International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 1273-1277

Received: 09-07-2019
Accepted: 13-08-2019

M Maheshwar
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Orissa University of agriculture and Tecnology, Bhubaneswar, Odisha, India

P Sindhusha
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Orissa University of agriculture and Tecnology, Bhubaneswar, Odisha, India

Dr. RK Nayakand
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Orissa University of agriculture and Tecnology, Bhubaneswar, Odisha, India

Bandita Jena
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Orissa University of agriculture and Tecnology, Bhubaneswar, Odisha, India

Correspondence
M Maheshwar
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Orissa University of agriculture and Tecnology, Bhubaneswar, Odisha, India

Limiting micronutrients for cop production in Jajpur district of Odisha

M Maheshwar, P Sindhusha, Dr. RK Nayakand and Bandita Jena

Abstract
A study of the secondery and micro-nutrients on soils of Jajpur district, Odisha (India) was carried out to study the soil fertility and micro- nutrient status and their deficiency percentage of the district. Surface soils (0 to 20 cm) was investigated for diethylenetriaminepentaacetate (DTPA)- extractable Zn, Cu, Mn, Fe and hot water extractable B along with secondary nutrients and their deficiency and `multinutrient deficiency in 300 representative soils. The mean values for DTPA-extractable Zn, Mn, Cu, Fe and hot water extractable B were 110. 9, 68. 81, 2. 87, 0. 99 and 0. 40 mg kg-1, respectively. The mean values of some basic properties like pH, EC, OC of the Jajpur soils were 5. 52, 0. 12 (dS/m) and 0. 66%. As per critical limit prescribed, in the district S, Zn and B were found to be 40%, 26. 6 % and 73. 3% deficient Not only single nutrient but also multi nutrients deficiency was observed in the district i. e., S+Zn, S+B, B+Zn, B+Zn+S up to 10. 3, 32, 26, 8% respectively. Plant tissue analysis result showed that PSD with respect to S, B, Zn, Mn and Cu were 25. 7%, 51. 4%, 17. 14%, 5. 7% and 5. 75 respectively.

Keywords: Diethylenetriaminepentaacetate, multi nutrients, Surface soils

Introduction
Soil fertility is one of the important factors controlling the crop yield. Soil related limitations affecting the crop productivity including nutritional disorders can be determined by evaluating the fertility status of the soils. Zinc (Zn), Copper (Cu), Manganese (Mn), Iron (Fe) and Boron (B) are essential micro- nutrients for plant growth. Through their involvement in various enzymes and other physiologically active molecules, these micro-nutrientsare important for gene expression, biosynthesis ofproteins, nucleic acids, growth substances, chlorophyll and secondary metabolites, metabolism of carbohydrates and lipids, stress tolerance, etc. (Singh, 2004, Rengel, 2007 and Gao *et al.*, 2008) [10, 8, 3].

Net sown area in the Jajpur district is 129, 000 ha with 119% cropping intensity. Rice is the staple food in the district. Rice is the major staple food crop of the district and occupying almost 80% of the total cultivable area during the kharif season. Total pulses cultivated in 13. 5 thousand ha in area with 2. 8% area sharing with Odisha. Total oil seeds and vegetables are cultivating with 10. 8 and 24. 02 thousand ha. Area with sharing of 7. 7 and 3. 4% of state cultivation in area respectively. Vegetables and groundnut crops are the major crops in raby season. S is the key nutrient for oil seed crops like groundnut, sesame. Zn and B are the crop limiting nutrients for the paddy and vegetable crops. India is the second largest consumer of mineral fertilizers in the world after China, consuming about 26. 5 million tons (Jaga and Patel, 2012). The application of mineral fertilizers is the most advantageous and the fastest way to increase crop yieldsand their deficiency leads to various types of disorders inmany commercially important crops (Duarah *et al*., 2011) [2]. Application of major nutrients (nitrogen, phosphorus, potassium) became common; therefore, the crops started responding to micro nutrientfertilizers. Concerted efforts have been made through the All India Coordinated Research Project on Micro nutrientsto delineate the soils of India regarding the deficiency of micronutrients. At present about 48. 1% of Indian soils are deficient in diethylene-triaminepentaacetate (DTPA) extractable zinc, 11. 2% in iron, 7% in copper and 5. 1% inmanganese. Apart from the deficiency of the semicronutrients, deficiencies of boron and molybdenum have also been reported in some areas. Areas with deficiencies are also occurred in the district, thus simple fertilizers are not sufficient to exploit the potential of crops and cropping systems. Keeping in view the above importance of mineralfertilizers for crop growth and yield, this study on the status of soil micro nutrients was carried out with micronutrients,

