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Micronutrients status and their relationship with soil physicochemical properties of Naugarh block, Chandauli district, Uttar Pradesh, India

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Abstract
Considering insufficient data on the status of micronutrients in Uttar Pradesh soils, the current inquiry was conducted to study the accessible micronutrient status and its relation to the physico-chemical characteristics of Naugarh block soils, Chandauli district, with distinct crop patterns and irrigated by the Ganga river and canal dams. In total, 52 samples were gathered and analyzed in the laboratory using conventional laboratory techniques from 5 Naugarh block villages. Results of this research show that in Naugarh block soils Fe, Mn, Cu and Zn are discovered at marginal level. Therefore, in perspective of a better agriculture with high yielding varieties, it is necessary to add this micronutrient for a long time to the soil.

Keywords: Micro-nutrient status, physico-chemical characteristics, Naugarh block, etc.

Introduction
Soil is an essential ecosystem element that relies on various life support systems and socio-economic growth. Nowadays, however, the ability of a soil to generate is decreased, and many inherent features, agro-ecological considerations, set manufacturing boundaries. Soils are vital to life on this planet earth and are therefore regarded one of the most significant natural resources. Therefore, understanding the soil system is a key to effective land use and environmental harmony. Soil quality degradation includes physical, chemical and biological degradation procedures with regard to fertility, according to (Lal and Singh, 1998)[4]. This is a prerequisite for determining suitable conservation actions in the management of our natural resource base.

Uttar Pradesh has a geographical region of 3, 42, 239 square. Km, which accounts for 10.41% of the country's land, is regarded to be the country's fourth biggest state based on its geographical region and is situated in the south eastern portion of the nation (Census, 2012 Provisional information). Agriculture projection in this country is mainly dependent on the monsoon's prompt arrival. The present monsoon season rainfall pattern shows that the State got 650 mm of rainfall from the southwest monsoon and 1000 mm from the northeast monsoon against the standard rainfall of 741 mm. Groundwater availability is inadequate owing to precipitation scarcity. The plants are suffering because of elevated temperature and wind velocity. There is inadequate ability to hold water in heavier soils. The organic carbon and the soil nitrogen status available are generally small to medium. Soils contain plenty of potassium. Micro-elemental deficiencies were also noted in some pockets of this region, mostly zinc. The current inquiry was helpful in evaluating the deficiency of various micronutrient components and therefore the effective use of fertilizers depending on their availability status. This research was conducted to cover the analysis of the correlation between physicochemical characteristics and micronutrients available in Naugarh block soils in Chandauli district.

Materials and Methods
Study Area
Chandauli is Uttar Pradesh's easternmost district in North India and lies on Ganga River banks. Naugarh is one of Chandauli's nine blocks in the southeast. It's between latitude 25.16 to 25.27 and longitude 83.16 to 83.27. The region is irrigated by the Ganga canals and other tributaries. The most important plants in this region are rice, wheat, gram, pea, maize, mustard and certain horticultural plants such as tomatoes, chilies, potatoes, brinjals, etc. (Table 1).

Soil sampling and analysis

Several GPS-based samples were randomly gathered with the assistance of Khurpi to a depth of 0-15 cm in V form from the farmer's field surface soil from five distinct villages of the Naugarh block district of Chandauli (Table 1). The several Soil samples have been carefully blended and about half a kilogram of field composite samples have been processed in separate villages for laboratory assessment.

Table 1: Description of sampling site

Sample No.	Name of Villages	Cropping pattern
1.	Persiya	Rice- Wheat, Chili-Rice-Wheat
2.	Bataoba	Gram, Gram-Pea, Tomato
3.	Laxmanpur	Chili-Potato-Rice, Potato-Vegetable, Till-Wheat-Vegetable, Tomato
4.	Majhganva	Rice-Wheat-Onion-Vegetable, Rice-Wheat-Mustard-Pea-Gram, Rice-Wheat-Mustard-Pea-Gram+Onion, Cauliflower+Cabbage, Maize-Potato-Onion, Rice-Vegetable
5.	Tendua	Maize-Chili-Brinjal-Potato+ Vegetable

Collected surface soil sample (0-15 cm depth) were brought into laboratory and shade dried at room temperature. Air dried soil samples were grinded with the help of wooden roller and sieved through 2 mm sieve. Finally dried soil samples were kept in polythene bags for further physicochemical properties analysis (Table 2).

