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Research Paper

Assessment of Micronutrient Indices in Soils of AmbajogaiTahsil of Beed District under Semiarid Agro ecological Region (Maharashtra)

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ABSTRACT:- The present investigation was carried out for assessment of micronutrient indices in Vertisol, Inceptisol and Entisol of Ambajogaitahsil of Beed district. For this purpose 140 representative soil samples were collected from different villages of Ambajogaitahsil. These soil samples were analyzed for soil properties and micronutrient fertility status of soil. The soils under the study were neutral to alkaline in reaction, safe in limit of electrical conductivity and moderately calcareous to calcareous in nature. However, DTPA-Cu was recorded in high quantity, while DTPA-Fe, DTPA-Mn, and DTPA-Zn were ranged from low to high. The organic carbon showed positive and significant correlation with DTPA-extractable micronutrients (Zn, Fe, Mn& Cu), whereas pH and $CaCO_3$ showed negative and significant correlation with DTPA-extractable micronutrients. According to nutrient index value of the soils of Ambajogaitahsil were found in low category for available Zn, while high with respect to available Cu and medium inDTPA-Fe and DTPA-Mn.

***Keywords*:-** Soil fertility, Soil Nutrient Index, Zn, Fe, Mn, Cu.

I. INTRODUCTION

Management of plant nutrients is largely governed by their status in the soil. Analysis of more than 3 lakhs soil samples carried out under the aegis of All India Co-ordinated Project on Micro and Secondary nutrients and pollutant elements in soil and plants of the ICAR showed that about 44, 33, 13, 15, 6 and 8 per cent soil are deficient in Zn, B, Mo, Fe, Mn and Cu, respectively. Micronutrient deficiencies that appear to be localized at present era may expand geographically in the near future posing threat to the production system (Bhuyan*et al*., 2014). As such it is important to estimate and monitor the micronutrient status/deficiencies in different agroecological regions to forecast potential micronutrient problems in order to evaluating fertility status of different soil crop situation. Under the study area soils are developed from basaltic and metamorphic rocks of varying geological age and also on alluvium derived from such rocks. These soils are scientifically known as "Mixed Montmorillonitic Hyperthermic Typic Chromostert". 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 to know the micronutrient indices and its fertility status in soils ofAmbajogaiTahsil of Beed district.

II. MATERIALS AND METHODS

The study area of AmbajogaiTahsil of Beed district is located between 18^0 28' to 19^0 28' North altitude and 74^0 54' to 76^0 57' East latitude. The geographical area of the district is 10615.3 sq. km and it is 3.44 per cent of Maharashtra state. The annual rainfall of this district is in between 458 mm and 814 mm. The maximum and minimum temperature of this district is 40.40^0 C and 17.68^0 C, respectively. The elevation is 530 m from mean sea level. Beed is located on the Deccan Plateau of south central Maharashtra, on the banks of `Bendsura` a sub-tributary of Godavari River. It is situated in the ranges of Balaghat.The study area comes under zone of assured rainfall zone where tropical climatic conditions often exists (Hot Dry Sub humid Agro ecological Region). In order to studies on assessment of micronutrient indices in soils of AmbajogaiTahsil of Beed District, one hundred and twenty five, representative surface (0-20 cm) soil samples were collected, passed through <2 mm sieve and stored in properly labeled plastic bags. The soil pH, EC and organic carbonwere estimated by the standard procedures as described by Jackson (1973). The micronutrients in these soil samples were extracted with DTPA solution (Lindsey and Norvell, 1978). The soil nutrient index was calculated according to the

procedure given by Parker (1951). The whole data was subjected to statistical analysis by the method described by Panse and Sukhatme (1985).