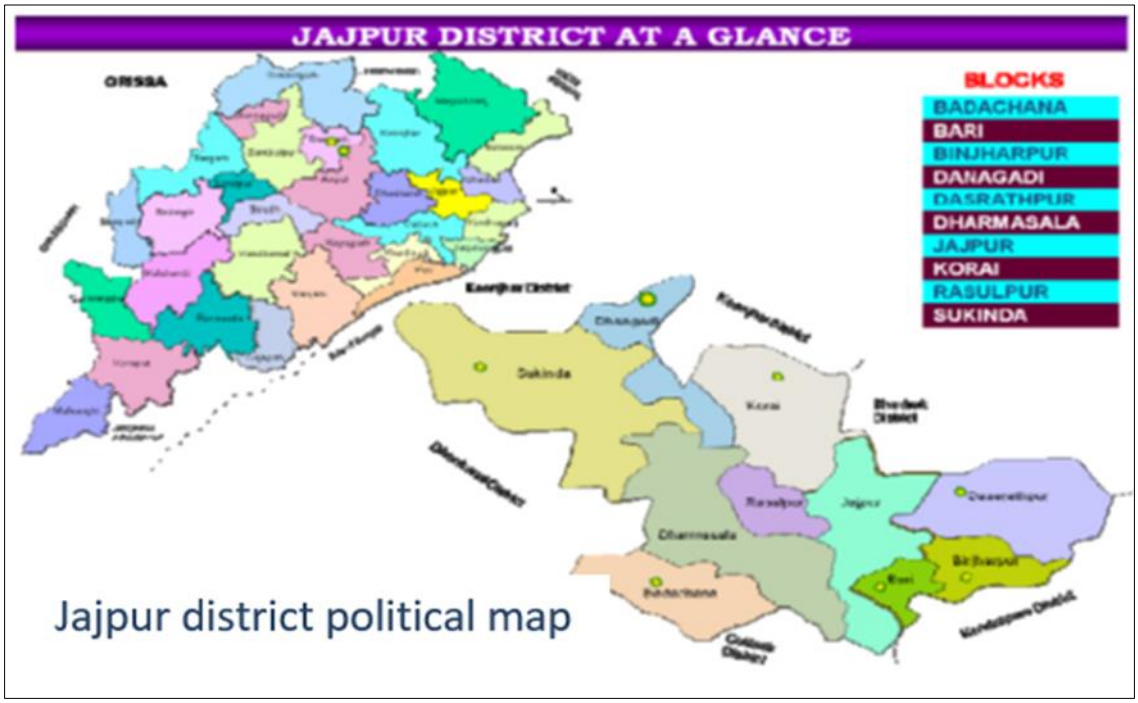
that is Zn, Cu, Mn, Fe and B distribution on the surface soils. This article emphasise the crop yield limiting nutrients and suitable crops for the soils of the Jajpur district.

Materials and Methods

The present investigation was carried out to assess secondary and micro-nutrient status of the soils of Jajpur district, Odisha (India). The geographical area of the district is 2887. 69km^2, which is 1. 85%of the total geographical area of the state. The average temperature ranges from 12 °C to 38 °C and average annual rain fall varies from 1168 mm/year. It is located between latitude 20°. 30' - 21°. 10' N and longitude 85°. 40' - 86°. 44 E.

