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# Micronutrient Cation Status of Paddy and Sugarcane growing Areas of West Godavari District, Andhra Pradesh

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***ABSTRACT:*** *A surveywas conducted paddy-sugarcane growing areas of west Godavari district. One hundred representative soil samples were collected from sixteen mandals in paddy-sugarcane growing areas of West Godavari district by following the random sampling technique.The soils were found to be mildly alkaline, medium salinity and high in organic carbon. Further the soil were non-calcareous with high cation exchange capacity, texture varied from clay to clay loams. The soils were medium in available nitrogen, phosphorus and high in available potassium. Exchangeable calcium, magnesium, available sulphur, DTPA extractable copper ranges from (0.26 to 7.55 mg $kg^{-1}$) manganese (0.02 to 39.42 mg $kg^{-1}$), iron (0.05 to 47.08 mg $kg^{-1}$), and zinc (0.42 to 3.86 mg $kg^{-1}$). DTPA extractable copper and manganese were above critical limits, whereas iron (21%) and zinc (22%) were deficient.*

***Key words:*** *SoilsofWest Godavari, Micronutrientcations*

Micronutrients or minor elements are required in very small quantities usually less than a pound per acre per year. Most micronutrient deficiencies are not wide spread but once they occur they result in plant abnormalities, reduced growth or crop failure. Toxicities can also occur since several of these elements have rather narrow range between deficiency and toxicity levels. Once harmful levels have been established the problem is more difficult to correct than a deficiency. The importance of micronutrients cations viz. Zn, Cu, Mn and Fe to agricultural crop is well recognized but the micronutrient status in paddy, sugarcane growing soils of west Godavari is not well known. The high yielding varieties of paddy and sugarcane grown with the application of fertilizers without the supplement of micronutrients. The objective of this survey was to assess the micronutrient status of paddy sugarcane growing areas of West Godavari District.

## MATERIALS AND METHODS

The detailed soil survey was carried in paddy and sugarcane growing areas of West Godavari District and after extensive field survey hundred different soil samples collected from different mandals of paddy and sugarcane growing areas of West Godavari District. The soil samples were air dried and processed for laboratory investigation soils were analyzed for pH (1:25), electrical conductivity (1:25), organic carbon, available NP and K following standard methods (Jackson 1973). The micronutrients Zn, Cu, Mn and Fe were determined by atomic absorption spectroscopy (AAS) method.

## RESULTS AND DISCUSSIONS

### Soil Reaction (pH)

Paddy growing areas have slightly lower pH value as compared to sugarcane growing areas. The reason might be due to continuous use of acid producing fertilizers and addition of farm yard manure which releases organic acids resulting in decrease in pH since these soils were of clayey type with high buffering capacity that too under submerged conditions, while most of sugarcane growing soils (clay loams) were weakly alkaline or tending to become alkali. Similar trend was reported by Raju*et al.*, (2006) and Srinivas (2007) in some paddy-sugarcane growing alluvial soils of West Godavari district, Andhra Pradesh.

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### Electrical Conductivity

The electrical conductivity of soils indicated the soils in the study area were non-saline. Paddy growing soils have higher EC values as compared to sugarcane growing areas. This might be due to rise of ground water table during monsoon season in paddy growing soils, while low EC values in sugarcane growing soils (clay loams) were found. Similar trends were reported by Subramanian *et al.* (2005) in paddy-sugarcane cropping sequences in soils of Erode district, Tamil Nadu.

### Organic Carbon Content (%)

Paddy growing areas have high organic carbon content, reason might be due to high clay content and heavy application of farmyard manure incorporation of crop residues by farmer, while in sugarcane growing areas have low organic carbon content might be due to application of FYM and incorporation of crop residues, compost in lesser quantities. Similar results were reported by Srinivas (2003) and Devender Reddy *et al.* (2005).

