**Short Communication**

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# Distribution of DTPA-extractable micronutrient cations in some soils of Hot Dry Subhumid agro-ecological zone of West Bengal

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Increasing cropping intensity with high yielding varieties and using high analysis fertilizers without micronutrients result in greater mining of native micronutrients in soils. Hence, there is a need to generate database on the status of micronutrients and their deficiency in soils. Agroecological zonewise generation of such information is a better approach than that done from a particular site. Keeping this in view, the present investigation was carried out to know the distribution of DTPA-Zn, Cu Fe and Mn and their relationship with soil properties in Hot Dry Sub-humid agro-ecological zone of West Bengal.

Soil samples from 21 typical pedons representing Hot dry sub-humid agro-ecological zone of West Bengal were collected, processed and analyzed for pH, organic carbon, clay content and CEC as per Jackson (1973). Available Zn, Cu, Fe and Mn were extracted with DTPA following the method of Lindsay and Norvell (1978) and their concentrations were estimated with the help of Atomic Absorption Spectrophotometer.

Fourteen pedons (P1 to P6; P8 to P12; P16 to P17and P20) belong to Alfisols, six (P7, P14, P15, P16, P19 and P21) to Inceptisols and one pedon (P13) to Entisol. Channabila (P1) and Binpur (P2) pedons from Midnapur (W) district, are developed from granite-gneiss that support forest. Bankati (P3) and Barakonda (P4) were collected from cultivated fields of Midnapur (W) district and they are developed from laterite and alluvium, respectively. Patapahari (P5), Dakshinbhal (P6) and Sirkabad (P7) occur in Purulia district and are developed from granite-gneiss. P5 is under forest and the other two are under cultivation. Mirgindihi (P8), Jharia (P9), Bhulanpur (P10), Dayalpur (P11), Taldangra (P12), Deuli (P13), Ranga (P14), Beliatore (P15) occur in Bankura district and are cultivated except P8, P14 (Forest) and P12 (Orchards). These soils have been developed in alluvium except P14. Four pedons viz. Chimpi (P16), Jagadishpur (P17), Kharbona (P18) and Nanoor (P16), located in Birbhum district, are developed in alluvium and are under cultivation. The two pedons of Bardhaman district viz. Garadaha (P20) and Panagarh (P21) developed in alluvium are cultivated.

The distributions of DTPA- Zn, Cu, Fe and Mn in different pedons and their important physical and chemical properties are presented in table 1. The pH of the soils ranged from 4.5 to 6.5, CEC from 3.9 to 13.5 cmol (+)$kg^{-1}$, clay from 13 to 33% organic carbon 2.0 to 6.3 $gkg^{-1}$ and DTPA- Zn from 0.9-1.64 $mgkg^{-1}$, Cu from 0.50-4.0 $mgkg^{-1}$, Fe from 15-109.32 $mgkg^{-1}$ and Mn from 9.5-109.5 $mgkg^{-1}$ in surface soils. In general, higher contents of DTPA-micronutrient cations have been observed in the surface than in the sub-surface layers. Sahu *et al.* (1990) also reported similar trend of distribution in rice-growing soils of Orrisa.

Results indicate that very acidic soils (below pH 5.0) are generally poor in DTPA- Zn and Cu (mean content) than the soils in near neutral condition (above pH 5.9). The available Fe and Mn (mean content), in general, are higher in acidic soils (below pH 5.0) than in the soils with pH values above 5.9 (Table 2). The positive relationship identified between pH and available Zn (mean) is in agreement with the results of Karan *et al.* (1992). Sahu *et al.* (1990), however, did not get significant relationship between DTPA-Zn and

