GAU Res. J. 1993 18 (2) : 30-32

# Distribution and Status of DTPA Extractable Micronutrient Cations in Some Soils of North and North West Agroclimatic Zones of Gujarat

K. M. Patel, R. M. Sadhasania, B. T. Patel and R. G. Patil*

Department of Agricultural Chemistry & Soil Science, College of Agriculture, Gujarat Agricultural University, Sardar Krushinagar-385 506

**ABSTRACT**

**A survey work was carried-out by excavating 10 profiles (0-15, 16-30, 31-60, 61-90 and 91-120 cm) from North and North West agroclimatic zones of Gujarat. Similarly, for knowing the status of DTPA extractable micronutrients, 10 surface (0-15 cm) samples were collected from the periphery of 2 km of each profile location. Data revealed that the content of DTPA extractable Fe and Zn was higher in the surface layers as compared to lower layers. However, gradual decrease in Mn content was found along with the depth of soil. The Cu content was maximum in 16-30 cm layer and it was found to decrease with soil depth. Further, the per cent distribution of surface samples based on critical levels was of the order of 47.8, 18.33, 1.00 and 52.56 per cent in deficient range for Fe, Mn, Cu and Zn respectively.**

*(Received on 26th Aug., 1992)*

## INTRODUCTION

Use of high analysis fertilizers and adoption of high yielding varieties in present day intensive agriculture has resulted in greater depletion of nutrients, particularly those of micronutrients. This situation become more acute in light textured and alkaline soils of Northern part of Gujarat, which are prone to micronutrients deficiencies. Not much information pertaining to vertical distribution and recent status of DTPA extractable micronutrients is available for this part of Gujarat. In order to generate some information on this aspect present survey was taken-up and the results are reported here in.

## MATERIALS AND METHODS

For determining the vertical distribution of micronutrients cations (DTPA extractable) viz. Fe, Mn, Cu and Zn in soil, 10 profiles were exposed at Research Stations of GAU coming under North and North West agroclimatic zones of Gujarat. The locations of profiles were : (1) Sardar Krushinagar, (2) Deesa and (3) Madana of Banaskantha district, (4) Jagudan and (5) Vijapur of Mehsana district, (6) Talod and (7) Khedbrama of Sabarkantha district, (8) Dehgam of Ahmedbad district and (9) Bhachau and (10) Mundra of Kutch district. From each profile, 5 samples were taken at varying depths i.e. 0-15, 16-30, 31-60, 61-90 and 91-120 cm.

*Associate Research Scientist, D.L.R.P., R.R.S., GAU, Sardar Krushinagar, (B. K.) - 385 506, (Gujarat).

*TABLE 1*

**Content (µg/g) of Fe, Mn, Cu and Zn in soil profiles.**

| *District Location* | *Depth (cm)* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Fe* | | | | | *Mn* | | | | |
| | *0-15* | *16-30* | *31-60* | *61-90* | *91-120* | *0-15* | *16-30* | *31-60* | *61-90* | *91-120* |
| **Banaskantha** | | | | | | | | | | |
| S. K. Nagar | 3.86 | 4.32 | 4.10 | 3.98 | 3.56 | 5.32 | 5.73 | 4.15 | 4.61 | 4.72 |
| Deesa | 4.26 | 4.28 | 4.12 | 4.34 | 5.45 | 10.91 | 4.23 | 4.71 | 6.36 | 8.90 |
| Madana | 6.06 | 2.52 | 2.57 | 6.22 | 2.50 | 9.53 | 8.20 | 6.53 | 8.29 | 5.25 |
| **Mehsana** | | | | | | | | | | |
| Jagudan | 3.04 | 2.84 | 2.77 | 3.15 | 2.94 | 4.98 | 6.15 | 6.49 | 6.78 | 5.01 |
| Vijapur | 3.77 | 3.64 | 4.50 | 4.96 | 4.98 | 7.90 | 7.38 | 8.54 | 9.99 | 11.51 |
| **Saharkantha** | | | | | | | | | | |
| Khedbrama | 24.88 | 15.28 | 10.41 | 8.50 | 6.37 | 19.92 | 23.00 | 15.08 | 12.95 | 6.42 |
| Talod | 4.36 | 4.08 | 4.45 | 4.63 | 4.36 | 9.65 | 7.93 | 8.26 | 9.69 | 8.70 |
| **Ahmedabad** | | | | | | | | | | |
| Dehgam | 9.15 | 12.29 | 0.10 | 7.19 | 5.30 | 12.96 | 22.86 | 27.50 | 15.86 | 12.71 |
| **Kutch** | | | | | | | | | | |
| Bhachau | 6.36 | 3.10 | 4.09 | 4.02 | 4.20 | 9.96 | 3.09 | 4.15 | 3.62 | 2.71 |
| Mundra | 6.20 | 7.32 | 6.47 | 7.99 | 15.56 | 2.64 | 2.80 | 1.97 | 1.62 | 2.05 |
| Mean | 7.19 | 5.97 | 4.36 | 5.50 | 5.53 | 9.38 | 9.14 | 8.74 | 8.00 | 6.80 |
| | Cu | | | | | Zn | | | | |
| **Banaskantha** | | | | | | | | | | |
| S. K. Nagar | 0.490 | 0.528 | 0.530 | 0.522 | 0.470 | 0.450 | 0.234 | 0.156 | 0.154 | 0.236 |
| Deesa | 0.544 | 0.550 | 0.576 | 0.632 | 0.822 | 0.766 | 0.422 | 0.186 | 0.460 | 0.354 |
| Madana | 0.728 | 0.688 | 0.598 | 0.722 | 0.478 | 0.564 | 0.210 | 0.210 | 0.328 | 0.340 |