**Table 1**
**Mechanical composition of soils of West Godavari district**

| S.No. | Mandal | % Sand | | % Silt | | % Clay | | Textural class |
|---|---|---|---|---|---|---|---|---|
| | | Range | Mean | Range | Mean | Range | Mean | |
| | | | | *Sugarcane growing areas* | | | | |
| 1 | Nidadavolu | 21.30-25.00 | 23.34 | 26.80-29.20 | 27.80 | 47.60-49.50 | 48.85 | C |
| 2 | Undrajavaram | 26.10-63.14 | 38.47 | 9.36-31.25 | 23.73 | 27.50-43.32 | 37.80 | CL |
| 3 | Tadepalligudem | 23.78-53.14 | 38.72 | 9.36-30.25 | 19.32 | 37.50-45.91 | 41.95 | C |
| 4 | Ungaturu | 44.10-47.40 | 44.20 | 23.50-25.00 | 24.26 | 32.60-33.40 | 33.86 | CL |
| 5 | Bhimadole | 43.42-61.28 | 44.70 | 7.5-20.18.00 | 20.89 | 31.20-36.40 | 34.40 | CL |
| 6 | Tanuku | 26.17-44.52 | 31.49 | 12.90-31.25 | 24.80 | 42.58-45.97 | 43.71 | C |
| 7 | Dwarakatirumala | 44.40-53.14 | 42.30 | 9.30-20.00 | 14.06 | 35.60-42.97 | 38.56 | CL |
| 8 | Denduluru | 33.45-52.12 | 42.70 | 17.88-24.80 | 19.06 | 30.00-41.75 | 34.58 | CL |
| | | | | *Paddy growing areas* | | | | |
| 9 | Poduru | 19.94-27.11 | 22.64 | 21.93-26.40 | 24.71 | 50.95-54.26 | 52.64 | C |
| 10 | Penugonda | 11.40-29.40 | 27.95 | 20.00-25.00 | 27.07 | 45.10-66.87 | 51.72 | C |
| 11 | Iragavaram | 33.12-43.44 | 41.50 | 9.92-24.80 | 18.30 | 31.76-46.40 | 40.18 | C |
| 12 | Undi | 26.10-32.40 | 28.22 | 20.00-31.25 | 25.78 | 42.58-47.60 | 44.50 | C |
| 13 | Bhimavaram | 41.40-47.68 | 45.58 | 9.92-21.50 | 10.78 | 42.40-46.10 | 43.63 | C |
| 14 | Pentapadu | 26.17-44.10 | 32.12 | 14.30-31.25 | 25.60 | 41.75-50.60 | 42.59 | C |
| 15 | Atchanta | 25.2-33.45 | 36.13 | 20.00-29.55 | 24.78 | 31.75-46.75 | 46.36 | C |
| 16 | Penumantra | 25.20-32.87 | 28.05 | 20.00-28.53 | 24.11 | 38.60-51.02 | 44.34 | C |

### Calcium Carbonate Content

Paddy growing soils have low $CaCO_3$ (%) content as compared to sugarcane growing soils. Similar results were reported by Siddhamalai *et al.* (1999) in rice growing tracts of Thanjavur district, Tamil Nadu.

### Exchange Capacity and Exchangeable Cations

Paddy growing soils have high CEC as compared to sugarcane growing areas. This might be due to high organic carbon and clay content. Similar results were reported by Raju *et al.* (2006).

### Mechanical Composition

Paddy growing soils contains high clay content when compared to sugarcane growing areas. The textural variation in low lands of found alluvial soils suggested lithological break which might be due to change in fluviccharacteristics of soil. Similar results were reported by Srinivas (2003).

