ASSESSMENT OF MICRONUTRIENTS STATUS AND THEIR CORRELATION WITH SOME SOIL PROPERTIES IN SOILS OF VALSAD DISTRICT, GUJARAT

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ABSTRACT

Surface soil samples (0-21.5 cm) were collected from 120 locations from six talukas of Valsad district using GPS. The soil samples were analyzed for DTPA extractable micronutrient. The DTPA extractable micronutrients Fe, Zn, Mn and Cu content varied from 1.83 to 68.96 mg/kg, 0.14 to 2.01 mg/kg, 0.3 to 66.75 mg/kg and 0.14 to 8.90 mg/kg, respectively. Out of 120 surface soil samples, 9.17 per cent samples were deficient in DTPA-Fe, 30.00 per cent samples in DTPA-Zn, 14.17 per cent samples in DTPA-Mn and 1.67 per cent samples were deficient in DTPA-Cu content. DTPA-Fe (-0.33**), DTPA-Zn (-0.40**) and DTPA-Mn (-0.28**) showed significantly negative correlation with soil pH.

KEY WORDS: DTPA extractable micronutrient, GPS

INTRODUCTION

Soil fertility is one of the important factors controlling the crop yield. Soil related limitations affecting the crop productivity including nutritional disorders can be determined by evaluating the fertility status of the soils. Soil testing provides the information about the nutrient availability of the soil upon which the fertilizer recommendation for maximizing crop yield is made. Zinc (Zn), Copper (Cu), Manganese (Mn) and Iron (Fe) are essential micro-nutrients for plant growth. Through their involvement in various enzymes and other physiologically active molecules, these micro-nutrients are important for gene expression, biosynthesis of proteins, nucleic acids, growth substances, chlorophyll and secondary metabolites, metabolism of carbohydrates and lipids, stress tolerance, etc. (Singh, 2004, Rengel, 2007 and Gao *et al.,* 2008). Original geologic substrate and subsequent geochemical and pedogenic regimes determine the total amounts of micro- nutrients in soils. However, total amount is rarely indicative of the availability by plant, because availability depends on soil pH, organic matter content, adsorptive surfaces and other physical, chemical and biological conditions in the rhizosphere.

Among the micro nutrients, zinc appears to be deficient in majority of the soils of Gujarat. The estimation, characterization and distribution of micronutrients are important issues in the site-specific crop management, precision farming and sustainable agriculture (Nayak *et al.*, 2006). Keeping this in view, the present study was conducted to know the spatial variability for micronutrients (Fe, Zn, Mn, Cu) in Valsad district of Gujarat.

MATERIALS AND METHODS

Study Area

The study area situated between the parallels of latitude 20°42'57" and the meridians of longitude 73°25'25" and 72°39'41" in Valsad district of Gujarat. Topography is highly undulating and uneven with deep black alluvial, laterite and medium black soil

Collection of soil samples

A total of 120 representative GPS-referenced (Trimble Juno 3D) surface soil samples were randomly collected from farmers field covering six *talukas* (Valsad, Dharampur, Kaparada, Pardi, Umargam and Vapi) of Valsad district at 0-21.5 cm depth. The collected soil samples were air dried, sieved (2 mm sieve) and analyzed for DTPA extractable micronutrient (Fe, Mn, Zn and Cu) as per the standard method proposed by Lindsay and Norvell (1978) using Atomic Absorption Spectrophotometer.

Physico-chemical parameters like soil $pH_{2.5}$ and $EC_{2.5}$ and $CaCO_3$ were determined as per standard methods described by Jackson (1973). Soil organic carbon was determined by rapid titration method (Walkley and Black, 1934). Free $CaCO_3$ was determined by rapid titration method as described by Piper (1950). The simple correlation among physico-chemical properties and available micronutrients were work out as per standard method given by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

The soils of Valsad district are medium acidic to strongly alkaline (pH 6.03 to 8.92), but free from salinity (EC 0.04 to 1.80 dS/m). The organic carbon content in soils varied from 0.10 to 1.99 per cent (mean 0.7. per cent). The free calcium carbonate content ranged from 0.07 to 6.47 per cent with an average value of 2.93 per cent (Table 1)

DTPA extractable micronutrients

DTPA-Fe content in soil varied from 1.83 to 68.96 mg/kg (mean value 18.55 mg/kg) (Table 2) and it was found deficient in 9.16 per cent samples, medium in 26.67 per cent and high in 64.17 per cent samples (Table 3). Correlation studied indicated that DTPA-Fe was positively and significantly correlated with DTPA-Mn and DTPA-Zn, but was significantly and negatively correlated with pH (Table 4). This might be due to at high pH, availability of micronutrient may decrease because at high pH, DTPA-Fe get fixed in soil.

