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Status of available micronutrient cations in soils of Aravalli district of Gujarat

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Abstract

A study was undertaken to assess the status of available micronutrient cations in soils of Aravalli district of Gujarat. Total 240 surface (0-15 cm) soil samples were collected from cultivated farmer's fields of 6 talukas of Aravalli district during 2016. The soil samples were analysed for DTPA-extractable micronutrients (Fe, Mn, Zn and Cu). The DTPA-extractable Fe, Mn, Zn and Cu content in these soils ranged from 3.99 to 16.23, 4.77 to 36.54, 0.15 to 2.76 and 0.12 to 2.40 mg/kg with a mean value of 9.27, 13.80, 0.74 and 0.87 mg/kg, respectively. Overall, nutrient index values for available Fe, Mn, Zn and Cu were 2.30, 2.69, 1.84 and 2.73 in soils of Aravalli district which indicates adequate, very high, marginal and very high fertility status, respectively.

Keywords: Fe, Mn, Zn, Cu, Nutrient index

Introduction

Soil is a medium for plant growth and development and its productivity depends on several factors among which soil fertility is a major one showing direct relation with the crop yields, provided other factors are at optimum level. Soil testing is the key to fertility management while reclamation and rehabilitation of degraded lands is strategic to maintain over all soil health. Soil fertility evaluation involves the estimation of the nutrient supplying power of a soil. A proper evaluation of the fertility of a soil before planting a crop helps in adopting appropriate measures to make up for the shortcomings and ensuring a good crop production. The soil must supply micronutrients as a consequence of adoption of high yielding varieties (HYVs) and intensive cropping together with shifting towards high analysis NPK fertilizers has caused decline in the level of micronutrients in the soil to below normal at which productivity of crops cannot be sustained. The improper nutrient status has led to emergence of multinutrient deficiencies in the Indian soils (Sharma, 2008) [8].

Material and Methods

To assess the available micronutrient cations (Fe, Mn, Zn and Cu) content in soils of Aravalli district, total 240 representative surface soil samples were collected from farmer's fields. One representative surface soil sample was collected from field upto a depth of 0 to 15 cm by zig-zag method. Forty soil samples were collected from each 6 talukas of Aravalli district during April-2016. The soil samples were air dried in shade. The soil samples, after air drying were ground with wooden mortar and pestle and passed through 2.0 mm sieve. The prepared soil samples were stored in polyethylene lined cloth bags with proper labels. The soil samples were brought to laboratory for further analysis. DTPA-extractable Fe, Mn, Zn and Cu were determined from soil samples by using Atomic Absorption Spectrophotometer method as suggested by Lindsay and Norvell (1978) [4].

Nutrient index was calculated utilizing the following formula suggested by Parker *et al.* (1951) [5]:

$$\text{Nutrient Index} = \frac{(N_l \times 1) + (N_m \times 2) + (N_h \times 3)}{N_t}$$

Where, N_l , N_m and N_h are the number of samples falling in low, medium and high categories for nutrient status and are given weightage of 1, 2 and 3, respectively. N_t is the total no. of sample. The nutrient index values are rated into various categories *viz.*, very low, low, marginal, adequate, high, and very high as rating given by Stalin *et al.* (2010) [9].

Results and Discussion

DTPA-extractable Fe

Overall available Fe status of soils of Aravalli district was medium. It ranged from 3.99 to 16.23 mg/kg with a mean value of 9.27 mg/kg. Bhiloda taluka soils possess the highest mean value of DTPA-extractable Fe (10.38 mg/kg) followed by that of Modasa (9.64 mg/kg) and Malpur (9.47 mg/kg) talukas (Table 1). The medium Fe content in these soils may be due to presence of minerals like magnetite. Patel *et al.*, (2017) [6] reported similar results for soils of Gandhinagar district.

DTPA-extractable Mn

As a whole, soils of Aravalli district were found high with respect to DTPA-extractable Mn content. It ranged from 4.77 to 36.54 mg/kg with a mean value of 13.80 mg/kg. Soils of Bhiloda taluka have the highest mean value (17.90 mg/kg) followed by Modasa (14.75 mg/kg) and Malpur (13.28 mg/kg) talukas (Table 1). This high status of Mn in soils might be due to less mobility of Mn²⁺ in soils, which might have contributed for the accumulation of reducible and soluble forms of manganese in the surface soils. Similar results were reported for soils of Gandhinagar district (Patel *et al.*, 2017) [6].

