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Status of Micronutrients in Soils of Nanded District, Maharashtra, India.

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Abstract:

Soil fertility determines crop growth productivity and consequently affects quality and sustainability. Micronutrients are essential for plant growth and development but it is needed in very small quantities in the plant system. Significance of micronutrient is unavoidable since plant relies primarily on micronutrient as it has profound influence on various plant activities. Although micronutrients are abundantly present in the soil but plants usually acquire them in relatively trace amounts, therefore known as tracer element. It includes Cu, Fe, Mn, Zn, S and B. In present study, soil samples collected from different locations and analysed for their micro nutrients. The evaluation of micronutrients analysis shows that most of soil parameter are not fulfilled to desired level and found to low fertility. Hence it is suggested that soil samples must be enriched with nutrient by organic manure or chemical fertilizers treatment to acquire optimum nutritional needs.

Keywords: Micronutrients, agriculture, soil, chemical fertilizers.

Introduction:

Soil may be defined as, "the natural medium for the growth of land plants on the surface of the earth composed of organic and mineral materials" [1]. Plant nutrition management in commercial crops through the application of macro and micronutrients is essential not only for achieving high yields but also for fulfilling market requirements for high quality end-products [2]. Common nutrition practices focus on the application of macronutrients through synthetic fertilizers without considering micronutrients [3]. In addition, it is not uncommon the irrational use of excessive fertilizer rates which may result in soil and/or ground water contamination and phytotoxicity. Population growth and living standards have increased requirements for food supply, and as a result, farmers are encouraged to intensive crop cultivation. Using the same soil continuously for the cultivation of the same crops causes nutrient depletion [4].

The optimal contents of macro and micronutrients in agricultural soil determine crop growth, quality, and productivity. The growth and development process of the plants require the optimal amount of Nitrogen as an irreplaceable nutrient, while Phosphorus, Carbon, Sulphur, Calcium, Potassium, and Magnesium also play roles in the same process [5]. Eight elements are known as micronutrients; namely B, Cl, Fe, Mn, Ni, Cu, Mo, and Zn, and maintain the ecosystem, quality, and yield of crop production. The Nanded region is characterized by intensive agricultural cultivation. There have been no previous studies on the contents and distribution of micronutrients in agricultural soils. The objectives of this study were analysis of micronutrient contents, fertility evaluation based on micronutrient contents.

Material and Method:

The site of study includes farmer's field in ten villages of Nanded district 19.2410° North latitude and 77.2205° East longitudes of Maharashtra. The main economic activity in the studied region is agriculture. The most cultivated crops are turmeric, sugarcane, banana, soyabean, cotton, wheat, etc.

The soil samples were collected in the summer season, before planting crops to avoid the effect of fertilization during crop cultivation. Soil samples were collected from different depth at ten villages near Nanded region. These samples were dried at room temperature and grind in powder form and analysed in the laboratory for the micronutrient analysis. The soil samples were collected from 0-15 cm deep and code them as S1, S2, S3, S4, S5, S6, S7, S8, S9 and S10 respectively. The soil samples were dried in oven at 45^0 C and passed through ~2 mm mesh sieve and stored in polythene bags [6].

Table 1. Micronutrient Contents in the analysed soil from the Study Area.

Sample No.	Cu (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	Zn (mg/kg)	S (mg/kg)	B (mg/kg)
S1	4.4	1.0	2.7	1.8	90.7	1.6
S2	0.1	0.2	0.4	0.6	89.1	0.6
S3	0.8	0.2	1.7	1.6	171	4.4
S4	0.9	0.4	0.6	0.4	32	0.6
S5	0.2	0.4	12.6	1.7	48.4	2.2
S6	1.7	2.8	1.1	1.4	44.4	2.2
S7	0.1	0.8	0.3	0.8	64	3.5
S8	1.6	0.6	0.4	1.1	64.1	8.6
S9	0.1	0.3	17.7	0.8	68	1.9
S10	0.5	3.7	1.33	3.8	12	0.55

Results and Discussion:

Micronutrients are required in lower amounts but are extremely vital for plant growth as compared to macronutrients. Crops grown in most soils in India suffer from deficiencies of one or more micronutrients, even though the soils often contain apparently adequate total amounts of the respective elements.

