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# Evaluation of micronutrient status of an Inceptisols of Surguja district (C.G)

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**Abstract**
The precise nutrient management is one of the most important and integral part of the modern day agriculture. The nutrients present in the soil fertility is the status of the soil to supply nutrients to plants in adequate amounts and in suitable proportions. The micronutrients are the nutrients which are used by the field crops in very small quantities (less than 1 ppm), however are required to catalyse various enzymic activities within the plants to ascertain this, a study was conducted to assess the fertility status of soils of research farm, College of Agriculture, Ambikapur and KVK farm, Ambikapur under Surguja district of Chhattisgarh. The 101 soil samples (0-15) were randomly collected. The available micronutrients Fe, Cu, Zn, Mn and B were analysed. The fertility ratings categorized based on nutrient value for different parameters.

**Keywords:** Micronutrients, enzymic activities, nutrient management, nutrient value, soil fertility

## Introduction
The increasing demand of food grain has forced farmers to use high doses of chemical fertilizers. Imbalanced use of chemical fertilizers is a serious threat to sustainable agricultural production system. The sustainability of the system has become major concern nowadays. The evaluation of soil fertility is perhaps the most basic decision making tool in order to impose appropriate nutrient management strategies (Brady and Weil, 2004) [5]. There are various techniques for soil fertility evaluation, among them soil testing is the most widely used in the world (Havlin *et al.* 2010) [15]. The soil testing assess the current fertility status and provides information regarding nutrient availability in soils which forms the basis for the fertilizers recommendations for maximising crop yields and to maintain the adequate fertility in soils for longer period. The physical and chemical tests provide information about the capacity of soil to supply mineral nutrients (Ganorkar and Chinchmalatpure, 2013) [6]. The nutrient index value method can be also used to evaluate the soil fertility status of the soil. The micronutrients are the nutrients which are used by the field crops in very small quantities (less than 1 ppm), it is required in relatively small quantities but is as essential as macronutrients, they are classified into micronutrient cations and micronutrients anions depending upon the form in which they are available to the plants, they play an imperative role in plant growth and development. Without these nutrients, mineral nutrition would be compromised leading to potential declines in plant productivity.

## Materials and methods
A total of 101 soil samples were collected from research farm, College of Agriculture and KVK farm, Ambikapur District Surguja Chhattisgarh State. The main crop of this region is rice and the area is covered with *Inceptisols.* The study area comes under Northern Hills Zone of the state. The region comes under the sub-humid climatic condition. The average rainfall of the area is 1150-1250.
The soil samples (0-15) were collected in cloths bags as per standard procedures. Quartering technique was used for preparation of soil samples. The samples were dried in air and passed through 2 mm sieve and stored in cloth bags. The soil pH and EC were determined from saturation extract 1:2.5 (Soil water ratio) of soils. Available Fe, Mn, Cu and Zn using DTPA extractant method proposed by Lindsay and Norvell (1978) [9] and available B using hot water extractant method described by Berger and Troug (1944) [16].

The analytical results of each sample was categorized as low, medium, high categories for available micronutrients and as deficient, moderate and sufficient based on standard rating values.

**Nutrient index values and fertility rating**

According to Ramamoorthy and Bajaj (1969) [12] nutrient index values (NIV) for various soil parameters were determined from the amount or proportion of samples with low, medium, or high usable nutrient status and classified into different fertility groups.

$$NIV = \frac{1\times PL+2\times PM+3\times PH}{100}$$

Where,
NIV = Nutrient index value
PL= % Samples fall under low category.
PM= % Samples fall under medium category.
PH= % Samples fall under high category.

In this assessment, NIV of less than 1.33, 1.33-2.33 and 2.33 indicates low, medium and high fertility level respectively for each nutrient.

## Results and Discussion

**Soil reaction**

A study on the soil reaction (pH) of the study area revealed that the soils were moderately acidic to strongly acidic and the pH varied from 4 to 5.3 with a mean value of 4.55 in research farm, College of Agriculture, Ambikapur and 4.7 to 5.9, with a mean value of 5.28 in KVK farm, Ambikapur (Table 1). Out of the total soil samples of research farm, College of Agriculture, Ambikapur, 60.78% of the soils were found moderately acidic and 39.22% are strongly acidic and in KVK farm, Ambikapur 70% samples fall under the category of moderately acidic in nature and remaining 30% samples fall under the category of slightly acidic in soil reactions. The low values of soil reaction as indicated by soil pH shows soils are acidic which may be due to leaching loss of basic cations from the soil surface because of high rainfall of study area as also reported by Barooah *et al*., (2020) [2].

