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# MICRONUTRIENT STATUS OF SELECTED BENCHMARK SOILS IN PUNJAB AND THEIR RELATIONSHIP WITH SOIL PROPERTIES

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This study reports the micronutrient status of 20 benchmark soils of Punjab which belonged to the orders: Entisols, Inceptisols, Aridisols and Alfisols. Seventy seven (77) samples from 0–15 cm soil depth were collected from different soil series. These soils were analyzed for various physico–chemical characteristics and AB–DTPA extratable micronutrients.

All the soil series were well supplied with Cu, Fe and Mn. Whereas 45% of the soils contained <1.5 mg $kg^{-1}$ Zn and 15% samples contained < 0.9 mg $kg^{-1}$ Zn, rest of the soils contained sufficient Zn. Copper and Zn were positively correlated with clay content in soils. All the micronutrients were negatively associated with soil pH and lime. Micronutrients do not seem to have any association with organic matter except for Mn, which was positively associated with it.

## INTRODUCTION

Soils of the Punjab are in the initial stages of chemical weathering and have got fair amounts of easily weatherable minerals (Chaudhri, 1978). Their characteristics vary from non saline non sodic to saline sodic; non calcareous to calcareous with invariably low organic matter (Mushtaq, 1986). The soils have developed in alluvium, or loess or residuum from sand stone and shale. Generally, the soils have mixed mineralogy.

The climate of the sampled area ranges from semiarid to subhumid subtropical continental (Ahmad, 1951). In view of diversity of factors such as parent material, precipitation, temperature, soil physico – chemical characteristics, land use and soil management, micronutrient status in various soil series is likely to vary to a great extent.

Rapidly developing demographic pressure has necessitated the need for increased agricultural production through increased cropping intensity, introduction of high yielding crop varieties and liberal use of pure forms of chemical fertilizers (N, P and K). This process is continuously mining the micronutrients from our soil resources. Since crop production is based not only on the use of the major nutrients, determination of micronutrient status of the soils becomes essential. Earlier efforts in this direction were mostly based on evaluating the micronutrient status of soils occuring in a particular area / district (Khattak and Parveen, 1986; PARC1986; Tahir, 1981). But since the soil series have defined range of soil characteristics it was thought more logical to determine the micronutrient status of soil series using AB – DTPA – a promising universal soil extractant and examine relationships between the micronutrients and the soil properties.

## MATERIALS AND METHODS

For the study twenty major soil series (see Table 1 ) were selected. The soil-samples from 0 –15 cm soil depth were collected. The soil samples from the soil series were collected from the districts of Gujranwala, Sheikhupura, Lahore, Sahiwal, Okara, Shahpur, Faisalabad, Kasur, Gujrat, Attock and Rawalpindi. These samples were air dried, ground with wooden pestle and mortar, passed through a sieve ( 2mm ) and

**Table 1. Soil Characteristics of Various Soil Series.**

| Soil Series | No. of Samples | Soil Texture | Clay % | Soil pH | Lime % | Organic Matter % | U.S. soil Classification. |
|---|---|---|---|---|---|---|---|
| Shujahabad | 5 | sandy clay loam to clay loam | 24.78 | 8.30 | 4.40 | 0.78 | Typic Camborthids |
| Gandhra | 4 | Loam tending to sandy loam | 19.75 | 8.67 | 5.75 | 0.69 | Typic Camborthids |
| Shahpur | 2 | Silty Clay | 43.25 | 8.40 | 8.50 | 0.86 | Ustollic Camborthids |
| Hafizabad | | Loam | 24.46 | 8.43 | 2.92 | 0.80 | Ustalfic Neplargids |
| Rasulpur | 4 | Sandy loam | 21.42 | 8.40 | 1.15 | 0.64 | ustollic Camborthids |
| Bhalwal | 7 | silty clay | 26.78 | 8.41 | 4.70 | 0.97 | Udic Haplustalfs |
| Gujiana | 4 | silty clay loam tending to clay loam | 30.08 | 8.92 | 6.95 | 0.51 | Typic Ustochrepts |
| Lyallpur | 4 | silt loam | 23.50 | 8.25 | 2.75 | 0.96 | Udic Ustochrepts |
| Bagh | | silt loam | 12.60 | 8.25 | 3.00 | 0.86 | Typic Ustochrepts |
| Bahalike | 4 | silty clay loam | 26.55 | 8.45 | 2.87 | 0.89 | Ustollic Camborthids |
| Miani | 5 | sily clay loam | 26.72 | 8.42 | 3.84 | 0.84 | Typic Camborthids |
| Kasur | 2 | silt loam | 25.60 | 10.05 | 10.50 | 0.48 | Typic Camborthids |
| Dungi | 1 | silty clay | 42.20 | 8.80 | 8.50 | 0.89 | |
| Gujranwala | 1 | silty clay loam | 27.20 | 8.20 | 0.40 | 1.13 | Udic Haplustalfs |
| Peelo | 1 | clay loam | 29.02 | 8.76 | 3.80 | 0.93 | Typic Haplaquepts |
| Balkasar | 6 | clay loam | 13.61 | 7.55 | 9.15 | 0.93 | Udic Haplustalfs |
| Qazian | 2 | sandy loam | 10.50 | 8.25 | 3.50 | 0.59 | Lithic Torrisamments |
| Missa | 6 | silt loam | 12.75 | 7.81 | 17.17 | 0.80 | Typic Ustochrepts |
| Ternaul | 3 | silty clay loam | 11.00 | 8.23 | 5.66 | 0.85 | Typic Ustochepts |
| Guliana | 1 | silty clay loam | 15.00 | 7.90 | 0.20 | 1.20 | Udic Haplustalfs |

