Environment Conservation Journal 17(3) 87-90, 2016
ISSN 0972-3099 (Print) 2278-5124 (Online)
Abstracted and Indexed

Assessment of micronutrients contamination in soil around different industrial belt of Gujarat

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Received:15.04.2016 **Revised:21.07.2016** **Accepted:10.08.2016**

Abstract

A preliminary survey work was taken up during the year 2014-2015. Assessment of micronutrient (Fe, Mn, Zn and Cu) contamination in soil around industrial areas of Gujarat like, Vapi, Ankleshwar and Sachin. Concentration levels of the micronutrient were determined using Perkin-Elmer Inductively Coupled Plasma Mass Spectrometry, (ICP-MS). the result showed that the concentrations of analyzed micronutrient range from Fe content 13.6 to 29.5 mg/kg with mean value of 21.6 mg/kg, Mn content 10.3 to 21.2 mg/kg, Mn value of 14.2, Zn content 2.4 to 8.2 with mean value of 5.5 mg/kg and Cu content 2.1 to 5.6 mg/kg with mean value of 3.8 mg/kg in fields situated within the 2 km area of Ankleshwar, Sachin and Vapi GIDC. While, Fe content in fields situated in outside Fe content 13.2 to 26.0 mg/kg with mean value of and 19.6 mg/kg. Mn content 7.2 to 20.4 mg/kg mean value of 12.0 mg/kg, respectively. Zn content 2.1 to 8.6 mg/kg with mean value of 4.6 and Cu content 3.0 to 5.3 mg/kg mean value of 3.2 mg/kg. Hence the agriculture soil situated within 2 km and out-side 2 km area of Ankleshwar, Sachin and Vapi GIDC industrial area of Gujarat, dose not indicated any micronutrient contaminant regarding industrial areas it all were found below maximum permissible limit in soil.

Keywords: micronutrient, contamination, icp-ms, soil, industrial belt

Introduction

The contamination of soil, due to large scale anthropogenic activity like, industrialization and urbanization by human being it has created enormous environment problems and pollution. It plays great concern reducing agricultural productivity and damaging health and ecosystem developing nation. Reports indicate that the untreated and contaminated industrial effluents pollute the soils with micronutrient and heavy metals which needs due attention for their remediation. The pollution includes point sources such as emission, effluents and solid discharge from industries, vehicle exhaustion and metals from smelting and mining, and nonpoint sources, such as soluble salts (natural and artificial), use of insecticides/pesticides, disposal of industrial and municipal wastes in agriculture, and excessive use of fertilizers (McGrath *et al.*,2001). Each source of contamination has its own damaging effects to plants, animals and ultimately to human health, but those that add heavy metals to soils and waters are of serious concern due to their persistence in the environment and carcinogenicity to human beings. They cannot be destroyed biologically but are only transformed from one oxidation state or organic complex to another (Garbisu and Alkorta, 2001; Gisbert *et al.*, 2003). Therefore, micronutrient and heavy metal pollution posses a great potential threat to the environment and human health.Ankleshwar, Sachin and Vapi is industrial belt of Gujarat, India. These estates consist of an estimated 3000, 100 and nearly 2000 industrial units respectively. These industrial belts contain many villages surrounding nearby industries and most of village farmers are engaged with cultivation of vegetable, mango and sapota. Although micronutrient such as Iron, Manganese, Zinc and Copper etc. are essential but their higher concentration may cause health problem animals, plant growth and soil contamination.

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Materials and Method

Samples were collected around Agricultural field of each GIDC area was divided two part (i) polluted site (2 km industrial peripheral area) and (ii) non polluted site (out-side 2 km industrial peripheral area). Total (50) soil samples were collected in order to assessment of micronutrient contamination in surface soil of different GIDC areas of Gujarat like Vapi, Ankleshwar and Sachin. For each chosen village a site/plot was randomly selected for soil sample collection nearby to water source which was being utilized for irrigation purposes to some crops. Then from the selected plot, soil samples from 0-15 cm depth were taken by scrapping through the surface layer from to 5 to 6 places following zig-zag method of soil sample collection. Utmost care was taken to keep the soil samples free from contamination from the soils of other samples. Collected samples were mixed well to make a composite representative and packed in polythene bags were brought to the laboratory for further laboratory studies. All the collected soil samples were allowed to dry in shade for two-three days. Then samples were grounded to pass through a 2 mm sieve to make the sample homogeneous. The micronutrient content (Fe, Mn, Zn and Cu) in soil were analyzed using Inductively Coupled Plasma Mass Spectrometry (ICP-MS).

