Original Research Article   https://doi.org/10.20546/ijcmas.2018.706.247

Distribution of DTPA Extractable Micronutrients in Soils of Jajpur District, Odisha, India

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A B S T R A C T

K e y w o r d s

DTPA extractable micronutrients, acidic soil, soil, critical limit deficiency

Article Info

Accepted:
18 May 2018
Available Online:
10 June 2018

Three hundred soil samples from ten blocks of Jajpur district, Odisha state were studied for distribution of DTPA extractable. Zn, Cu, Fe and Mn and Boron their relationship with some soil properties. Soil pH, calcium carbonate, organic carbon and particle-size fractions had strong influence on the distribution of these micronutrients. The content of micronutrient increased with the increase in organic carbon and decreased with increase in pH. As per critical limit prescribed for Zn 26 per cent and Boran 73.3 percent of the soil could be rated as deficient in available zinc and boron. Iron, Copper and manganese were found to be adequate.

Introduction

The knowledge of distribution of micronutrient cations in soils provides an idea of the inherent capacity of soils to supply the nutrients from lower horizons. Studies were conducted by different researchers (Mishra *et al.,* 2016, Arvind *et al.,* 2014; Bansal and Takkar 1985) to understand the content and distribution of the nutrient cations in different soils and their relationship with soil properties. However, information in this regard for the soils of Jajpur district of Odisha is scanty and therefore, an attempt has been made to assess the micronutrient status in these soils and their relationship with some important soil properties.

Materials and Methods

Soil sampling grids of one sample/4km^2 areas were pre-determined systematically for each community block from revenue map. Thirty numbers of surface samples collected from each block totally 300 soil samples collected from the district. District is situated between latitude 20°.30' - 21°.10' N and longitude 85°.40' - 86°.44 E. It has 10 community development blocks with total population 18, 26,275 with rural population 17, 31,950 (94.84%) and density is 630/km^2 as per 2011 census. The moisture regime in the study area is usticand soil temperature class is isohyperthennic. The major crops grown in the study area are rice, maize, cotton, black gram,

green gram and red gram. The samples were analyzed for pH, organic carbon (OC) and particle-size distribution following standard procedures. The available micronutrient cations were extracted with DTPA solution and determined with Atomic Absorption Spectrophotometer as described by Lindsay and Norvell (1978). Simple correlations were calculated between DTPA-extractable micronutrient cations and soil properties and available Boron determined by hot water extractable method.

Results and Discussion

In general, the soils were very strongly acidic to neutralin reaction and pH ranged from 4.09-7.40. The soils were sandy loam to clay in texture with clay content ranging from 13.9 to 48.6 %. Higher content of micronutrients were found in surface layers which might be due to their regular addition through plant residues, organic manures and fertilizers. Micronutrient content was decreasing with depth.

Soil reaction (pH) and Electrical Conductivity

The pH of surface soils of Jajpur district ranged from 4.09 to 7.40 with mean 5.52. Most of the soils were found acidic in reaction (Jena *et al.,* 2008). All together 92.33 % of samples were acidic, 7.33 % samples were neutral and only 0.33% samples were found alkaline.

The electrical conductivity value varied from 0.02 to 0.89 dS/m with mean value of 0.12. The soils are mostly non saline nature expecting few which contain little quantity of salts (Kher and Khajura, 2005).

Soil Organic Corban (SOC)

SOC value of the distinct ranged between 0.09 to 1.87% with mean value of 0.66 %. This values were categorized under low (below 0.5%), medium (0.5 to 0.75%) and high (>7.5%) and the values under each group were 28.67%, 33.67% and 37.66% respectively. The most SOC deficient block was Jajpur followed by Dharmasala (Mishra *et al.,* 2006).

Zinc

The DTPA Zn result content of the soil reported in table 4.2.5. The table showed that DTPA Zn varied from 0.13-40.8 with mean value of 0.99 mg./kg. Considering the of 0.6 mg kg^{-1} (Katyal, 1985) as critical limit of DTPA-Zn. It was found 26.66% soils were defined in Zn in the district. The maximum DTPA-Zn was seen in Sukinda block and minimum in Badachana block. Maximum deficiency (43.33%) was observed in Bari block followed by Dasarathpur (36.66%) and Korei block (36.66%). Sood *et al.,* 2009, Shukla *et al.,* 2014 found similar resultsin the soils of Punjab and India. The parent material of the soil containing less Zn which is further aggravated in surface due to light texture nature of the soil. White and Zasoski, 1999 found similar type of variation in micronutrient content in soils.

Copper

DTPA extractable Cu content in soils ranged from 0.39-7.54mg kg^{-1} with mean value of 2.87mg kg^{-1}. Considering the critical limit of 0.2 mg kg^{-1} for Cu for normal plant growth (Katyal and Randha 1983), the soils are rated adequate in available Cu Very few sample (0.3%) deficient in district.

Under Sukindablock (3%) were found deficient. No Cu deficiency was observed in other blocks. It was due to rich Cu bearing parent material of the soils. The maximum Cu was found in Dasarathpur block (7.54mg./kg.) and minimum(0.39mg./kg.) in Dharmasala block.

