Micronutrients Status in Hasanganj and Auras blocks of Unnao district in Uttar Pradesh, India

Abstract

The study was carried out during 2020-2021to judge the status of micronutrient levels in Hasanganj and Auras blocks of Unnao district in Uttar Pradesh, India. Five representative villages were selected from each block and total 200 samples analysed for this study. Twenty numbers of representative surface soil samples were collected from each village from the depth of 0 to 15 cm and analysed for the selective micronutrients. ~~Five important micronutrients~~ Zinc (Zn), Copper (Cu), Iron (Fe), Manganese (Mn), Iron (Fe) and Boron (B) content ~~level~~ in soil was examined to know the micronutrients level in these two blocks. The micronutrient deficiency in the soils of both blocks was recorded on an average in order of zinc (39.5%), boron (32.5%), copper (25%), manganese (20%) and iron (19%). Zinc and boron deficiency was found more prominent in both blocks as compared to other micronutrients. Available zinc content level was found deficit in 42 and 37% of samples of Hasanganj and Auras blocks, respectively. Boron was found second most deficit micronutrient in these blocks after zinc. Boron deficiency was more prominent in Hasanganj block (36%) as compared to Auras block (29%). On an average Cu micronutrient was found in the deficit and critical range in 25 and 61% of soil samples. In case of Fe and Mn about 19% samples were deficit, more than 35 and 45% samples were found under critical and high content respectively.

Keywords: micronutrient, zinc, boron, copper, manganese, iron, boron

Introduction

The increasing population requires higher production and productivity of crops. Achieving the target maintenance of soil fertility is necessary for sustainable agriculture and future food security. Evaluation of the soil fertility of an area or region is a very important aspect of sustainable agriculture production. Soil nutrients govern the fertility of the soil and crop production. Soil fertility is the inherent capacity of soil which provides the nutrients for crop production. Interaction of soil's physical, chemical and biological properties results in soil fertility which is directly related to agricultural production (Rakesh *et al.*, 2012).

The nutrients need for crops and associated nutrient losses of Indian agriculture are so large and growing each year. Continuous intensive cropping with improper soil management practices and inadequate nutrient use leads to depletion in soil fertility. Imbalanced and inadequate use of chemical fertilizers, improper irrigation practices, and soil erosion are important causes of soil fertility depletion (Meena *et al*., 2017). Depletion in soil fertility is a major concern because it affects sustainable agriculture production as well as food security (Tan *et al.*, 2005). Other than this over and underuse of fertilizers leads to low productivity, wastage of nutrients, and increase risk of soil pollution (Miao *et al.* 2011). Lack of knowledge of farmers about soil tests and the fertilizers recommendation guidelines is adversely affecting soil health (Sahay *et al.*, 2019). Most farmers make decisions about the use of fertilizers on the basis of the cost, subsidy and availability of fertilizers in local markets without knowing the soil fertility status and crop requirement. Farmers often use nutrients inefficiently to grow crops (Nasrin *et al.*2019). Farmers are in the practice of using more urea and phosphoric fertilizers and don't consider the micronutrients as an important factor for crop production. The consumption ratio of NPK in India is about 6.7:2.4:1 as compared to the ideal ratio i.e., 4:2:1 (Reference ???). Farmers use more macronutrients through fertilizers than the required level and it leads to a gap between recommended

fertilizer and actual use of fertilizer (Fishman *et al.* 2016). Both macro and micronutrients are being removed continuously by the crops and depleting the soil fertility.

Intensive continuous rice-wheat cropping system, adoption of high-yielding varieties exhausting nutrient pool in soil, other than this lack of using micronutrient fertilizers, manures and negative crop management practice such as residue burning and lower subsidy facilities for micronutrients resulting the more lack of micronutrients in the soils and depleting the soil fertility (Pathak, 2010). The use of high-analysis NPK fertilizers led to a decline in the status of micronutrients in the soil to below normal at which productivity of crops cannot be sustained (Reference?). Since the crops are utilizing micro elements year after year and generation after generation without adding ~~traces of~~ them, therefore, it becomes imperative to determine their existing status in the soil ~~because their role is significant in crop production~~. In the absence of balanced nutrition, farmers were losing 8% to 102% of current yields of the crop??? in season 1 and 15% to 24% in each of the succeeding 3 to 4 seasons (Chander, *et al.*2014). With ~~proper use of~~ balanced recommended nutrient use practices 30 to 40% increase in crop yield could be achieved in India (Murthy *et al.*,2015). Micronutrient-deficit food is produced by micronutrient-deficit soil ~~, it~~ that may results in micronutrient-deficient disorder in the human population. Important agricultural soils in the world are deficient to the tune of 49% in Zn, 31% ~~deficient~~ in B, 15% ~~deficient~~ in Mo, 14% ~~deficient~~ in Cu, 10% ~~deficient~~ in Mn, and 3% ~~deficient~~ in Fe (Sillanpaa, 1990).