### Micronutrient cation status of soils

#### *Available Iron (mg kg$^{-1}$)*

Available iron content of surface and sub-surface soils samples ranged from 1.64 to 34.64 mg kg$^{-1}$ and 0.05 to 47.08 mg kg$^{-1}$ with mean values of 16.47 and 14.02 mg kg$^{-1}$ respectively (Table.3). Twelve per cent of surface and seventy per cent of sub-surface soil samples were found below critical limit (< 4.0 mg kg$^{-1}$). Similar results were reported by Lakshminarayana and Rajagopal (2004) in soils of West Godavari district. Highest mean value of available iron found in paddy growing Penumantra (37.8 mg kg$^{-1}$) mandal and lowest was in sugarcane growing Dwarakatirumala (2.43 mg kg$^{-1}$) mandal. Available iron content in sugarcane growing mandals was low in mandals of Bhimadole, Nidadavolu, Tadepalligudem and Dwarakatirumala. This could be due to precipitation of iron in the form of insoluble iron compounds, particularly so in view of the high pH of these soils.

**Table 2**
**Chemical characterstics of paddy-sugarcane growing areas of West Godavari district**

| S.No | Name of the Mandal | pH | EC ($dSm^{-1}$) | CACO3 (%) | ORG.CARBON (%) | CEC(c.mol (p+) $kg^{-1}$ |
|---|---|---|---|---|---|---|
| | | | *Sugarcane growing areas* | | | |
| 1 | Nidadavolu | 7.04 | 0.56 | 2.84 | 1.09 | 48.68 |
| 2 | Undrajavaram | 6.48 | 0.34 | 0.84 | 1.02 | 29.71 |
| 3 | Tadepalligudem | 7.54 | 0.72 | 1.97 | 0.99 | 32.31 |
| 4 | Ungaturu | 7.75 | 0.52 | 1.90 | 0.75 | 30.61 |
| 5 | Bhimadole | 8.07 | 0.39 | 0.95 | 0.46 | 24.71 |
| 6 | Tanuku | 7.73 | 0.41 | 2.21 | 0.75 | 40.00 |
| 7 | Dwarakatirumala | 7.83 | 0.19 | 1.82 | 0.88 | 27.74 |
| 8 | Denduluru | 8.15 | 0.34 | 0.76 | 0.45 | 25.34 |
| | | | *Paddy growing areas* | | | |
| 9 | Poduru | 7.23 | 0.69 | 2.63 | 1.25 | 56.30 |
| 10 | Penugonda | 6.55 | 0.78 | 1.44 | 1.12 | 49.39 |
| 11 | Iragavaram | 7.04 | 0.88 | 1.01 | 1.01 | 41.17 |
| 12 | Undi | 6.14 | 0.94 | 1.17 | 1.04 | 45.59 |
| 13 | Bhimavaram | 7.13 | 0.60 | 1.17 | 1.30 | 38.75 |
| 14 | Pentapadu | 7.26 | 0.33 | 1.37 | 0.84 | 38.75 |
| 15 | Atchanta | 7.21 | 0.56 | 1.93 | 0.85 | 42.65 |
| 16 | Penumantra | 6.85 | 2.15 | 1.30 | 0.87 | 45.20 |