Table 2: Procedure used for physico-chemical analysis of soil

Properties	Method applied	Reference
Physical properties		
Bulk Density (Mg kg^{-1})	Pycnometer	Black *et al.* (1965) [2]
Particle Density (Mg kg^{-1})	Pycnometer	Black *et al.* (1965) [2]
Water holding capacity	Keen box	Piper (1966) [8]
Chemical properties		
pH	Glass electrode pH meter	Jackson (1973) [3]
EC (dSm^{-1})	Electrical conductivity meter	Jackson (1973) [3]
Organic carbon (%)	Wet Oxidation Method	Walkey and Black (1934) [12]
Cationic Micronutrient Zn, Fe, Cu and Mn (mg/kg)	DTPA solution by Atomic Absorption Spectrophotometer	Lindsay and Norvell (1978) [5]

Statistical analysis

Using correlation coefficients, the relationship between different soil characteristics and micronutrient content in soils and plants was statistically determined:

$$r = \sqrt{\frac{SP\ (xy)}{SS(x), SS\ (y)}}$$

Where:

r = Correlation coefficient

SP (xy) = Sum product of x and y variables

SS (x) = Sum of square of x no. variable

SS (y) = Sum of square of y no. variable

Results and Discussion

Status of available micronutrients viz. Fe, Mn, Zn and Cu in soil

The rating limits are irrespective of crops or soils. Critical limits for soil test (values available Fe, Mn, Zn and Cu) used in India is listed in table 3.

Table 3: Rating ranges for soil test values used in India.

S. No.	Element	Deficient	Sufficient	High level
1	Fe	<4.80	4.8-8.0	>8.00
2	Mn	<2.00	2.0-4.0	>4.00
3	Cu	<0.20	0.2-0.4	>0.40
4	Zn	<0.60	0.6-1.2	>1.20

It can be obviously noted from the information described in table 4 and its subparts that the accessible Fe content of these soils ranged from 13.4 to 271.0 mg kg^{-1} with an average value of 126.79 mg kg^{-1}. The lowest (13.4 mg kg^{-1}) and highest (271.0 mg kg^{-1}) value was noted in Persiya village. Of the 52 gathered soil samples, 100 percent of the soil samples were bases that contained enough iron. However, it should be observed that there are no low-iron soil samples (Table 3). These findings are in conformation with Prabhuraj *et al.* (2001) [9].

Table 4: Status of available micronutrients viz. Fe, Zn, Mn and Cu in soils of Naugarh block

Soil characteristics	Range	Mean	S.D.	C.V.
Available Fe (mg kg^{-1})	13.4-271.0	126.79	48.08	37.92
Available Mn (mg kg^{-1})	8.0-99.0	45.90	21.43	46.69
Available Cu (mg kg^{-1})	0.8-4.6	2.7	0.99	36.95
Available Zn (mg kg^{-1})	0.21-2.20	1.10	0.65	59.80

Source: Ramamoorthy and Bajaj, 1969

Table 5: Classification of available Micro nutrients status content in soils of Naugarh block

S. N.	Element	Deficient		Sufficient		High level	
		No. of samples	% of samples	No. of samples	% of samples	No. of samples	% of samples
1	Fe	0	0	0	0	52	100
2	Mn	0	0	0	0	52	100
3	Cu	0	0	0	0	52	100
4	Zn	15	28.84	13	25.0	24	46.15

The available Mn content of these soils ranged from 8.0 to 99.0 mg kg^{-1} with an average 45.90 mg kg^{-1} value. The smallest amount of Mn (8.0 mg kg^{-1}) was discovered in the village of Tendua, while the largest value of Mn (99.0 mg kg^{-1}) was discovered in the village of Persiya. Of the 52 soil samples gathered, 100% of soil specimens were discovered to be adequate in Manganese content (Table 5). Similar result was also presented by Chaudhary and Kadu (2007) [1] on status of micronutrients.