Among different micronutrients zinc, iron, copper, manganese and boron are relatively more important. Zinc is one of the most important elements in carbohydrate metabolism as most enzymes that play a role in carbohydrates metabolism are activated by it ~~zinc~~. Zinc regulates the consumption of sugars influencing the growth and development of crops. Most of the Uttar Pradesh district soils are found deficit in zinc content (Kumar*etal*., 2017,). Copper plays roles in photosynthesis and respiration, including the final transfer of

electrons to oxygen. Copper helps to form lignin in cell walls, which provide support to hold plants upright. It is particularly important to the formation of viable pollen, seed set, and stress resistance. It also promotes the formation of vitamin A. Deficiency of Cu in soil has been observed in certain pockets of Uttar Pradesh ~~therefore response of crops to Cu were assed only a few locations~~ (Sakal, 2001). With increasing level of soil pH the availability ~~level~~ of cu in soil decreases (Lindsay, 1972). Iron plays critical role in metabolic processes such as DNA synthesis, respiration, and photosynthesis. Further, many metabolic pathways are activated by iron. Uttar Pradesh is having a significant percentage of soil deficient in iron content (Shukla *et al.*,2021). Manganese regulates plant growth, particularly in the oxidation-reduction process and decarboxylation and hydrolysis reactions. More than 25% Mn deficiency is reported in many districts of Punjab, Haryana, Tamil Nadu, Rajasthan and Uttar Pradesh (Shukla *et al.*, 2021). Boron is also important in a diverse range of plant functions including cell wall formation and stability, maintenance of structural and functional integrity of biological membranes, movement of sugar or energy into growing parts of plants, pollination, and seed set. ~~Over the replenishment,~~ Continuous negligence of boron replenishment led to the emergence of its deficiency across the soils and crops in India. ~~Widespread deficiencies of boron are noticed in the area that was generally considered rich in boron.(Shukla *et al.*, 2012)~~

Keeping these points in view a study was carried out to judge the status of micronutrient levels in the Unnao district to encourage the balanced use of fertilizers to improve crop productivity ~~because other than macronutrients it is also essential to maintain the micronutrients level of the soil. The availability of macro and micronutrients in the soil determines the fertility level which governs the crop productivity of that soil (Bharti *et al.*,2017).~~ The study was undertaken to delineate the status of micronutrients (Fe, Mn, Cu, Zn, and B) in soils of the Unnao district of Uttar Pradesh.

Material and Methods

Unnao district is located in Uttar Pradesh in the central plain zone and lies between latitude 26^0 8' N & longitude 80^0 3' E. having sixteen blocks. This study was carried out in Hasanganj and Auras block. ~~Ten villages were selected,~~ Five villages from each blocks were selected for the study. A total of 200surface soil samples (0-15 cm) were collected with the help of a screw auger and composite soil samples were air dried at room temperature, ground, and passed through 2 mm sieve and analysed for different soil parameters. The available micronutrients (Zn, Cu, Fe, and Mn) were determined by PUSA, Digital Soil Test and Fertilizer Recommendation (STFR) Kit, Mridaparikshak and extracting soil samples with DTPA using atomic absorption spectrophotometer. (What about B analysis?) The study was carried out from the year 2020 to 2021.

Result and Discussion

The available zinc, copper, iron, manganese and boron content in the soils ranged from 0.21 to 2.4, 0.08 to 3.1, 1.0 to 39.3,0.8 to 43.0 and 0.1 to 3.9mg kg^{-1}respectively (Table1). Zinc and boron deficiency was found more prominent in both blocks as compared to other micronutrients. The micronutrient deficiency in the soils of both blocks was recorded on an average in order of zinc (39.5%), boron (32.5%), copper (25%), manganese (17%) and iron (12%).

The level of zinc was found almost same in both blocks i.e., 0.22 to 2.3 mg kg^{-1}in Hasanganj and 0.21 to 2.4mg kg^{-1}in Auras block (Table1). Available zinc content level was found deficit in 42 and 37% samples of Hasanganj and Auras blocks, respectively. Other than this 54% sample of Hasanganj and 56% samples of Auras blocks lies in critical level range (Fig.1) and are prone to Zn deficiency if proper management practices are not followed.Only 4 and 7%

samples were higher in Zn content in Hasanganj and Auras block, respectively. Most of the Uttar Pradesh district soils are found deficit in zinc content (Shukla *et al*., 2021). ~~Zn deficiency is the highest priority among micronutrients for agriculture because its directly linked to the food chain in such a manner that its deficiency is extensive in humans and food crops. (~~**Fe deficiency is even more critical, especially among the women!!!!!)**