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. |
|---|---|---|---|---|---|---|---|---|---|---|
| **Mehsana** | | | | | | | | | | |
| Jagudan | 0.626 | 1.984 | 0.786 | 1.020 | 0.566 | 0.250 | 0.278 | 0.968 | 0.314 | 0.156 |
| Vijapur | 1.286 | 1.602 | 1.476 | 1.140 | 1.032 | 0.598 | 0.484 | 0.220 | 0.212 | 0.216 |
| **Sabarkantha** | | | | | | | | | | |
| Khedbrama | 1.842 | 1.772 | 1.210 | 1.048 | 0.470 | 0.930 | 0.502 | 0.328 | 0.258 | 0.248 |
| Talod | 0.764 | 0.762 | 0.804 | 0.826 | 0.770 | 0.238 | 0.167 | 0.186 | 0.202 | 0.392 |
| **Ahmedabad** | | | | | | | | | | |
| Dehgam | 1.498 | 1.894 | 1.950 | 1.544 | 1.030 | 0.554 | 0.258 | 0.364 | 0.232 | 0.294 |
| **Kutch** | | | | | | | | | | |
| Bhachau | 0.838 | 0.526 | 0.512 | 0.500 | 0.364 | 0.618 | 0.222 | 0.462 | 0.506 | 0.306 |
| Mundra | 0.424 | 0.386 | 0.390 | 0.324 | 0.762 | 0.570 | 0.374 | 0.522 | 0.322 | 0.432 |
| Mean | 0.903 | 1.069 | 0.883 | 0.827 | 0.676 | 0.533 | 0.315 | 0.360 | 0.299 | 0.292 |

Similarly, for knowing the status of available (DTPA extractable) micronutrients cations in surface (0-15 cm) soils of North and North West agroclimatic zones of Gujarat, 10 surface soil samples were collected from 2 km periphery of each profile location except that of Sardar Krushinagar from where only 9 samples were collected.

After proper processing of soil samples, micronutrient cations were extracted using 0.005 M DTPA reagent (pH = 7.3) as described by Lindsay and Norvell (1978). Then estimation of Fe, Mn, Cu and Zn from filtrate was carried-out on Atomic Absorption Spectrophotometer (Model : Shimadzu, AA-646, Japan). The samples were then categorized in to deficient and sufficient groups based on critical values of respective elements.

## RESULTS AND DISCUSSION

### Vertical distribution of micronutrient cations

Data presented in table 1 and mean values depicted in fig. 1 reveal that Fe content was higher in surface strata and found to decrease up to 60 cm depth and thereafter tended to increase up to 120 cm. With increase in depth, Mn content was decreasing gradually. Similar decrease in Mn content with depth was also reported by Singh *et al.* (1990) for soils of Haryana. Higher content of Zn and Cu was registered at 0-15 and 16-30 cm depth, respectively. Both of these elements were almost uniformly distributed in the lower horizons of the profile. The pattern of Zn and Fe distribution (Fig. 1) in the profile clearly indicates that there is depletion of these two elements in sub-surface soil. The deficient layers of Fe and Zn

