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

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Abstract
A study was undertaken to assess the status of available micronutrient cations in soils of Kheda district of Gujarat. Total 160 surface (0-15 cm) soil samples were collected from cultivated farmer's fields of 8 talukas of Kheda district during April-May, 2016. The soil samples were analyzed for DTPA-extractable Fe, Mn, Zn and Cu. The DTPA-extractable Fe, Mn, Zn and Cu content in these soils ranged from 2.31 to 17.83, 3.93 to 18.17, 0.24 to 2.08 and 0.14 to 2.02 with their corresponding mean values of 8.02, 10.11, 1.0 and 0.95 mg kg^{-1}, respectively. Overall, nutrient index values for available Fe, Mn, Zn and Cu were 2.02, 2.44, 2.39 and 2.88 in soils of Kheda district which medium in Fe and high fertility of Mn, Zn and Cu status.

Keywords: Soil testing, DTPA-extractable Fe, Mn, Zn Cu and nutrient index

Introduction
The concept of soil quality has evolved since the last decade of the 20^{th} century to answer the growing concern about sustainable soil management. Over exploitation and mismanagement of Soil resources in quest for immediate gains without any regards to long term sustainability of its health have led to adverse alteration in soil properties, environment quality, agricultural productivity and sustainability.

The basic objective of the soil-testing programmer is to give farmers a service leading to better and more economic use of fertilizers and better soil management practices for increasing agricultural production. High crop yields cannot be obtained without applying sufficient fertilizers to overcome existing deficiencies. Soil survey is the process of classifying soil types and other soil properties in given area and geo-encoding such information. The information in a soil survey can be used by farmers and ranchers to help determine whether a particular soil type is suited for crops or livestock and what type of soil management might be required.

Soil fertility is one of the important factors which determines the productivity and profitability of crops and cropping systems in agriculture. In simple terms soil fertility is the ability of the soil to provide all essential nutrients required for plant growth in a proper proportion. In order to achieve higher productivity and profitability, every farmer should realize that fertility levels must be measured as these measurements can be used to manage soil fertility. Soil surveying and mapping provide information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing crop yields. Soil fertility maps are meant for highlighting the nutrient needs, based on fertility status of soils (and adverse soil conditions which need improvement) to realize good crop yields. Obviously, a soil fertility map for a particular area can prove high benefit in guiding the farmers, manufacturers and planners in ascertaining the requirement of various fertilizers in a season/year and making projections for increased requirement based on cropping pattern and intensity.

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) [11].

Material and methods

To assess the available Fe, Mn, Zn and Cu content in soils of Kheda district, total 160 representative surface soil samples were collected from farmer's fields. One representative surface soil sample was collected from field up to a depth of 0 to 15 cm by Zig-Zag method. 20 soil samples were collected from each 8 Talukas of Kheda district during April-May, 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. Nutrient index was calculated utilizing the following formula suggested by Parker *et al*. (1951) [6].

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

Where, Nl, Nm and Nh 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. Nt is the total number 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) [15].

Results and discussion

DTPA-extractable Fe

The overall Fe status of the soils of Kheda district was medium (Table 1.0). It was ranged from 2.31 to 17.83 mg kg^{-1} with mean value of 8.02 mg kg^{-1}. Soils of Matar Taluka recorded the highest mean value of DTPA extractable Fe (11.61 mg kg^{-1}) followed by that of Kheda (9.53 mg kg^{-1}) and Mehmedabad (8.83 mg kg^{-1}) Talukas, whereas, the lowest mean value (5.32 mg kg^{-1}) of DTPA extractable Fe was found in the soils of Kapadvanj Talukas. About 28.12, 41.87 and 30 per cent samples rated as low, medium and high in DTPA-Fe status, respectively (Table 2.0). Similar results were also reported for villages of northern Madhya Pradesh by Rajput *et al*. (2015) [10], Hadiyal *et al*. (2016) [2] for Girgadhda and Una talukas of Gir Somanth district, Karajanagi *et al*. (2016) [3] for Malaprabha command area of Karnataka, for Patan district by Patel *et al*. (2016) [8], Wagh *et al*. (2016) [18] for Nagpur district of Maharashtra.

Table 1: Taluka wise range and mean values for available micronutrient cations in soils of Kheda district

Name of Taluka	Fe	Mn	Zn	Cu
	(mg/kg)			
Nadiad	3.87-14.25 (7.62)	5.75-15.24 (9.39)	0.46-1.89 (1.04)	0.89-1.82 (1.25)
Mahudha	3.23-15.12 (8.09)	5.05-18.17 (12.77)	0.58-1.96 (1.38)	0.58-1.74 (1.16)
Matar	4.49-17.83 (11.61)	4.15-14.56 (9.05)	0.40-2.08 (1.10)	0.56-1.76 (1.13)
Kheda	2.45-14.56 (9.53)	3.93-13.67 (8.30)	0.38-1.94 (1.17)	0.76-1.50 (1.11)
Kapadvanj	3.33-12.23 (5.32)	4.99-15.45 (10.85)	0.52-1.45 (0.91)	0.14-1.14 (0.47)
Thasra	2.31-14.56 (5.90)	4.55-15.07 (10.17)	0.34-1.78 (0.82)	0.30-2.02 (0.91)
Mehmedabad	3.25-15.97 (8.83)	4.33-14.71 (9.71)	0.32-1.56 (0.79)	0.36-1.80 (0.99)
Kathlal	3.99-13.19 (7.26)	4.93-14.75 (10.63)	0.24-1.72 (0.75)	0.22-1.04 (0.60)
District	2.31-17.83 (8.02)	3.93-18.17 (10.11)	0.24-2.08 (1.00)	0.14-2.02 (0.95)

