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Evaluation of micronutrient status of soils and their relation with some chemical properties of soils of Wardha district, Maharashtra

■ YOGITA D. GORE, NILIMA S. SADANSHIV AND N. S. WAGH

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MEMBERS OF RESEARCH FORUM:

Corresponding author :
YOGITA D. GORE, Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, AKOLA (M.S) INDIA

Co-authors :
NILIMA S. SADANSHIV AND N. S. WAGH, Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, AKOLA (M.S) INDIA
Email: nil.sadanshiv@gmail.com; nwagh98@gmail.com

Summary

The present investigation was carried out for evaluation of the status of DTPA- Fe, Mn, Cu and Zn in relation with physico-chemical properties in soils of Wardha district. Total 75 surface soil samples were collected and analysed for soil properties and fertility status of study area. The results revealed that the soils are neutral to strongly alkaline in soil reaction, safe in electrical conductivity, low to high in organic carbon content and high cation exchange capacity.Soils were sufficient in DTPA-extractable micronutrient cations except zinc which was found deficient in nearly 44 per cent of the samples. Pearson correlation co-efficients indicated positive correlation of DTPA- extractable micronutrient cations with organic carbon and negative correlation with pH, EC and no significant relationship of DTPA-Mn, Cu, Zn was found with CEC.

Key words : Soil fertility, DTPA-extractable micronutrient

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Introduction

The micronutrients are essential for the proper biochemical transformations within the plant body, so as to yield the desired end products, Zn is essential for protein and auxin production, cu is a constituent of cytochrome oxidase, Fe helps in photosynthesis while Mn is essential for photosynthesis, carbon assimilation and nitrogen metabolism. Soil fertility is one of the important factors controlling yield of the crops soil characterization in relation to fertility status of the soil of an area or region is an important aspects in context of sustainable agricultural production because of imbalanced fertilizer use couples with low efficiency of other inputs, the response (production) efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent years (Yadav and Meena, 2009). Keeping these in view and also lack of information on micronutrients status to identify the emerging micronutrient deficiency or toxicity in the soils, therefore, a comprehensive study was undertaken for evaluation of micronutrient status of soils and their relation with some chemical properties of soils of Wardha district, Maharashtra.

Resource and Research Methods

The present study was undertaken to assess the

nutrient status of soils of micro-watershed during the year 2014-2015. Geographically, the Savli village is located between 78° 30' to 78° 32'E longitudes and 21° 7' to 21° 9'N latitudes in Karanja tehsil of Wardha district, Maharashtra. The total area of the village is 1158 ha. The study area falls in the survey of India (SOI) toposheet No. 55 K/12 and 55 K/8. The climate of the area is sub-tropical dry sub-humid with well-expressed summer. The mean annual temperature is 33.5°C and mean annual precipitation is about 903 mm. The area qualifies for ustic soil moisture regime and hyperthermic soil temperature regime.In the present study, grid sampling was selected which reduces a large degree of uncertainty. A grid size of 400 by 400 m was chosen. A total of 75 surface soil samples were collected at a depth of 0-20 cm covering the entire study area. The soil samples collected during the field work were initially air dried in laboratory at room temperature, ground using wooden mortar and pestle, screened through 2 mm sieve, properly labeled and stored in polythene bags for laboratory analysis.The soil pH, EC, organic carbon and CEC were estimated by the standard procedures as described by Jackson (1973). The micronutrients (Fe, Mn, Cu, Zn) from soils were extracted with 0.005 diethylene triamine penta acetic acid (DTPA) as per method out lined by Lindsey and Norvell (1978).

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Soil reaction (pH) :

The results of study presented in Table (1 and 2) indicated that all the soil samples were neutral to strongly alkaline in soil reaction. The pH of soil varied from 6.1 to 8.6 with a mean value of 7.4 this may be because of formation of soils from basaltic parent material rich in basic cations as reported by Mali and Raut (2001) and Chinchmalatpure *et al*. (2000).

Electrical conductivity (EC):

Data regarding EC of different soil samples of the study area are given in Table 1. The results showed that the low EC values of these soils were in safe range from 0.06 to 0.88 dsm^{-1} at 25^0C, which are within the acceptable limit and the soils have no salinity hazard at present and there is no deleterious effect on crop. The low EC values were observed in these soils may be due to leaching of salts from surface layer soils.

Organic carbon (OC):

The organic carbon content was varied from 0.18 to 2.80 per cent with a mean value of 0.91. It indicates

Table 1: Descriptive statistical parameters of physico-chemical properties of soils

Soil property	No. of soil samples	Minimum	Maximum	Mean	Standard deviation	Co-efficient of variance
PH	75	6.10	8.6	7.4	0.73	0.10
EC(dS/m)	75	0.06	0.88	0.18	0.06	0.33
Organic carbon (%)	75	0.18	2.80	0.91	0.43	0.47
CEC (cmol ($p+kg^{-1}$)	75	13.1	63.7	36.2	16.3	0.57
Available Fe (mg kg^{-1})	75	4.8	103.8	32.0	21.2	0.66
Available Mn (mg kg^{-1})	75	3.5	131.4	42.5	30.2	0.71
Available Cu (mg kg^{-1})	75	2.7	36.7	7.5	4.6	0.61
Available Zn (mg kg^{-1})	75	0.16	1.90	0.70	0.42	0.60