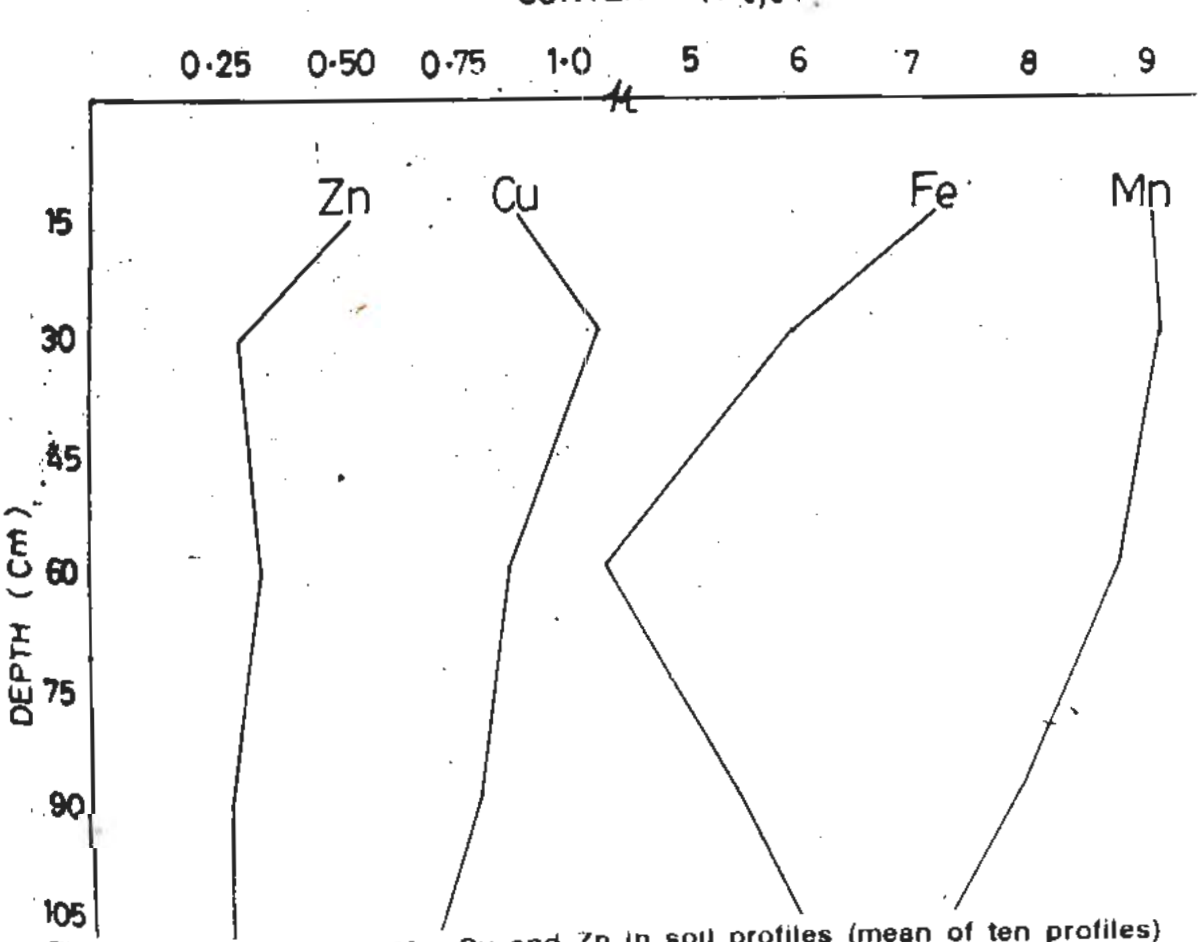


Fig. 1 - Content of Fe, Mn, Cu and Zn in soil profiles (mean of ten profiles)

are coinciding with the effective root zone of crops normally grown in this area. Deficiencies of these two elements are also reported from this area (Dangarwala *et al.* (1983) by earlier workers.

### Status of micronutrient cations

Locationwise, mean and range values of DTPA extractable cations viz. Fe, Mn, Cu and Zn are reported in table 2. Relatively higher mean values of 19.02, 21.87 and 1.55 µg/g soil for Fe, Mn and Cu content, respectively, were recorded with Khedbrama area and in the case of Zn (1.395 µg/g soil) it was with Vijapur location. This might be due to hilly area and low cropping intensity in Khedbrama area. The use of $ZnSO_4$ in Vijapur area seems to be probable reason for higher Zn content. On the other hand, lower values of 3.77 for Fe at Deesa, for Mn 2.48 and Zn 0.328 at Mundra and for Cu 0.51 µg/g soil at Sardar Krushinagar were recorded. High cropping intensity in Deesa area

