

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.609.105>

## Mapping and Current Available Nutrient Deficiencies in Soils of Chittoor District Soils of Andhra Pradesh, India

E. Govardhan<sup>1\*</sup>, M.C. Patnaik<sup>2</sup> and P. Surendra Babu<sup>3</sup>

<sup>1</sup>Department of soil science and Agri. Chemistry, PJTSAU, Rajendra Nagar, Hyderabad 500 030, India

<sup>2</sup>AICRP on Micronutrients, PJTS Agricultural University, Rajendra Nagar, Hyd-500 030, India

<sup>3</sup>Director of ARI farm, Hyderabad 500 030, India

\*Corresponding author

### ABSTRACT

#### Keywords

Nutrient deficiencies, Soils, Chittoor district.

#### Article Info

##### Accepted:

14 July 2017

##### Available Online:

10 September 2017

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<sup>-1</sup> 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. The NI values for sulphur in soils of Chittoor district was found to be 2.54 (high) and 2.24 (medium) for B. All the thematic maps related to studied micronutrients and sulphur were prepared in GIS environment and presented.

### Introduction

Soil plays a major role in determining the sustainable productivity of an agro ecosystem. 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 (Bingham, 1982; Chesnin and Yien, 1950). 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. 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.

Realising its more important role in the country's agricultural production, outflow of exchequer for importing costly fertilizers and to help farmers to prevent imbalanced use of fertilizers in their fields, the Government of India, through Department of Agriculture and

Co-Operation started an ambitious project 'GPS and GIS based Soil Fertility Maps' in 2010. This project was intended to help in making precise fertilizer recommendations for the farmers of the country. Nineteen out of 26 states in the country have been covered so far under this project where in both major and micronutrients of soils are analysed for their fertility status (www.iiss.nic.in and pib.nic.in/newsite). 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.

The validity and usefulness of generated soil fertility maps of an area depends upon the intensity of sampling done, methods of analysis and classes of fertility adopted, time lapse since its preparation and the backed-up fertilizer prescription accuracy for adoption by farmers. It is a herculian task to map the fertility of entire cultivated area of the country having about 138.35 million holdings at one time due to logistics involved and the under usage of logistics developed as the re-assessment of fertility is needed only after 2 to 3 years. Therefore, a viable approach is to concurrently carryout the soil fertility mapping on rotation basis in terms of space and time by encompassing all holdings and farming community.

## **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<sup>H</sup>, EC and OC. Nutrient index value calculated from the proportion of soils under low, medium and high available nutrient categories, as represented by

$$\text{NIV} = \frac{[(\text{PH} \times 3) + (\text{PM} \times 2) + (\text{PL} \times 1)]}{100}$$

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<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>. The P content in the extract was colorimetrically (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<sub>2</sub>O ha<sup>-1</sup>.

### **Available sulphur**

The available sulphur in soil samples was extracted with 0.15% CaCl<sub>2</sub> solution (Williams and Steinbergs, 1961). Five grams

of soil was shaken with 25ml of 0.15% CaCl<sub>2</sub> 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<sup>-1</sup>

### 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).

## Results and Discussion

### Available phosphorus (kg ha<sup>-1</sup>)

The available phosphorus status of soils of Chittoor district ranged from 11 to 239 kg ha<sup>-1</sup> with mean of 73 kg ha<sup>-1</sup>. 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.

All soils of seventeen *mandals* in Chittoor district totalling to 140 analyzed for available phosphorus was found to be high. They are Peeleru, Kaligiri, Chowdepalli, Gudipala, Pakala, Puthuru, Renigunta, Bucchinadu kandriga, Thotembeedu, KVB puram, Rompicharla, Ramachandrapuram, Chandragiri, Chinnagotikallu, Yerravaripalem and Mulakalacheruvu *mandals*. These

*mandals* constituted 26.5 per cent of total *mandals* of the district. The soils of only one *mandal* i.e. of Gurramkonda registered highest under low category of phosphorus availability to an extent of 50 per cent (5 samples out of 10). The other *mandals* wherein their soils registering perceptible low available phosphorus were Ramasamudram (43%), Gudipalli and Srikalahasti (37% each) (Fig. 1).