Table 2: Correlation co-efficients between available micronutrients and soil properties

Soil properties	DTPA-Fe	DTPA-Cu	DTPA-Mn	DTPA-Zn
pH	-0.528**	-0.401**	-0.368**	-0.338**
EC (dS/m)	-0.398**	-0.221**	-0.225**	0.132
Organic carbon (%)	0.410**	0.578**	0.185**	0.386**
CEC (cmol (+) / kg)	0.400**	0.026	0.115	0.052

* and ** indicate significance of values at P=0.05 and 0.01, respectively EC: Electrical conductivity; CEC: Cation exchange capacity

that these soils were low to high in organic carbon content. The high content of organic carbon might be due to addition of organic matter through either artificially or naturally and its subsequent decomposition. These results are in confirmatory with results reported by Bante *et al.* (2012) that organic carbon content of soils ranged from 0.26 to 1.35 per cent in general, decrease with depth. These findings are also in conformity with the findings of Likhar and Prasad (2011) who noticed that the soils of Nagpur district showed the higher organic carbon in surface layers than underlying horizons.

Cation exchange capacity (CEC) :

Cation exchange capacity (CEC) varied from 13.1 to 63.7 cmol (p^+) kg^{-1} with a mean value of 36.2 cmol (p^+) kg^{-1}. Similar results were reported by Srivastava *et al.* (2014) that the CEC of soils varied from 11.3 to 75.7 and base saturation from 68.5 to 122.5 per cent owing to presence of zeolite, respectively. In general, more than 75 per cent soils were clayey due to their development from basaltic parent material.

Status and correlation studies of available micronutrients of soils :

Pearson correlation co-efficients were worked out between DTPA-extractable Fe, Mn, Cu, Zn and various physico-chemical characteristics using SPSS v 11.5 software, to understand the relationship between them.

Iron:

The data of available iron content of different soil samples of savali village of Wardha district are given in Table 1. The results showed that the available iron content ranged from 4.8 to 103.8 with a mean value of 32.0. This high Fe content in soil may be due to presence of minerals like feldspar, magnetite, hematite and limonite which together constitute bulk of trap rock in these soils (Vijayakumar *et al.,* 2013). DTPA-Fe showed significant negative correlation with soil pH in Table 2. The positive correlation between DTPA-Fe and organic carbon may be due to chelation of micronutrient cations with the formation of organic complexes that protects it from leaching (Chinchmalatpure *et al.*, 2000 and Hamza *et al*., 2009).

Manganese:

DTPA-Mn content was found to be ranged from 3.5 to 131.4 with mean value of 42.5 mg kg^{-1} indicating that its sufficiency in these soils. The relative high content of Mn in these soils could be due to the soils derived from basaltic parent material which contained higher ferromagnessium minerals. Similar results were reported by Shukla *et al.* (2012) that the DTPA-Fe, Mn and Cu were above the critical levels of 4.5 mg kg^{-1},1.0 mg kg^{-1} and 0.2 mg kg^{-1} in the soil samples. Meena *et al.* (2006) found that the DTPA-Mn content varied from 6.85 to 45.25 mg kg^{-1} with a mean value of 21.56 mg kg^{-1} in soils of Tonk district of Rajasthan. DTPA-Mn showed significant negative correlation with soil pH and EC whereas; it showed a positive correlation with organic carbon in Table 2. However, nosignificant correlation of DTPA-Mn was observed with CEC. Mandavgade *et al*. (2015) reported that the available Mn had significant and positive correlationship with EC (r = 0.159*) and organic carbon (r = 0.028).

Copper:

In case of DTPA-Cu content, it was ranged from 2.7to 36.7 mg kg^{-1} with mean value of 7.5 mg kg^{-1} indicating its sufficiency in these soils. The higher amount of DTPA-Cu in surface layer might be due to higher biological activities and chelating effect (Kadao *et al*., 2002). DTPA-Cu showed significant negative correlation with soil pH and EC and positive correlation with organic carbon content in Table 2. However, no significant relationship of DTPA-Cu was found with CEC. Srivastava *et al.* (2014) reported similar findings that available Cu was negatively correlated with pH and EC and positive correlation with organic carbon and silt content.

Zinc:

The DTPA-Zn content in the soils varied from 0.16 to 1.90 mg kg^{-1} with mean value of 0.70 mg kg^{-1} indicating Zn deficiency in these soils. This low content of DTPA-Zn in these soils might be due to fact that under alkaline conditions, the zinc cations are changed largely to their oxides or hydroxides and thereby lower the availability of zinc. The similar results were also reported by Srivastava *et al.* (2014) that Zn was found deficient in 62 per cent of the samples against critical level 0.6 mg kg^{-1}. DTPA-Zn had negative correlation with soil pH and positively correlated with organic carbon in Table 2. Katkar *et al.* (2013) also reported similar findings that Zn had negative and significant correlation with soil pH (r = -0.20**). However, no significant relationship of

DTPA-Zn was found with EC and CEC.

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