**Soil electrical conductivity (d $Sm^{-1}$)**

The electrical conductivity of the soil water suspension ranged from 0.04 to 0.06 d Sm-$^{-1}$ with a mean value of 0.075 d $Sm^{-1}$ in College of Agriculture, Ambikapur and 0.05 to 0.38 d $Sm^{-1}$ in KVK farm, Ambikapur (Table 1). All the soil samples falls under the normal range (<1.0 d $Sm^{-1}$). The soil were good enough for growing of all types of crops. All soil samples i.e. 100% were having low range, and is classed as "Good" indicating that there is no requirement of the corrective measures. The extremely low EC value of the area can be attributed to semi-arid to sub-arid climate. The considerable leaching of all soluble salts from the top soil layer is made possible by the humid atmosphere. Once more, the area's geography makes it possible for sufficient runoff losses of water that contain soluble salts (Balakrishna, (2017) [1].

**Table 1:** Salient Properties of soils in study area

| S. No. | Parameters | Range | | Average | | Standard deviation | |
|---|---|---|---|---|---|---|---|
| | | CoA, Ambikapur | KVK, Ambikapur | CoA, Ambikapur | KVK, Ambikapur | CoA, Ambikapur | KVK, Ambikapur |
| 1. | pH | 4-5.3 | 4.7-5.9 | 4.55 | 5.28 | 0.31 | 0.27 |
| 2. | EC (d $Sm^{-1}$) | 0.04 -0.06 | 0.05-0.38 | 0.075 | 0.11 | 0.08 | 0.04 |
| 3. | Iron (mg $kg^{-1}$) | 23.04-53.34 | 18.88-47.02 | 38.11 | 30.59 | 7.59 | 5.39 |
| 4. | Manganese (mg $kg^{-1}$) | 11.32 -38.2 | 15.1-43.9 | 21.37 | 24.28 | 7.65 | 4.99 |
| 5. | Copper (mg $kg^{-1}$) | 0.56 -1.9 | 0.04-1.06 | 1.25 | 0.40 | 0.37 | 0.20 |
| 6. | Zinc (mg $kg^{-1}$) | 0.12 -3.7 | 0.42-3.38 | 0.88 | 1.55 | 0.58 | 0.728 |
| 7. | Boron (mg $kg^{-1}$) | 0.1 -3.7 | 0.1-8.7 | 1.03 | 1.46 | 0.92 | 1.27 |

**Table 2:** The data pertaining to the soil fertility index based on the NIV of research farm, College of Agriculture, Ambikapur

| S. No. | Soil Characteristics | Range | Mean | % Samples Category | | | NIV | Fertility Class |
|---|---|---|---|---|---|---|---|---|
| | | | | Low | Medium | High | | |
| 1. | Fe (mg $kg^{-1}$) | 23.04-53.34 | 38.11 | 0 | 0 | 100 | 3 | H |
| 2. | Mn (mg $kg^{-1}$) | 11.32 - 38.2 | 21.37 | 0 | 0 | 100 | 3 | H |
| 3. | Cu (mg $kg^{-1}$) | 0.56-1.9 | 1.24 | 0 | 0 | 100 | 3 | H |
| 4. | Zn (mg $kg^{-1}$) | 0.12-3.7 | 0.87 | 35.3 | 43.14 | 21.56 | 1.86 | M |
| 5. | B (mg $kg^{-1}$) | 0.1-3.7 | 1.03 | 27.45 | 35.29 | 37.25 | 2.09 | M |

**Table 3:** The data pertaining to the soil fertility index based on the NIV of KVK, Ambikapur

| S. No. | Soil Characteristics | Range | Mean | % Samples Category | | | NIV | Fertility Class |
|---|---|---|---|---|---|---|---|---|
| | | | | Low | Medium | High | | |
| 1. | Fe (mg kg-1) | 18.88-47.02 | 30.59 | 0 | 0 | 100 | 3 | H |
| 2. | Mn (mg kg-1) | 15.1-43.9 | 24.28 | 0 | 0 | 100 | 3 | H |
| 3. | Cu (mg kg-1) | 0.04-1.06 | 0.40 | 12 | 40 | 48 | 2.36 | H |
| 4. | Zn (mg kg-1) | 0.42-4.18 | 1.75 | 8 | 30 | 62 | 2.42 | H |
| 5. | B (mg kg-1) | 0.1-8.7 | 1.46 | 4 | 38 | 58 | 2.54 | H |