Copper is involved in several enzyme systems, cell wall formation, electron transport and oxidation reactions. Solubility and plant availability of Cu is highly dependent on soil pH [7]. The value of copper nutrient was found to be ranged from (0.1 to 4.4 mg/kg) in different soil samples (Table. 1). Sample S2, S5, S7 and S9 shows Cu deficiency, so there is need of HCL-Cu 4kg/acre. The deficiency of copper shows leaves including veins become yellow and tending towards whiteness occurrence of marginal leaf burning, whereas excess copper shows Fe deficiency may be induced with very slow growth. Roots may be stunted.

Iron is a central component of electron chains and a co-factor of many vital enzymes [8]. It is essential micronutrient for optimum growth and yield of crop. Iron (Fe) is catalyst to chlorophyll formation in plant cells. It serves as an activator for biochemical processes such as respiration, photosynthesis and symbiotic nitrogen fixation [9]. Insufficient iron uptake causes retarded growth, interveinal chlorosis. For proper functioning of various activities Fe ranges from 25 to 45 mg/kg. Soil samples from our region are too much iron deficient, so iron rich fertilizers are required like Iron Sulphate around 40kg/acre.

Manganese is an essential element for plants, intervening in several metabolic processes, mainly in photosynthesis and as an enzyme antioxidant-cofactor. Manganese (Mn) availability in soils is determined by various factors like organic matter, pH, CaCO3, and redox conditions. Flooded conditions cause higher valent forms of Mn like MnO_2, Mn_2O_3 and Mn_3O_4 to get reduced to Mn^{2+} form which is accessible to plants [10]. The content of Mn in soils varied from 0.3 to 17.7 mg kg^{-1}. Considering critical limits >10mg/kg, most of our soil samples are Mn deficient except S5 and S9. Mn content can be increased by addition of Mang. sulphate-50kg/acre. Green manuring is another way to upsurge the Mn availability in soils.

Zinc is an essential mineral that is involved in multiple aspects of cellular metabolism [11]. Zinc is required for the activity of more than 200 enzymes, and it is critical for immune system function, cell division, and protein and DNA synthesis. It is important micronutrient of soil required for catalysis of different enzymes like aldolases, carbonic anhydrase. It is required for protein synthesis and auxin production. The concentration of zinc in samples under study occurs in the range of 0.4 to 3.8 mg kg^{-1}. All the soil samples under study found to be zinc deficient. Inorganic Zn deficiency can be corrected fairly easily by the soil application of zinc salts such as $ZnSO_4$.

Sulphur is one of the essential elements required by all living organisms, including plants. Sulphur is a constituent of the proteinaceous amino acids such as methionine and cysteine, glutathione, vitamins. Breakdown or decomposition of organic matter results in mineralization of organic sulphur into the SO_4^{2-}, which will be available to plants [12]. Apart from the organic matter, various minerals inside the soil also consist of a different sulphur form. Hence, breaking down or weathering these minerals results in transforming a part of sulphur into sulphate [13] The analysed soil showed sufficient level of S content except S10 which requires Gypsum around 120 kg/acre.

Boron functions in plants in differentiation of meristem cells. It performs many important functions in plants and is mainly involved in cell wall synthesis and structural integration. B influences the availability and uptake of other plant nutrients from the soil [14]. Additionally, this element is involved in nucleic acid synthesis, phenolic metabolism, carbohydrate biosynthesis and translocation, pollen tube growth [15]. Boron level is sufficient in collected soil samples of our region.

Conclusion:

The obtained results from soil samples in the Nanded region indicate lack of micronutrients. Screening of micronutrient efficient crops and their cultivation should be done on a priority basis, and more importantly, nutrient efficient crop rotations should be recommended to farmers of the State, particularly those on deficient soils. Systematic studies to monitor micronutrient deficiencies in different crop rotations and soils should be carried out using GIS. Increases in crop yields from application of micronutrients have been reported in many parts of the world.