**Table 3**
**Available Iron content (mg $kg^{-1}$) of soils of West Godavari district**

| S.No. | Mandal | No. of samples | Surface | | | | Sub-Surface | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Range | Mean | Below critical limit % | Above critical limit % | Range | Mean | Below critical limit % | Above critical limit % |
| | | | *Sugarcane growing areas* | | | | | | | |
| 1 | Nidadavolu | 3 | 4.01-19.48 | 10.43 | 33.33 | 66.67 | 0.85-38.21 | 13.78 | 66.67 | 33.33 |
| 2 | Undrajavaram | 3 | 17.03-34.61 | 26.19 | - | 100.00 | 4.16-31.48 | 14.16 | 33.33 | 66.67 |
| 3 | Tadepalligudem | 4 | 5.39-13.68 | 10.71 | - | 100.00 | 0.98-27.42 | 8.32 | 75.00 | 25.00 |
| 4 | Ungaturu | 3 | 5.17-15.80 | 9.60 | - | 100.00 | 10.36-28.36 | 21.33 | - | 100.00 |
| 5 | Bhimadole | 3 | 2.82-13.51 | 7.31 | 33.33 | 66.67 | 3.14-5.32 | 4.43 | 33.33 | 66.67 |
| 6 | Tanuku | 3 | 2.87-10.52 | 6.46 | 33.33 | 66.67 | 0.82-31.48 | 11.17 | 66.67 | 33.33 |
| 7 | Dwarakatirumala | 3 | 2.45-14.31 | 9.67 | 33.33 | 66.67 | 0.05-6.34 | 2.43 | 66.67 | 33.33 |
| 8 | Denduluru | 3 | 2.82-11.37 | 7.43 | 33.33 | 66.67 | 1.28-10.31 | 5.63 | 33.33 | 66.67 |
| | | | *Paddy growing areas* | | | | | | | |
| 9 | Poduru | 3 | 17.51-31.43 | 22.15 | - | 100.00 | 2.92-26.52 | 11.78 | 33.33 | 66.67 |
| 10 | Penugonda | 4 | 15.67-28.52 | 24.38 | - | 100.00 | 9.70-28.23 | 19.86 | - | 100.00 |
| 11 | Iragavaram | 3 | 20.24-29.31 | 26.02 | - | 100.00 | 0.35-11.75 | 6.46 | 33.33 | 66.67 |
| 12 | Undi | 3 | 25.53-27.53 | 26.71 | - | 100.00 | 5.67-26.84 | 19.31 | - | 100.00 |
| 13 | Bhimavaram | 3 | 1.64-28.73 | 18.42 | 33.33 | 66.67 | 5.70-25.98 | 13.26 | - | 100.00 |
| 14 | Pentapadu | 3 | 5.17-27.43 | 14.94 | - | 100.00 | 3.94-28.63 | 14.31 | 33.33 | 66.67 |
| 15 | Atchanta | 3 | 7.06-28.62 | 20.85 | - | 100.00 | 7.61-28.89 | 20.51 | - | 100.00 |
| 16 | Penumantra | 3 | 11.19-29.49 | 22.37 | - | 100.00 | 25.15-47.08 | 37.80 | - | 100.00 |
| | Average | 50 | 9.15-22.74 | 16.47 | 12.00 | 88.00 | 5.17-26.92 | 14.02 | 30.00 | 70.00 |

## Available Manganese (mg $kg^{-1}$)

Available manganese content of surface and sub-surface soils ranged from 2.32 to 39.42 and 0.02 to 38.43 mg $kg^{-1}$with mean values of 16.51 and 11.61 mg $kg^{-1}$respectively (Table 4). All surface and sub-surface soil samples were found to be above critical limit. Similar trend was reported by Lakshminarayana and Rajagopal (2004) for available manganese content in paddy growing soils of West Godavari district. Highest mean value of available manganese content

was found in paddy growing Penugonda (30.26 mg $kg^{-1}$) mandal and lowest was found in sugarcane growing Ungaturu (1.12 mg $kg^{-1}$) mandal. Available manganese content of sugarcane growing areas have low values as compared to paddy growing areas. This could be due to higher pH values prevailing in sugarcane growing areas and available manganese content is significant negative correlation with soil pH (r = - 0.530).

**Available Zinc (ppm)**

Available zinc content of surface and sub-surface soils ranged from 0.43 to 3.84 mg $kg^{-1}$ and 0.42 to 3.86 mg $kg^{-1}$ with mean values of 1.36 and 1.24 mg $kg^{-1}$ respectively (Table 5). Available zinc content of 14% of surface and 30% sub-surface soil samples were found below critical limit, 86% of surface and 70% of sub-surface soils were found to be above critical limit. Similar results were reported by Lakshminarayana and Rajagopal (2004) for paddy growing areas of West Godavari district. The highest and lowest mean values were found in sugarcane growing Bhimadole (2.83 mg $kg^{-1}$) and Denduluru (0.71 mg $kg^{-1}$) mandals. Paddy growing soils have low available zinc content as compared to sugarcane growing areas. This might be due to slightly acidic soils were subjected to submerged conditions, the initial pH increases towards neutrality. There by increasing concentration of $OH^-$ and thus causing precipitation of $Zn^{2+}$ as hydroxide. This justifies the negative effect of rising pH due to submergence on $Zn^{2+}$ availability in soils. Similar results were reported by Siddhamalai*et al.* (1999) for paddy growing tracts of Tamil Nadu.