Results and discussion

Content of Fe, Mn, Zn and Cu in surface soil nearby surrounding area of industrial belt, Ankleshwar, Sachin and Vapi.Results on DTPA-extracted Fe from soil samples are presented in Table-1. The results revealed that Fe content in fields situated within the 2 km area of Ankleshwar, Sachin and Vapi GIDC was widely range from 13.6 to 29.5 mg/kg with mean value of 21.6 mg/kg. While, Fe content in fields situated in outside 2 km area of Ankleshwar, Sachin and Vapi GIDC was range from and 13.2 to 26.0 mg/kg with mean value of and 19.6 mg/kg. There are no adverse effects of contamination/toxicity of Fe in soils and did not show any indication of Fe pollution. There is no maximum permissible threshold value of Fe in soil. Similar result also documentation by Dheeba et al. (2012) it recorded 46.6 mg/kg Fe as maximum value in surface soil around industrial area, Tamil Nadu, India. While Shaikh and Bhosle (2013) obtained Fe concentration of 60 mg/kg in surface soils near Siddheshwar Dam, Maharashtra, India.Overall range and mean of DTPA-extractable Mn from soil samples collected from inside and outside 2 km of three industrial area was 10.3 to 21.2 mg/kg and 14.2 mg/kg and 7.2 to 20.4 mg/kg and 12.0 mg/kg, respectively. Similar result also reported by Odoi et al. (2011) in soils of industrial area of Ghana, Stephen and in top soils around the Iron-ore mining field Itakpe, Nigeria and Shaikh and Bhosle (2013) in surface soils near Siddheshwar Dam, Maharashtra, India, with range of 19.90, 6.39-20.31 and 12.59 mg/kg Mn. While Assah and Abimbola (2005) reported exceptional high range of Mn (55-3282 mg/kg). The data regarding to Mn content in soil were found below permissible threshold value, there are no adverse effect of Mn by contamination/toxicity, and did not show any indication of Mn pollution in soil, However, the differences in available Mn content in soils by various industrial complex might be ascribed to varying soil pH, organic matter and nutrient removal by crop. DTPA extractable Zn content in field situated in 2 km range of Ankleshwar, Sachin and Vapi GIDC was varied from 2.4 to 8.2 with mean value of 5.5 mg/kg. The content of DTPA extractable Zn in field situated outside the 2 km range was varied from 2.1 to 8.6 mg/kg with mean value of 4.6 mg/kg (Table-1). More or less, similar results were obtained by Odai et al. (2011) and Dheeba et al. (2012) with a value of 9.06 mg/kg and 13.6 mg/kg respectively, However, other researchers (Assah and Abimbola, 2005 recorded 30-3782 mg/kg; Krishna and Govil, 2007 recorded 139.0 mg/kg; Gowed et al., 2010 noted 43.5-687.6 mg/kg; Sayyed Sayadi, 2011 registered 22.6-73.7 mg/kg; Kumar and Srikantaswamy, 2012 recorded 66-121 mg/kg; Stephen and Oladele, 2012 noted 43.8-75.2 mg/kg) obtained much higher Zn content in surface soils of surrounding area/vicinity of various industrial complexes in different areas/countries. However, the differences in available Zn content in soils by various industrial complexes might be ascribed to varying soil pH, organic matter and nutrient removal by crop. Result on DTPA-extractable Cu from fifty (50) surface soil samples presented in table-1 revealed that Cu content in fields located in 2 km periphery of three industrial areas was in range of 2.1 to 5.6 mg/kg with mean value of 3.8 mg/kg. The content of DTPA-extractable Cu in field situated outside the 2 km of three industrial

Table 1:- DTPA-extractable Fe, Mn, Zn and Cu content in soil of Ankleshwar, Sachin and Vapi

