	-	0.284	-	0.373*	-	0.062	-	0.075

* Significant at 5% level ** Significant at 1% level.

Sharma (1991) reported the positive dependence of DTPA-Cu with total Cu.

The total Fe content of soil did not show any significant relationship with any of the soil properties but the DTPA-Fe showed a negative association with pH ($r = -0.730^{**}$) which agreed with the findings of Rajkumar *et al* (1990). Veeraiah (1990) and Katyal and Sharma (1991).

The total Mn was found to correlate positively with clay ($r = 0.353^{*}$), silt ($r = 0.329^{*}$), pH ($r = 0.613^{**}$), EC ($r = 0.336^{*}$) by and $CaCo_3$ ($r = 0.486^{*}$) and negative by with coarse sand ($r = -0.520^{**}$). Sharma and Yadav (1986) observed that the total Mn level is a function of finer fractions of soil and thus, positive dependence with clay and silt fraction and negative dependance with sand fraction was quite apparent. Jalali *et al.* (1989) have observed negative correlation of total Mn with pH and $CaCo_3$ of soil. However, positive relationship were exhibited between them in the present study which was on line with the findings of Katyal and Sharma (1991). The DTPA-Mn level correlated significantly only with CEC ($r = 0.432^{*}$) obviously due to greater retention of Mn in exchangeable form in high CEC soils than low CEC soils

Multiple regression analysis

Linear multiple regression was established between DTPA extractable micronutrients and other soil parameters known to affect their availability in soils. These regression equations are given below:

DTPA -Zn = - 0.187 + 0.007 clay + 0.021 pH - 0.001 CEC -0.125 $CaCO_3$ + 0.592 OC + 0.008 total Zn ($R^2 = 0.336$ NS)

DTPA-Cu = 1.255 + 0.037 clay - 0.251 pH + 0.025 CEC -0.481 $CaCO_3$ + 4.676 OC^{**} + 0.014 total Cu ($R^2 = 0.700^{**}$)

DTPA-Fe = 140.085 + 0.411 Clay - 13.085 pH - 0.255 CEC -4.607 $CaCO_3$ + 37.414 OC^{**} - 0.045 total Fe ($R^2 = 0.711^{**}$)

DTPA-Mn = 5.410 +0.048 clay - 2.020 pH + 0.169 CEC-1.183 $CaCO_3$ + 1.362 OC + 0.035 total Mn^{**} ($R^2 = 0.479^{*}$)

The results of the multiple regression analysis showed that about 37, 70, 71 and 48 per cent variations in DTPA extractable Zn, Cu, Fe and Mn respectively are accounted for by the combined effect of clay, pH, CEC, CaCo3, organic carbon and respective total micrountrient content of the soil. The organic carbon content was found to be the dominating factor in influencing the availability of Cu and Fe whereas the total Mn level greatly influenced the availability of Mn in soils.

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FIXATION OF OPTIMUM TEMPERATURE AND MEDIUM FOR THE GERMINATION OF *Stylosanthes* SEEDS

. SRIKANTH AND T.V. KARIVARATHARAJU

Department of Seed Technology
Agricultural College and Research Institute
Tamil Nadu Agricultural University
Coimbatore 641 003

ABSTRACT

Experiments were conducted in *Stylosanthes scabra*, an important forage crop to standardise the requirements at different temperature regimes *viz* constant temperatures of 20^{0}C, 25^{0}C and 30^{0}C and alternate temperatures of 25 -30^{0}C, 20-25^{0}C and 10- 20^{0}C in 16-8 hours cycle in different germination media *viz.*, roll towel, top of paper, sand and pleated paper. The experimental results showed that the ideal temperature and germination medium for the germination of *Stylosanthes scabra* seeds were 25-30^{0}C and top of paper respectively.

KEY WORDS : *Stylosanthes*, Germination, Optimum Temperature, Medium

Germination plays a major role in uniform emergence, field stand and maturity. Each kind of seeds has its own optimum temperature and germination media at which it exhibits maximum germination potential. This study on the temperature and media suitability of a seed kind is