Major Field crops cultivated are paddy, maize, groundnut, green gram, blackgram, jute, sugarcane. Major horticultural crops are potato, onion, chilly, sweet potato, and coriander. In some areas of the district pulses and oil seed crops are dominant. The altitude of the district is 331 m above MSL The soils of the district are broadly comes under Red soil, Laterite soil and alluvial soil. In table land zone the soils are mostly red and lateritic types. In coastal plain zone dominant soil type is alluvial and lateritic alluvial.

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 total 300 samplings was done with the help of GPS (Global Positioning System) instrument. Latitude and Longitude recorded for each site. The soil samples were collected from 20cm depth (Muhr *et al*, 1980) [7]. All the composite soil samples were air-dried, ground and passed through 2 mm sieve for chemical analysis. Soil pH and electrical conductivity (EC) were using 1: 2. 5 soil water suspensions (Page, Miller and Kenny, 1982), organic carbon (Walkley and Black, 1934), and available SO4- S (Williams and Steinberg, 1959). The available Zn, Cu, Mn and Fe extracted with DTPA (Lindsay and Norvell, 1978) [5] was determinedon an Atomic Absorption Spectrophotometer. The hot water soluble B was estimated bb UV-VIS Spectrophotometer (Wear, 1965). The relationship between various soil properties and micro-nutrients distribution were established by using simple correlation coefficient. The deficiency of the nutrients were identified by standard critical limits of respective nutrients.



Results and Discussion

Three hundred surface soils (0 to 20 cm) of Jajpur district, Odisha (India) were investigated. The results of soil pH, EC, organic carbon (OC), SO4-S are presented in Table 1 and DTPA- extractable Zn, Cu, Mn, Fe and hot water extractables B are presented in Table 2. Result shows that pH of the soils ranged from 4. 09 to 7. 40 (mean 5.52), EC varied from 0. 02 to 0. 89 dSm-1 (Mean 0. 12 dSm-1) and organic carbon content ranged from 0. 09 to 1. 87% with a mean value of 0. 66%. 0. 5% taking as critical limit 28. 66% of the jajpur district is in deficient. Available S varied from 1. 13 to114. 98 mg/kg (mean 16. 72mg/kg). There was 40% deficiency of Sin Jajpur soil. Deficiency of S was found in all blocks with PSD ranging from 6. 66% in Korei block to 60% in Binjharpur. This type of results were found by Sahrawath. K. L *et al*., 2007 [9] and Mishra A *et. al*., 2016 [6].

The soils were strongly acidic to neutral in reaction. Acidic in reaction of the district might be due to the high rainfall leading to the leaching losses of bases from the surface soils. Application of nitrogenous fertilizers and decomposition of organic residues hastened the soil acidity. The electrical conductivity value showed that the surface soils were free from salts. The EC value were good for crop growth, there is no threat.

Soil organic carbon with deal life line of soil and place significant role for maintenance of soil health (R. Lal, 1965). Farmers should apply recommended quantity of compost and organic matter to the soil in the soils of Jajpur, Dharmasala, Bari and Sukinda. Compost should be applied for achieving better agricultural produce. Similar type of results found by Wani L and Sreenivasa Rao, 2013.

Available sulphur

Available S is the most limiting secondary nutrient in Indian soils. This type of observation given by (Shukla AK, 2013). From crops requirement angle it stands next to NPK. The

Sulphur value ranged between 1. 13 to 114. 98 mg. /kg. with an district average of 16. 72 mg. /kg. There was 40% deficiency of S in Jajpur soil. Deficiency of S was found in all blocks with PSD ranging from 6. 66% in Korei block to 60% in Binjharpur. This type of results were found by Sahrawath. K. L *et al*., 2007 [9] and Mishra A *et. al*., 2016 [6].

