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# Assessment of soil micronutrient status of southern light soils under Flue Cured Virginia tobacco in *Prakasam* district of Andhra Pradesh

*L. K. Prasad[1], D. Damodar Reddy[2], C. Chandrasekhararao[3], J. Poorna Bindu[4] and N. Johnson[5]*

***Abstract:*** *Two hundred and fifty two soil samples were collected from different farmers of 15 villages of* Kandukur *and* Ponnaluru mandals *under southern light soil area of FCV tobacco in Prakasam district of Andhra Pradesh. The representative soil samples from 6" depth from the surface were taken with the help of famers. The chemical analysis of samples for micronutrients indicates that in the study area the available zinc varied from 0.09 to 3.20 µg/g and available iron ranged from 0.49 to 32.5 µg/g. The available copper and available Manganese varied from 0.11 to 5.31 µg/g and 3.01 to 30.26 µg/g, respectively. Among the DTPA extractable micronutrients, Manganese was found high to very high, whereas the soils were very low to low in available zinc and medium to high in available iron and available copper. The nutrient index values were low for available Zn (1.14), medium to high for Fe (2.36) and high for available Cu (2.64) and Mn (3.00) in FCV tobacco grown light textured soils of* Prakasam *district.*

***Key words:*** *DTPA extractable micronutrients, FCV Tobacco, Light soils and Nutrient Index.*

## INTRODUCTION

Exploring soil fertility variation including micronutrients in areas under commercial crops is important to have comprehensive information for managing natural resources, crop diversification and improving production. Especially, the importance of micronutrients has been realized during past three decades when wide spread micronutrient deficiencies observed throughout the country [4]. 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 [1, 3]. 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 [14].

Micronutrients play a vital role in plant nutrition, and are essential for various enzymatic reactions and metabolic processes. Micronutrients availability is with various changes occurring in the soils. Majority of our soils are generally light to

[1] Principal Scientist, (CC & SS), CTRI, Rajahmundry – Corresponding author
[2] Director, CTRI, Rajahmundry
[3] Principal Scientist and Head, (CC & SS), CTRI, Rajahmundry
[4] Scientist, (CC & SS), CTRI, Rajahmundry
[5] Senior Technical Assistant, (CC & SS), CTRI, Rajahmundry

medium textured, high in pH, low in organic matter, deficient in nitrogen and phosphorus, calcareous to varying degrees, where micronutrients may form insoluble compounds and become unavailable to the plants. Moreover high application of nitrogen and phosphorus fertilizers, introduction of high yielding varieties and intensive crop production system may also induce the deficiencies of micronutrients. Due to these facts, the micronutrients have become of widespread concern during recent years. Application of micronutrient is very important for getting high yield and quality of tobacco. Maximum percentage of top quality leaves was obtained at a higher dose of Cu fertilization [7]. Gul [6] concluded that deficiency of B resulted in extreme turgidity and breakage of the midribs of the leaves. Baber *et al.* [2] mentioned that Zn and B application increased the yield of Flue cured Virginia (FCV) tobacco, while Cu fertilization increased the potash and sugar contents of tobacco.

In this context the study is pertinent in exploring the status of soil nutrients in light textured southern light soils in which tobacco and other important crops are being cultivated.

## MATERIALS AND METHODS

### Natural resources, landforms and land use pattern of the study area

Soil type varied with different land forms. Land forms observed are uplands, low lands, river alluviums and uncultivated barren lands. The area is a conglomerate of red, black and red-black mixed soils. Red sandy loams to sandy clay loams are found in uplands. Depth of the soil is very shallow (<30 cm) to moderate. Irrigation facilities available in the study area are dug wells, dug-cum-bore wells, shallow & deep tube wells, tanks and filter points near streams. Local streams like *Manneru and Paleru* help in maintaining shallow water table and better water quality in the areas. Ground water wells/ bores depth ranged between 25-160 feet. In low lands rice is grown during *kharif* followed by summer pulses in rice fallows. Cotton is grown in black soil with plenty of ground water and nearer to *Manneru and Paleru* streams. Red gram is grown in uplands, low lands and all type soils as *kharif* crop. During *rabi*, sole crops grown are Tobacco and Chickpea. Tobacco is irrigated with the help of rain fed tanks and ponds in *Mopadu and Kondamudusupalem*, during dry spell. Stream water is also being extensively used especially for tobacco nurseries [12].

### Sample collection and analysis

The samples were collected from different farmers of 15 villages of *Kandukur* and *Ponnaluru mandals* under southern light soil area of FCV tobacco. The representative soil samples from 6" depth from the surface were taken with the help of famers. The samples were air-dried, ground and passed through a 2 mm sieve for analysis of micronutrients (Zn, Fe, Mn, and Cu). Analysis of Zn, Fe, Mn and Cu was performed using Diethylene Triamine Penta Acetic Acid (0.005 DTPA+0.1 M Tri-ethanol amine and 0.01M $CaCl_2$ solution buffer) extractant and with the help of AAS as outlined by Lindsay and Norwell [8]. Critical limits used to categorize level of deficiency were 0.60 mg kg-1 soil for DTPA extractable Zn, 5.0 mg kg-1 soil for DTPA-extractable Fe, 0.20 mg kg-1 soil for DTPA-extractable Cu, 2.0 mg kg-1 soil for DTPA extractable Mn. Based on soil critical limits soil samples were categorized in to five classes.