Table.1 Basic properties of surface soil

Sl. No.	Name of block	pH(1:2.5)		EC(dS/m)		SOC %		
		Range	Mean	Range	Mean	Range	Mean	Deficiency (%)
1	Sukinda	4.09-6.83	5.29	0.015-0.874	0.138	0.16-1.87	0.82	26.6
2	Danagadi	4.40-7.40	5.84	0.035-0.306	0.102	0.35-1.57	0.76	16.6
3	Korei	4.43-7.23	5.46	0.035-0.399	0.129	0.19-1.63	0.62	26.6
4	Dasarathpur	4.82-6.92	5.84	0.015-0.38	0.121	0.09-1.63	0.73	20.0
5	Badachana	4.59-6.49	5.33	0.03-0.183	0.061	0.29-1.00	0.68	23.3
6	Dharmasala	4.38-6.62	5.35	0.022-0.74	0.139	0.21-1.12	0.59	40.0
7	Rasulpur	4.34-6.74	5.71	0.054-0.894	0.23	0.17-1.19	0.61	36.6
8	Binjharpur	4.86-5.91	5.46	0.02-0.133	0.062	0.39-0.99	0.73	10.0
9	Jajpur	4.64-6.97	5.79	0.04-0.493	0.14	0.09-1.00	0.48	50.0
10	Bari	4.44-7.40	5.17	0.023-0.894	0.08	0.15-1.63	0.63	30.0
	Mean	**4.09-7.40**	**5.52**	**0.02-0.89**	**0.12**	**0.09-1.87**	**0.66**	**28.66**

Table.2 DTPA-Fe, Mn, Cu, Zn and B (mg/kg) status of Jajpur district

Sl. No.	Block	Fe (mg/kg)		Mn (mg/kg)		Cu (mg/kg)		Zn (mg/kg)			B (mg/kg)		
		Range	Mean	Range	Mean	Range	Mean	Range	Mean	PSD%	Range	Mean	PSD%
1	Sukinda	11.68-396.8	68.87	25.12-271.4	92.16	0.39-4.06	1.94	0.22-4.08	1.23	16.6	0.03-0.92.	0.47	56.6
2	Danagadi	25.0-207.8	104.13	16.92-196.12	74.41	1.18-6.72	3.89	0.25-2.43	1.32	23.3	0.12-1.71	0.40	73.3
3	Korei	23.76-282	141.87	4.96-206.16	50.05	1.91-4.37	2.40	0.29-2.93	1.03	36.6	0.08-0.95	0.33	83.3
4	Dasarathpur	23.44-294.54	101.28	55.16-152.68	99.80	1.37-7.54	4.30	0.27-1.97	0.91	36.6	0.17-0.66	0.38	70.0
5	Badachana	24.28-318.18	142.16	5.36-126.0	53.08	1.16-4.83	3.21	0.12-1.60	0.81	33.3	0.10-0.58	0.34	86.6
6	Dharmasala	53.24-238.8	123.25	7.0-94.52	52.47	1.07-3.9	1.82	0.17-2.49	1.15	20.0	0.22-1.19	0.97	33.3
7	Rasulpur	22.96-189.84	75.48	9.2-117.08	54.28	0.79-3.02	1.90	0.13-2.21	0.86	26.6	0.07-0.61	0.26	80.0
8	Binjharpur	73.36-232.86	135.60	29.65-149.58	78.22	1.67-5.53	4.14	0.20-2.25	1.04	13.3	0.02-0.63	0.27	83.3
9	Jajpur	36.12-178.28	87.89	10.74-134.82	61.88	0.89-4.95	3.04	0.46-1.26	0.82	30.0	0.04-0.73	0.28	83.3
10	Bari	53.80-318.18	129.30	23.44-206.16	71.73	0.42-7.54	2.08	0.22-3.25	0.72	43.3	0.03-1.77	0.29	80.0
	Mean	**11.68-396.8**	**110.98**	**4.96-271.74**	**68.81**	**0.39-7.54**	**2.87**	**0.13-4.08**	**0.99**	**26.66**	**0.02-1.77**	**0.40**	**73.33**

Iron

DTPA extractable Fe content in these soils varied between 11.68 to 396.8 mg/kg with an average of 110.98 mg/kg considering the critical limit of 4.5 mg kg^{-1} for Fe (Lindsay and Norvell 1978), the soils are rated adequate in available Fe. It was maximum in Sukinda block Badachana and Bari and minimum in Jajpur block 10.74 to 134.85 mg./kg. These findings are agreement with Shukla *et al.,* 2014 in soils of Odisha. Tabular zone having red and laterite soils contains maximum Fe. Whereas in coastal plain like Jajpur block, the content was comparatively less. In mid and low land rice growing are Fe toxicity was observed, due to high content of Fe.

Manganese

The DTPA-Mn value in the soils of the district ranged between 4.96 to 271.74 mg./kg with an average value of 68.61 mg./kg. considering the critical limit as 2 mg/kg All soil samples of the district was found sufficient. It might be due to rich content of this element in soil forming parent material of this district. Maximum content of Mn was found in Sukinda soil and minimum in Dharmasala block. Similar results were found by Kumar *et al.,* (2009).

Boron

Hot water extractable boron ranged between 0.02 to 1.77mg/kg with a mean value of 0.40 mg/kg (Mishra *et al.,* 2016). The 73.33% soils were deficient in boron and it is the most limiting nutrient in the district considering critical as 0.5mg/kg. Deficiency is maximum in Badachana block (86.66%) and minimum in Dharmasala block (33.33%). In six blocks more than 80% soil samples were deficient in Boron (Sahrawath, *et al.,* 2007). Parent material devoid of B bearing minerals and B

demanding crops like vegetables, pulses, and oilseeds might be leading to B deficiency up to this extent.

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How to cite this article:

Maheshwar M., R. K. Nayak and Bandita Jena. 2018. Distribution of DTPA Extractable Micronutrients in Soils of Jajpur District, Odisha, India. *Int.J.Curr.Microbiol.App.Sci.* 7(06): 2092-2096. doi: https://doi.org/10.20546/ijcmas.2018.706.247