DTPA-Zn content of soil varied from 0.14 to 2.01 mg/kg with a mean value 0.87 mg/kg (Table 2) and was found to be deficient in 30.00 per cent samples, medium in 34.17 per cent and high in 35.83 per cent samples (Table 3). This wide variation in Zn content might be due to site specific Zn application. Correlation study showed that DTPA-Zn was positively and significantly correlated with DTPA-Fe, DTPA-Mn and DTPA-Cu, but significantly and negatively correlated with pH (Table 4).

The highest and lowest values of DTPA-Mn content in soil were 0.3 mg/kg and 66.75 mg/kg, respectively, with the mean value 19.03 mg/kg (Table 2). Out of the 120 soil samples, 14.17 per cent samples were deficient, 15.00 per cent were medium and 70.83 per cent samples were high in range (Table 3). Correlation study indicated that DTPA-Zn was positively and significantly correlated with DTPA-Fe and

DTPA-Zn, but significantly and negatively correlated with soil pH (Table 4).

DTPA-Cu in surface soils was grouped under low (1.67 %), medium (2.50 %) and high (95.83 %) category. The highest and lowest values were recorded 0.14 mg/kg and 8.90 mg/kg, respectively. Meena *et al.* (2012) also reported the similar finding.

Significant and positive correlation between available micronutrients and SOC were well documented by Sharma *et al.* (2003), Behera and Shukla (2013), Iratkar *et al*. (2014) and Singh *et al.* (2015). Further, significantly and negative correlations of all or some micronutrients with pH were also documented by Sharma *et al*. (2003), Iratkar *et al.* (2014) and Meena *et al*. (2012).

CONCLUSION

From the results and discussion, it can be seed that DTPA extractable micronutrients Fe, Zn, Mn and Cu content varied in the soils of Valsad districts from 1.83 to 68.96 mg/kg, 0.14 to 2.01 mg/kg, 0.3 to 66.75 mg/kg and 0.14 to 8.90 mg/kg, respectively. Out of 120 surface soil samples, 9.16 per cent samples were deficient in DTPA-Fe, 30.00 per cent samples in DTPA-Zn, 14.17 per cent samples in DTPA-Mn and 1.67 per cent samples were deficient in DTPA-Cu content. DTPA-Fe, DTPA-Zn and DTPA-Mn showed significantly negative correlation with soil pH.

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Table 1: Range and mean values of soil properties and micronutrients

Soil Proeperties	Lowest	Highest	Mean	SD
pH	6.03	8.92	-	0.58
EC (dS/m)	0.04	1.80	0.27	0.21
Organic carbon (%)	0.10	1.99	0.70	0.42
$CaCO_3$ (%)	0.07	6.47	2.93	1.46
DTPA-Fe (mg/kg)	1.83	68.96	18.55	14.97
DTPA-Zn (mg/kg)	0.14	2.01	0.87	0.51
DTPA-Mn (mg/kg)	0.30	66.75	19.04	16.48
DTPA-Cu (mg/kg)	0.14	8.90	2.11	1.46

Table 2: Soil properties and micronutrient status in different *talukas* of Valsad district

Taluka	Number of Samples	$pH_{1:2.5}$	EC (dS/m)	Soil Organic Carbon (%)	$CaCO_3$ (%)	DTPA-Fe (mg/kg)	DTPA-Zn (mg/kg)	DTPA-Mn (mg/kg)	DTPA-Cu (mg/kg)
Valsad	20	6.45-8.25 (7.40)	0.08-0.70 (0.25)	0.20-1.99 (0.71)	0.07-5.50 (2.71)	2.51-18.44 (9.70)	0.23-1.24 (0.61)	0.35-23.24 (10.52)	0.25-6.15 (1.74)
Dharampur	20	6.03-8.08 (6.82)	0.08-0.96 (0.22)	0.10-1.43 (0.83)	0.38-5.26 (2.95)	2.51-63.76 (32.08)	0.22-1.66 (1.05)	12.35-66.75 (31.93)	0.53-4.32 (1.74)
Kaparada	20	6.31-8.92 (7.16)	0.09-0.92 (0.28)	0.12-1.71 (0.87)	0.53-6.71 (3.41)	3.80-68.96 (27.21)	0.14-2.01 (0.96)	0.33-65.68 (33.33)	0.14-4.31 (2.03)
Pardi	20	6.27-8.69 (7.28)	0.04-0.35 (0.20)	0.20-1.46 (0.62)	0.38-4.80 (2.61)	2.30-21.63 (14.03)	0.14-1.90 (0.76)	3.28-25.26 (15.64)	0.50-3.99 (2.47)
Umargam	20	6.58-8.18 (7.56)	0.08-0.46 (0.29)	0.18-1.22 (0.59)	0.60-5.30 (2.78)	3.14-21.82 (15.35)	0.33-1.27 (0.82)	0.30-18.63 (14.10)	0.57-3.32 (1.76)
Vapi	20	6.65-8.70 (7.45)	0.09-1.80 (0.36)	0.15-1.49 (0.61)	0.35-5.10 (3.10)	1.83-24.89 (12.95)	0.15-2.01 (1.05)	0.93-20.54 (8.71)	0.16-8.90 (2.91)
Overall	120	6.03-8.92 (7.28)	0.04-1.80 (0.27)	0.10-1.99 (0.70)	0.07-6.47 (2.93)	1.83-68.96 (18.55)	0.14-2.01 (0.87)	0.3-66.75 (19.03)	0.14-8.90 (2.10)