The nutrient index (NI) values for available micronutrients nutrients present in the soils were calculated utilizing the formula as suggested by Parker *et al.* [10] and classified this index as low (< 1.5), medium (1.5 to 2.5) and high (> 2.5) giving under weightage to medium category. Ramamoorthy and Bajaj [13] modified the index classification as low (< 1.70), medium (1.71 to 2.33) and high (> 2.33).

Nutrient index = (NL x 1) (Nm x 2) (Nh x 3) / Nt

Where, NL, Nm and Nh are the number of soil 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 samples. Macronutrient Nutrient indexes were grouped according to index ratings.

## RESULTS AND DISCUSSION

The data on available micronutrients status and their distribution and index values are presented in

the table 1, 2 and 3, respectively. In the study area the available zinc varied from 0.09 to 3.20 µg/g. Lowest mean value for zinc was recorded in *Ananthasagaram* village (0.24 µg/g). While, highest value of zinc was observed in the village *Kakumanivaripalem* (1.72 µg/g). The available Iron ranged from 0.49 to 32.5 µg/g. Lowest mean value of Iron was recorded in *Cheruvukommupalem* village (2.26 µg/g) and highest mean value of Iron was observed in the village *Divivaripalem* (10.56 µg/g).

The available copper varied from 0.11 to 5.31 µg/g. Highest mean value of copper was observed in the village *Kakumanivaripalem* (1.87 µg/g). Whereas, lowest mean value of copper was recorded in soils of *Venkupalem* village (0.26 µg/g). Available Manganese varied from 3.01 to 30.26 µg/g. Lowest mean value (5.55 µg/g) of Manganese was recorded in *Kothapalem* village. While, highest mean value of Manganese was observed in *Ananthasagaram* village (24.40 µg/g). The details are given in Table 1.

Distribution of different categories was studied for four micronutrients and classified according to critical limits (Table 2 and 3). Among the four micronutrients available zinc was low to very low category in 88.6 % samples followed by available iron (36 %) and available copper (14 %). Micronutrient deficiencies were found in soils of *Andhra Pradesh and Telangana states*, especially the available forms of zinc and iron [15] and [16].

**Table 1**
**Soil available micronutrient status in sampled villages of SLS area of FCV tobacco**

| *S.No* | *VillageName* | *Available Zinc* | *AvailableIron* | *Available Copper* | *Available Manganese* |
|---|---|---|---|---|---|
| | | ——— Range & Mean in µg/g ——— | | | |
| 1 | *Ananthasagaram* | 0.12-0.40 (0.24) | 5.20-7.25 (6.17) | 0.25-0.88 (0.48) | 25.30-30.26 (24.40) |
| 2 | *Boganampadu* | 0.12-0.55 (0.26) | 3.85-6.49 (4.88) | 0.51-0.91 (0.66) | 6.45-13.00 (9.34) |
| 3 | *Cheruvukommupalem* | 0.27 | 2.26 | 0.38 | 6.54 |
| 4 | *Divivaripalem* | 0.20-1.91 (0.78) | 4.36-30.94 (10.56) | 0.35-1.76 (1.16) | 10.25-55.02 (22.89) |
| 5 | *Ganigunta* | 0.17-2.50 (0.69) | 4.19-32.48 (9.82 | 0.25-2.15 (0.99) | 8.08-75.32 (20.41) |
| 6 | *Kakumanivaripalem* | 0.92-2.36 (1.72) | 5.55-13.99 (8.56) | 1.44-2.39 (1.87) | 12.74-24.90 (18.57) |
| 7 | *Kothapalem* | 0.10-0.52 (0.26) | 3.08-5.29 (4.20) | 0.11-1.19 (0.81) | 3.01-8.57 (5.55) |
| 8 | *Machavaram* | 0.18-2.45 (0.78) | 4.37-20.38 (8.78) | 0.21-0.71 (0.46) | 4.15-28.70 (10.25) |
| 9 | *Mahadevapuram* | 0.28-0.87 (0.53) | 0.49-7.42 (4.66) | 0.71-2.02 (1.23) | 8.57-18.56 (12.11) |
| 10 | *Mopadu* | 0.47 | 5.89 | 1.02 | 5.9 |
| 11 | *Oguru* | 0.09-3.28 (0.66) | 3.08-20.54 (5.89) | 0.24-5.31 (1.44) | 3.99-30.22 (11.18) |
| 12 | *Pantavaripalem* | 0.20-1.31 (0.56) | 4.67-17.00 (7.79) | 0.33-0.57 (0.43) | 9.80-20.74 (13.76) |
| 13 | *Ponnaluru* | 0.18-0.55 (0.38) | 4.27-7.08 (5.18) | 0.61-1.60 (0.95) | 5.13-7.89 (6.27) |
| 14 | *Samavaripalem* | 0.25-0.99 (0.53) | 4.61-12.45 (7.73) | 0.30-1.40 (0.86) | 6.01-21.58 (12.26) |
| 15 | *Venkupalem* | 0.13-0.53 (0.26) | 2.06-3.11 (2.41) | 0.18-0.32 (0.26) | 4.47-7.71 (6.36) |

