Trends in Biosciences 10(1), Print : ISSN 0974-8431, 284-285, 2017

Micro and Secondary Nutrients Status of Georeferenced Soils of Nabarangapur district, Odisha

LATA MALIK[1], SAI PARASAR DAS[2], GOUTAM KUMAR GHOSH[2] AND ASIT KUMAR PAL[1]

[1]*Department of Soil Science and Agril. chemistry, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha*
[2]*Department of Soil Science and Agricultural Chemistry, Palli Siksha Bhavana, Institute of Agriculture, Visva-Bharati, Sriniketan*
**email: ghoshgk1@gmail.com*

ABSTRACT

Georeferenced surface soil samples representing three major maize growing blocks viz. Umerkote, Raigarh and Jharigaon of Nabarangpur district of Odisha were collected from 154 sites using global positioning system (GPS). The soils are strongly to moderately acidic in soil reaction. The soil samples were analyzed for micronutrients viz. Zn, Cu, Fe, Mn and B and a secondary nutrient i.e. S. The DTPA - Zn, Cu, Fe and Mn in soils varied from 0.06 to 7.8 mg kg^{-1}, 0.07 - 2.4 mg kg^{-1}, 10.7 - 266.7 mg kg^{-1} and 5.9 - 155.3 mg kg^{-1}, respectively. The hot water extractable B and 0.15% $CaCl_2$ extractable S in soils ranged from 0.045 - 20.53 mg kg^{-1} and 0.39 - 22.3 mg kg^{-1}, respectively. The availability of Fe and Mn are sufficient enough to sustain crop productivity barring few soil samples are in toxic level. Cu deficiency (3.8%) although not so acute but requires due attention. The deficiency of B (33%) and S (94%) besides acidity are emerging as the major constraints of productivity in soils of Nabrangapur district.

Key words *DTPA extractable micronutrients, Secondary nutrient, GPS*

The soil micronutrient constraint to productivity and other related aspects are being studied since long because of their widespread deficiencies in soil in majority of the agricultural progressive states of the country. It is important to estimate and monitor the micronutrient status / deficiency in agro-ecological regions to forcast pontential micronutrient problem in order to develop models for different soil crop situation (Nayar 1999). The advent of information technology have provided tools like global positioning system (GPS), geographical information system (GIS) which help in collecting a systematic set of georeference samples and generating data about the distribution of nutrients (Sharma 2004). The Maps generated through remote sensing help to monitor the changes in micronutrient status over a period of time as georeference sampling sites can be revisited with the help of GPS which is otherwise difficult in the random sampling (Sood et al. 2004). Keeping this in view, the present study was taken up to identify the micronutrient status in soils of maize growing soils of Nabarangpur district of Odisha.

MATERIALS AND METHODS

The surface (0.15 m) soil samples (154 nos.) were collected with the help of GPS from three major maize growing blocks viz. Umerkote (66 nos.), Raigarh (40 nos.) and Jharigaon(48nos.) of Nabarangpur district of Odisha. The soil samples were ground, passed through 2mm sieve and analysed for the DTPA extractable micronutrients (Fe, Mn, Zn and Cu) as per the method suggested by Lindsay and Norvell (1978) and the concentration of Fe, Mn, Zn and Cu were determined using atomic absorption spectrophotometer. Hot water soluble B was extracted by boiling soil : water suspension (1:2) for five minutes and determined by Azomethrin-H colorimetric methods (Wolf, 1974) and available S in the extract of 0.15% $CaCl_2$ by turbidimetric methods. (Chesmin and Yien 1951).

RESULTS AND DISCUSSION

The soil pH of maize growing blocks of Nabarangpur disrict ranged from 4.1 to 7.79. The soils of these are strongly acidic to moderately acidic in nature. The electrical conductivity of the soil varied from 0.01 to 0.188 dS m^{-1} indicating non-saline nature of soils. The organic carbon ranged between 0.03 to 2.37 %. The mean value of organic carbon status was high. Similar finiding was reported by Mitra et al. (2006).

The DTPA-Zn in soils varied from 0.06 to 7.8 mg kg^{-1} (Table 2). The results are in agreements with those of Talukdar et al. (2009) and Mahashabde and patel (2012). The mean value (0.63 mg kg^{-1}) of DTPA - Zn was slightly more than the critical limit of Zn deficiency (0.6 mg kg^{-1}) as suggested by Bansal and Takkar (1986). Further, the criteria for assessment of nutrient in soil was modified and suggested by Singh (2006) based on report of Coordinated Research 'AICRP on Micro and Secondary Nutrients and Pollutant Elements in Soil and Plants' (Table 1). Out of 154 soil samples analyzed, 60.4% samples were found to be deficient in DTPA extractrable Zn whereas 29.9 and 9.7 per cent soil samplels were registered as marginal and adequate category,respectively. The results showed that the samples were deficient in Zn needs to be supplemented with Zn fertilizer for the better crop yield specifically for maize which have high Zn requirement.

