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

PATEL D. J.[1]; PATEL K. H.[2*]; GOHIL D. J.[3]; ITALIA A. P.[4]; PATEL D. D.[5] AND THANKI P. M.[6]

DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY
N. M. COLLEGE OF AGRICULTURE
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI-396 450, GUJARAT, INDIA.

E-MAIL: khpatel@nau.in

1. M. Sc. Scholar, Dept. of Soil Sci. & Ag. Chem., N. M. College of Agriculture, NAU, Navsari-396 450
2 Associate Professor, Dept. of Soil Sci. & Ag. Chem., College of Agriculture, NAU, Bharuch –392012*
3. M. Sc. Scholar, Dept. of Soil Sci. & Ag. Chem., N. M. College of Agriculture, NAU, Navsari-396 450
4. Assistant Professor, Dept. of Soil Sci. & Ag. Chem., College of Agriculture, NAU, Bharuch – 392 012
5. Associate Professor, Department of Agronomy, College of Agriculture, NAU, Bharuch – 392 012
6. Associate Professor, Dept. of Agril. Economics, College of Agriculture, NAU, Bharuch – 392 012

ABSTRACT

Surface soil samples (0-22.5 cm) were collected from 135 locations from nine talukas of Bharuch district using GPS. The soil samples were analysed for DTPA extractable micronutrients (Fe, Zn, Mn and Cu). The DTPA-Fe ranged from 3.17 to 19.58 mg kg^{-1} with a mean value 10.86 mg kg^{-1}, DTPA- Zn varied from 3.17 to 19.58 mg kg^{-1} with a mean value 0.64 mg kg^{-1} (marginal status), DTPA-Mn varied from 0.07 to 16.54 mg kg^{-1} with a mean value 8.24 mg kg^{-1} and Cu content varied from 0.12 to 4.27 mg kg^{-1} (mean value 1.13 mg kg^{-1}). Out of 135 surface soil samples, 11.11 per cent samples were deficient in DTPA-Fe, 43.70 per cent samples were deficient in DTPA-Zn and 11.11 per cent samples were deficient in DTPA-Mn content. DTPA-Fe (-0.22**), DTPA-Zn (-0.25**), DTPA-Mn (-0.39**) and DTPA-Cu (-0.23**) showed significantly negative correlation with soil pH and DTPA-Fe (0.23**), DTPA-Zn (0.41**), DTPA-Mn (0.36**) and DTPA-Mn (0.55**) showed significantly positive correlation with soil organic carbon.

KEY WORDS: DTPA extractable micronutrient, correlation, 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 Bharuch district of Gujarat.

MATERIALS AND METHODS

Study Area

The study area situated between the parallels of latitude 21.30" to 22.09" and longitude 70.00" to 73.28" in Bharuch district of Gujarat. Topography is undulating and uneven with deep black alluvial, laterite and medium black soil.

Collection of soil samples

A total of 135 representative GPS-referenced (Trimble Juno 3D) surface soil samples were randomly collected from farmers fields during summer 2015-16 following zig-zag method of sampling covering nine *talukas* (Bharuch, Anklesver, Valia, Vagra, Jambusar, Amod, Hansot , Netrang and Jhagadia) of Bharuch district at 0-22.5 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 $EC_{2.5}$, $CaCO_3$ 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 (1967).

RESULTS AND DISCUSSION

The soils of Bharuch district are neutral to very strongly alkaline (pH varied from 7.13 to 9.71 with a mean pH value 8.22), but free from salinity, varied from EC 0.13 to 1.34 dS^{-1} with a mean value 0.38 dsm^{-1} The organic carbon content in soils varied from 0.19 to 1.17 per cent with a mean value 0.48 per cent. The free calcium carbonate content ranged from 0.09 to 17.60 per cent with an average value of 3.16 % (Table 1).

DTPA extractable micronutrients

DTPA-Zn varied from 0.11 mg to 1.81 $kg^{-1}$with a mean value 0.6 mg kg^{-1} (Table 2) and was found to be deficient in 43.70 per cent samples, 40.74 per cent were medium and 15.55 per cent samples were high in DTPA-Zn content. This wide variation in Zn content in might be due to site specific Zn application. Correlation study shows that DTPA-Zn was positively and significantly correlated with SOC, DTPA-Fe, DTPA-Mn and DTPA-Cu but significantly and negatively correlated with pH (Table 4).