Micro nutrient status of intensively rice growing soils of Andhra Pradesh revealed that Zn deficiency was severe in Krishna – Godavari Zone, which needs regular application of $ZnSO_4$ @ 50 kg $ha^{-1}$ along with balanced N P K fertilizers to sustain the rice yields.

Available copper (mg $kg^{-1}$)

Available copper content in surface and subsurface soils of paddy-sugarcane growing areas was in the range of 0.26 to 7.37 mg $kg^{-1}$ and 0.38 to 7.55 mg $kg^{-1}$ with mean values of 2.82 and 2.90 mg $kg^{-1}$ respectively (Table.6). All surface and sub-surface soil samples were above critical limit. These results were in conformity with results of available copper content in paddy growing areas were above critical limits in West Godavari district, (Lakshminarayana and Rajagopal, 2004). The highest mean available copper content was recorded in paddy growing Undi (5.83 mg $kg^{-1}$) mandal, while the lowest value of the same was observed in sugarcane growing

**Table 4**
**Available Manganese content (mg $kg^{-1}$) of soils of West Godavari district**

| S.No. | Mandal | No. of samples | Surface | | | Sub-Surface | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Range | Mean | Above critical limit % | Range | Mean | Below critical limit % | Above critical limit % |
| | | | *Sugarcane growing areas* | | | | | | |
| 1 | Nidadavolu | 3 | 5.08-20.93 | 10.71 | 100.00 | 2.87-25.05 | 12.11 | - | 100.00 |
| 2 | Undrajavaram | 3 | 13.70-34.73 | 23.40 | 100.00 | 9.70-30.14 | 19.08 | - | 100.00 |
| 3 | Tadepalligudem | 4 | 3.26-9.47 | 6.08 | 100.00 | 0.02-2.63 | 1.33 | 50.00 | 50.00 |
| 4 | Ungaturu | 3 | 2.32-4.70 | 3.74 | 100.00 | 0.70-1.97 | 1.12 | 66.67 | 33.33 |
| 5 | Bhimadole | 3 | 2.42-4.19 | 3.36 | 100.00 | 2.76-9.78 | 5.32 | - | 100.00 |
| 6 | Tanuku | 3 | 6.37-9.24 | 7.60 | 100.00 | 3.00-27.17 | 11.08 | - | 100.00 |
| 7 | Dwarakatirumala | 3 | 2.57-15.16 | 7.32 | 100.00 | 3.12-24.84 | 11.81 | - | 100.00 |
| 8 | Denduluru | 3 | 2.42-26.76 | 14.25 | 100.00 | 1.83-3.95 | 3.12 | - | 100.00 |
| | | | *Paddy growing areas* | | | | | | |
| 9 | Poduru | 3 | 14.13-30.45 | 20.28 | 100.00 | 9.28-31.86 | 17.13 | - | 100.00 |
| 10 | Penugonda | 4 | 20.24-39.39 | 30.26 | 100.00 | 5.28-38.43 | 23.06 | - | 100.00 |
| 11 | Iragavaram | 3 | 7.06-39.42 | 27.63 | 100.00 | 7.72-35.53 | 19.13 | - | 100.00 |
| 12 | Undi | 3 | 18.78-30.43 | 26.24 | 100.00 | 6.92-30.68 | 17.15 | - | 100.00 |
| 13 | Bhimavaram | 3 | 10.97-37.13 | 21.64 | 100.00 | 4.98-20.95 | 11.19 | - | 100.00 |
| 14 | Pentapadu | 3 | 2.32-38.24 | 17.10 | 100.00 | 0.70-37.28 | 14.77 | 33.33 | 66.67 |
| 15 | Atchanta | 3 | 5.95-36.45 | 22.10 | 100.00 | 2.12-36.37 | 16.87 | - | 100.00 |
| 16 | Penumantra | 3 | 4.21-38.55 | 22.60 | 100.00 | 0.76-2.37 | 1.52 | 33.33 | 66.67 |
| | Average | 50 | 7.61-25.95 | 16.51 | 100.00 | 3.81-22.43 | 11.61 | 12.00 | 88.00 |