**Table 2. Interpretation for AB – DTPA extractable micronutrient in soils ( Soltanpour, 1985).**

| Element | Low | Medium | High |
|---|---|---|---|
| Cu | 0–0.2 | 0.3–0.5 | >0.5 |
| Zn | 0–0.9 | 1.0–1.5 | >1.5 |
| Fe | 0–3.0 | 3.1–5.0 | >5.0 |
| Mn | 0–0.5 | 0.6–1.0 | >1.0 |

stored in clean labelled plastic containers. They were analysed for soil texture, soil pH, lime and organic matter contents using standard techniques ( Table 1 ). AB – DTPA extractable micronutrients ( Cu, Zn, Fe and Mn) were determined according to the procedure of Soltanpour ( 1985 ) and was correlated with the physico – chemical characteristics of the soil series.

## RESULTS AND DISCUSSION

### Soil Characterization :

Physico – chemical characteristics of the soil series ( Table 1 ) indicate that the soils varied in texture from sandy loam to silty clay. Clay content in the soils ranged from 10.50 to 43.50%. All the soils except Gujranwala and Guliana were calcareous. The soil reaction varied from moderately alkaline to very strongly alkaline ( pH values ranging from 7.55 to 10.05 ) and lime content ranging from 0.2 to 17.2 %. Organic matter content ranged from 0.48 to 1.20%. The soils belonged to the orders: Entisols, Inceptisols, Aridisols and Alfisols.

### Micronutrient Status:

#### COPPER

AB – DTPA extractable Cu level in the soil series ranged from 1.09 to 5.9 mg $kg^{-1}$ The highest Cu content was recorded for Guliana soil series whereas the lowest value of Cu was determined for Ternaul soil series. Most of the soils ( 70% ) contained 3 mg $kg^{-1}$ Cu. Rest of the 30% soils contained Cu below 3 and above 1.09 mg kg . According to the limits given by Soltanpour (1985 ) presented in Table 2, none of the soils was deficient in Cu. All the soils were rather high in it.

#### ZINC

Zn levels in the soil series were comparatively lower. Forty five per cent soil series contained Zn less than 1.5 mg $kg^{-1}$. * According to Soltanpur (1985) soils with this range of Zn content are medium in Zn. Fifteen per cent soils were low in zinc because they contained Zn less than 0.9 mg $kg^{-1}$

* Bhalwal, Rasulpur, Miani, Gujranwala and Hafizabad soil series were well supplied with Zn. Balkasar, Qazian, Guliana and Gandhra were rather low in it. Rest of soil series contained Zn slightly higher than medium level of Zn.

#### IRON

None of soil series was deficinet in iron and all of them contained rather high contents. Rasulpur soil series was exceptionally high in iron content (60 mg $kg^{-1}$). Other soils which also contained very high contents of iron were Peelo , Guliana, Miani, Bhalwal and Shujaabad. Gujranwala, Dungi, Kasur, Gujiana, Bagh, Bahalike, Gandhra and Shahpur contained comparative lower Fe contents.

#### MANGANESE

All the soil series were rather very high in Mn content because most of them(90%) contained > 5 mg $kg^{-1}$ Mn . Only 2 soil series i.e. Gujiana and Miani contained Mn below 5 mg $Kg^{-1}$. Soils series which were rather very high in Mn content are given in

**Table 3. Correlation Co – efficient between soil characteristics and the micronutrients**

| Soil characteristics | AB–DTPA extractable Micronutrients | | | |
|---|---|---|---|---|
| | Cu | Zn | Fe | Mn |
| Clay | 0.54** | 0.48** | 0.02 | –0.02 |
| Soil pH | –0.25* | –0.37** | –0.13 | –0.25 |
| Lime | –0.29** | –0.47** | –0.24* | –0.34** |
| Organic matter | 0.15 | 0.05 | 0.18 | 0.27* |

ascending order: Gandhra, Peelo, Shujaabad, Guliana, Miani and Hafizabad.

**RELATIONSHIP OF MICRONUTRIENT CATIONS WITH SOIL PROPERTIES.**

Cu and Zn are significantly positively associated with clay content in soil ( Table 3 ) and negatively associated with soil pH and lime content. Similar results have been reported by Ranjha et al (1987) and Rashid et al. (1987 ). Both of these micronutrients were poorly correlated with organic matter content of the soil series. Iron and Mn were also significantly but negatively correlated with lime content of the soils. Also, they were negatively associated with soil pH but the correlation values were rather low. Similar results have been reported by Ranjha et al. ( 1987 ) . Iron and Mn were slightly better correlated with organic matter content than were Cu and Zn.From the above findings it is concluded that clay fraction of soil appears to be the main carrier of extractable Cu and Zn but not for Fe and Mn. The organic matter content on the other hand which is known to be associated with micronutrient cations, does not have any influence on the micronutrients studied except for Mn which is positively associated with organic matter content.

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