**DTPA extractable micronutrients**

**Available iron (Fe) status in soil**

The status of the available Fe varied from 23.04 to 53.34 mg $kg^{-1}$ with a mean value of 38.11 mg $kg^{-1}$ in research farm, College of Agriculture, Ambikapur mg $kg^{-1}$ and in KVK farm, Ambikapur it was found to be ranging from 18.88 to 47.02 mg $kg^{-1}$ with mean value of 30.59 mg $kg^{-1}$. (Table 1). It was noted that in both farms all of the samples (100%)

were high in available Fe (Table 2) and categorized under high fertility level as per NIV. (Table 3).

**Available Manganese (Mn) status in soil**

The status of the available Mn ranged from 11.32 to 38.2 mg $kg^{-1}$ with a mean value of 21.37 mg $kg^{-1}$ in research farm, College of Agriculture, Ambikapur and in KVK farm, Ambikapur it was found 15.1 to 43.9 mg $kg^{-1}$ with a mean value of 24.28 mg $kg^{-1}$ of soil in the study area (Table 1). It was noted that in both farms all of the samples (100%) were high in available Mn (Table 2) and categorized under high fertility level as per NIV (Table 3).

**Available Copper (Cu) Status in Soil**

The status of the available Cu in the study area ranged from 0.56 to 1.9 mg $kg^{-1}$ with a mean value of 1.25 mg $kg^{-1}$ in research farm, College of Agriculture, Ambikapur and in KVK farm, Ambikapur it was found 0.04 to 1.06 mg $kg^{-1}$ with a mean value of 0.40 mg $kg^{-1}$. (Table 1). It was noted that in research farm, College of Agriculture, Ambikapur, all samples (100%) were high in available Cu (Table 2) and in KVK farm it was found low (12%), medium (40%) and high (48%) respectively (Table 3).

**Available Zinc (Zn) status in soil**

The status of the available Zn varied from 0.12 to 3.7 mg $kg^{-1}$ with a mean value of 0.88 mg $kg^{-1}$ (Table 1). In research farm, College of Agriculture, Ambikapur the results were classified into 3 different rating categories, accordingly it was found that 35.30%, 43.14%, 21.56% samples were under deficient, sufficient and high range (Table 2) and in KVK farm, Ambikapur, the available Zn content in study area found to be ranges from 0.42 to 3.38 mg $kg^{-1}$ with a mean value of 1.55 mg $kg^{-1}$ (Table 1). Also, it was discovered that 8% of the samples fell under low range, 30% of samples fell in medium range and 62% of the samples fell with high level of Zn (Table 3).

**Available boron (B) status in soil**

The status of the available B varied from 0.1 to 3.7 mg $kg^{-1}$ with a mean value of 1.03 mg $kg^{-1}$ (Table 1). In research farm, College of Agriculture, Ambikapur, the percentage distribution of the soil samples were found to be high (37.25%), sufficient (35.29%) and deficient 27.45% respectively (Table 2) and in KVK farm, Ambikapur, it was found to be ranged from 0.1 to 8.7 mg $kg^{-1}$, with an average value of 1.46 mg $kg^{-1}$ (Table 1), 38%, 4% and 58% samples were found under the category of sufficient, deficient and high respectively (Table 3).

**Conclusion**

The soils of Research Farm, College of Agriculture, Ambikapur and KVK farm, Ambikapur District Surguja Chhattisgarh, were discovered to have predominantly acid soils and their electrical conductivity was relatively low (<1 d $Sm^{-1}$), falling under "normal" category. These qualities make the soils virtually universally suited for agricultural cultivation without significant issues or the need for corrective action. However due to acidic nature these soils require lime application. In research farm, College of Agriculture, Ambikapur the micronutrients Fe, Mn and Cu, B, were discovered to be in a high range while Zn was in sufficient level and in the KVK farm, Ambikapur the available Fe, Mn, Cu, Zn and B were discovered to be in a high range.

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