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Nutrient status in Soils of Chittoor district of Andhra Pradesh

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ABSTRACT

Soil fertility mapping with specific reference to micronutrients and sulphur was carried out by analyzing 576 geo-referenced soils collected from 64 mandals of Chittoor district of Andhra Pradesh. The available phosphorus content was found to be in the range of 11 to 239 kg ha^{-1} and indicated that their fertility class was medium and high in 21 and 79 per cent soils, respectively. The Nutrient Index (NI) value for available phosphorus (2.66) indicated that it was high. Potassium availability was found to be low in 4, medium in 42 and high in 54 per cent of soils of Chittoor with a NI value of 2.49 (high). The sulphur deficiency in the district's soils was found to be 18 per cent and boron in 21% samples. Among individual nutrients, the soils of Chittoor were found to be deficient in available zinc to an extent of 33 per cent and boron in 21% samples. The iron deficiency in the district was found to be 19 per cent followed by copper in 4 and manganese in 2.6 per cent of samples. The sulphur deficiency in the district's soils was found to be 18 per cent.

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INTRODUCTION

The sustainable productivity of a soil mainly depends upon its ability to supply essential nutrients to the crop. The deficiency of micronutrients has become a major constraint in optimizing crop productivity and soil sustainability (1, 2). The availability of micronutrients in soil is dependent on the parent material, pedogenic process and soil management which may promote, in some cases a reduction of cationic micronutrients content (9). Reduction in native levels of micronutrients in soils due to continuous shipping away of micronutrients without replenishment has been a cause of concern for all the stakeholders. It is well known that optimum plant growth and crop yields depend upon plant available micronutrients to the
crop not on their total concentration. In the former state of Andhra Pradesh (which was re-organised in 2014 as Telangana and residuary Andhra Pradesh states), such work was taken up in 10 districts (Ramana Reddy *et al.*, 2013) and the efforts are being made to complete the left over work in the newly re-organised two states .

MATERIALS AND METHODS

Soil Sampling, Analysis and Preparation of Deficiency Maps

The methodology adopted was, about 7 to 10 soil samples were collected from each *mandal*. The samples were collected from cultivated lands on grid basis; as a result, the spatial coverage of survey area will be more. Accordingly, 576 soil samples were collected from 64 *mandals* of 66 *mandals* present in the district. The depth of the soil sampling was 0-15 cm. The soil samples collected were processed and analysed for P^{H}, EC and OC. Nutrient index value calculated from the proportion of soils under low, medium and high available nutrient categories, as represented by

$$NIV= \frac{[(P_H*3)+ (P_M*2)+ (P_L*1)]}{100}$$

The index values are rated in to various categories viz., high (>2.33), medium (1.66 - 2.33) and low (<1.66) for fertility rating [Ramamurthy and Bajaj 1969]. Simple correlations were carried out between the soil available micronutrients and soil properties to determine the relationship between these parameters using standard procedures at central computer facility of the university using in built software.

Available phosphorus

The available phosphorus in soil samples was extracted by Olsen's method and was estimated by colorimeter method and is expressed as kg P_2O_5 ha^{-1}. The P content in the extract was colorimtrically (Model ECIL GS5701 SS) determined as per procedure given by Watanabe and Olsen (1965) using ascorbic acid.

Available potassium

The available potassium in soil samples was determined by neutral normal ammonium acetate method using flame photometer (Jackson, 1973) and expressed as kg K_2O ha^{-1}.

Available sulphur

The available sulphur in soil samples was extracted with 0.15% $CaCl_2$ solution (Williams and Steinbergs, 1961). Five grams of soil was shaken with 25ml of 0.15% $CaCl_2$ for 30 minutes in a shaker. The extract was filtered through Whatman no.42 filter paper and the sulphur was determined by turbidometric method and the absorbance of this solution was read by using spectrophotometer at 420 nm (Chesnin and Yien, 1950) and expressed as mg kg^{-1}

Available boron

It was determined following the method of Berger and Troug (1945) and details are presented below;
Azomethine-H was prepared by dissolving 0.45 g of Azomethine-H in 100 ml of 1 per cent ascorbic acid. The buffer solution was prepared by dissolving 250 g of ammonium acetate and 15 g of Di-Sodium salt of EDTA (Ethylene Diamine Tetra Acetic acid) in 400 ml of double distilled water. All the reagents were dissolved and 125 ml of acetic acid was added to the solution and mixed thoroughly (Bingham, 1982).