High and continuous application of phosphatic fertilizers might have resulted in occurrence of high phosphorus soils in the district. 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<sup>-1</sup>)

The available potassium determined in soils of Chittoor district ranged from 25 to 777 kg ha<sup>-1</sup> with mean of 337 kg ha<sup>-1</sup>. 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.

Among the *mandals*, the entire soils analyzed for available potassium were found to be high in potassium fertility in Vedula kuppam, Bucchinadu kandriga and Thotembeedu *mandals*. The soils of twenty *mandals* of 64 present in Chittoor district recorded medium NI values while the rest have fallen under NI value of potassium fertility. The NI value for potassium status was found to be 2.49 and is depicted in figure 2.

**Table.1** Categorization of *mandals* of Chittoor district based on extent of sulphur deficiency in soils for prioritization of fertilizer usage decisions

0-10		11-25	26-50	51-75
35 Mandals		8 Mandals	16 Mandals	5 Mandals
Bangaru Palem	Gangadhara Nelluru	Chadumu	Chinnagottikallu	Bucchinadu Kandriga
Bireddy	K.V. B. Puram	Chandragiri	Choudapelli	Irpedu
Chittoor	Karvetinagar	Gudipalli	Gurram Konda	Ramachandrapuram
Gangavaram	Nangalapuram	Kothakota	Kalkada	Rompicharla
Gudipala	Narayanavanam	Nagiri	Kammavaripally	Thottambeedu
Irala	Nindra	Peddamandem	Kuravalakota	
Kaligiri	Pala Samudram	Puthuru	Madanapalli	
Kuppam	Penumooru	Tambalapalle	Mulkalacheruvu	
Pakala	Pichatoor		Nemman Palli	
Palamaneru	Poothalapattu		Peeleru	
Pedda Panjani	Pulicharla		PTM	
Punganuru	Renigunta		Rama Samudram	
Ramakuppam	Sathyavedu		Srirangarajapuram	
Santhipuram	Srikalahasti		Vayalpadu	
Somula	Vadamala Peta		Veduru Kuppam	
Tavanam Palle	Varadaiah Palem		Yerravaripalem	
Venkatagiri Kota	Vijayapuri			
Yedamari				

PSD: Per cent samples deficient

**Table.2** Categorization of *mandals* of Chittoor district based on extent of boron deficiency in soils for prioritization of fertilizer usage decisions

0-10		11-25	26-50	51-75	>75
32 Mandals		10 Mandals	14 Mandals	6 Mandals	2 Mandals
Bangaru Palem	Chandragiri	Chadumu	Bucchinadu Kandriga	Kalkada	Kaligiri
Bireddy	Chinnagottikallu	Chittoor	Gangavaram	Mulkalacheruvu	Kothakota
Choudapelli	Gurram Konda	K.V. B. Puram	Irala	Pichatoor	
Gangadhara Nelluru	Kuravalakota	Nemman Palli	Irpedu	Tavanam Palle	
Gudipala	Madanapalli	Pakala	Karvetinagar	Thottambeedu	
Gudipalli	Nagiri	Palamaneru	PTM	Veduru Kuppam	
Kammavaripally	Nangalapuram	Pedda Panjani	Ramakuppam		
Kuppam	Narayanavanam	Puthuru	Renigunta		
Peeleru	Nindra	Ramachandrapuram	Somula		
Penumooru	Pala Samudram	Yerravaripalem	Srikalahasti		
Poothalapattu	Peddamandem		Srirangarajapuram		
Punganuru	Pulicharla		Vadamala Peta		
Rama Samudram	Rompicharla		Vayalpadu		
Santhipuram	Sathyavedu		Vijayapuri		
Venkatagiri Kota	Tambalapalle				
Yedamari	Varadaiah Palem				

Fig.1 Phosphorus fertility status in soils of Chittoor District, A.P.