III. RESULT AND DISSCUSSION

Chemical properties

Optimization of soil properties is an emerging selected study area investigation presented in Table (1) indicated that all the soil samples from AmbajogaiTahsil were moderately alkaline in soil reaction (100 %) and within safe limit of electrical conductivity (100 %). The pH value of Vertisols, Inceptisols and Entisols varied from 6.99 to 8.89, 7.11 to 8.77 and 7.01 to 8.60 respectively, which indicated that these soils are neutral to alkaline in reaction, whereas EC of soil were ranged from 0.100 to 0.652, 0.104 to 0.556 and 0.105 to 0.370 dSm^{-1} respectively, which were categorized as normal. It may be due to formation of these soils from basaltic parent material rich in basic cations. Similar findings were reported by Jibhakate*et al*. (2009). The organic carbon in Vertisols, Inceptisols and Entisols ranged from 1.30 to 19.90, 1.40 to 16.00 and 1.40 to 11.40 g kg^{-1} with a mean value 5.00, 4.50 and 3.80 g kg^{-1}. The organic carbon ranges from low to high in different orders. It indicates that majority of these soils were low to moderately high in organic carbon content. This might be due to increased rate of decomposition of organic matter as concluded by Rashmi*et al*. (2009). The $CaCO_3$ of Vertisols, Inceptisols and Entisols varied from 35 to 154, 36 to 148 and 38 to 114 g kg^{-1} with a mean value 95.50, 92.90, 80.80 g kg^{-1}, respectively. The majority of soils were categorized as calcareous in nature. However, DTPA-Fe in the Vertisols, Inceptisols and Entisols of Ambajogaitahsil was ranged from 1.14 to 10.46, 0.64 to 9.54 and 0.26 to 9.46 mg kg^{-1} with a mean value 4.57, 4.60, 4.21 mg kg^{-1} in Vertisols, Inceptisols and Entisols, respectively. DTPA-Mn in the soils of Ambajogaitahsilwere ranged from 1.09 to 13.07, 1.02 to 11.46 and 1.24 to 12.18 mg kg^{-1} with a mean value 5.82, 5.08, 4.32 mg kg^{-1} in Vertisols, Inceptisols and Entisols, respectively. DTPA-Zn in the soils of Ambajogaitahsil were ranged from 0.11 to 1.82, 0.12 to 1.98 and 0.10 to 2.34 mg kg^{-1} with an average of 0.62, 0.42, 0.58 mg kg^{-1} in Vertisols, Inceptisols and Entisols, respectively. DTPA-Fe, Mn, Zn content in the soils of Ambajogaitahsilwere categorized as low to high. DTPA-Cu in Vertisol, Inceptisol and Entisol were ranged from 1.80 to 7.86, 1.32 to 7.84 and 1.26 to 6.90 mg kg^{-1} with a mean value 3.64, 3.41, 3.30 mg kg^{-1}, respectively. All the soil samples of three orders were showed high DTPA-Cu content. Similar results were reported by Mahesh Kumar *et al.* (2011) and Murthy *et al.* (2005).

Table 1. Range and average value of soil site characteristics

Soil order	pH	EC (dSm^{-1})	O.C. (%)	$CaCO_3$ (%)	DTPA-Fe (mg kg^{-1})	DTPA-Mn (mg kg^{-1})	DTPA-Zn (mg kg^{-1})	DTPA-Cu (mg kg^{-1})
Vertisol	6.99-8.89 (8.20)	0.100-0.652 (0.278)	1.30-19.9 (5.0)	35.0-154 (95.5)	1.14-10.46 (4.57)	1.09-13.07 (5.82)	0.11-1.82 (0.62)	1.80-7.86 (3.64)
Inceptisol	7.11-8.77 (7.97)	0.104-0.556 (0.234)	1.40-16.0 (4.5)	36.0-148 (92.9)	0.64-9.54 (4.60)	1.02-11.46 (5.08)	0.12-1.98 (0.42)	1.32-7.84 (3.41)
Entisol	7.01-8.60 (7.90)	0.105-0.370 (0.195)	1.40-11.4 (3.8)	38.0-114 (80.8)	0.26-9.46 (4.21)	1.24-12.18 (4.32)	0.10-2.34 (0.58)	1.26-6.90 (3.30)

Parenthesis "( )" indicates average mean value

Soil Nutrient Index Value

The DTPA-Zn was found low in soils, while high with respect to available Cu, whereas medium for DTPA-Fe, and DTPA-Mn. According toRamamoorthy and Bajaj (1969) who developed the nutrient index value (NIV) for soils of Vertisol, Inceptisol and Entisol from different villages of AmbajogaiTahsil of Beed District represents low fertility status (Table 2). The nutrient index values of Fe, Mn, Zn and Cu were 2.11, 2.24, 1.36 and 3.00 respectively, against the fertility index values < 1.67 for low, 1.67 to 2.33 for medium and > 2.33 for high fertility status of soils of Ambajogaitahsil.

Table 2. Nutrient index value (NIV) of Ambajogaitahsil of Beed district

Sr No.	Nutrient	NIV	Category
1	Available Fe	2.11	Medium
2	Available Mn	2.24	Medium
3	Available Zn	1.36	Low
4	Available Cu	3.00	High