Secondary plant nutrient S stands fourth next to primary nutrients. Preferential uptake of S nutrient is more by oil seed, pulses and vegetable crops (ref.) Jajpur is growing adequate quantity of oil seeds, pulses and vegetables. S deficiency may limit the growth of above crops. The blocks showing more S deficiency grow above crops for which gradually the soil is becoming deficient with S. intensive cultivation S loving crops, low soil organic matter coupled with light texture surface soils might be causing S deficiency. These type of discussion was given by Jena *et al*., 2006.

Table 1: Basic properties of surface soil.

Sl No.	Name of block	pH(1:2. 5)		EC(dS/m)		SOC %			AVAILABLE S (ppm)		
		Range	Mean	Range	Mean	Range	Mean	Deficiency (%)	Range	Mean	PSD%
1	Sukinda	4. 09-6. 83	5. 29	0. 015-0. 874	0. 138	0. 16-1. 87	0. 82	26. 6	2. 67-23. 23	11. 65	43. 3
2	Danagadi	4. 40-7. 40	5. 84	0. 035-0. 306	0. 102	0. 35-1. 57	0. 76	16. 6	1. 65-114. 94	22. 44	36. 6
3	Korei	4. 43-7. 23	5. 46	0. 035-0. 399	0. 129	0. 19-1. 63	0. 62	26. 6	5. 56-49. 87	23. 52	6. 6
4	Dasarathpur	4. 82-6. 92	5. 84	0. 015-0. 38	0. 121	0. 09-1. 63	0. 73	20. 0	1. 44-58. 50	16. 70	43. 3
5	Badachana	4. 59-6. 49	5. 33	0. 03-0. 183	0. 061	0. 29-1. 00	0. 68	23. 3	1. 16-46. 16	11. 69	5. 3
6	Dharmasala	4. 38-6. 62	5. 35	0. 022-0. 74	0. 139	0. 21-1. 12	0. 59	40. 0	1. 44-80. 61	17. 52	46. 6
7	Rasulpur	4. 34-6. 74	5. 71	0. 054-0. 894	0. 23	0. 17-1. 19	0. 61	36. 6	4. 7-69. 05	26. 80	13. 3
8	Binjharpur	4. 86-5. 91	5. 46	0. 02-0. 133	0. 062	0. 39-0. 99	0. 73	10. 0	2. 89-41. 74	10. 54	60. 0
9	Jajpur	4. 64-6. 97	5. 79	0. 04-0. 493	0. 14	0. 09-1. 00	0. 48	50. 0	2. 47-35. 57	14. 02	43. 3
10	Bari	4. 44-7. 40	5. 17	0. 023-0. 894	0. 08	0. 15-1. 63	0. 63	30. 0	1. 23-114. 94	12. 33	46. 6
	Mean	4. 09-7. 40	5. 52	0. 02-0. 89	0. 12	0. 09-1. 87	0. 66	28. 66	1. 13-114. 98	16. 72	40

Available micronutrients status and influence of soil chemical characteristics

Iron: The DTPA-Fe ranged from 11. 68 to 396. 8mg. /kg with an average of 110. 98mg. /kg. All soil samples of district were found sufficient. It was maximum in Sukinda block Badachana and Bari and minimum in Jajpur block 10. 74 to 134. 85 mg. /kg similar results was reported by 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. This status of Fe may develop Fe toxicity leading top limit the crop yield. The parent materials are rich in Fe containing rocks and minerals.

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. All soil samples of the district was found sufficient. Maximum content of Mn was found in Sukinda soil and minimum in Dharmasala block. Similarresults were found by Kumar *et al.* (2009). It might be due to rich content of this element in soil forming parent material of this district.

Copper: The value of DTPA-Cu ranged from 0. 39-7. 54 mg. /kg. with an average value of 28. 87mg. /kg. Very few sample (0. 3%) deficient in district. Under Sukindablock (3%) were found deficient. No Cu deficiency was observed in other blocks. The maximum Cu was found in Dasarathpur block (7. 54mg. /kg.) and minimum (0. 39mg. /kg.) in Dharmasala block. (Tagore GS *et al*, 2015 and Vijaya KM *et al*, 2015) reported similar results in Madhyapradesh and Tamilnadu soils.