**Table 5**
**Available Zinc content (mg kg$^{-1}$) of soils of West Godavari district**

| S. No. | Mandal | No. of samples | Surface | | | | Sub-Surface | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Range | Mean | Below critical limit % | Above critical limit % | Range | Mean | Below critical limit % | Above critical limit % |
| | | | *Sugarcane growing areas* | | | | | | | |
| 1 | Nidadavolu | 3 | 0.81-1.21 | 1.01 | - | 100.00 | 0.82-2.16 | 1.53 | - | 100 |
| 2 | Undrajavaram | 3 | 1.44-2.22 | 1.99 | - | 100.00 | 0.61-2.83 | 1.99 | 33.33 | 66.67 |
| 3 | Tadepalligudem | 4 | 0.86-1.34 | 1.05 | - | 100.00 | 0.56-1.32 | 0.88 | 25.00 | 75.00 |
| 4 | Ungaturu | 3 | 0.68-2.22 | 1.24 | 33.33 | 66.67 | 0.58-3.86 | 2.42 | 33.33 | 66.67 |
| 5 | Bhimadole | 3 | 1.82-3.41 | 2.83 | - | 100.00 | 0.72-2.84 | 1.54 | 33.33 | 66.67 |
| 6 | Tanuku | 3 | 0.50-1.82 | 1.25 | 33.33 | 66.67 | 0.46-1.83 | 0.96 | 66.67 | 33.33 |
| 7 | Dwarakatirumala | 3 | 0.82-1.26 | 0.98 | - | 100.00 | 0.73-2.22 | 1.26 | 33.33 | 66.67 |
| 8 | Denduluru | 3 | 0.44-0.87 | 0.71 | 33.33 | 66.67 | 0.42-1.47 | 0.91 | 33.33 | 66.67 |
| | | | *Paddy growing areas* | | | | | | | |
| 9 | Poduru | 3 | 0.48-1.89 | 1.36 | 33.33 | 66.67 | 0.42-2.05 | 1.33 | 33.33 | 66.67 |
| 10 | Penugonda | 4 | 1.41-3.42 | 2.18 | - | 100.00 | 0.47-1.42 | 1.16 | 25.00 | 75.00 |
| 11 | Iragavaram | 3 | 0.89-3.40 | 1.97 | - | 100.00 | 0.92-2.22 | 1.60 | - | 100.00 |
| 12 | Undi | 3 | 1.41-3.12 | 1.98 | - | 100.00 | 1.42-1.92 | 1.60 | - | 100.00 |
| 13 | Bhimavaram | 3 | 0.81-1.82 | 1.24 | - | 100.00 | 1.16-1.46 | 1.34 | - | 100.00 |
| 14 | Pentapadu | 3 | 0.43-3.84 | 1.63 | 66.67 | 33.33 | 046-1.27 | 0.80 | 66.67 | 33.33 |
| 15 | Atchanta | 3 | 0.68-2.14 | 1.35 | 33.33 | 66.67 | 0.45-1.62 | 0.92 | 66.67 | 33.33 |
| 16 | Penumantra | 3 | 1.43-2.22 | 1.93 | - | 100.00 | 0.63-1.81 | 1.22 | 33.33 | 66.67 |
| | **Average** | **50** | **0.43-3.84** | **1.36** | **14.00** | **86.00** | **0.42-3.86** | **1.24** | **30.00** | **70.00** |