The values of DTPA-Mn content in soil were varied from 0.07 mg kg^{-1} to 16.45 mg kg^{-1} with the mean value 8.2 mg kg^{-1}. Out of the 135 soil samples, 11.11 per cent samples were deficient, 64.44 per cent were medium and 24.44 per cent samples were high in range. Correlation study indicated that DTPA-Mn was positively and significantly correlated with SOC and DTPA-Fe but significantly and negatively correlated with soil pH(Table 4)

DTPA-Cu in surface soils was grouped under low (2.22 per cent), medium (25.8 per cent)
and high (72.53 per cent) category. The highest and lowest values were recorded 0.12 mg kg^{-1} and 4.27 mg kg^{-1}, respectively with a mean value 1.1 mg kg^{-1}.

Significant and positive correlation between available micronutrients and SOC were well documented by Sharma *et al.* (2003), Bahera 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).

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Table 1: Range and mean values of soil properties and micronutrients content in soils of Bharuch district

Soil proeperties	Lowest	Highest	Mean	SD
pH	7.13	9.71	8.20	0.25
EC (dS m^{-1})	0.13	1.34	0.38	0.49
Organic carbon (%)	0.19	1.17	0.48	0.21
$CaCO_3$ (%)	0.09	17.60	3.16	3.01
DTPA-Fe (mg kg^{-1})	3.17	19.58	10.9	3.72
DTPA-Zn (mg kg^{-1})	0.11	1.81	0.6	0.36
DTPA-Mn (mg kg^{-1})	0.07	16.45	8.2	3.07
DTPA-Cu (mg kg^{-1})	0.12	4.27	1.1	0.94

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

Taluka	No. of samples	$pH_{1:2.5}$	EC (dS m^{-1})	Soil Organic carbon (%)	$CaCO_3$ (%)	DTPA-Fe	DTPA-Zn	DTPA-Mn	DTPA-Cu
Anklesvar	15	7.44-8.31 (7.96)	0.20-0.96 (0.38)	0.38-0.83 (0.60)	0.14-5.16 (2.20)	4.9-17.3 (12.0)	0.4-1.2 (0.7)	4.5-12.7 (9.9)	0.4-4.0 (1.6)
Amod	15	7.80-8.78 (8.21)	0.21-1.20 (0.35)	0.21-0.75 (0.42)	0.48-9.65 (3.13)	3.2-15.5 (8.7)	0.1-1.4 (0.5)	3.6-11.8 (7.3)	0.2-2.2 (0.9)
Hansot	15	7.53-9.71 (8.52)	0.21-1.11 (0.40)	0.29-1.03 (0.55)	0.54-5.62 (2.31)	4.7-19.0 (12.3)	0.2-1.6 (0.8)	3.2-13.6 (8.4)	0.2-4.2 (1.6)
Vagra	15	7.59-8.98 (8.30)	0.22-1.34 (0.53)	0.29-1.09 (0.59)	0.41-3.27 (1.93)	4.8-19.6 (11.5)	0.1-1.4 (0.8)	5.0-12.3 (8.9)	0.3-4.3 (1.6)
Jambusar	15	7.48-9.68 (8.39)	0.19-1.26 (0.50)	0.19-0.99 (0.51)	0.45-6.25 (3.54)	4.1-16.7 (9.9)	0.2-1.3 (0.6)	3.3-16.5 (9.5)	0.3-3.1 (1.5)
Valia	15	7.13-8.89 (7.97)	0.21-0.51 (0.34)	0.24-1.17 (0.52)	0.10-8.90 (1.99)	4.7-18.0 (9.9)	0.2-1.8 (0.8)	4.2-11.5 (7.6)	0.2-2.9 (1.0)
Bharuch	15	7.26-9.17 (8.16)	0.17-0.44 (0.30)	0.21-0.79 (0.49)	0.09-5.16 (2.06)	3.5-15.8 (9.2)	0.1-1.1 (0.4)	0.1-16.4 (6.0)	0.1-2.7 (0.6)
Netrang	15	7.59-8.98 (8.35)	0.21-0.48 (0.32)	0.26-0.50 (0.35)	0.19-17.60 (6.65)	9.4-15.2 (12.1)	0.3-0.9 (0.5)	5.5-10.9 (8.0)	0.3-0.9 (0.5)
Jhagadia	15	7.13-8.52 (8.12)	0.13-0.50 (0.27)	0.19-0.61 (0.34)	0.17-11.68 (9.83)	9.8-15.6 (12.1)	0.2-0.8 (0.5)	5.4-16.5 (8.5)	0.2-1.4 (0.7)
Overall	135	7.13-9.71 (8.20)	0.13-1.34 (0.38)	0.19-1.17 (0.48)	0.09-17.60 (3.16)	3.17-19.58 (10.9)	0.11-1.81 (0.6)	0.07-16.45 (8.2)	0.12-4.27 (1.1)