Sr. No.	Fe (mg/kg)		Mn (mg/kg)		Zn (mg/kg)		Cu (mg/kg)	
	In-side fields	**Out-side fields**	**In-side fields**	**Out-side fields**	**In-side fields**	**Out-side fields**	**In-side fields**	**Out-side fields**
Ankleshwar								
1	23.1	20.5	17.8	20.4	4.2	3.2	3.9	2.1
2	20.1	16.8	15.3	14.0	5.2	3.8	4.2	3.9
3	17.3	15.2	11.7	11.1	7.1	5.1	3.6	2.5
4	14.8	13.2	10.4	9.2	6.1	5.1	3.1	2.6
5	24.8	19.7	16.5	16.4	3.4	3.1	5.1	4.8
6	27.2	18.0	16.6	14.4	8.2	6.2	5.1	5.3
7	21.3	19.8	13.2	12.3	5.1	4.2	4.1	3.6
8	23.2	21.5	12.5	12.1	5.5	5.1	2.1	2.6
9	14.3	17.8	12.1	8.5	3.1	3.2	3.8	2.4
10	17.4	17.0	11.0	7.2	6.3	4.2	3.5	2.5
Min	14.3	13.2	10.4	7.2	3.1	3.1	2.1	2.1
Max	27.2	21.5	17.8	20.4	8.2	6.2	5.1	5.3
Mean	20.3	17.9	13.7	12.6	5.4	4.3	3.9	3.2
Sachin								
11	19.0	16.4	13.5	12.5	4.9	4.1	2.7	2.4
12	21.7	20.3	10.3	9.1	2.4	2.1	3.8	3.1
13	23.0	21.2	13.6	12.5	3.9	3.3	2.7	2.0
14	23.4	22.4	12.9	12.2	5.2	4.5	4.2	3.5
15	25.4	25.1	11.7	9.1	7.6	6.3	3.0	2.4
Min	19.0	16.4	10.3	9.1	2.4	2.1	2.7	2.0
Max	25.4	25.1	13.6	12.5	7.6	6.3	4.2	3.5
Mean	22.5	21.1	12.4	11.1	4.8	4.1	3.3	2.7
Vapi								
16	25.4	22.9	20.2	17.9	7.2	5.4	3.7	2.6
17	22.4	19.2	12.7	10.7	6.5	5.3	4.5	2.5
18	19.0	18.1	16.9	13.1	7.8	6.5	4.6	3.6
19	16.5	15.6	14.6	8.2	5.8	4.8	5.6	5.2
20	26.9	21.8	18.5	15.3	5.7	4.2	4.1	3.1
21	29.5	20.4	12.6	9.2	4.3	3.4	4.9	4.6
22	23.9	22.8	21.2	18.4	6.3	8.6	2.6	2.2
23	27.8	26.0	13.4	8.1	6.7	5.5	3.1	2.9
24	13.6	19.1	15.2	10.4	4.7	3.4	5.1	4.7
25	18.7	18.3	11.7	8.6	3.7	3.4	3.0	2.3
Min	13.6	15.6	11.7	8.1	3.7	3.4	2.6	2.2
Max	29.5	26.0	21.2	18.4	7.8	8.6	5.6	5.2
Mean	22.4	20.4	15.7	12.0	5.9	5.0	4.1	3.4
Overall								
Min	13.6	13.2	10.3	7.2	2.4	2.1	2.1	2.0
Max	29.5	26.0	21.2	20.4	8.2	8.6	5.6	5.3
Mean	21.6	19.6	14.2	12.0	5.5	4.6	3.8	3.2
MPL	-	-	80	80	200	200	30	30

MPL- Maximum Permissible Limit based on (WHO-1996).
Fe- There is no maximum permissible limit for Fe.

areas was in the range of and 3.0 to 5.3 mg/kg and 3.2 mg/kg Further, available Cu content of all the soil samples were below the maximum permissible threshold value which clearly indicated that there are no adverse effect of contamination/toxicity of Cu were observed, Results, more or less, corroborated with the data of Cu obtained by other scientists (1.7-126.1 mg/kg by Gowed et al., 2010; 10.42-35.57 mg/kg by Sayyed Sayadi, 2011; 15.23 mg/kg by Odoi et al., 2011; 6.8-20.3 mg/kg by Kumar and Srikantaswamy, 2012) in surface/top soils nearby to various industrial complex in different parts of India and abroad. Krishna and Govil (2007) 137 mg/kg, Stephen and Oladele (2012) 33.4-51.5 mg/kg (all higher values) of Cu in surface soil in the vicinity of industrial belt. However, the differences in available Cu content in soils may due to various industrial complexes might be ascribed to varying soil pH, organic matter and nutrient removal by crop.

Conclusion

Monitoring of micronutrient in the soil provides efficient way to assess the qualitative and quantitative difference in metal concentration at distinct industrial locations. It can be concluded that the soil samples collected from nearby surrounding area of industrial belt like, Ankleshwar, Sachin and Vapi does not showed any contamination of Fe, Mn, Zn and Cu toxicity in soil of nearby different industrial area. The concentration of micronutrient Fe, Mn, Zn and Cu were below maximum permissible limit.

Acknowledgement

The authors are grateful to the thank I/C Professor and Head of Food Quality Testing Laboratory, Dean of N. M. College and Directorate of Research, Navsari Agricultural University, Navsari for providing necessary requirements in conducting the laboratory and farm work.

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