Table 3: Categorization of micronutrients of surface soils of Valsad district

Micronutrients in Surface Soils (ppm)												
Taluka	**Number of Samples**	**DTPA-Fe**			**DTPA-Zn**			**DTPA-Mn**			**DTPA-Cu**	
		L	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**
Valsad	20	**2** (10.0)	**12** (60.0)	**6** (30.0)	**7** (35.0)	**12** (60.0)	**1** (5.0)	**3** (15.0)	**8** (40.0)	**9** (45.0)	**0** (0)	**03** (15.0)	**17** (85.0)
Dharampur	20	**1** (5.0)	**1** (5.0)	**18** (90.0)	**4** (20.0)	**3** (15.0)	**13** (65.0)	**0** (0)	**0** (0)	**20** (100)	**0** (0)	**0** (0)	**20** (100)
Kaprada	20	**1** (5.0)	**8** (40.0)	**11** (55.0)	**7** (35.0)	**3** (15.0)	**10** (50.0)	**4** (20.0)	**0** (0)	**16** (80.0)	**1** (5.0)	**0** (0)	**19** (95.0)
Pardi	20	**2** (10.0)	**5** (25.0)	**13** (65.0)	**11** (55.0)	**3** (15.0)	**6** (30.0)	**2** (10.0)	**3** (15.0)	**15** (75.0)	**0** (0)	**0** (0)	**20** (100)
Umargam	20	**2** (10.0)	**1** (5.0)	**17** (85.0)	**2** (10.0)	**14** (70.0)	**4** (20.0)	**1** (5.0)	**2** (10.0)	**17** (85.0)	**0** (0)	**0** (0)	**20** (100)
Vapi	20	**3** (15.0)	**5** (25.0)	**12** (60.0)	**5** (25.0)	**6** (30.0)	**9** (45.0)	**7** (35.0)	**5** (25.0)	**8** (40.0)	**1** (5.0)	**0** (0)	**19** (95.0)
Overall	120	**11** (9.16)	**32** (26.67)	**77** (64.17)	**36** (30.00)	**41** (34.17)	**43** (35.83)	**17** (14.17)	**18** (15.00)	**85** (70.83)	**2** (1.57)	**3** (2.50)	**115** (95.83)

L=Low, M=Medium, H=High; Values in bold no. expressed No. of villages and values in parenthesis ( ) means per cent soils

Table 4: Simple correlation among different parameters of surface soils of Valsad district (n=120)

Soil Proeperties	pH	EC	SOC	$CaCO_3$	Fe	Mn	Zn	Cu
pH	1.00							
EC (dS/m)	0.31**	1.00						
Organic carbon (%)	-0.13	-0.11	1.00					
$CaCO_3$ (%)	0.01	0.08	0.12	1.00				
DTPA-Fe (mg/kg)	-0.33**	-0.11	0.01	0.15	1.00			
DTPA-Zn (mg/kg)	-0.40**	-0.03	0.04	0.12	0.81**	1.00		
DTPA-Mn (mg/kg)	-0.28**	0.01	-0.10	0.08	0.58**	0.42**	1.00	
DTPA-Cu (mg/kg)	-0.06	-0.07	0.16	0.01	-0.12	-0.09	0.20*	1.00

Note: ** and * denote significance at 1% and 5% levels of probability, respectively

[MS received : April 27, 2018] ***[MS accepted : May 19, 2018]***