*TABLE 2*

**Mean and range values (µg/g) of DTPA extractable Fe, Mn, Cu & Zn content in the soils.**

| *District*<br>*Location* | *Fe* | *Mn* | *Cu* | *Zn* |
|---|---|---|---|---|
| **Banaskantha** | | | | |
| Sardar Krushinagar | 4.78<br>(2.86-10.84) | 6.49<br>(3.86-8.44) | 0.51<br>(0.38-0.84) | 0.78<br>(0.28-1.69) |
| Deesa | 3.77<br>(2.22-5.56) | 5.90<br>(3.59-8.35) | 0.86<br>(0.59-1.90) | 1.04<br>(0.36-4.70) |
| Madana | 5.40<br>(3.62-9.56) | 10.69<br>(16.14-13.36) | 0.56<br>(0.36-0.80) | 0.38<br>(0.26-0.53) |
| **Mehsana** | | | | |
| Jagudan | 4.52<br>(3.35-8.26) | 6.55<br>(4.84-8.63) | 1.19<br>(0.48-3.27) | 0.85<br>(0.23-2.92) |
| Vijapur | 4.91<br>(3.42-8.41) | 8.65<br>(6.73-11.49) | 1.16<br>(0.65-2.10) | 1.39<br>(0.47-3.30) |
| **Sabarkantha** | | | | |
| Khedbrama | 19.02<br>(9.30-29.62) | 21.87<br>(11.28-41.88) | 1.55<br>(1.32-1.90) | 0.62<br>(0.42-0.93) |
| Talod | 6.15<br>(4.24-9.16) | 9.14<br>(4.56-17.07) | 0.60<br>(0.31-0.77) | 0.50<br>(0.19-0.93) |
| **Ahmedabad** | | | | |
| Dehgam | 6.29<br>(5.37-8.08) | 17.36<br>(5.54-25.43) | 1.03<br>(0.64-1.67) | 0.41<br>(0.29-0.66) |
| **Kutch** | | | | |
| Bhachau | 5.64<br>(4.06-10.64) | 8.11<br>(2.35-11.89) | 1.00<br>(0.19-1.79) | 0.62<br>(0.23-1.41) |
| Mundra | 8.37<br>(5.63-15.37) | 2.48<br>(1.60-3.76) | 0.83<br>(0.32-1.21) | 0.33<br>(0.17-0.60) |
| Mean | 6.89<br>(2.22-29.62) | 9.72<br>(1.61-41.88) | 0.93<br>(0.19-3.27) | 0.70<br>(0.17-4.70) |

TABLE 3

**Per cent distribution of soil samples in sufficient and deficient categories.**

| Location | Fe | | Mn | | Cu | | Zn | |
|---|---|---|---|---|---|---|---|---|
| | S | D | S | D | S | D | S | D |
| S. K. nagar | 22 | 78 | 67 | 33 | 100 | 0 | 44 | 56 |
| Deesa | 10 | 90 | 80 | 20 | 100 | 0 | 60 | 40 |
| Madana | 40 | 60 | 100 | 0 | 100 | 0 | 20 | 80 |
| Jagudan | 20 | 80 | 90 | 10 | 100 | 0 | 40 | 60 |
| Vijapur | 20 | 80 | 100 | 0 | 100 | 0 | 90 | 10 |
| Khedbrama | 100 | 0 | 100 | 0 | 100 | 0 | 70 | 30 |
| Talod | 80 | 20 | 90 | 10 | 100 | 0 | 40 | 60 |
| Dehgam | 100 | 0 | 100 | 0 | 100 | 0 | 30 | 70 |
| Bhachau | 30 | 70 | 90 | 10 | 90 | 10 | 70 | 30 |
| Mundra | 100 | 0 | 0 | 100 | 100 | 0 | 10 | 90 |
| Mean | 52.2 | 47.8 | 81.67 | 18.33 | 99 | 1 | 57.44 | 52.56 |

S = Sufficient and D = Deficient.

and proximity of Mundra to sea might have reduced the availability of Fe, Mn and Zn. An overall mean values of 6.89, 9.72, 0.93 and 0.704 µg/g soil, for Fe, Mn, Cu and Zn content, respectively, suggest that Fe and Zn content are nearer to their respective critical values, but Mn and Cu content are on sufficient side.

