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Analyzing the micronutrient status of basmati growing areas of Jammu subtropical region

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Abstract
An experiment examining the soil micronutrient status of the basmati growing areas of the Jammu sub-tropical was conducted. A total of 180 samples were collected from the study area. Surface soil (0-30) was examined for DTPA extractable Zn, Cu, Fe and Mn. The mean value of DTPA extractable Zn, Cu, Fe and Mn were 1.38, 3.89, 30.89 and 15.16 with a range of 0.18-13.07, 0.10-34.80, 4.50-80.65 and 2.40-64.88 μkg^{-1}. From the study it was observed 43.8% of the samples were deficient in Zn while as 11.78% of the samples were deficient in Cu where Fe and Mn were present above critical limit.

Keywords: micronutrient, Zn, Cu, Fe, Mn, basmati, Jammu subtropical

Introduction
The Jammu subtropical region (Jammu, Kathua and Samba) are known to be cultivated with basmati out of which the maximum share being Cv B-370 occupying nearly 91.6% of the total area under basmati production. Basmati being a major export commodity with its export steadily growing from 7.71 lakh metric tons in 2003 to an estimate of 4.05 million metric tons in 2015-16 [1] and it is grown only in India and Pakistan, where as 70% of the total production is from India. Micronutrients play and vital part in the physiological and physical growth of plants, and have been proven indispensable for production of food grains especially Zn whose deficiency causes Khera disease in rice [8]. These micronutrients are indispensable for optimal plant growth. They are vitally imperative for gene expression, synthesis of proteins, nucleic acids, growth substance, chlorophyll, secondary metabolism of carbohydrates and lipids, stress tolerance etc. (2, 3, 10) Weathering of rocks, atmospheric deposition in dust form are among the main sources of micronutrients which occur in different chemical form *i.e* water soluble, exchangeable, chelated or complexed oxide or secondary clay mineral, primary minerals etc. (7). The All India Coordinate Project on Micronutrients states that currently 48% in Zn, 11.2% in Fe, 7% in Cu and 5.1% in Mn soils are deficient. The soils of Jammu region are also found to be micronutrient deficient (5, 6, 9, and 12).

Materials and Methods
Basmati is known to grow best in the Himalayan foothills, but basmati is now being protected under GI and in J&K it is limited to Jammu, Kathua and Samba region (1), therefore the present investigation was carried out to access the availability of some micronutrients in these soils. A total of 180 samples were collected from the Jammu subtropical region. The samples were analyzed for physic chemical properties using the standard procedure and for the DTPA extractable micronutrients Zn, Cu, Fe and Mn (4).

Result and Discussion
Soil Characteristics: The data pertaining to the physic chemical properties is present in Table 1. Soils of Jammu Subtropical, which were collected and analyzed for the purpose of this study varied from clay, clay loam, sandy loam and sandy clay loam in texture with pH ranging 5.30-8.84, EC 0.04-0.96, OC 1.05-9.80.

Table 1: Major chemical characteristics of the soils of Jammu Subtropical

S No.	Soil characteristics	Mean	Range
1	pH	6.94	5.30-8.84
2	EC (ds/m)	0.28	0.04-0.96
3	OC gkg^{-1}	5.92	1.05-9.80
4	Clay	32.99	10.00-56.70
5	Zn µkg^{-1}	1.38	0.18-13.07
6	Cu µkg^{-1}	3.89	0.10-34.89
7	Fe µkg^{-1}	30.89	4.50-80.65
8	Mnµkg^{-1}	15.16	2.40-64.88

Micronutrients concentration

Zinc: The data pertaining to available micronutrient status is present in Fig 1. Zn concentration in the lithosphere is 67 mg kg^{-1}. It has a strong tendency to combine with sulfide ores and it occurs most frequently in the lithosphere as sphalerite (11). Available Zn in the study area varied from 0.18-13.07 µg kg^{-1}, with an average of 1.38 µg kg^{-1}. Considering 0.60 µg kg^{-1} as the critical limit a total of 43.8% soils were found to be below critical limit. The result might attribute that soil OM reduces pH to some extent increasing the Zn solubility besides its effect on weathering of Zn containing minerals and formation of cheated Zn. The variation in the concentration of Zn might be due to the difference in OM, pH etc. pH (0.060) and OC (0.050) had a positive but non-significant correlation with Zn where as EC (-0.303**) and Clay (-0.511**) had a negative and significant correlation.