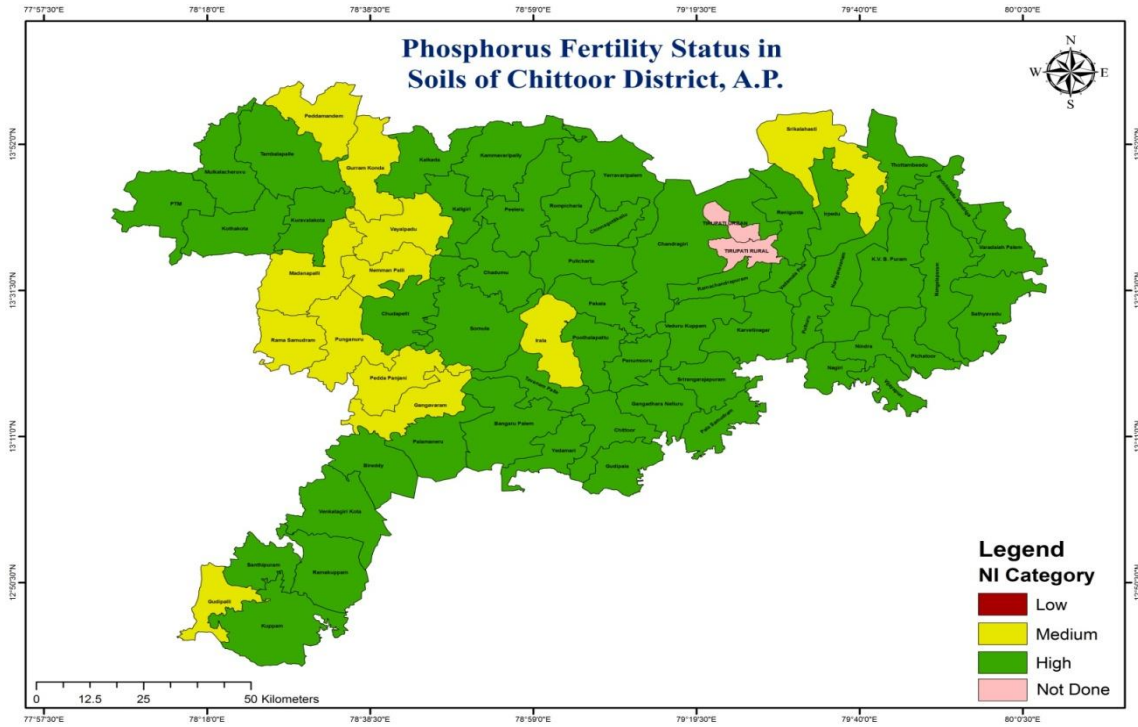


Fig.2 Potassium fertility status in soils of Chittoor District, A.P

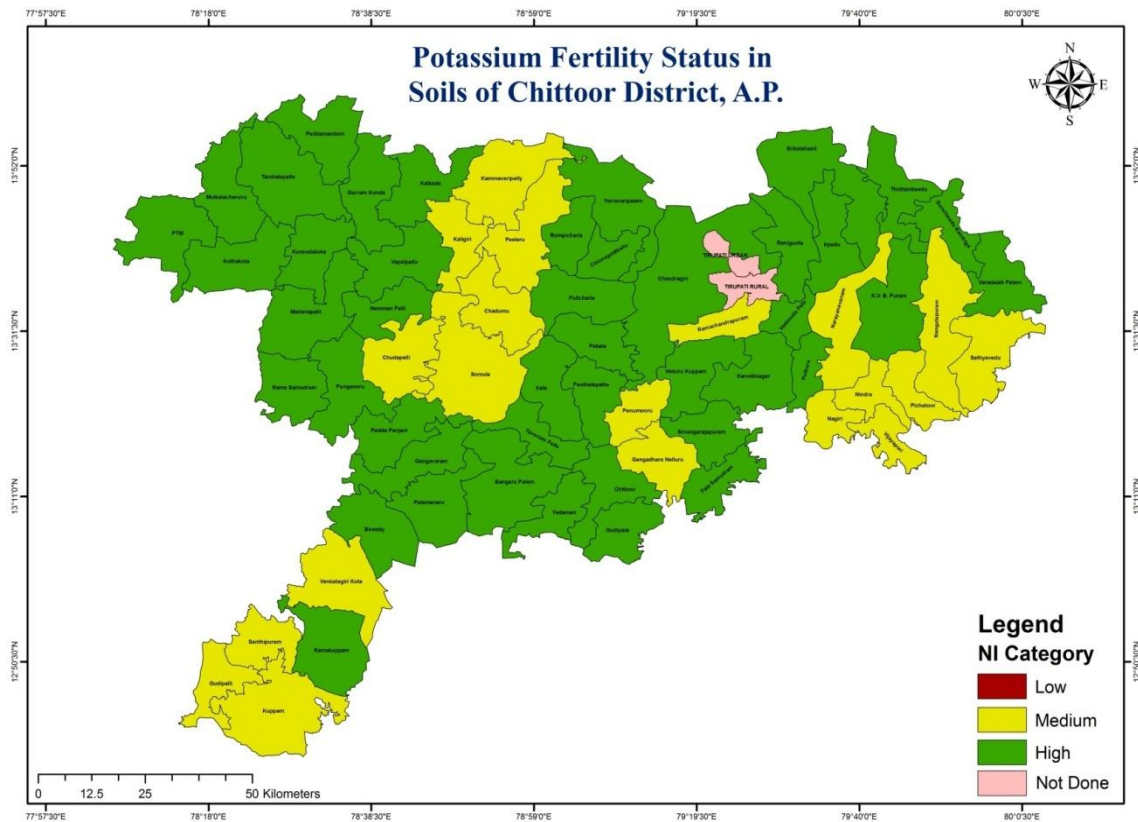


Fig.3 Sulphur fertility status in soils of Chittoor District, A.P.

