SHORT COMMUNICATION

Oryza Vol. 54 No. 2, 2017 (247-249)
DOI 10.5958/2249-5266.2017.00033.9

Delineation of major and micronutrient status of soils of rice based cropping system in Mayurbhanj district of Odisha

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Received : 01 June 2017 Accepted : 20 September 2017 Published : 28 September 2017

ABSTRACT

The present study was conducted to delineate the extent of macro and micro-nutrient deficiency in red and lateritic soils of Mayurbhanj district of Odisha during 2010-11. Soil samples were collected from paddy fields of five selected blocks (Shyamakhunta, Kuliana, Badasahi, Betanati and Baripada) of the district and analyzed for major and micronutrients. The results revealed that the soils were acidic in reaction (pH: 4.1 to 6.6) and low in available P and K values (kg ha^{-1}) which varied from 0.20 to 6.0 and 50.0 to 419.0, respectively. The soils of Kuliana and Baripada block were low in organic carbon content whereas others have medium status. The available B, Zn and S content in soils (mg kg^{-1}) varied between 0.04-0.94, 0.05-6.01 and 0.02-17.0 respectively with respective mean values of 0.45, 1.54 and 5.20 mg kg^{-1}. About 66% of soils were deficient in hot water soluble B. Available S deficiency varied between 61-77% with mean value of 83%. The soils were rich in DTPA-extractable Zn. Application of B and S fertilizer in addition to major nutrients is highly essential for getting higher yield in red and laterite soils of Odisha.

Key words: *Micronutrient, cropping system, Odisha*

Soil resources in India, as anywhere else in the World, are finite, unequally distributed, fragile and prone to degradation by improper land use and soil mismanagement (Sanyal et al., 2014; Dash et al., 2015). Micronutrients are indispensable like any other essential nutrient. Deficiency or toxicity of these elements in soil adversely affects the growth and development of crops.

Adoption of modern scientific cropping sequencies results in higher crop production per unit area (Roy et al., 2011; Kumar et al., 2016), greater depletion of available micro and secondary nutrients from soil due to the fertilizer practices where fertilizer application is designed to meet needs for only major nutrients (NPK). Eventually micronutrient deficiency has become a limiting factor for crop productivity across the country (Sanyal et al., 2014). Crops grown in most of the Indian soils suffer from deficiencies of one or more nutrients, even though the soils often contain apparently adequate total amounts of respective elements. The nature and extent of deficiencies vary with soil type, agro-ecological situations, crop genotype and management practices (Shukla 2011; Shahid et al., 2014). With this background, a delineation study was conducted to evaluate the major and micronutrient status of red and laterite soils of Mayurbhanj district of Odisha.

The delineation study was undertaken in five blocks (Shyamakhunta, Kuliana, Badasahi, Betanati and Baripada) of Mayurbhanj district of Odisha to evaluate the extent of macro and micro-nutrient deficiency in red and lateritic soils. In this area, rice is a major crop during *Kharif* season followed by oilseed and pulses in *Rabi*. Vegetables are grown during winter and summer season where irrigation is available. The surface soil samples were collected, processed and analyzed for different nutrients.

Available nitrogen content of soil was estimated by alkali permanganate method as outlined by Subbiah and Asija (1956). The available phosphorus was determined by Olsen's method (Olsen et al., 1954) by using 0.5 N $NaHCO_3$ as extracting solution in 1:20 soil extractant ratio. After extraction the blue colour was developed with ammonium molybdate ascorbic acid solution and then estimated with spectrophotometer at 660 nm wave length. Available potassium was determined by shaking 5 g soil in 25 ml neutral normal ammonium acetate (NH_4OAc) for five minutes and reading of the extractant was observed flame photometrically (Muhr et al., 1965). The available sulphur in soil was extracted with 0.15% $CaCl_2$ solution and determined by turbidometric method as suggested by Massoumi and Cornfield (1963). The available boron in soil was extracted by hot water reflux method and determined spectrophotometrically using azomethrin-H (Page et al., 1982). The available zinc in soil was determined by using DTPA extractant (Lindsay and Norvell 1978) 20 g soil with 40 ml of DTPA was shaken for 2 hours in an environmental shaker. Estimation of Zn was done by Perkin Elmer Atomic Absorption Spectrophotometer. The data generated were analyzed statistically (Gomez and Gomez, 1976).