Zinc: DTPA Zn varied from 0. 13-40. 8 mg. /kg with mean value of 0. 99 mg. /kg. Considering the 60mg. /kg. ascritical limit of DTPA-Zn. Considering 0. 6 mg kg-1 as critical limit of available Zn 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. Sood A *et al*. 2009, Shukla *et al*, 2014 found similar results in the soils of Punjab and India. Zn is an important micronutrient and limits the crop growth particularly in rice ecosystem of the state (report of AICRP on micro and secondary nutrients, 2013.) The deficiency of this nutrient up to 27% in the district soil and this was most constraining paddy production. Paddy is being the major crop in kharif season. And occurrence of Fe toxicity in mid and low land is prevalent. The application of Zn to rice crop cannot be ignore. 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.

Zinc deficiency canbe best alleviated with the use of 11 kg Zn ha-1 towheat, rice and maize; 5. 5 kg Zn ha-1 to, mustard, sunflower and sugarcane and with2. 5kg Zn ha-1 to groundnut, ragi, gram, green gram, etc.

Boron: The (HWS) Boron ranged between 0. 02 to 1. 77mg/kg with a mean value of 0. 40mg/kg. Similar results reported in the districts of Nayagarh and Dhenkanal by Mishra *et al*., 2016 [6]. The soils in the district was found deficient in boron up to 73. 33% among all nutrients Boron was found maximum deficient in the district. Deficiency was maximum in Badachana block (86. 66%) and minimum in Dharmasala block (33. 33%). Six blocks were found more than 80% deficient in Boron. Similar extent o Boron deficiency were reported by Sahrawath. K. L *et al*. 2007 [9], not only in Mahaboobnagar district of Telangana State but also in different states of India. B is an important nutrient for all crops, vegetables, oilseeds and high yielding rice varieties are highly sensitive to B application. From the data B is the most limiting nutrient in Jajpur district soils. Parent material devoid of B bearing minerals, Soil acidity, light texture and B demanding crops like vegetables, pulses, and oilseeds might be leading to B deficiency up to this extent. Care must be taken for soil application and foliar spray of B to all crops in the entire district. Not only to increase to quality of production but also to increase soil health.

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

Multinutreint deficiency in Jajpur district

Not only single nutrients were deficient in the district but also more than one nutrient were found deficient in a particular soil. Presently, single and multi micro and secondary nutrient deficiency are occurring in large scale in many parts of our country. Very often these nutrients are the cause of yield limiting factors in accordance with the Liebig's law of minimum leading to yield stagnation and ill health of soil. The multi nutrient deficiency number and percentage are presented in the figure no1. It was revealed from the table for both Sulphur and Zinc was deficient upto 10. 33%. Similarly S+ B, Zn+B&S+Zn+B were found deficient to the extent of 32%, 40% and 8% respectively. The maximum deficiency S+B was observed followed by Zn+B, S+Zn and S+Zn+B. Similar type of results were founded by Shukla A. K., 2014. Multi nutrient deficiency is more than that of single nutrient. In a particular soil is difficult to manage multimicro nutrient deficiency. As the district is a agriculturally dominated area with intense cropping of rice-pulse, rice-oilseeds and rice-vegetables without proper application of above nutrients leads to high multi micro nutrient deficiency. In future above deficiency nutrients has to be supplemented, otherwise they withstand as a major constraint of crop production In Jajpur district.

Graph showing the PSD and multinutrient deficiency.

