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MICRONUTRIENT STATUS OF SOILS IN THE THIKRIWALA PROJECT AREA OF FAISALABAD DISTRICT

A.M. Ranjha*, Mirza Bargees Baig, Arshad Iqbal* A. Jabbar* and M. B. Tahir

PARC, National Agricultural Research Centre, Islamabad

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The micronutrient status of the soil of the Thikriwala area was determined for their better management. Soil samples from 82 sites were collected for physico-chemical characterization and the determination of Na_2EDTA extractable Cu, Zn, Fe, Mn and B. Twenty percent of the samples were deficient in Zn and none of them in Cu. Iron and Mn were also present in sufficient amounts. Four percent of the samples showed somewhat higher quantities while others had sufficient amount of boron. Soil pH indicated a negative correlation with Zn and Fe but Cu, Mn, and B were positively correlated with the amount of clay. The presence of $CaCO_3$ indicated a negative correlation with the available amounts of all the trace elements assessed in the study.

Key words: Micronutrients; Soil properties; Deficiencies.

INTRODUCTION

The importance of micronutrients for plant growth is well recognised. Their deficiency may result in crop failure. The deficiency in soil and their low availability to plants may be due to different factors like organic matter, soil pH, $CaCO_3$ and clay content. Anjum [1] observed a positive correlation between 0.1 N HCl extractable Cu, Fe, Mn and organic matter but a negative correlation was found between pH and Cu and Zn distribution. The availability of Cu was also adversely affected by the presence of $CaCO_3$. Similarly B was positively correlated with pH and negatively with organic matter [9]. Iqbal [3] studied the available micronutrient status of the soils of Kabirwala and found a positive correlation between Cu and clay content while negative correlation between Fe and amount of clay. Kolling *et. al* [57] observed a significant decrease in the available Mn with increasing $CaCO_3$ content. To assess the likelihood of yield being limited by trace elements or the need of applying them in the form of fertilizers for the betterment of the rural life by boosting up the agricultural production, it was imperative to study the available micronutrient status of soils of the Thikriwala project.

MATERIAL AND METHODS

For the evaluation of the micronutrient status of soil in the Thikriwala project area, surface (0-15 cm.) soil samples were collected from 82 sites well distributed throughout the project area. Samples were ground with wooden pestle and mortar, passed through a 2 mm sieve and were stored in clean labelled plastic containers. They were analysed for texture, organic matter and $CaCO_3$ contents according to the methods described by Moodie *et. al* [8]. Beckman Zerometric pH meter with catomel and glass electrodes was used to determine the pH of the saturated soil paste. Available Cu, Zn, Fe and Mn were extracted by shaking 10 g soil with 0.05 M Na_2EDTA solution for an hour. Determinations of micronutrients in the soil extract were made by an atomic absorption spectrophotometer, while available B was determined by using curcumin exalic acid on Spectronic 20 -Bausch and Lomb colorimeter [4].

*University of Agriculture, Faisalabad.

RESULTS AND DISCUSSION

Physico-chemical analysis of the samples (Table 1) indicate that the soils were alkaline in reaction. They were low in organic matter and calcareous in nature.

Analysis of soil samples for the available micronutrient status (Table 2) shows that :

(1) The available Zn content ranged between 0.9 to 6.8 ppm. About 20% samples were found deficient, 50% low and rest 30% had sufficient Zn for crop growth. Low and deficient samples were uniformly distributed throughout the area (Table 4).

(2) The range of available Cu content was within the minimum and maximum limits of 0.6 and 4.8 ppm and this

was not deficient for normal plant growth though 70 % of the samples were in the low Cu content limit.

(3) Iron and Mn ranged from 15-125 and 20 to 240 ppm respectively showing that none of the sites was deficient in available Fe and Mn, and all the samples had fair amounts of these two elements for normal plant growth.

(4) The available B varied from 0.7 to 1.88 ppm indicating that nearly all samples had sufficient amount of B. Only 4% samples had higher amounts of B, which were not considered toxic.

A negative correlation between available Zn and pH and a significant positive correlation between B and pH were observed (Table 3).

The decrease in Zn availability at high pH was due to the fact that Zn ion might be converted to negatively charged zincate complex and this conversion in the presence of calcium ion favoured the formation of very complex insoluble calcium zincate [7].