Correlation coefficient

The overall correlation studies between physicochemical properties and available micronutrients in Vertisol are presented in Table (3). In Vertisol pH showed negative and significant correlation with DTPA-Fe, DTPA-Mn, DTPA-Zn and DTPA-Cu which is evident by 'r' values of -0.281*, -0.292*, -0.284* and -0.286*, respectively. The EC of Vertisols could not established any correlation with DTPA-Fe, DTPA-Mn, DTPA-Zn and DTPA-Cu. Organic carbon showed positive relationship with DTPA-Fe, DTPA-Mn, DTPA-Zn and DTPA-Cu which is evident by 'r' values of 0.292*, 0.298*, 0.288* and 0.287*, respectively. Further, it was indicated that $CaCO_3$ was negatively and significantly correlated with DTPA-Fe (-0.282*), DTPA-Zn (-0.312*) and DTPA-Cu (-0.314*). However, the effect of $CaCO_3$ with DTPA-Mn did not reach to the level of significance. However in Inceptisol (Table 4), pH of soil was noted negatively and significantly correlated with DTPA-Fe, Mn, Zn and Cu, which is evident by 'r' values of -0.293*, -0.294*, -0.288* and -0.292*, respectively. This might be due to organic carbon forms soluble complexes with micronutrients which subsequently become available to plants (Shah and Andrabi, 2010). The EC of Inceptisols did not show any correlation with available nutrients and DTPA extractable micronutrients. Further, it was indicated that organic carbon showed positive and significant correlation with DTPA-extractable Fe, Mn, Zn and Cu which is indicated by 'r' values of 0.330*, 0.342*, 0.338* and 0.345*, respectively.

Table 4. Correlation between chemical properties and micronutrients in Vertisols

Chemical properties	DTPA-Fe	DTPA-Mn	DTPA-Zn	DTPA-Cu
pH	-0.281*	-0.292*	-0.284*	-0.286*
EC	-0.083	-0.091	-0.075	0.027
O.C	0.292*	0.298*	0.288*	0.287*
$CaCO_3$	-0.282*	0.056	-0.312*	-0.314*

*** Significant at p=0.05 level: - 0.273, ** Significant at p=0.01 level : - 0.354**

Table 5. Correlation between chemical properties and micronutrients in Inceptisol

Chemical properties	DTPA-Fe	DTPA-Mn	DTPA-Zn	DTPA-Cu
pH	-0.293*	-0.294*	-0.288*	-0.292*
EC	-0.140	0.075	-0.127	-0.069
O.C	0.330*	0.342*	0.338*	0.345*
$CaCO_3$	-0.322*	-0.297*	-0.293*	-0.331*

*** Significant at p=0.05 level: - 0.273, ** Significant at p=0.01 level: - 0.354**

Table 6. Correlation between chemical properties and micronutrients in Entisols

Chemical properties	DTPA-Fe	DTPA-Mn	DTPA-Zn	DTPA-Cu
pH	-0.358*	-0.346*	-0.383*	0.359*
EC	-0.091	0.026	-0.293	-0.064
O.C	0.356*	0.335*	0.385*	0.419**
$CaCO_3$	-0.339*	-0.059	-0.333*	-0.253

*** Significant at p=0.05 level : - 0.325, ** Significant at p=0.01 level : - 0.418**

However, $CaCO_3$ of soil was negatively and significantly correlated with DTPA-extractable Fe, Mn, Zn and Cu which is evident by 'r' values of -0.322*, -0.297*, -0.293* and -0.331*, respectively. In Entisol (Table 5), pH was significantly and positively correlated with DTPA-extractable micronutrients. The EC of Entisols did not reach to the level of significance with available nutrients and DTPA-extractable micronutrients. However, organic carbon in Entisols associated positively and significantly with DTPA-extractable Fe, Mn, Zn and Cu which is evident from 'r' values of 0.356*, 0.335*, 0.385* and 0.419**, respectively. Further, $CaCO_3$ showed negative relationship with DTPA extractable Fe and Zn. Which was evident by 'r' values of -0.339* and -0.333*, respectively, while $CaCO_3$ did not show any correlation with other properties. Negative and significant correlation between DTPA-extractable micronutrients and pH and $CaCO_3$ were observed. At higher pH and $CaCO_3$ the soluble metallic cation precipitates chemically and inturn decrease their availability (Jibhakate*et al.* 2009). The whole results indicated that increasing contents of organic carbon in soils resulted increases in availability of nutrients indicated by higher 'r' values. Availability of DTPA-extractable micronutrients in presence of higher content of organic carbon is due to chelation of these metallic cations with humic substances in organic matter (Malewar*et al.* 2004; Mandal*et al.* 2006).

IV. CONCLUSION

The soils of study areas are classified into Vertisols, Inceptisols and Entisols. Almost soil samples pH was observed in alkaline nature and EC was in safe limit for the crop growth. The organic carbon status was found low to high, $CaCO_3$were calcareous in nature. DTPA-Cu was noticed in high quantity, while DTPA-Fe, DTPA-Mn, and DTPA-Zn were ranged from low to high. The organic carbon showed positive and significant correlation with DTPA-extractable micronutrients, whereas pH and $CaCO_3$were significantly and negatively correlated with available nutrients and DTPA-extractable micronutrients. In contrast to deficiency of micronutrients in soil may cause decline in crop yields and total productivity in future. As par the nutrient index value, soil factors such as pH, EC, OC and $CaCO_3$ were contributed lower fertility status in relation to availability of micronutrients. Strategies involving the soil application of micronutrients by seed treatment, foliar sprays or use of organic manures can adopt to sustain an optimum yield potential and enhanced their content in soil.

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