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Short Communication

STATUS OF SULPHUR AND ZINC IN HAMIRPUR SOILS AND THEIR ASSOCIATION WITH SOME SOIL PROPERTIES

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Inventory of available S and Zn status of the soil helps in demarcating areas where application of particular nutrient is needed for profitable crop production. The soil must supply S and Zn for desired growth of plants and synthesis of human food. The continuous use of S and Zn free high analysis N and P fertilizers in the intensive cropping system with the diminishing use of organic manures has resulted in the depletion of S and Zn from the soil reserves. The improper nutrient management has led to emergence of sulphur and zinc deficiencies in the soils. The deficiencies of S and Zn which were sparse and sporadic initially are now widespread. Since no systematic information is yet available on status of sulphur and zinc in soils of Hamirpur district of Uttar Pradesh, the present study was conducted to assess the status of S and Zn in soils of the district and find out the relationship of various soil properties with available S and Zn. Two hundred surface soil (0-23 cm) samples were collected from four types of soils namely Rakar, Parwa, Kabar and Mar of district Hamirpur. These soil samples were analysed for pH, EC, organic carbon, silt + clay and $CaCO_3$ by adopting standard procedures (Jackson 1973). Available S was extracted from soil with 0.15% $CaCl_2$ solution and in the extract S was determined by turbidi metric method (Chesnin and Yien, 1951). Available Zn in these soils was extracted by DTPA (0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 trienthnolamine, pH 7.3) as per method described by Lindsay and Norvell (1978) and Zn in the extract was determined on Atomic Absorption Spectrophotometer. The soils were neutral to alkaline in reaction, the variation in pH being from 7.0 to 7.9 in Rakar soils, 7.2 to 8.2 in Parwa soils, 7.0 to 8.4 in Mar soils and 7.0 to 8.4 in Kabar soils. The electrical conductivity (EC) ranged from 0.18 to 0.89 in Rakar soils, 0.19 to 0.72 in Parwa soils, 0.21 to 1.01 in Mar soils and 0.24 to 1.72 dSm^{-1} in Kabar soils. Organic carbon content varied from 0.7 to 6.4, 4.8 to 13.4, 1.4 to 22.3 and 11.8 to 22.5 g kg^{-1} in Rakar, Parwa, Mar and Kabar, soils, respectively. It showed a considerable variation with types of soils with lowest mean value of 3.4 g kg^{-1} in Rakar soils and highest in Kabar soils (16.3 g kg^{-1}). The calcium carbonate content of soils, which varied from 4.5 to 78.0 g kg^{-1}, is a useful parameter to assess the extent of nutrient availability and their release behaviour. The silt +clay content varied from 13.01 to 20.01, 20.54 to 29.45, 47.29-72.19 and 48.29 to 69.29 % in Rakar, Parwa, Mar and Kabar soils, respectively.

Table 1: Physico-chemical characteristics and available S and Zn status of soils of Hamirpur district

Soil characteristics	Soil Types			
	Rakar	Parwa	Mar	Kabar
pH	7.0-7.9	7.2-8.2	7.0-8.1	7.0-8.4
EC (dSm^{-1})	0.18-0.89 (0.48)	0.19-0.72 (0.42)	0.21-1.01 (0.45)	0.24-1.72 (0.67)
$CaCO_3$ (gKg^{-1})	5.7-9.4 (7.5)	4.5-12.0 (7.2)	15.0-78.0 (27.0)	10.0-47.0 (24.0)
Organic carbon (g kg^{-1})	0.7-6.4 (3.4)	4.8-13.4 (7.7)	10.4-22.3 (7.9)	11.8-22.5 (16.3)
Silt + clay (%)	13.01-20.01 (16.38)	20.54-29.45 (24.19)	47.29-72.19 (57.49)	48.29-69.29 (56.41)
Available sulphur (kg ha^{-1})	8.25-18.46 (13.68)	7.84-19.75 (13.43)	14.50-45.70 (30.97)	17.23-48.60 (34.65)
Available zinc (mg kg^{-1})	0.22-4.33 (1.20)	0.32-5.25 (1.48)	0.25-5.20 (1.46)	0.45-6.71 (1.79)

Available S (extracted by 0.15% $CaCl_2$) is used as an index of S availability in many soils, since the variation in this form causes variations in yield and uptake of S in crops. The average available S content ranged from 7.84 kg ha^{-1} in Kabar soils to 48.60 kg ha^{-1} in Parwa soils (Table 1). Available S ranged from 8.25 to 18.46 kg ha^{-1} with a mean value of 13.68 kg ha^{-1} in Rakar soils, 7.84 to 19.75 kg ha^{-1} with a mean value of 13.43 kg ha^{-1} in Parwa soils, 14.50 to 45.70 kg ha^{-1} (mean of 30.97 kg ha^{-1}) in Mar soils and 17.23 to 48.60 kg ha^{-1} mean of 34.65 kg ha^{-1} in Kabar soil. On an average, 58 and 42 percent soils