**Table 1.** Important physical and chemical properties of soils and distribution of DTPA - Zn, Cu, Fe and Mn

| Pedon | Soil layer | Clay (%) | pH (1:2:5) | OC (gkg$^{-1}$) | CEC (cmol (+) Kg$^{-1}$ | DTPA-extractable (mgkg$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Zn | Cu | Fe | Mn |
| P1 | Surface | 14 | 6.1 | 4.9 | 10.5 | 0.96 | 0.84 | 83.82 | 15.00 |
| | Sub-surface | 19 | 6.2 | 4.6 | 11.5 | 1.43 | 0.67 | 80.86 | 16.25 |
| | Sub-soil | 36 | 5.8 | 4.3 | 12.5 | 1.76 | 0.74 | 77.46 | 12.50 |
| P2 | Surface | 19 | 6.0 | 6.3 | 12 | 0.82 | 1.88 | 80.00 | 20.00 |
| | Sub-surface | 30 | 6.0 | 6.0 | 12.8 | 0.63 | 0.52 | 51.63 | 13.50 |
| | Sub soil | 27 | 6.4 | 5.9 | 11.7 | 0.44 | 0.44 | 44.44 | 15.20 |
| P3 | Surface | 15 | 6.5 | 4.6 | 9.5 | 1.64 | 2.88 | 87.50 | 42.50 |
| | Sub-surface | 17 | 6.1 | 4.4 | 10.0 | 1.89 | 1.38 | 33.00 | 20.25 |
| | Sub-soil | 20 | 6.4 | 4.3 | 11.0 | 1.64 | 1.14 | 26.60 | 16.50 |
| P4 | Surface | 18 | 6.2 | 6.2 | 9.0 | 0.80 | 1.36 | 95.00 | 19.00 |
| | Sub-surface | 21 | 6.4 | 5.9 | 11.5 | 0.71 | 0.54 | 74.57 | 14.29 |
| | Sub-soil | 24 | 6.4 | 5.6 | 13.0 | 0.78 | 0.50 | 74.12 | 14.02 |
| P5 | Surface | 27 | 5.5 | 6.1 | 7.0 | 0.84 | 1.48 | 107.00 | 38.50 |
| | Sub-surface | 39 | 5.7 | 5.9 | 7.7 | 0.93 | 1.87 | 98.64 | 30.50 |
| | Sub-soil | 43 | 5.4 | 5.6 | 8.5 | 1.16 | 2.20 | 98.42 | 28.00 |
| P6 | Surface | 22 | 5.1 | 3.4 | 5.3 | 0.30 | 2.16 | 94.50 | 40.50 |
| | Sub-surface | 30 | 6.6 | 3.0 | 5.9 | 0.40 | 1.09 | 77.00 | 35.50 |
| | Sub-soil | 31 | 6.8 | 3.0 | 6.8 | 0.40 | 0.78 | 66.00 | 30.00 |
| P7 | Surface | 25 | 5.9 | 4.9 | 8.1 | 0.88 | 1.26 | 28.00 | 18.50 |
| | Sub-surface | 33 | 6.2 | 2.6 | 10.6 | 0.59 | 0.81 | 26.25 | 14.50 |
| | Sub-soil | 35 | 6.6 | 2.1 | 12.7 | 0.44 | 0.80 | 22.59 | 11.50 |
| P8 | Surface | 16 | 4.5 | 3.2 | 7.2 | 0.19 | 0.75 | 94.00 | 53.00 |
| | Sub-surface | 24 | 4.6 | 2.4 | 7.7 | 0.13 | 0.54 | 66.00 | 42.00 |
| | Sub-soil | 24 | 4.7 | 1.7 | 7.3 | 0.15 | 0.33 | 39.00 | 35.00 |
| P9 | Surface | 13 | 5.9 | 4.6 | 9.8 | 0.60 | 0.86 | 109.32 | 56.00 |
| | Sub-surface | 15 | 6.0 | 4.4 | 10.6 | 0.44 | 0.52 | 66.66 | 52.00 |
| | Sub-soil | 18 | 6.3 | 4.3 | 12.0 | 0.28 | 0.36 | 36.24 | 37.50 |
| P10 | Surface | 21 | 5.0 | 2.8 | 12.5 | 0.56 | 1.38 | 99.50 | 55.50 |
| | Sub-surface | 34 | 5.3 | 2.1 | 15.4 | 0.20 | 0.40 | 77.00 | 52.00 |