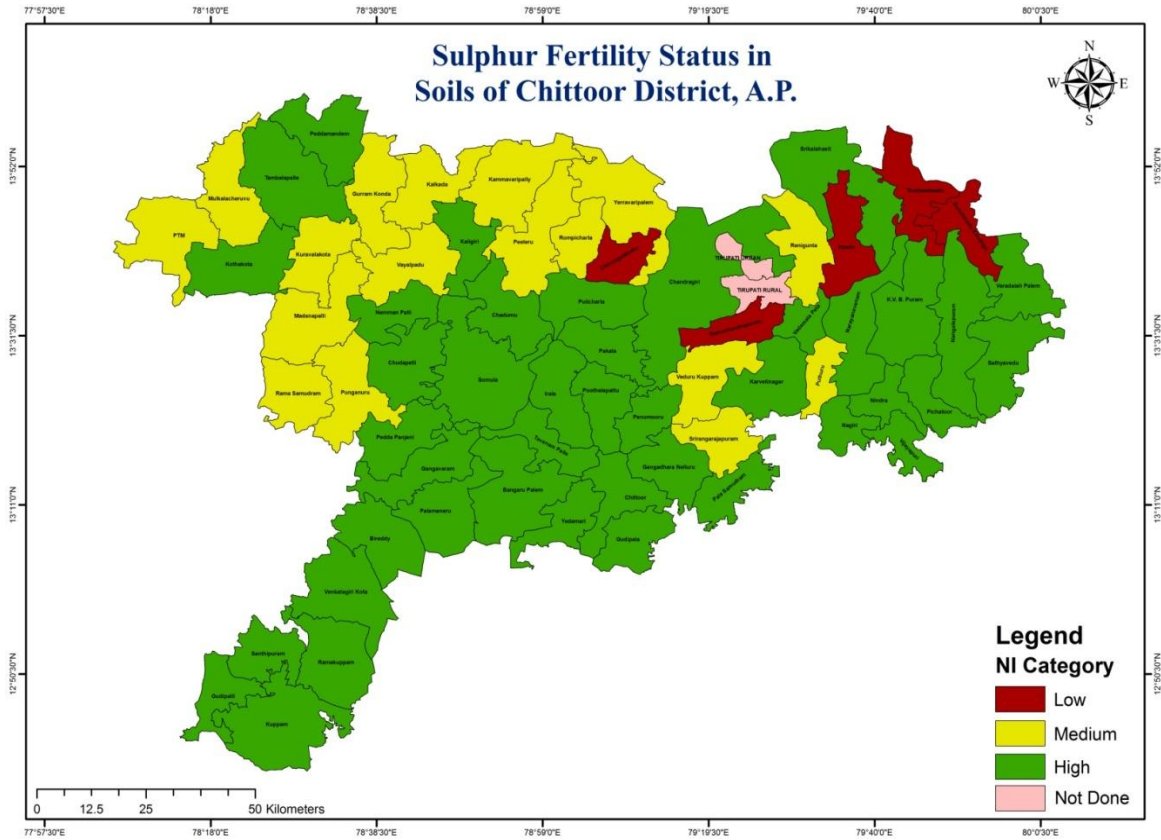
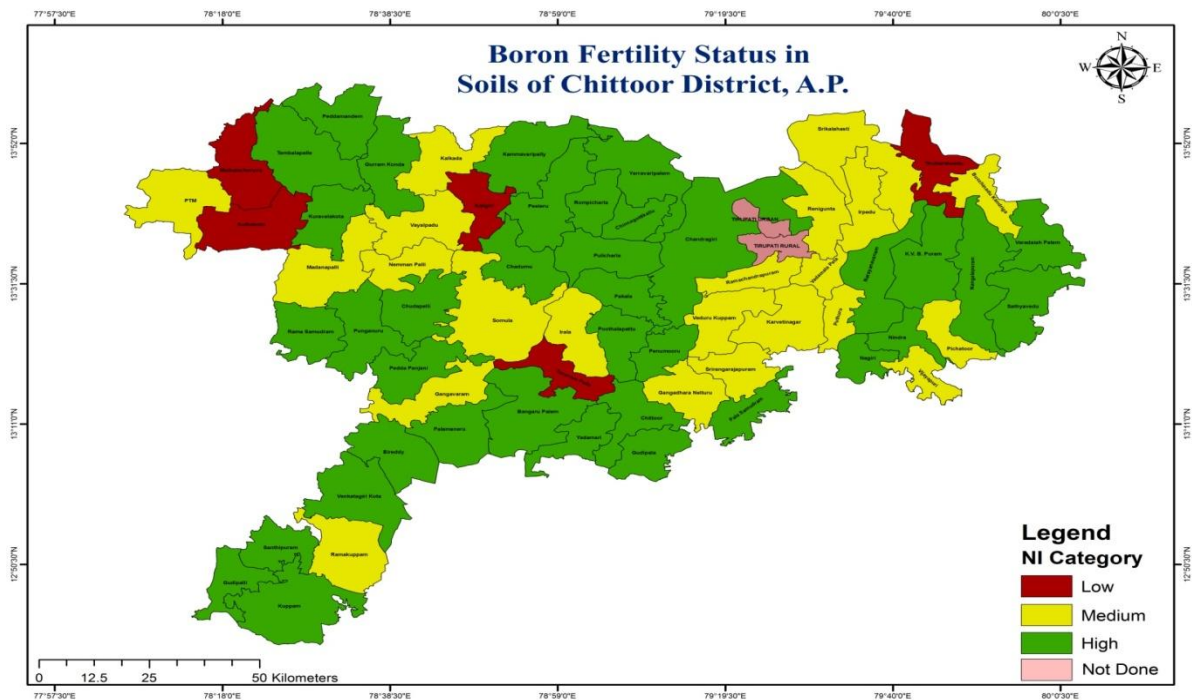


Fig.4 Boron fertility status in soils of Chittoor District, A.P.



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; Dhamak *et al.*, 2014) and was attributed to variation in mineralogical compositions.

### Available sulphur

It is observed from the table 1 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<sup>-1</sup> with mean of 29.4 mg kg<sup>-1</sup>.

The perusal of data indicated that the mean sulphur content was in the range of 8.6 to 58.1 mg kg<sup>-1</sup> with in the *mandals*. Likewise, the extent of sulphur deficiency within the *mandals* ranged from 10 to 71 per cent among their soils. As many as 26 *mandals* out of 64 in the district have not registered any sulphur deficiency in their soils. The NI values for available sulphur in different *mandals* of the district ranged from 1.29 (Buchinadu kandriga) to 3.0. Only 5 *mandals* of the district registered low NI values and they are irpedu, Bucchinadu kandriga, Thotembeedu, Ramachandrapuram and Chinnagottikallu. The overall NI value for sulphur of Chittoor district was found to be high (2.54). The map generated for sulphur NI is depicted in figure 3. 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.