No correlation was observed between available Cu and pH while Fe and Mn were negatively correlated. The decreased availability of Fe at high pH value was likely due to the conversion of ferrous form of iron to the ferric oxide form [6]. The presence of organic matter was correlated significantly positively with Cu, Zn, Fe and Mn and negatively with B. The availability of trace elements was influenced by organic matter due the formation of their che-

Table 1. Physico-chemical characteristics of the soils.

pH			Organic matter			$CaCO_3$			Clay content		
Value	No. of samples	% of total	Value	No. of samples	% of total	Value	No. of samples	% of total	Value	No. of samples	% of total
7.5-8.0	29	35	0.0-0.5	43	52	0.0-2.0	0	0	10-20	52	63
8.0-8.5	47	57	0.5-1.0	39	48	2.0-4.0	53	65	20-30	29	35
8.5-9.0	6	8	1.0-1.5	0	0	4.0-5.37	29	35	35-55	1	2

Table 2. Available Na_2 EDTA extractable micronutrient contents of soils of Thikriwala project area.

Zn			Cu			Fe			Mn			B		
Range ppm	No. of samples	% of total	Range ppm	No. of samples	% of total	Range ppm	No. of samples	% of total	Range ppm.	No. of samples	% of total	Range ppm.	No. of samples	% of total
0.0-0.9	16	20	0.0-0.6	0	0	0-15	0	0	0-20	0	0	0.0-0.7	63	77
0.9-2.5	41	50	0.6-2.5	58	70	15-70	62	75	20-70	9	11	0.7-1.5	16	19
2.5-6.8	25	30	2.5-4.8	24	30	70-125	20	25	70-240	73	89	1.5-1.88	3	4

Effect of soil attributes on 0.05 M Na_2 EDTA extractable micronutrient.

Table 3. Simple/linear correlation coefficients between soil characteristics and micronutrients.

Soil Characteristics	Micronutrients				
	Zn	Cu	Fe	Mn	B
1. pH	- 0.2086	- 0.0751	- 0.2353*	- 0.2550*	+ 0.9388**
2. Organic matter	+ 0.1921	+ 0.4825**	+ 0.0682	+ 0.1022	- 0.2401*
3. Clay	- 0.3160**	+ 0.5214**	- 0.1836	+ 0.0079	+ 0.2271*
4. Calcium carbonate	- 0.3537**	- 0.2301*	- 0.2546*	- 0.4601**	- 0.1869

* = Significant at 5 percent level. $P < 0.05$

** = Significant at 1 percent level. $P < 0.01$

Table 4. Critical levels of micronutrients in soils.

Element	Extractant	Deficiency range	Sufficiency range	Reference
Zn	Ammonium dithizone carbon tetrachloride	< 1.0 ppm *	2.5 ppm	Shaw and Dean (1952)
"	0.1N HCl	0.5 – 0.9 ppm	1.2 – 4.7 ppm	Wear and Sommer (1948)
"	Ammonium acetate	0.5 – 0.6 ppm	1.7 – 3.5 ppm	Lyman and Dean
"	Dithizone	< 0.6 ppm	1.0 ppm	Massey (1956)
"	– do –	< 0.5 ppm	–	Brown *et al* (1964).
Cu	Acetate Buffer	< 0.5 ppm	–	Bittel (1957).
"	Na_2 EDTA	< 0.6 ppm	–	Mitchell (1964).
Mn	Ammonium acetate and Hydroquinine	< 20.0 ppm	–	Jones and Leeper (1951).
"	– do –	10-20 ppm	41 – 68 ppm	Leeper (1947).
B			0.0-0.7 ppm	U.S. Salinity Lab. Staff (1954).

* > Greater than
< Lesser than

lates which prevented the micronutrients from entering into the insoluble complexes.

The quantity of clay showed a negative effect upon the available Zn and Fe while a positive relationship was found with the available Cu, Mn, and B. The increased availability of Cu with an increase in the clay content was probably due to the retention of this element on the clay fraction which was released during extraction [10].

Statistical analyses of the data showed that there was highly significant negative correlation between Zn, Mn, significant with copper, iron and nonsignificant with B and amount of $CaCO_3$. According to Boischot and Durroux [2] the decreased availability of Fe and Mn at high $CaCO_3$ contents were due to the fixation of these elements in calcareous soils and deposition of $CaCO_3$ on Fe particles.

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