| | Sub-soil | 39 | 5.4 | 1.6 | 17.9 | 0.17 | 0.30 | 31.00 | 43.50 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| P11 | Surface | 33 | 5.6 | 4.0 | 13.2 | 0.96 | 3.38 | 35.50 | 19.00 |
| | Sub-surface | 35 | 6.3 | 2.7 | 16.5 | 0.67 | 2.03 | 19.40 | 15.00 |
| | Sub-soil | 38 | 6.6 | 1.8 | 18.9 | 0.72 | 1.42 | 19.00 | 11.50 |
| P12 | Surface | 20 | 4.8 | 4.4 | 7.4 | 0.60 | 2.26 | 99.50 | 31.50 |
| | Sub-surface | 28 | 5.4 | 2.4 | 9.6 | 0.50 | 1.28 | 79.00 | 26.00 |
| | Sub-soil | 31 | 5.4 | 2.4 | 12.0 | 0.20 | 0.88 | 43.00 | 13.50 |
| P13 | Surface | 21 | 5.8 | 2.8 | 9.7 | 0.88 | 1.82 | 56.00 | 25.00 |
| | Sub-surface | 9 | 6.1 | 1.9 | 8.6 | 0.72 | 0.86 | 35.70 | 20.70 |
| | Sub-soil | 8 | 6.6 | 1.6 | 8.2 | 0.64 | 0.66 | 12.50 | 17.50 |
| P14 | Surface | 20 | 4.7 | 2.8 | 6.2 | 1.15 | 0.5 | 15.50 | 9.50 |
| | Sub-surface | 44 | 5.6 | 1.4 | 8.4 | 0.86 | 0.86 | 13.00 | 9.00 |
| P15 | Surface | 20 | 5.5 | 2.5 | 6.2 | 0.72 | 4.00 | 15.00 | 10.00 |
| | Sub-surface | 23 | 6.7 | 1.5 | 7.7 | 0.55 | 1.09 | 12.50 | 7.30 |
| | Sub-soil | 24 | 6.9 | 1.3 | 10.0 | 0.30 | 0.68 | 10.50 | 4.50 |
| P16 | Surface | 27 | 6.0 | 2.3 | 13.5 | 0.62 | 2.22 | 97.00 | 56.50 |
| | Sub-surface | 51 | 6.0 | 2.0 | 16.7 | 0.87 | 0.79 | 53.20 | 23.75 |
| | Sub-soil | 38 | 6.4 | 1.9 | 13.8 | 0.72 | 0.74 | 22.60 | 18.00 |
| P17 | Surface | 24 | 4.8 | 3.8 | 10.5 | 0.42 | 2.88 | 86.50 | 32.00 |
| | Sub-surface | 46 | 6.0 | 1.9 | 15.6 | 0.15 | 0.85 | 47.75 | 23.75 |
| | Sub-soil | 39 | 6.3 | 1.4 | 18.4 | 0.76 | 0.62 | 23.50 | 12.00 |
| P18 | Surface | 15 | 5.5 | 5.7 | 3.9 | 1.60 | 2.64 | 26.00 | 17.50 |
| | Sub-surface | 28 | 5.9 | 2.1 | 7.3 | 0.79 | 0.89 | 15.50 | 12.75 |
| | Sub-soil | 12 | 6.3 | 1.9 | 7.7 | 0.55 | 0.64 | 12.50 | 9.00 |
| P19 | Surface | 25 | 5.6 | 2.8 | 8.7 | 0.66 | 1.22 | 29.50 | 13.50 |
| | Sub-surface | 27 | 6.3 | 2.1 | 13.2 | 0.50 | 0.59 | 17.76 | 11.75 |
| | Sub-soil | 30 | 7.1 | 1.8 | 14.2 | 0.32 | 0.56 | 13.50 | 11.50 |
| P20 | Surface | 31 | 5.3 | 2.0 | 8.1 | 1.00 | 1.32 | 83.50 | 109.50 |
| | Sub-surface | 27 | 5.2 | 1.7 | 7.0 | 1.32 | 0.93 | 48.75 | 86.25 |
| | Sub-soil | 22 | 5.2 | 1.5 | 4.8 | 2.60 | 0.64 | 17.00 | 55.00 |
| P21 | Surface | 21 | 5.3 | 4.7 | 8.5 | 0.85 | 2.38 | 50.50 | 47.00 |
| | Sub-surface | 25 | 6.4 | 3.0 | 10.3 | 0.70 | 1.32 | 35.00 | 26.00 |
| | Sub-soil | 32 | 6.7 | 2.0 | 12.5 | 0.70 | 0.94 | 13.00 | 18.00 |