On the basis of test analysis, it was found that on an average 61% of soil samples were found in critical available limit (What is the critical limit?) of Cu. In Hasanganj block 27%, 58% and 15% soil samples and in Auras block 23%, 64% and 13% soil samples were low, critical and high in Cu content, respectively (Fig.2). Deficiency of Cu in soil has been observed in certain pockets of Uttar Pradesh (Tiwari & Tiwari, 1993). Therefore the response of crops to Cu was assessed in only a few locations .On an average, Fe was found most deficient as compared to other micronutrients. The Fe content in farmers' field vary from 1.0 to 39.3mg/kg (Table1). Variability of micronutrient in the farmers' field is very high because of the differences in management practices followed by them. In Auras block, 13% of samples were deficient in Fe and in Hasanganj, it was deficient in 25% of samples (Fig.3). In Hasanganj and auras block respectively 32 and 39% of soil samples were found in critical limit of iron content (Fig.3). The high pH of soil may be responsible for this level of Fe deficiency. As alkaline pH and moisture deficit situation results in the transformation of Fe from ferrous (Fe^{2+} soluble) to ferric (Fe^{3+} insoluble) state (Arvind K. Shukla *et al.,* 2021). More than 60% of the samples were found higher in Fe content. On average 48%of soil samples were found higher in Mncontent. In Auras Mn content was higher in 52% of samples and in Hasanganj it was higher in 44% of samples (Fig.4). On average 19.5 % of samples were found deficient in Mn content (Fig.4). In many districts of Uttar Pradesh, more than 25 % Mn deficiency was reported (Shukla *et al.,* 2021). Boron was found second most deficit micronutrient in these blocks after zinc. Boron deficiency was more prominent in Hasanganj

block (36%) as compared to Auras block (29%).Other than this on an average 46% samples were found under critical B content range and 21.5 samples were recorded higher in B content (Fig.5). Shukla *et. al*., 2012 also reported in their study about one-third of samples were found deficient in boron content in the analysis of forty thousand samples.

Conclusion

Insufficient micronutrient content in soil is unable to produce the good quantity and quality yield. Low organic matter content and use of fertilizers like DAP and Urea in intensive agriculture are key component for micronutrient deficiency. The other factor responsible for lower level of micronutrient in Unnao is negligence of farmers for application of micronutrient fertilizers. Use of straight micronutrient fertilizers and organic matters supplements is best way to meet out the micronutrient deficiency of soils and for quality crop production. There is need to treat the micronutrient deficiencies of soils to obtain a great improvement in quantity and quality produce.

(Conclusion should be specifically based on the findings of the experiment. Please avoid general statement in the conclusion section)

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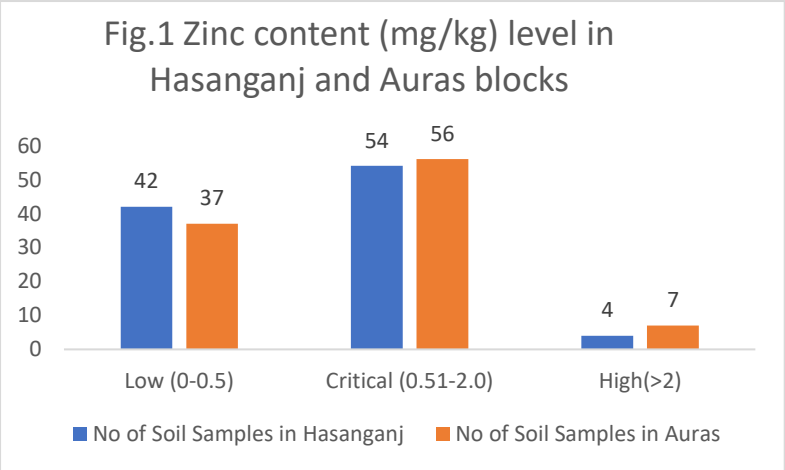
Table-1: Available micronutrients (mg kg^{-1}) status of soil in different blocks of Unnao

Name of Block	Number of Villages	Number of soil samples	Zinc range (Mg/Kg)	Copper range (Mg/Kg)	Iron range (Mg/Kg)	Manganese range (Mg/Kg)	Boron range (Mg/Kg)
Hasanganj	5	100	0.22-2.3	0.13-2.9	1.0-27.6	1.1-43.0	0.10-3.5
Auras	5	100	0.21-2.4	0.08-3.1	2.7-39.3	0.8-37.8	0.22-3.9