Thus, analysis of these soil samples gives information about its nature and fertility status. Available S, Fe, Cu, Zn, Mn and B increased with increasing level of organic carbon. Available Fe, Cu, Zn, Mn, B decreased with increasing value of $CaCO_3$ content in soil. Based on good practices of agricultural management, recommended the addition of fertilizers rich in N and P as well as the addition of micronutrients to achieve their optimal balance for sustainable agricultural development in this region.

References:

1. Carmelo Dazzi, Giuseppe Lo Papa, A new definition of soil to promote soil awareness, sustainability, security and governance, *International Soil and Water Conservation Research*,**2022**,*10*,1, 99-108.
2. Sarwar, N., Saifullah, Malhi, S.S., Zia, M.H., Naeem, A., Bibi, S. and Farid, G. Role of mineral nutrition in minimizing cadmium accumulation by plants. *J. Sci. Food Agric.* **2010***, 90*, 925-937.
3. Baldantoni, Daniela. Assessment of macro and microelement accumulation capability of two aquatic plants. *Environmental Pollution*. **2004,** *130*. 149-156.
4. Coulibaly, Brahima & Li, Shixiang, Impact of Agricultural Land Loss on Rural Livelihoods in Peri-Urban Areas: Empirical Evidence from Sebougou, Mali. *Land*.**2020**, *9*, 470.
5. Hak-Jin Kim, Kenneth A. Sudduth and John W. Hummel , Soil macronutrient sensing for precision agriculture, *J. Environ. Monit.*, **2009**,*11*, 1810-1824.
6. Shehu, Bello & Merckx, Roel & Tijjani Aliyu, Kamaluddin & Kamara, Alpha & Rurinda, Jairos & Craufurd, Peter & Garba, Ismail & Jibrin, Jibrin M. & Adam, Adam Muhammad, Compositional nutrient diagnosis and associated yield predictions in maize: A case study in the northern Guinea savanna of Nigeria. *Soil Sci Soc Am J.* **2022**, *87*,1-19.
7. Oorts, K. Copper. In: Alloway, B. (eds) *Heavy Metals in Soils. Environmental Pollution*, **2013**,22.
8. Liu Y, Xiong Z, Wu W, Ling H-Q, Kong D. Iron in the Symbiosis of Plants and Microorganisms. *Plants*. **2023**; 12(10),1958.
9. Reddy, B. V. and Khanna, S. N, Self-Stimulated NO Reduction and CO Oxidation by Iron Oxide Clusters, *Phys. Rev. Lett*. **2004**,*63*, 9, 068301.
10. F.N. Ponnamperuma, The Chemistry of Submerged Soils, *Advances in Agronomy*, **1972**, *24*, 29-96.
11. Christos Noulas, Miltiadis Tziouvalekas, Theodore Karyotis, Zinc in soils, water and food crops, *J Trace Elem Med Biol*. **2018**, *49*, 252-260.
12. Blum SC, Lehmann J, Solomon D, Caires EF, Alleoni LR. Sulfur forms in organic substrates affecting S mineralization in soil. *Geoderma*. **2013**,200,156–164.
13. Uroz S, Calvaruso C, Turpault MP, Frey-Klett P. Mineral weathering by bacteria: ecology, actors and mechanisms. Trends Microbiol. **2009**;*17*(8),378–387.
14. Shireen F, Nawaz MA, Chen C, Zhang Q, Zheng Z, Sohail H, Sun J, Cao H, Huang Y, Bie Z. Boron: Functions and Approaches to Enhance Its Availability in Plants for Sustainable Agriculture. *Int J Mol Sci*. **2018**,*24*,(7),1856.
15. Landi, M., Margaritopoulou, T., Papadakis, I. E., and Araniti, F.Boron toxicity in higher plants: an uptade. *Planta,* **2019**,*250*, 1011–1032.