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of Hamirpur district were low and marginal in available S, respectively. Variation in SO_4-S in different soils could be explained on the basis of variation in organic carbon, clay, pH and other soil properties. Available S was significantly and positively correlated with organic carbon. The observed significant positive correlation of available S with organic carbon suggests that sulphur supplying power of these soils is largely dependent upon organic carbon. The available S was correlated positively and significantly with silt+ clay content (Table 2) whereas with EC and $CaCO_3$ it did not exhibit any significant correlation. Similar relationships between available S and soil properties were reported by Ghosh et al. (2005) and Kour and Jalali (2008).

Table 2: Correlation matrix between soil properties and available nutrients

Soil Properties	Available Nutrients	
	Sulphur	Zinc
pH	-0.51**	-0.66**
EC	0.21	0.11
Organic Carbon	0.49**	0.62**
$CaCO_3$	0.10	-0.73**
Silt + Clay	0.46**	0.63**

*** Significant at 1% level*

The DTPA-Zn values varied widely (0.22-6.71 mg kg^{-1}) in different soils of Hamirpur district. The highest mean value of Zn (1.79 mg kg^{-1}) was recorded in Kabar soils and lowest (1.20 mg kg^{-1}) in Rakar soils. Thus, Kabar soils were relatively rich in DTPA-Zn as compared to other soil types. Similar results were reported by Yadav and Meena (2009) and Singh et al. (2009). Critical limits for DTPA-Zn identified by Takkar and Mann (1975) are < 0.6, 0.6-1.2 and > 1.2 mg kg^{-1} for deficient, medium and high categories, respectively. Accordingly, 33% soil samples in Hamirpur district are classified as deficient, 36% marginal and 31% adequate in available Zn. The Rakar and Parwa soils had low to marginal level of Zn which indicates that corrective measures would be required to avoid Zn deficiency in the near future. Almost similar results have been reported by Singh et al. (2009). Soil pH showed significant relationship with DTPA-Zn. Association with EC and available Zn was not observed in our study probably due to a narrow range of EC of the soils. Calcium carbonate exhibited significant negative relation with available Zn status as reported by Yadav and Meena (2009). Organic carbon content of these soils was positively correlated with the extractable quantities of Zn under all the four soil types. The availability of Zn increased with the increase in organic matter because organic matter acts as chelating reagent. Singh et al. (2009) reported that organic carbon showed positive relationship with available Zn. The results suggested that higher organic carbon content in soils leads to protection of crops from zinc deficiency. Availability of Zn increased significantly with increase in silt + clay as reported by Yadav and Meena (2009). It is apparent from the study that the status of available S and Zn is relatively low in Rakar and Parwa soil than those of Mar and Kabar soils. The silt + clay and organic carbon are the soil properties that mostly increase the availability of S and Zn. On the other hand, availability of nutrients was reduced with increase in $CaCO_3$ and soil pH.

REFERENCES

Chesnin, L. and Yien, C.H. (1951) Turbidimetric determination of available sulphate. *Soil Science Society of America Proceedings* **15**, 149-151.

Ghosh, G.K., Chattopadhyay, G.N. and Chattopadhyaya, S. (2005) Availability and forms of sulphur in red and lateritic soils of Birbhum district of West Bengal. *Journal of the Indian Society of Soil Science* **53**, 464-466.

Jackson, M.L. (1973) *Soil Chemical Analyses.* Prentice Hall of India Private Limited, New Delhi.

Kour, S. and Jalali, V.K. (2008) Forms of sulphur and their relationships in soils of different agroclimatic zones of Jammu Region. *Journal of the Indian Society of Soil Science* **56**, 309-312.

Lindsay, W.L. and Norvell, W.A. (1978) Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Science Society of America Journal*. **42**, 421-428.

Singh, V.K., Agrawal, H.P. and Prasad, S. (2009) Distribution of DTPA-extractable micronutrients in the soils of district Ghazipur, Uttar Pradesh. *Journal of the Indian Society of Soil Science* **57**, 370-372.

Takkar, P.N. and Mann, M.S. (1975) Evaluation of analytical methods for estimating available zinc and response of maize to applied zinc in major soil series of Ludhiana, Punjab, India. *Agrochimica* **20**, 420-430.

Yadav, R.L. and Meena, M.C. (2009) Available micronutrients status and their relationship with soil properties of Degana soil series of Rajasthan. *Journal of the Indian Society of Soil Science* **57**, 90-92.