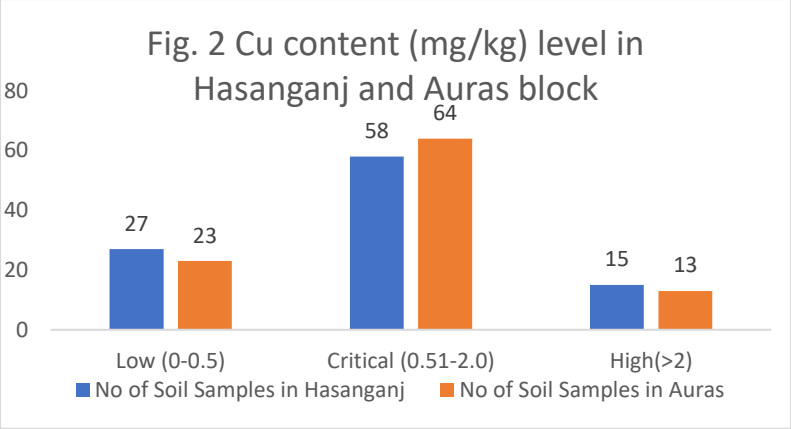


Fig. 2 Cu content (mg/kg) level in Hasanganj and Auras block
80
60
40
20
0
27
23
58
64
15
13
Low (0-0.5)
Critical (0.51-2.0)
High(>2)
No of Soil Samples in Hasanganj
No of Soil Samples in Auras

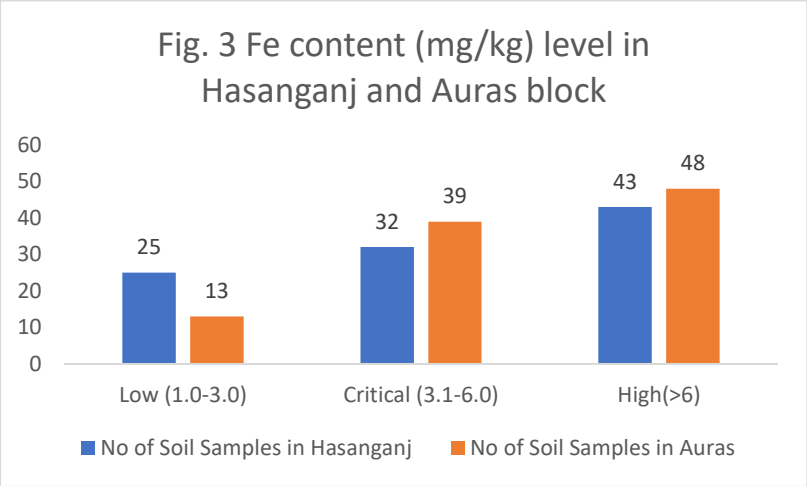


Fig. 3 Fe content (mg/kg) level in Hasanganj and Auras block
60
50
40
30
20
10
0
25
13
32
39
43
48
Low (1.0-3.0)
Critical (3.1-6.0)
High(>6)
No of Soil Samples in Hasanganj
No of Soil Samples in Auras

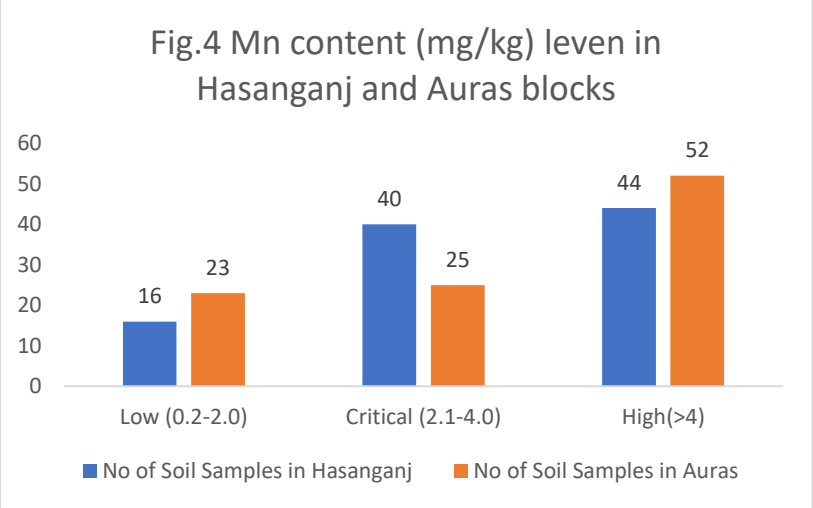


Fig.4 Mn content (mg/kg) leven in Hasanganj and Auras blocks
60
50
40
30
20
10
0
16
23
40
25
44
52
Low (0.2-2.0)
Critical (2.1-4.0)
High(>4)
No of Soil Samples in Hasanganj
No of Soil Samples in Auras