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Short Communication

Available Micronutrient Status of Some Calcareous Soils of Andhra Pradesh

A. Sairam and V. Rajgopal
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Rajendranagar, Hyderabad 500 030, India

With intensive cultivation, micronutrient deficiency has become a limiting factor in crop production, particularly in calcareous soils of arid and semi arid regions. In India, 30 m ha area is found to be calcareous and around 20 to 30% of the cultivated area in Andhra Pradesh is regarded as calcareous, and these are mostly vertisols. As the available information on the micronutrient status of these soils is meagre, it was contemplated to study the status of available micronutrients and to see their inter-relationship with certain soil properties.

Thirty eight representative calcareous vertisol surface soil samples (0-0.15 m depth), distributed in three semi arid districts, viz., Guntur, Kurnool and Mahaboobnagar of Andhra Pradesh, were processed and analysed for important physico-chemical characteristics, following standard methods. Active calcium carbonate, the fraction of $CaCO_3$ present in silt and clay particles, was determined following Yaalon (1957). The available Zn, Cu, Fe and Mn were extracted with diethylene triamine penta-acetic acid (DTPA) following Lindsay and Norvell (1978). Simple correlations were worked out between different micronutrients and soil properties.

The data presented in Table 1 indicate that these soils had mean values of 8.4, 0.38 dSm^{-1} and 0.39% for pH, electrical conductivity and organic carbon, respectively. In majority of the soils (79%), the organic carbon content was fairly low. These soils had an average content of 6.82% and 3.17% total calcium carbonate and active calcium carbonate, respectively. The texture of the soils varied from sandy clay loam to clayey. The mean DTPA extractable content of Zn, Cu, Fe and Mn were 0.53, 2.00, 6.25 and 15.50 ppm, respectively. While majority of the soils were deficient in Zn (63%) and Fe (31%), contents of Cu and Mn appeared to be adequate in these soils as per the critical limits suggested by Lindsay and Norvell (1978).

The relationship between available micronutrients and different soil properties (Table 2) revealed significant negative correlation between pH and Cu ($r = -0.52^{**}$) and Mn ($r = -0.70^{**}$). These results are similar to those obtained by Joshi *et al.* (1981) in respect of Mn, and Kuhad *et al.* (1986) in case of Cu. However, organic carbon had significant positive correlation with Cu ($r = 0.60^{**}$) and Mn ($r = 0.69^{**}$). It is evident that the presence of organic matter may promote the availability of micronutrients, presumably by chelation, thus reducing its fixation to unavailable form. Similar

Table 1. Range and mean of micronutrient cations and soil characteristics

Character	Range	Mean
pH (1:2.5)	7.9–9.4	8.4
EC (dSm^{-1})	0.22–0.74	0.38
$CaCO_3$ (%)	1.43–33.44	6.82
Active $CaCO_3$ (%)	0.58–8.54	3.17
Organic carbon (%)	0.16–0.59	0.39
DTPA extractable micronutrients (ppm)		
Zn	0.24–0.88	0.53
Cu	1.00–3.80	2.00
Fe	1.26–12.18	6.25
Mn	6.60–24.80	15.50

Table 2. Correlation coefficients between available micronutrients and soil properties

Soil property	Available micronutrients			
	Zn	Cu	Fe	Mn
pH	−0.12	−0.52**	−0.07	−0.70**
Organic carbon	0.19	0.60**	0.10	0.69**
Calcium carbonate	−0.52**	−0.09	−0.58**	−0.08
Active calcium carbonate	−0.32*	0.15	−0.41**	0.17

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

results have been reported by Sahni *et al.* (1980) in respect of Cu, and by Joshi *et al.* (1983) in the case of Mn.

The $CaCO_3$ content in these soils was significantly and negatively correlated with the available Zn ($r = -0.52^{**}$) and Fe ($r = -0.58^{**}$). The decrease in availability of Zn may be due to strong adsorption of Zn 2^+ by calcite and formation of insoluble compounds such as Ca-zincates and Zn (OH) (Gupta and Singh, 1972). The reduction in available iron due to $CaCO_3$ content is ascribed to the oxidising effect of $CaCO_3$ on Fe^{2+}, and decreased solubility of iron due to a rise in pH (Mehra and Baser, 1991). Besides total $CaCO_3$, the active $CaCO_3$ had also shown significant negative relation with available Zn ($r = -0.32^{**}$) and Fe (-0.41^{**}). It is inferred that the adsorption of Zn might have been accentuated by the presence of collidal sized lime particles, in addition to the clay surface. Similar observation was also reported by Michael *et al.* (1987). The role of active $CaCO_3$ in decreasing Fe availability was attributed to the high reactive surface area of the carbonate phase as observed by Yaalon (1957). As such, it is important to take the different forms of $CaCO_3$ in assessing the availability of micronutrients, particularly Zn and Fe.

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