However, Available manganese was very high to high in almost all the samples. The results showed that a large scale area under the study was zinc deficient followed by iron and copper (Table 2). The low zinc content is ascribed to low amount of zinc bearing minerals in these light textured red and mixed soils which are categorized mostly in to Alfisols coupled with meager usage of zinc based fertilizers in the FCV tobacco cultivation. The low content of organic matter in soils influences the Fe solubility in soils. The available Fe content is low in some soils due to conversion of total Fe into less available ferric form especially under arid and semiarid conditions. Poor addition of fertilizer iron and copper to tobacco cultivated soils led to reduction in the available status of these micronutrients. High available manganese content in most of the soil samples is due to high contents of manganese bearing minerals in the parent material of these red and mixed soils under the study which were originated from recent alluviums and cainozoic laterites [5]. The soils under the deficient zone would require fertilization of these micronutrients for better crop production.

**Table 2**
**Distribution of Soil available micronutrient status in FCV tobacco growing area of SLS**

| *S.No* | *Class* | *Available Zinc* | *Available Iron* | *Available Copper* | *Available Manganese* |
|---|---|---|---|---|---|
| 1 | *Very Low* | 145 (56.2) | 1 (0.4) | 0 (0.0) | 0 (0.0) |
| 2 | *Low* | 79 (30.6) | 35 (13.6) | 14 (5.4) | 0 (0.0) |
| 3 | *Medium* | 33 (12.8) | 92 (35.7) | 66 (25.6) | 1 (0.4) |
| 4 | *High* | 1 (0.4) | 96 (37.2) | 175 (67.8) | 25 (9.7) |
| 5 | *Very High* | 0 (0.0) | 34 (13.2) | 3 (1.2) | 232 (89.9) |

*Note:* ( ) % distribution of samples under each class

**Table 3**
**Critical limits for DTPA extractable micronutrients**

| *S.No* | *Class* | *Available Zinc* | *Available Iron* | *Available Copper* | *Available Manganese* |
|---|---|---|---|---|---|
| 1 | *Very Low* | 0.0-0.5 | 0.0-2.0 | 0.0-0.1 | 0.0-0.5 |
| 2 | *Low* | 0.5-1.0 | 2.0-4.0 | 0.1-0.3 | 0.5-1.2 |
| 3 | *Medium* | 1.0-3.0 | 4.0-6.0 | 0.3-0.8 | 1.2-3.5 |
| 4 | *High* | 3.0-5.0 | 6.0-10.0 | 0.8-3.0 | 3.5-6.0 |
| 5 | *Very High* | >5.0 | >10 | >3.0 | >6.0 |

Nutrient Index and rating of micronutrients in southern light soil area of FCV Tobacco were calculated utilizing the formula as suggested by Parker *et al.* [10] and Ramamoorthy and Bajaj [13] and classified according to the suggested classes (Table 5). Nutrient index values varied from 1.14 to 3.0 among the four micronutrients. NI value for available zinc is 1.14 which is falling under the low class while available iron is medium (2.36). Available copper (2.64) and available manganese (3.0) values were in high index class according to NI classification of Parker *et al.* [10] (Table 4). Similar

**Table 4**
**Nutrient Index and Rating of Micronutrients in SLS area of FCV Tobacco**

| *NI/Rating* | *Available Zinc* | *Available Iron* | *Available Copper* | *Available Manganese* |
|---|---|---|---|---|
| Nutrient Index | 1.14 | 2.36 | 2.64 | 3.0 |
| Parker *et al.* (1951) | Low | Medium | High | High |
| Ramamoorthy and Bajaj (1969) | Low | High | High | High |

**Table 5**
**Nutrient Index classes *(Parker et., al. 1951 & Ramamoorthy and Bajaj, 1969)***

| *Nutrient index rating* | *Low* | *Medium* | *High* |
|---|---|---|---|
| Parker *et al.* (1951) | < 1.50 | 1.50 – 2.50 | > 2.50 |
| Ramamoorthy and Bajaj (1969) | < 1.70 | 1.71 – 2.33 | > 2.33 |

index classes were obtained according to Ramamoorthy and Bajaj [13] classification except in case of available iron. The light textured soils were found deficient in Zn and medium in available with low to medium classes of index values in Gir district of Gujarat as reported by Polar, J.V and Chauhan, R.B [11].

## CONCLUSIONS

The southern light soils area under the FCV tobacco cultivation had significantly low mean available zinc (0.24 µg/g) with a nutrient index value of 1.14 and followed by available iron (2.26 µg/g) with a index value of 2.36. The balanced fertilization along with micro nutrients to the soils as per requirement of FCV tobacco grown in these light textured soils would not only improve the status of macronutrients there by soil health but also help in productivity and quality of FCV tobacco.

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