The analyzed parameters of major nutrient status (pH, organic carbon, P_2O_5 and K_2O) of different blocks are presented in Table 1. The results of 999 soil samples analyzed for major nutrients revealed that the soils were acidic in reaction (pH: 4.1 to 6.6). The soils were deficient in available P (0.2 to 6.0 kg ha^{-1}) and K (50-419 kg ha^{-1}), except certain patches in Baripada block which had the values to the maximum side. Generally the soils are low in available K except Baripada block. The organic carbon content of soils ranged from 0.05-1.25%. The soils of Kuliana and Baripada are low in organic carbon content, whereas others have medium statuses; however, in all the blocks some areas have high organic carbon content with values upto 1.25%.

The hot water soluble B, DTPA-extractable Zn and $CaCl_2$ - extractable S status of the soil of Mayurbhanj district is presented in Table 2. Hot water soluble B content of the soil in the district ranged from 0.04 to 0.94 mg kg^{-1} with mean of 0.45 mg kg^{-1}. B deficiency in soils ranged between 61-77 % with mean value of 66%. The highest deficiency (77%) was observed in Baripada block followed by Shyamakhunta and Kuliana. Acute B deficiency was observed which might be due to intensive cultivation of cereals, vegetables and oil seed crops without B fertilization. Coarse soil texture with low organic carbon content may have enhanced boron leaching. Farmers are thus

Table 1. Available P, K and organic carbon status of soils of Mayurbhanj district, Odisha

Sl. No.	Name of block		Available P (kg ha^{-1})			Available K (kg ha^{-1})			Organic carbon (%)		
		n*	Range	Mean	SD**	Range	Mean	SD	Range	Mean	SD
1	Shyamakhunta	149	0.2-5.0	2.04	0.31	51.0-134.0	71.58	6.62	0.14-1.25	0.59	0.12
2	Betnoti	265	0.20-5.6	2.04	0.31	50.0-200.0	91.25	27.20	0.14-1.25	0.53	0.13
3	Baripada	127	0.20-6.0	2.28	0.63	68.0-419.0	241.5	45.42	0.05-1.25	0.53	0.10
4	Kuliana	188	0.20-3.6	1.30	0.18	51.0-114.0	74.35	7.85	0.14-1.03	0.36	0.09
5	Barasahi	270	0.20-4.6	1.59	0.34	51.0-112.0	70.37	11.87	0.11-1.08	0.43	0.12
	District	999	0.20-6.0	1.80	0.48	50.0-419.0	97.71	59.62	0.05-1.25	0.48	0.14

* n= number of samples; **SD= standard deviation

Table 2. Percent soils deficient in available B, Zn and S in Mayurbhanj district of Odisha

Sl.No	Name of block	Available B (mg kg^{-1})				Available Zn (mg kg^{-1})				Available S (mg kg^{-1})			
		No. of sample	Range	Mean	*PSD	No. of sample	Range	Mean	*PSD	No. of sample	Range	Mean	*PSD
1	Samakhunta	56	0.08-0.94	0.42	73.2	149	0.20-6.01	2.07	3.35	149	0.51-11.38	4.66	97.3
2	Betnoti	88	0.08-0.94	0.51	60.2	275	0.36-3.27	1.56	0.36	275	0.02-17.01	5.60	61.1
3	Baripada	48	0.12-0.82	0.40	77.1	127	0.05-5.92	1.88	5.51	127	0.26-12.68	4.47	96.8
4	Kuliana	68	0.04-0.93	0.41	69.1	188	0.06-5.36	1.34	6.91	188	1.29-13.71	5.66	84.6
5	Barasahi	120	0.29-0.65	0.46	61.0	270	0.29-3.01	1.22	18.15	270	1.5-10.0	5.12	90.7
	District	380	0.04-0.94	0.45	66.31	1009	0.05-6.01	1.54	6.86	1009	0.02-17.01	5.20	83.2

*PSD= pooled standard deviation

advised to use B fertilizers based on soil test value.