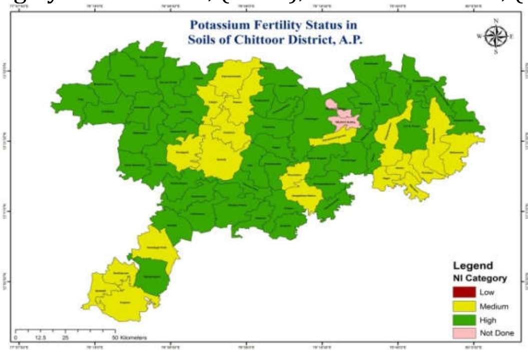
DTPA extractable micronutrients (Zn, Fe, Mn and Cu)

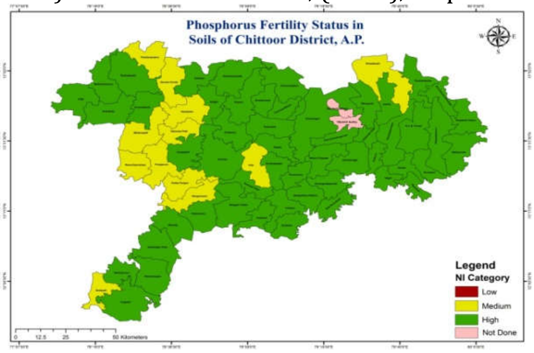
The available Zn, Fe, Mn and Cu of soils were determined following the method given by Lindsay and Norvell, 1978. The details in brief are given below
One liter of DTPA extracting solution was prepared by dissolving 1.967 g DTPA (AR grade) and 1.47 g of $CaC1_2$ in seperate beakers, pour it in one litre volumetric flask, then 20 to 25 ml of double distilled water was added followed by 13.1 ml of TEA buffer and 100 ml of double distilled water. It was allowed to stand for some time for the DTPA to dissolve and diluted to approximately 900 ml. The pH was adjusted to 7.3 ± 0.5 using 1:1 HCl and was made up to 1liter.

Results and Discussion

Available Phosphorus (kg ha^{-1})

The data presented in table 4.3 indicated that the available phosphorus status of soils of Chittoor district ranged from 11 to 239 kg ha^{-1} with mean of 73 kg ha^{-1}. As per phosphorus fertility ratings given by Muhr *et al* (1965), the extent of soils in Chittoor district falling under low, medium and high category was 9, 17 and 74 per cent, respectively. Such build up in available phosphorus was also noticed in the soils of Amritsar district of Punjab, Haveri district of Karnataka and Coimbatore of Tamil Nadu during fertility mapping by Sharma *et al*, (2008), Mamladesai *et al*, (2012) and Padmavathi *et al*, (2014), respectively.



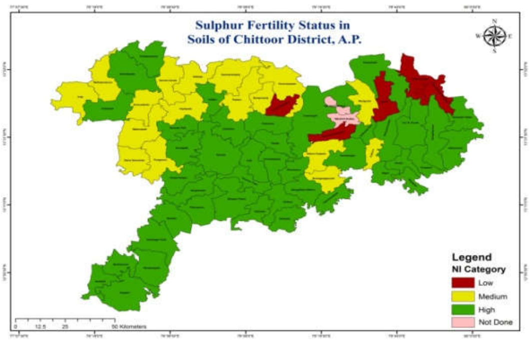


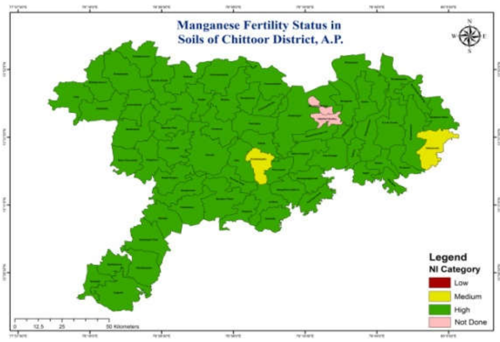
Available Potassium (kg ha^{-1})

The available potassium determined in soils of Chittoor district ranged from 25 to 777 kg ha^{-1} with mean of 337 kg ha^{-1}. Out of this 576 samples, three and eleven (54%) were found to be fall under high potassium fertility class followed by 42 per cent (241 no) in medium fertility category. Very few samples in the district (24) have registered low available potassium status. These results indicate that majority of the soils in the district fall in the medium to high potassium fertility category. Variation in available potassium across the soils of different districts was noticed by several workers (Rezo *et al*, 2007, Sharma *et al*, 2009, Pulakeshi *et al*, 2012 and Dhamak *et al*, 2014) and was attributed to variation in mineralogical compositions.

Available Sulphur

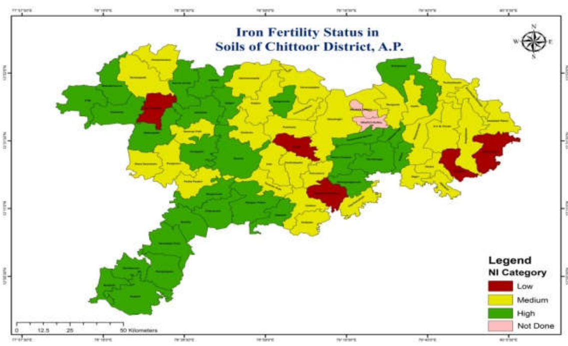
It is observed from the table 3.6 that 18 per cent (104 no) analyzed soils in Chittoor district were found to be deficient in available sulphur. Its content ranged from 3.5 to 194 mg kg^{-1} with mean of 29.4 mg kg^{-1}. In an earlier study restricted to limited areas of Chittoor district, Munaswamy (1991) and Venkatesu (1993) reported sulphur deficiency to an extent of 50 per cent by analyzing few soil samples.