Values in parenthesis ( ) indicates mean value

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

Micronutrients in surface soils (ppm)												
Taluka	**No. of samples**	**DTPA-Fe**			**DTPA-Zn**			**DTPA-Mn**			**DTPA-Cu**	
		L	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**
Anklesvar	15	1 (6.66)	4 (26.64)	10 (66.6)	3 (20.0)	10 (66.6)	2 (13.32)	1 (6.66)	5 (33.3)	9 (59.94)	0 (0.0)	0 (0.0)	15 (100.0)
Amod	15	2 (13.32)	11 (73.27)	2 (13.32)	11 (73.270	2 (13.32)	2 (13.32)	2 (13.32)	11 (73.27)	2 (13.32)	0 (0.0)	6 (40.0)	9 (59.94)
Hansot	15	1 (6.66)	3 (20.0)	11 (73.27)	6 (40.0)	3 (20.0)	6 (40.0)	3 (20.0)	7 (46.62)	5 (33.3)	0 (0.0)	4 (26.64)	11 (73.27)
Vagra	15	1 (6.66)	7 (46.62)	7 (46.62)	6 (40.0)	5 (33.30	4 (26.64)	1 (6.66)	9 (59.94)	5 (33.3)	0 (0.0)	2 (13.32)	13 (86.6)
Jambusar	15	4 (26.64)	5 (33.3)	6 (40.0)	7 (46.62)	5 (33.3)	3 (20.0)	1 (6.66)	8 (54.0)	6 (40.0)	0 (0.0)	2 (13.32)	13 (86.6)
Valia	15	2 (13.32)	4 (26.64)	9 (59.94)	4 (26.64)	8 (54.0)	3 (20.0)	1 (6.66)	13 (86.6)	1 (6.66)	0 (0.0)	3 (20.0)	12 (79.92)
Bharuch	15	4 (26.64)	5 (33.3)	6 (40.0)	9 (59.94)	5 (33.3)	1 (6.66)	6 (40.0)	7 (46.62)	2 (13.32)	3 (20.0)	7 (46.62)	5 (33.3)
Netrang	15	0 (0.0)	1 (6.66)	14 (93.24)	7 (46.62)	8 (54.0)	0 (0.0)	0 (0.0)	14 (93.24)	1 (6.66)	0 (0.0)	5 (33.3)	10 (66.6)
Jhagadia	15	0 (0.0)	2 (13.32)	13 (86.6)	6 (40.0)	9 (59.94)	0 (0.0)	0 (0.0)	13 (86.6)	2 (13.32)	0 (0.0)	5 (33.3)	10 (66.6)
Overall	135	15 (11.11)	42 (31.11)	78 (57.77)	59 (43.70)	55 (40.74)	21 (15.55)	15 (11.11)	87 (64.44)	33 (24.44)	3 (2.22)	34 (25.18)	98 (72.53)

L=Low, M=Medium, H=High; Values in parenthesis ( ) indicates per cent soils

Table 4: Simple correlation among different parameters of surface soils of Valsad district

(n=120)

	pH	**EC**	**SOC**	**$CaCO_3$**	**Fe**	**Mn**	**Zn**	**Cu**
pH	1.00							
EC	0.09	1.00						
SOC	-0.15	0.18*	1.00					
$CaCO_3$	0.14	-0.02	-0.07	1.00				
DTPA-Fe	-0.22**	-0.11	0.23**	0.13	1.00			
DTPA-Mn	-0.39**	0.22**	0.36**	0.01	0.59**	1.00		
DTPA-Zn	-0.25**	-0.01	0.41**	-0.09	0.63**	0.54**	1.00	
DTPA-Cu	-0.23**	0.30**	0.55**	-0.15	0.50**	0.65**	0.69**	1.00

Note: ** and * denote significant at 1% and 5% level respectively

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