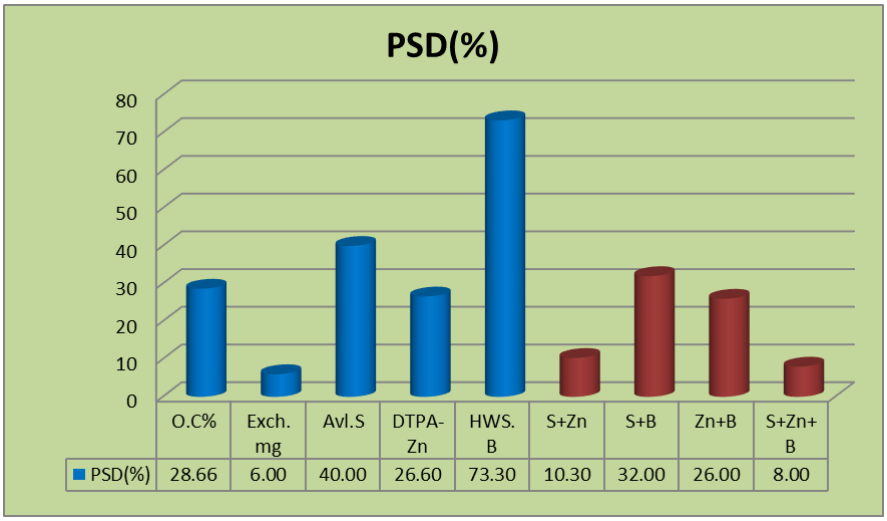


Fig 1: PSD (%)

References

1. Arvind KS, Pankaj K, Tiwariand, Chandra Prakash. Micronutrients deficiencies vis-a-vis food and nutritional security of India. Countrydian J. Fert., (19 pages). AICRP on Micronutrients, Indian Institute of Soil Science. 2014; 10(12):94-112.
2. Duarah I, Deka M, Saikia N, DekaBoruah HP. Phosphate solubilizers enhance NPK fertilizer use efficiency in rice and legume cultivation. 3 Biotech. 2011; 1(4):227-238.
3. Gao S, Yan R, Cao M, Yang W, Wang S, Chen F. Effect of copper on growth, antioxidant enzymes and phenyalanineammonialyse activities in *Jatropha curcas* I., seedling. Plant Soil Environ. 2008; 54:117-122.
4. Jeena M, Sumam G, Indira M. Effect of sulphur and boron on the performance of sesame (*Sesamum indicum* l.) In onattukara sandy soil of Kerala, India, Indian journal on agriculture research. 2013; 47(3):214-219.
5. Lindsay WL, Norvell WA. Development of DTPA soil test for zinc, iron, manganese and copper. Soil Science. Society of America Journal. 1978; 42:421-428.
6. Mishra A, Das D, Saren S, Dey P. GPS and GIS based soil fertility maps of Nayagarh district, Odisha annals of plant and soil research. 2016; 18(1):23-28.
7. Muhr GR, Datta NP, Sankara Subraney N, Dever F, Lecy VK, Donahue RR. Soil testing in India. USAID. Mission to India, New Delhi, 1965.
8. Rengel Z. Cycling of micro-nutrients in terrestrial *ecosystems*. In: Marschner, P, Rengel Z. (Ed.): Nutrient Cycling in Terrestrial Ecosystem. Springer-Verlag, Berlin, Heidelberg, 2007, pp.93-121.
9. Sahrawath KL, Wani SP, Rego TJ, parthasarathi G, Murthy KVS. Widespread deficiency of S, B, Zn in dryland soils of the Indian semi arid tropics. *Current science* I. 2007; 93(10).

10. Singh MV. Micronutrient deficiencies in Indian soils and field usable practices for their correction. IFA International Conference on Micronutrients, Feb. 23-24, 2004, at New Delhi, 2004.
11. Sood A, Sharma PK, Tur NS, Nayyar VK. Micronutrient Status and their Spatial Variability in Soils of Muktsar District of Punjab – A GIS Approach Journal of the Indian Society of Soil Science. 2009; 57(3):300-306.
12. Walkey A, Black CA. An examination of the degtjareff method for determining the soil organic matter and a proposed modification of the chromic acid titration method, Soil Science. 1934; 37:29-38.