The DTPA-extractable Zn in 1009 soil samples ranged from 0.05-6 mg kg^{-1} with mean value of 1.54 mg kg^{-1}. Zn deficiency in soils of different blocks ranged from 0.36 to 18.1%. The data further revealed that the soils of Mayurbhanj district were rich in available Zn and a starter dose of Zn is recommended for rice and potato crops for higher yield.

The sulphur content of soil samples of the district ranged from 0.02-17 mg kg^{-1} with a mean value of 5.2 mg kg^{-1}. Based on the critical limit of S as 10 mg kg^{-1}, the soils are extremely deficient in S ranging from 61-97% with a mean value of 83%. This might have happened due to growing of high value crops without sulphur fertilization. Cultivation of groundnut and potato without S fertilization may limit crop yield. The farmers are advised to use S fertilizers in addition to limiting nutrients for getting higher yield.

The results reported by Jena et al. (2008) on micro and secondary nutrient status of Mayurbhanj district indicated that the soils were deficient in S by 37%, B 66% and Zn 12%. The S deficiency was increased from 37% to 83% over 10 years of cropping. On the other hand, the deficiency of Zn and B was declined might be due to addition of B and Zn fertilizers over the period.

From this study, it may be concluded that the soils of Mayurbhanj district of Odisha were acidic in reaction, low in available P, K and organic carbon. About 66% of soils were deficient in B and 83% in S. The soils were rich in DTPA Zn. The farmers are advised to use S, B and Zn fertilizers in addition to major nutrients for higher yield.

REFERENCES

Dash AK, Singh HK, Mahakud T, Pradhan KC and Jena D (2015). Interaction effect of nitrogen, phosphorus, potassium with sulphur, boron and zinc on yield and nutrient uptake by rice under rice - rice cropping system in inceptisol of coastal Odisha. Int. Res. J. Agric. Sci. Soil Sci. 5(1): 14-21

Gomez KA and Gomez AA (1976). Statistical procedure for agricultural research. John Wiley & Sons

Jena D, Singh MV, Patnaik MR and Nayak SC (2008). AICRP on micro and secondary nutrients and pollutant elements in soils and plants, Technical Bulletin 1, OUAT, Bhubaneswar

Kumar M, Kumar R, Meena KL, Rajkhowa DJ and Kumar A (2016). Productivity enhancement of rice through crop establishment techniques for livelihood improvement in Eastern Himalayas. Oryza 53(3): 300-308

Lindsay WL and Norvell WA (1978). Development of DTPA soil test for Zn, Fe, Mn and Cu. Soil Sci. Soc. Am. J. 42: 421-428

Massoumi A and Cornfield AH (1963). A rapid method of determining sulphate in water extracts of soils. Analyst 88: 321-322

Muhr GR, Datta NP, Sankara, Subramoney H, Liley VK and Donahue RR (1965). Soil testing in India. US Agency for International Development, New Delhi, pp. 120

Olsen SR, Cole CV, Watanable FS and Dean LA (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA Circular 939

Page AL, Miller RH and Keeney DR (1982). Methods of Soil Analysis, Part-2, Second Edition, Soil Sci. Soc. Am. J., Madison, Wisconsin, USA

Roy DK, Kumar R and Kumar A (2011). Production potentiality and sustainability of rice-based cropping sequences in flood prone lowlands of North Bihar. Oryza 48(1): 47-51

Sanyal SK, Majumdar K and Singh VK (2014). Nutrient management in Indian agriculture with special reference to nutrient mining - a relook. J. Indian Soc. Soil Sci. 62(4): 307-325

Shahid Md, Nayak AK, Shukla AK, Tripathi R, Kumar A, Raja R, Panda BB, Meher J and Dash D (2014). Mitigation of Iron toxicity and Iron, Znic and Manganese nutrition of wetland rice cultivars (*Oryza sativa* L.) grown in Iron toxic soil. Clean-Soil, Air, Water. 42: 1604-1609

Shukla AK (2011). Micronutrient research in India: current status and future strategies. J. Indian Soc. Soil Sci. 59 (Suppl.): S88-S98.

Subbiah BV and Asija GL (1956). A rapid procedure for the estimation of available nitrogen in soil. Curr. Sci. 25: 259-260