**Table 6**
**Available Copper content (mg kg$^{-1}$) of soils of West Godavari district**

| S.No. | Mandal | No. of samples | Surface | | | Sub-Surface | | |
|---|---|---|---|---|---|---|---|---|
| | | | Range | Mean | Above critical limit % | Range | Mean | Above critical limit % |
| | | | *Sugarcane growing areas* | | | | | |
| 1 | Nidadavolu | 3 | 1.15-3.27 | 2.18 | 100.00 | 1.29-4.58 | 2.67 | 100.00 |
| 2 | Undrajavaram | 3 | 1.59-5.50 | 3.23 | 100.00 | 2.53-4.17 | 3.08 | 100.00 |
| 3 | Tadepalligudem | 4 | 0.48-0.98 | 0.74 | 100.00 | 0.49-1.07 | 0.79 | 100.00 |
| 4 | Ungaturu | 3 | 0.26-1.81 | 0.82 | 100.00 | 0.55-4.71 | 2.30 | 100.00 |
| 5 | Bhimadole | 3 | 1.02-2.25 | 1.5 | 100.00 | 1.37-1.86 | 1.56 | 100.00 |
| 6 | Tanuku | 3 | 0.72-2.23 | 1.54 | 100.00 | 1.67-6.50 | 3.31 | 100.00 |
| 7 | Dwarakatirumala | 3 | 0.64-0.94 | 0.84 | 100.00 | 0.64-6.24 | 2.59 | 100.00 |
| 8 | Denduluru | 3 | 0.67-2.00 | 1.15 | 100.00 | 0.48-5.01 | 2.15 | 100.00 |
| | | | *Paddy growing areas* | | | | | |
| 9 | Poduru | 3 | 2.75-6.82 | 4.46 | 100.00 | 2.98-7.55 | 4.76 | 100.00 |
| 10 | Penugonda | 4 | 2.51-6.12 | 4.78 | 100.00 | 4.10-4.96 | 4.05 | 100.00 |
| 11 | Iragavaram | 3 | 3.83-7.06 | 5.66 | 100.00 | 3.55-4.96 | 4.37 | 100.00 |
| 12 | Undi | 3 | 4.49-7.37 | 5.83 | 100.00 | 2.57-6.53 | 4.55 | 100.00 |
| 13 | Bhimavaram | 3 | 1.53-5.82 | 3.98 | 100.00 | 1.86-4.50 | 3.44 | 100.00 |
| 14 | Pentapadu | 3 | 0.26-3.09 | 1.75 | 100.00 | 0.55-2.66 | 1.74 | 100.00 |
| 15 | Atchanta | 3 | 0.88-5.36 | 3.93 | 100.00 | 0.38-3.42 | 2.63 | 100.00 |
| 16 | Penumantra | 3 | 1.38-4.35 | 2.81 | 100.00 | 1.30-2.86 | 2.06 | 100.00 |
| | Average | 50 | 0.26-6.82 | 2.82 | 100.00 | 0.38-7.55 | 2.90 | 100.00 |

Tadepalligudem (0.74 mg $kg^{-1}$) mandal. Paddy growing soils have higher available copper content as compared to sugarcane growing soils. Sub-surface soils contained comparatively higher quantities of available copper than surface soils. This could be due to return of nutrients by the plants from surface to sub-surface layers. Addition of organic matter in the form of farm yard manure, green manuring, green leaf manuring and application of copper containing fungicides like fytolon, blue copper, blitox to pulse crop grown in rice fallows as relay crop.

**Relationship of available nutrients with Physico-chemical properties**

The coefficient of correlation obtained between soil properties and available micronutrients revealed that soil Ph has a significant and negative correlation with available iron, copper, Zinc and Manganese. The available micronutrients showed a positive and non significant correlation with clay negative and significant correlation with calcium carbonate and positive and significant correction with organic carbon in all the mandals of paddy-sugarcane growing areas of West Godavari District.

## CONCLUSION

From the experimental findings it was evident that the paddy sugarcane growing soils of West Godavari District are mildly alkaline, medium saline and high organic carbon content and cation exchange capacity. Soil analysis also revealed that these soils DTPA extractable Iron, Zinc Content was below critical limit in 21 and 22 percent samples respectively. The contents of Manganese and copper recorded above critical limit in all mandals.

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