The soil samples were further categorized in to two groups viz. deficient and sufficient using the critical levels of 5 µg/g for Fe and Mn as suggested by Katyal and Sharma (1979) and 0.2 µg/g for Cu and 0.5 µg/g for Zn by Katyal and Randhawa (1983). Almost similar values were also reported by Dangarwala *et al.* (1983) for soils of Gujarat. The per cent deficient values of Fe range between 0 to 90 and that of Zn from 10 to 90 per cent. Similar extent of Zn deficiency was also reported by Singh and Sekhon (1991) and Dangarwala *et al.* (1983). However, this was not the case with Mn and Cu content excepting Mundra location (Table 3). From the overall mean per cent dificient values (Fig. 2) of 47.8 and 52.56 for fe and Zn,

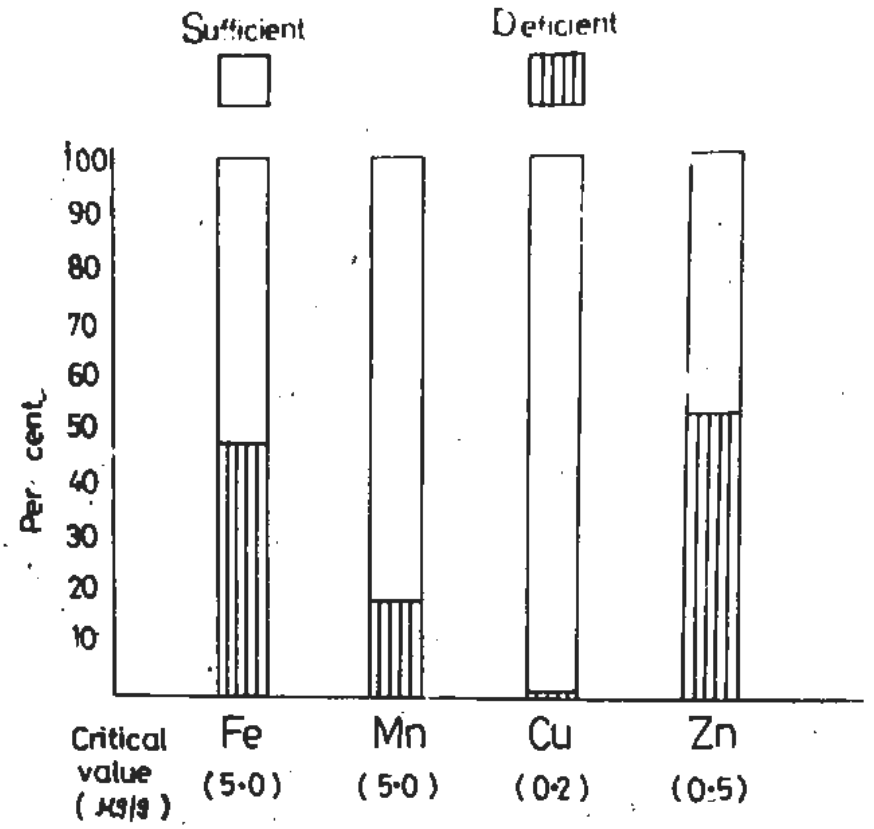


**Fig. 2 : Distribution of surface samples into sufficient and deficient categories**

respectively, it can be said that an application of Fe and Zn considering the soil type, its analysis and cropping pattern, may prove beneficial in this area. In the case of Mn, the per cent deficient samples (18.33) clearly indicate that some attention should be paid toward this element. So far as, Cu content is concern, there is no need to worry about it at present.

## REFERENCES

Dangarwala, R. T.; Trivedi, B. S.; Patel, M. S. and Mehta, P. M. (1983). Micronutrients Research in Gujarat, Gujarat Agricultural University, Anand Campus, Anand.

Katyal, J. C and Sharma, B. D. (1979). Role of micronutrients in crop production. *Fert. News.* **24** (9) : 33-50

Katyal, J. C. and Randhawa, N. S. (1983). *In* micronutrient, FAO Fertilizer and Plant Nutrition Bull. No. 5, Rome, p 92.

Lindsay, W. L. and Norvell, W. A. (1978). Development of DTPA micronutrient soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Am. J.* **42** : 421-428.

Singh, Kuldeep; Goyal, V. P. and Singh, Mahendra, (1990). Distribution of micronutrient cations in semi-arid alluvial soil profiles. *J. Indian Soc. Soil. Sci.* **38** : 736-737.

Singh, Muneshwar and Sekhon, G. S. (1991). DTPA extractable micronutrient cations in twenty soil series of India *J. Indian Soc. Soil. Sci.* **39** : 129-133.