**Table 2.** Mean micronutrient cations (mg $kg^{-1}$) in the soils under different ranges of pH, organic carbon and clay contents

| Soil layer | Range classes of pH | | | Range classes of OC ($gkg^{-1}$) | | | Range classes of clay ($gkg^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | <5.0 | 5.1-5.9 | >5.9 | <3.0 | 3.0-4.9 | >4.9 | <200 | 201-250 | >250 |
| | | | | | **Zn** | | | | |
| surface | 0.58 | 0.84 | 0.97 | 0.80 | 0.74 | 1.02 | 1.05 | 0.69 | 0.86 |
| sub-surface | 0.13 | 0.76 | 0.74 | 0.61 | 0.97 | 0.75 | 1.12 | 0.46 | 0.65 |
| sub-soil | 0.15 | 1.42 | 0.62 | 0.64 | 1.22 | 0.79 | 0.49 | 0.95 | 0.69 |
| | | | | | **Cu** | | | | |
| surface | 1.55 | 2.05 | 1.84 | 1.84 | 1.96 | 1.84 | 1.68 | 2.04 | 1.93 |
| subsurface | 0.54 | 1.04 | 0.93 | 0.91 | 0.99 | 0.97 | 0.85 | 0.72 | 1.02 |
| sub-soil | 0.33 | 0.97 | 0.73 | 0.70 | 0.74 | 1.04 | 0.55 | 0.65 | 0.86 |
| | | | | | **Fe** | | | | |
| surface | 81.10 | 57.74 | 88.66 | 56.57 | 76.91 | 77.09 | 84.39 | 55.87 | 70.27 |
| sub-surface | 66.00 | 55.31 | 45.38 | 39.29 | 59.52 | 59.52 | 74.94 | 55.32 | 51.00 |
| sub-soil | 39.00 | 55.97 | 28.25 | 23.27 | 46.77 | 72.32 | 20.41 | 33.44 | 39.22 |
| | | | | | **Mn** | | | | |
| surface | 36.30 | 34.60 | 30.60 | 39.93 | 35.50 | 23.75 | 31.81 | 29.12 | 48.12 |
| sub-surface | 42.00 | 36.08 | 21.03 | 26.52 | 30.00 | 19.43 | 27.31 | 21.19 | 27.16 |
| sub-soil | 35.00 | 34.75 | 16.19 | 21.31 | 22.16 | 19.00 | 21.33 | 25.00 | 19.24 |

pH of the soil. The positive correlation between available Cu (mean) and pH values in soils corroborates the findings of Kavimandan *et al.* (1964).

In general, soils having organic carbon (<3.0 $gkg^{-1}$) are poor in available Zn (table 2). The sub-surface soils having organic carbon ranging from 3.0 to 4.9 $gkg^{-1}$ have higher DTPA-Zn. The positive relationship between available Zn and organic carbon has also been reported by Sakal *et al.* (1988). No definite trend of relationship has been observed between organic carbon and DTPA-Cu (mean content). There is a positive relationship between organic carbon and DTPA-Fe which may be due to the formation of soluble Fe complexes by naturally occurring chelating ligands (Olomu *et al.* 1973). DTPA- Mn has negative relationship with organic carbon. DTPA-Zn is observed to decrease with increase in clay, particularly in surface layers. Arora and Sekhon (1984) also observed a significant decrease in extractable Zn with increase in proportion of finer particles in soils. An increase in DTPA-Cu was observed with increase in clay content of the soils. Mandal and Jha (1970) also reported similar findings. DTPA- Fe and Mn in the surface and sub-surface horizons are slightly higher, associated with less than 20% clay than the corresponding horizons having 20.1 to 25.0 per cent clay.

The distribution of DTPA- Zn, Cu, Fe and Mn with depth indicates that the surface horizons generally have higher contents of these nutrients. This may be attributed to their regular turnover through higher crop residues. Based on the rationale of critical limits of DTPA-. Zn, Cu, Fe and Mn in soils reported by different workers, the soils have been categorized as deficient in Zn (<1.0 mg $kg^{-1}$), Cu <0.66 mg $kg^{-1}$), Fe (<4.5 mg $kg^{-1}$) and Mn (<3.0 mg $kg^{-1}$). Eighteen out of twenty one pedons have been observed to be deficient in Zn and one pedon (P14) in Cu.

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