DTPA extractable micronutrients (Zn, Fe, Mn and Cu)

The soils of Chittoor district was found to be suffering from one or other or combination of two or more micronutrients in 324 out of analysed 576 samples and constituted 56 per cent (Zn alone in 103, Fe in 40, B in 60, Mn in 5, Cu in 5 and multi micronutrient deficiencies in 107 samples). Among individual nutrients, the soils of Chittoor were found to be deficient in available zinc to an extent of 33 per cent and boron in 21% samples. The iron deficiency in the district was found to be 19 per cent followed by copper in 4 and manganese in 2.6 per cent of samples. The sulphur deficiency in the district's soils was found to be 18 per cent. The NI values for different micronutrients and sulphur in soils of Chittoor district was found to be 1.77 (medium) for Zn, 2.24 (medium) for B, 2.26 (medium) for Fe, 2.74 (high) for Cu, 2.82 (high) for Mn and 2.54 (high) for S. The correlation coefficients were worked out for various parameters studied in the investigation. All the thematic maps related to studied micronutrients and sulphur were prepared in GIS environment and presented.



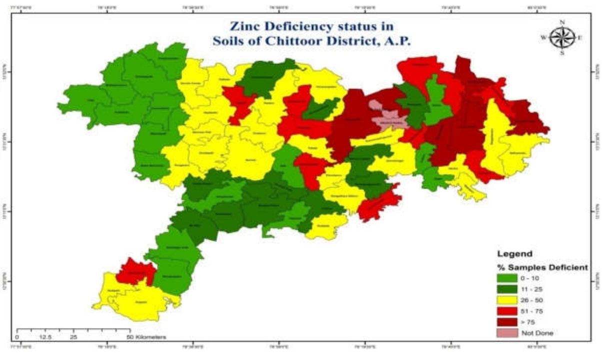
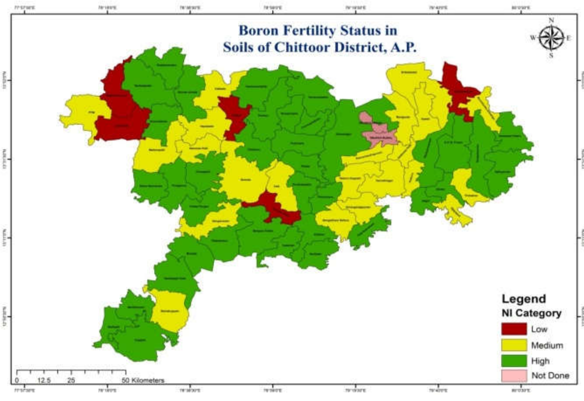


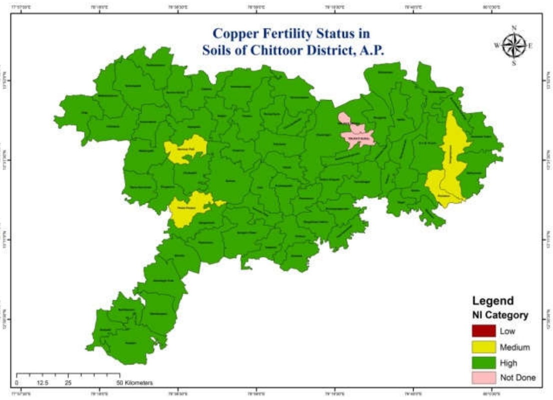
Table 1. Soil available nutrient status in soils of Chittoor district of Andhra Pradesh

S NO	Element	No of samples	Status		PSD	Sample no. in Category			Nutrient Index	
			Range	Mean		Low	Medium	High	Value	Rating
1	Sulphur	576	3.5-194	29.4	18	106	56	414	2.54	High
2	Zinc	576	0.19-5.83	0.91	34	188	325	63	1.77	Medium
3	Iron	576	1.02-39.9	8.31	19	107	205	265	2.26	edium
4	Boron	576	0.15-2.12	0.91	20	119	103	354	2.42	High
5	Manganese	576	1.20-45.4	9.54	3	15	71	490	2.82	High
6	Copper	576	0.10-4.28	0.93	5	27	93	456	2.74	High

Available Boron

The available boron was found to be deficient in 21 per cent of 576 soil samples analyzed from Chittoor district. The extent of boron deficiency in soils of individual *mandal*s ranged from 0 to 100 per cent. Its content in the district soils ranged from 0.15 to 2.12 mg kg^{-1} soil with a mean value of 0.91 mg kg^{-1}.





CONCLUSION

Soil nutrients maps would be highly useful in improving our understanding regarding native and extent of nutrient problems and this can aid in developing appropriate nutrients management strategies leading to better yield and environmental stewardship, which ultimately would be helpful in determining their relationship with animal and human health.

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