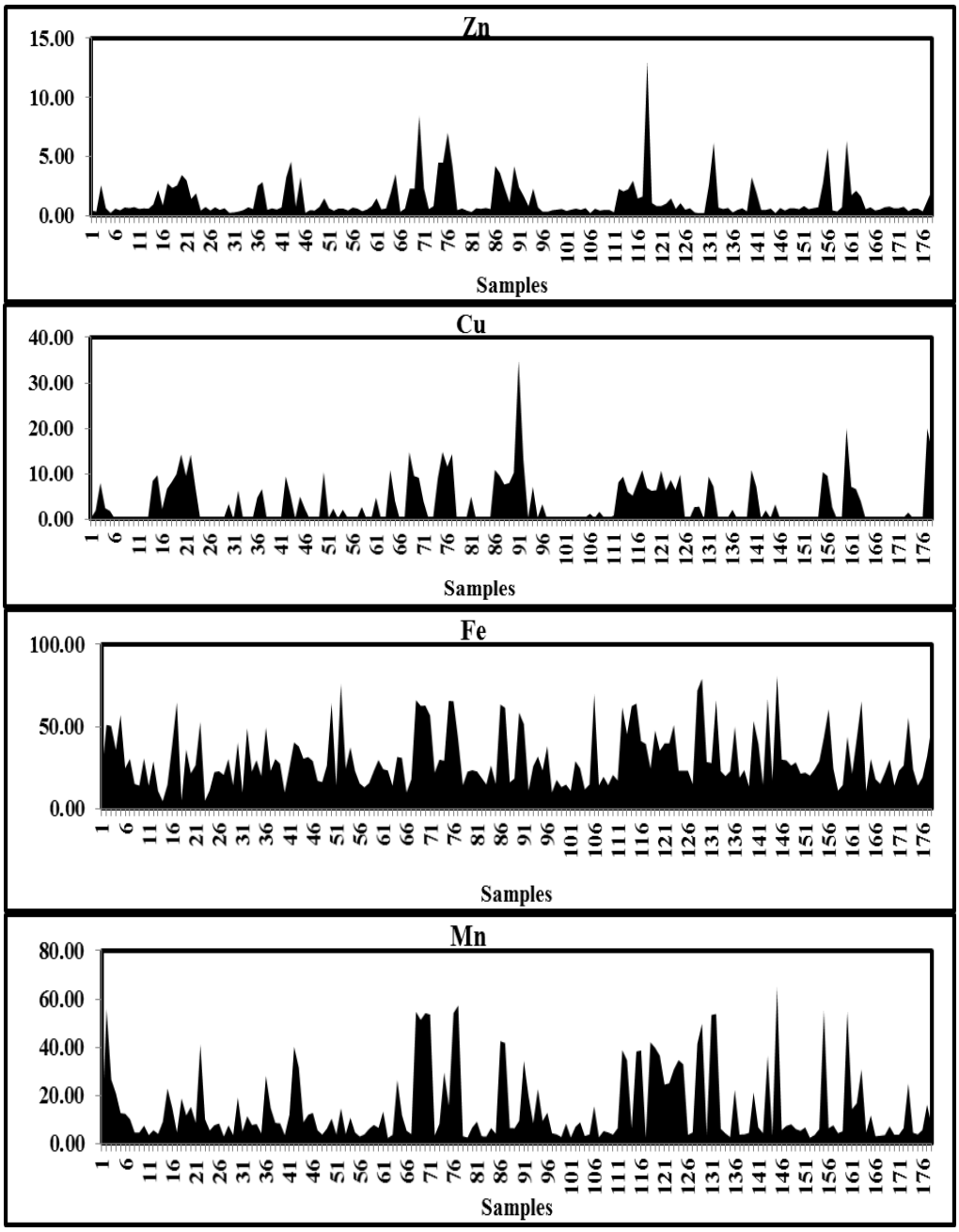

Fig 1: Micronutrients (Zn, Cu, Fe and Mn) status of Jammu Subtropical.

Copper

The concentration of Cu in the earth's crust is averaged 28 mg kg^{-1} (11). Considering 0.20 µg kg^{-1} as the critical limit 11.78% of the samples were below critical limit. Available Cu in the study area varied from 0.10-34.89 µg kg^{-1}, with an average value of 1.38 µgkg^{-1}. The variation in the Cu concentration among different locations varied due to the diverse pH, OM and clay. Cu showed a positive non-significant correlation with pH (0.089), but a negative and significant correlation with EC (-0.311**) and clay (-0.640**) while as a negative

non-significant relation with OC (-0.124).

Table 2: Correlation among the different soil parameters under study.

	Zn	Cu	Fe	Mn
pH	0.060	0.089	-0.220*	-0.113
EC	-0.303**	-0.311**	-0.213**	-0.364**
OC	0.050	-0.124	0.119	0.029
Clay	-0.511**	-0.640**	-0.430**	-0.518**

**Significant at 1%
*Significant at 5%

Iron

The Fe concentration in the earth's crust and is the fourth most abundant element in the lithosphere (11). Most of the soil Fe is found in the primary minerals, clays, oxides and hydroxides. Considering 4.5 µg kg^{-1} as the critical limit, none of the samples were found to be below the critical limit. Fe in the study area was found to be in the range of 4.50-80.65 µg kg^{-1} with an average of 30.89 µg kg^{-1}. The study area was found to be highly contaminated with Fe. Fe showed a negative and significant relation with pH (-0.220*), EC (-0.213**) and Clay (-0.430**) while as with OC (0.119) it showed a positive non-significant relation.

Manganese

The Mn concentration in the earth's crust is 1000 mg kg^{-1}. (11). Considering 4 µg kg^{-1} as the critical limit, none of the samples were found to be below critical limit. Mn in the study area was found to be in the range of 2.40 - 64.88 with an average value of 15.16 µg kg^{-1}.Mn showed negative significant correlation with EC (-0.364**) and Clay (-0.518**) while as a negative non-significant with pH (-0.113) and a positive non-significant correlation with OC (0.029).

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