DTPA-extractable Zn

The available Zn status of soils of Aravalli district was medium. It ranged from 0.15 to 2.76 mg/kg with a mean value of 0.74 mg/kg. Soils of Bhiloda taluka possess the highest mean value (0.99 mg/kg) of available Zn followed by Bayad (0.88 mg/kg) and Modasa (0.70 mg/kg) talukas (Table 1). Similar results were obtained for soils of Gir Somnath district of Gujarat (Hadiyal *et al.*, 2016) [3].

DTPA-extractable Cu

In general, the available Cu status of soils of Aravalli district was high. The available Cu ranged from 0.12 to 2.40 mg/kg with a mean value of 0.87 mg/kg. The highest mean value of available Cu content was observed in Bhiloda taluka soils (1.05 mg/kg) followed by soils of Modasa (0.91 mg/kg) and

Malpur (0.90 mg/kg) talukas (Table 1). The high status of available Cu in soils of Aravalli district might be due to the application of copper containing chemicals mostly as fungicides. Similar results were also obtained for soils of Banaskantha district (Anonymous, 2012) [1-2] and for Gandhinagar district (Patel *et al.*, 2017) [6].

Table 1: Talukawise range and mean values for available micronutrient cations in soils of Aravalli district

Name of Taluka	Fe (mg/kg)	Mn (mg/kg)	Zn (mg/kg)	Cu (mg/kg)
Modasa	4.12-16.23 (9.64)	6.25-27.59 (14.75)	0.15-2.10 (0.70)	0.16-2.12 (0.91)
Dhansura	4.86-12.10 (8.87)	5.78-21.85 (11.50)	0.18-1.79 (0.62)	0.19-2.22 (0.82)
Bayad	3.99-12.86 (8.90)	5.89-23.65 (13.01)	0.29-2.38 (0.88)	0.17-1.76 (0.81)
Meghraj	4.15-12.89 (8.34)	6.25-21.25 (12.39)	0.19-1.59 (0.59)	0.12-1.98 (0.75)
Malpur	5.21-13.25 (9.47)	4.77-20.56 (13.28)	0.18-1.56 (0.64)	0.24-2.38 (0.90)
Bhiloda	6.98-14.46 (10.38)	7.49-36.54 (17.90)	0.32-2.76 (0.99)	0.35-2.40 (1.05)
District	3.99-16.23 (9.27)	4.77-36.54 (13.80)	0.15-2.76 (0.74)	0.12-2.40 (0.87)

Note: Value in parenthesis indicates mean values

Nutrient index values of available micronutrient cations

The nutrient index values for available micronutrient cations content in soils are presented in Table 2. Overall, nutrient index values for available Fe, Mn, Zn and Cu were 2.30, 2.69, 1.84 and 2.73 in soils of Aravalli district, respectively. Based on overall nutrient index values of soils in Aravalli district and the criteria suggested by Stalin *et al.* (2010) [9], soils of Aravalli district were found in very high categories for available Cu and Mn, adequate for available Fe and marginal for available Zn. Similar results were reported for available Fe and Mn in soils of Amreli district of Gujarat (Polara and Kabaria, 2006) [7], for available Zn and Cu in soils of Patan district of Gujarat (Anonymous, 2013) [2].

Table 2: Talukawise nutrient index values and fertility status of available micronutrient cations in soils of Aravalli district

Name of Taluka	Nutrient index values				Fertility status			
	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
Modasa	2.28	2.73	1.80	2.70	Adequate	Very high	Marginal	Very high
Dhansura	2.18	2.60	1.65	2.73	Adequate	High	Low	Very high
Bayad	2.25	2.65	2.05	2.83	Adequate	High	Adequate	Very high
Meghraj	2.13	2.60	1.65	2.53	Adequate	High	Low	High
Malpur	2.48	2.68	1.73	2.70	High	Very high	Marginal	Very high
Bhiloda	2.53	2.90	2.18	2.93	High	Very high	Adequate	Very high
District	2.30	2.69	1.84	2.73	Adequate	Very high	Marginal	Very high

Conclusion

The soil survey data of Aravalli district clearly indicates that the status of DTPA-extractable Mn and Cu was high while status of DTPA-extractable Fe and Zn was medium. Based on overall nutrient index value in soils of Aravalli district, available Fe, Mn, Zn and Cu were classified in adequate, very high, marginal and very high fertility status, respectively.

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