The results (Table 4) showed that adequate amount of Fe and Mn were present in the soil. The average content of Fe and Mn in the soils were 71.8 and 48.8 mg kg^{-1}, respectively (Table 2). The DTPA extractable Cu content of the soil ranges from 0.07 to 2.4 mg kg^{-1} with a mean of 4.23 mg kg^{-1}. The results showed that only 4% of the soil are deficient in Cu, 16% as marginal and 80% of the soils were adequate in B content (Table 4). But the deficiency of Cu in these soils are becoming an emerging iussue now a days. Similar observation was reported by Jena et al. (2008) , Singh et al. (2006) and Pal et al. (2015).

The status of available Sulphur and hot water soluble boron content are presented in Table 3. The results showed that sulphur content varied from 0.39 to 22.3 mg kg^{-1} with a mean of 3.9 mg kg^{-1}. It is alarming to note that the soils of Nabarangapur district registered 94% deficiency of S whereas only 4 and 2% were in marginal and adequate level,

Table 1. Criteria for assessment of secondary and micronutrients in soils

Nutrient	Very low (mg kg^{-1})	Low (mg kg^{-1})	Marginal (mg kg^{-1})	Adequate (mg kg^{-1})
Categories	**I**	**II**	**III**	**IV**
Zn	<0.3	0.3-0.6	0.6-1.2	>1.2
Fe	<2.5	2.5-4.5	4.5-9.0	>9.0
Mn	<1.0	1.0-2.0	2.0-4.0	>4.0
Cu	<0.1	0.1-0.2	0.2-0.4	>0.4
S	<5.0	5.0-10.0	10.0-20.0	>20.0
B	<0.2	0.2-0.5	0.5-0.75	>0.75

Table 2. Micronutrient status (mg kg^{-1}) of soils in Nabarangapur district

Nutrients	Minimum (mg kg^{-1})	Maximum (mg kg^{-1})	Mean (mg kg^{-1})
Zn	0.06	7.8	0.63
Fe	10.7	266.7	71.8
Mn	5.9	155.3	48.8
Cu	0.07	2.4	4.23

Table 3. Available S and B status in soils of Nabarangapur district

Nutrients	Minimum (mg kg^{-1})	Maximum (mg kg^{-1})	Mean (mg kg^{-1})
S	0.39	22.3	3.9
B	0.045	20.53	2.5

Table 4. Percentage of soil samples of Nabrangpur district falling in different ranges of micro and secondary nutrients

Nutrients	Very low (mg kg^{-1})	Low (mg kg^{-1})	Marginal (mg kg^{-1})	Adequate (mg kg^{-1})
Categories	**I**	**II**	**III**	**IV**
Zn	20.8	39.6	29.9	9.7
Fe	-	-	-	100
Mn	-	-	-	100
Cu	0.6	3.2	16.2	79.9
B	9.7	23.4	18.2	48.7
S	72.1	22.1	3.9	1.9

respectively. So there is an immediate need to aply sulphur fertilizer to enhance the crop growth. Similar observation was reported by Jena et al. (2008).

The hot water soluble Boron status varied from 0.04 to 20.53 mg kg^{-1} with a mean value of 2.5 mg kg^{-1} in soil. The results (Table 4) indicate that about 33% of soils are deficient in B whereas 18 and 49% soils respectively are in the marginal and adequate range. There is an urgent need to apply B fertilizer for better crop grain formation particularly for maize crop. Similar observation was reported by Jena et al. (2008) and Pal et al. (2015).

CONCLUSION

Multinutrient deficiencies particularly micronutrients like Zn, Cu, B and secondary nutrient like sulphur are widespread and acidity problems have been identified as the reasons for low agricultural productivity and food security in three major maize growing blocks viz. Umerkote, Raigarh and Jharigaon of Nabarangpur district of Odisha. Georeferenced micro and second-ary nutrients status for maize growing areas of Nabarangapur district will help the farmers, planners and scientists for site specific nutrient management and monitoring the soil health for present and future agriculture.

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Received on 16-12-2016 *Accepted on 21-12-2016*