### 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 *mandals* ranged from 0 to 100 per cent. Its content in the district soils ranged from 0.15 to 2.12 mg

kg<sup>-1</sup> soil with a mean value of 0.91 mg kg<sup>-1</sup> (Table 2). The mean hot water extractable boron in soils of different *mandals* ranged from 0.38 (Kaligiri *mandal*) to 1.59 mg kg<sup>-1</sup> (Nagiri). The boron deficiency status map generated for soils of Chittoor is depicted in figure 4.

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.

### References

- Bingham, F.T., 1982. Boron, In: Methods of soil analysis, part 2. *Chemical and micro biological properties* (A.L. Page Ed), 431-448. *American Society of Agronomy*. Madison. WI. USA.
- Chesnin, L., and Yien C H 1950 Turbidometric determination of available sulphates. *Soil Science Society of America Proceedings*. 14:149-151.
- Dhamak, A.L., Meshram, N. A and Waikar, S. L.2014. Comparative Studies on Dynamics Soil Properties and Forms of Sulphur in Oilseed Growing Soils of Ambajogai Tahsil of Beed District. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*. 7(12): 98-102.
- Jackson, M.L., 1973. *Soil chemical analysis - An advanced course*, Second Edition, University of Wisconsin, Madison, USA.
- Mamaledesai, N.R., Patil, P.L., Chandrashekar, C.P., Potdar, M.P., Astaputre, S.A., Desai, S.R and Hanumantha Swamy.2012. Assessment

- of nutrients status in Cotton growing area of Haveri district in northern transitional zone of Karnataka and response of cotton to applied nutrients at different yield targets. *Agro-Informatics and Precision Agriculture*.42-46.
- Munaswamy, V., 1981. Secondary nutrient status of groundnut growing soils of Chittoor district of Andhra Pradesh. M.Sc (Ag). Thesis submitted to Andhra Pradesh Agricultural University, Hyderabad.
- Olsen, S.R., Cole, C.V., Watanade, F.S and Dean, L.A. 1954. Estimation of available phosphorus in soil by extraction with sodium bicarbonate. *Cri. U.S. Dep. Agric.* 939.
- Padmavathi, T., Muthukrishnan, R., Mani and S. Sivasamy, R.2014. Assessment of Soil Physic-Chemical Properties and Macronutrients Status in Coimbatore District of Tamil Nadu Using GIS Techniques. *Trends in biosciences*. 7(19):2879-2881.
- Pulakeshi, H. B. P., Patil, P. Dasog, G. S., Radder, B. M. B., Bidari, I and C. P. Mansur. Mapping of nutrients status by geographic information system (GIS) in Mantagani village under northern transition zone of Karnataka. *Karnataka Journal of Agricultural Sciences*.25 (3): 332-335.
- Ramamoorthy, B., and Bajaj, J.C. (1969) Available N, P and K status of Indian soils. *Fertilizers News* 14, 24-26.
- Rego, T.J., Sahrawat, K.L. Wani, S.P. and Pardhasaradhi, G. 2007. Widespread deficiencies of sulphur, boron and zinc in dryland soils of the Indian semi-arid tropical soils: on farm crop responses. *Journal of Plant Nutrition*. 30: 1569-1583.
- Sharma, J.C., and Chaudhary, K. 2007. Vertical Distribution of Micronutrient cations in relation to soil characteristics in lower Shiwaliks of Solan district in North-West Himalayas. *Journal of the Indian Society of Soil Science*. 55(1): 40-44.
- Venkatesu, T., 1993. Distribution and availability of cationic Micronutrients in Groundnut grown sandy soils of Nellore district.M.sc thesis submitted to, Andhra Pradesh Agricultural University, Hyderabad.
- Williams, C.H., and Steinbergs, A. 1961. The evaluation of plant available sulphur in soils. *Plant and Soil*. 17:276-278.

#### **How to cite this article:**

Govardhan, E., M.C. Patnaik and Surendra Babu, P. 2017. Mapping and Current Available Nutrient Deficiencies in Soils of Chittoor District Soils Of Andhra Pradesh. *Int.J.Curr.Microbiol.App.Sci*. 6(9): 871-878. doi: <https://doi.org/10.20546/ijcmas.2017.609.105>