Note: Value in parenthesis indicates mean values

DTPA Extractable Mn

The soils of Kheda district were ranged from 3.93 to 18.17 mg kg^{-1}with mean value of 10.11 mg kg^{-1} in case of DTPA-Mn (Table 1.0). The soils of Mahudha taluka had highest mean value (12.77 mg kg^{-1}) followed by Kapadvanj (10.85 mg kg^{-1}) and Kathlal (10.63 mg kg^{-1}) talukas. The lowest mean value (8.30 mg kg^{-1}) was observed in Kheda taluka. About 6.87, 42.50 and 50.62 per cent samples rated as low, medium and high in DTPA-Mn status, respectively (Table 2.0). Similar results were also reported for for villages of northern Madhya Pradesh by Rajput *et al*. (2015) [10], Hadiyal *et al*. (2016) [2] for Girgadhda and Una talukas of Gir Somanth district, Karajanagi *et al*. (2016) [3] for Malaprabha command area of Karnataka, for Patan district by Patel *et al*. (2016) [7], Wagh *et al*. (2016) [18] for Nagpur district of Maharashtra.

DTPA Extractable Zn

The DTPA-Zn status of the soils of Kheda district was medium. It was ranged from 0.24 to 2.08 mg kg^{-1} with a mean value of 1.0 mg kg^{-1}. Mahudha Taluka soils had highest mean value (1.38 mg kg^{-1}) of DTPA-Zn followed by Kheda (1.17 mg kg^{-1}) and Matar (1.10 mg kg^{-1}) Talukas. Soils of Kathlal Taluka had the lowest mean value (0.75 mg kg^{-1}) for DTPA-Zn status (Table 1.0). About 7.5, 46.25 and 46.25 per cent soil samples were categorized as low, medium and high in DTPA-Zn status, respectively (Table 2.0). Similar results were also reported for Coastal Region of Kutch district by Patel *et al*. (2012) [8], by Srinivasan and Poongothai (2013) [14] for villages of Tittakudi taluka of Tamil Nadu, by Verma *et al*. (2013) [17] for Malkharauda block of Janjgir Champa district, Singh *et al*. (2014) [12] for Chambal region of Madhya Pradesh, by Kumar (2015) [4] for Saharsa district of Bihar.

DTPA Extractable Cu

In general, the DTPA-Cu status of the soils of Kheda district was high (Table 1.0). The DTPA-Cu ranged from 0.14 to 2.02 mg kg^{-1} with mean value of 0.95 mg kg^{-1}. The highest mean value of DTPA-Cu was observed in Nadiad (1.25 mg kg^{-1}) followed by soils of Mahudha (1.16 mg kg^{-1}) and Matar (1.13 mg kg^{-1}) talukas. The lowest mean value was registered in Kapadvanj taluka (0.47 mg kg^{-1}). About 0.62, 10.62 and 88.75 per cent samples were found in low, medium and high categories of DTPA-Cu, respectively (Table 2.0). Results reported in present investigation find supports from the work reported elsewhere for villages of northern Madhya Pradesh by Rajput *et al*. (2015) [10], Hadiyal *et al*. (2016) [2] for Girgadhda and Una talukas of Gir Somanth district, Karajanagi *et al*. (2016) [3] for Malaprabha command area of Karnataka, for Patan district by Patel *et al*. (2016) [7], Wagh *et al*. (2016) [18] for Nagpur district of Maharashtra.

Table 2: Taluka wise nutrient index values and fertility status of available micronutrient cations in soils of Kheda district

Name of taluka	Nutrient index values				Fertility status			
	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
Nadiad	1.90	2.35	2.50	3.00	Medium	High	High	High
Mahudha	2.05	2.85	2.95	3.00	Medium	High	High	High
Matar	2.55	2.25	2.40	3.00	High	Medium	High	High
Kheda	2.35	2.15	2.65	3.00	High	Medium	High	High
Kapadvanj	1.50	2.50	2.35	2.50	Low	High	High	High
Thasra	1.65	2.45	2.10	2.90	Low	High	High	High
Mehmedabad	2.20	2.45	2.05	2.95	Medium	High	High	High
Kathlal	1.95	2.50	2.10	2.70	Medium	High	High	High
District	2.02	2.44	2..39	2.88	Medium	High	High	High

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 2.02, 2.44, 2.39 and 2.88 in soils of Kheda district, respectively. Based on overall nutrient index values of soils in Kheda district and the criteria suggested by Stalin *et al*. (2010) [15], soils of Kheda district were found in medium categories for available Fe, whereas high categories for Mn, Zn and Cu. Similar results were reported for available Fe and Mn in soils of Amreli district of Gujarat (Polara and Kabaria, 2006) [9], for available Zn and Cu in soils of Patan district of Gujarat (Anonymous, 2013) [1].

Conclusion

The soil survey data of Kheda district clearly indicates that the status of available iron was medium, whereas the available manganese, zinc and copper were high. Based on overall nutrient index value in soils of Kheda district, available Fe was medium, Mn, Zn and Cu were classified in high fertility status.

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