The above information disclosed an average value of 1.10 mg kg^{-1} from 0.21 to 2.20 mg kg^{-1} in the accessible Zn status. The smallest value (0.21 mg kg^{-1}) and the largest value (2.20 mg kg^{-1}) of Zn content was discovered in Persiya village soils (Table 4). Out of a total of 52 samples, 28.84 percent of soil samples were found to be deficient, 25 percent of soil samples were discovered to be adequate and 46.15 percent were discovered to be high in Zn (Table 5). However, it should be observed that there is elevated Zinc available in 24 soil samples (Table 3). Similar results were revealed by Singh et *al*. (2017) [13] and Meena *et al.* (2006) [6].

Naugarh block soils ranged from 0.8-4.6 mg kg^{-1} with an average value of 2.7 mg kg^{-1} to the status of the available Cu content. The lowest value of Cu (0.8 mg kg^{-1}) was seen in Tendua village where the highest value of Cu (4.6 mg kg^{-1}) was seen in Persiya soils (Table 4). One hundred percent of the soil samples analyzed were found to be high (Table 5). The results are in line with Prabhuraj *et al.* (2001) [9].

Correlation between physico-chemical properties and available nutrients in the soil of Naugarh block

Data on the correlation between soil properties and nutrients available in Naugarh block top soil were provided in Table 6. The available Fe has a negative non-significant correlation with EC(r=-0.097) and porosity(r=-0.039) in the collected soil, a non-significant positive correlation of bulk density (r=0.134), organic carbon(r=0.025), particle density (r=0.124). Fe in the soil non-significant negatively correlated with soil pH (r=-0.223). EC, pH, porosity were negatively associated with Fe and Fe had a positive correlation with bulk density, organic carbon and density of particles. This result was similar to that reported by Yadav (2011) [11], it was found that the available Fe, Mn, Cu and Zn showed a positive and significant correlation with organic carbon and also found a negative and significant correlation with pH.

The available Mn has a negative and significant correlation between pH (r=-0.303*) and porosity (r=-0.320*).Positive non-significant bulk density relationship (r=0.162), organic carbon(r=0.054). The adverse non-significant connection was noted with Mn and EC (r=-0.147), particle density (r=-0.222). This outcome was comparable to that reported by Minakshi *et al.* (2005) [7], in the spatial distribution of micronutrients in Patiala district soils.

The zinc content in these soils was not significantly correlated with pH (r=-0.201) indicating the availability of Zn decreases with increases in soil pH and also negatively correlated with EC(r=-0.203), bulk density(r=-0.133) and particle density (r=-0.062) and positively correlated with organic carbon (r=0.033). Zn content in soil was non-significantly related to porosity (r=0.025). This positive relationship could be attributed to the increased availability under low pH of Mn, Zn, and Fe, which increased solubility of oxides and hydroxides of micronutrients. These findings were confirmative with outcomes acquired and observed negatively correlated with EC (r=-0.126), as reported by Yadav and Meena (2009) [11].

Table 6: Correlation between physicochemical properties and available micronutrients in the soil of Naugarh block

	Fe	Mn	Zn	Cu
pH	-0.223	-0.303*	-0.201	-0.112
EC	-0.097	-0.147	-0.203	0.019
OC	0.025	0.054	0.033	0.211
BD	0.134	0.162	-0.133	0.135
PD	0.124	-0.222	-0.062	-0.274*
Porosity	-0.039	-0.320*	0.025	-0.292*

There was a significant negative correlation between particle density (r=-0.274*), porosity (r=-0.292*) and available Cu and non-significant negative pH (r=-0.112). Singh *et al*. (2017) [13], also observed no significant and positive correlation between the available Cu and organic carbon and pH. Between OC(r=0.211), EC (r=0.019) and bulk density (r=0.135) and Cu content, the positive non-significant relationship was observed. Minakshi *et al*. (2005) [7], also found similar findings in the spatial distribution of micronutrients in district Patiala soils. Cu has important particle density adverse correlation (r=-0.102). Results acquired and shown by Minakshi *et al.* (2005) [7]. Verified these findings.

Conclusion

We can conclude that the Naugarh block soils of the district of Chandauli are classified as neutral to moderately saline in response. Organic carbon is medium to high in range in the studied region soils. The average of 28.84 percent and the elevated organic carbon of 51.92 percent were discovered out of the 52 soil samples gathered. The soil studied was discovered to be high in Fe, Mn and Cu, whereas 15 samples found to be deficient, 13 samples discovered to be adequate, and 24 samples discovered to be high in the Zn content region under research.

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