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Assessment of lead concentration levels in roadside tea cultivated soil and tea leaf samples in Dibrugarh district of Assam, India.

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ABSTRACT

The contamination of tea soils and tea plants by lead from automobile sources has become a serious environmental issue. The content of lead in the tea soils and tea leaves from roadside tea estates in Dibrugarh district was investigated using atomic absorption spectroscopy (AAS) technique. Samples of soil and tea leaves were collected from a site located on a highway, and another in a rural area which served as the reference site. Level of lead in soil and tea leaves were found to be 27.78 ± 3.16 to 34.72 ± 4.14 and 19.18 ± 2.78 to 24.32 ± 3.02 mg/kg respectively from Moran to Dibrugarh. The result of the analysis showed that as the roadside distance increases from the road edge the metal concentration decreases in a constant pattern. The level of lead concentration in roadside tea soils and tea leaves were higher as compared to reference soil level and the concentration lead in leave samples were found higher than the soil samples. In the absence of any major industry in the sampling sites the concentration of lead level indicates that automobiles are major source of this metal in roadside soil and leaf.

KEY WORDS: Environmental, roadside soil, AAS, automobile

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INTRODUCTION

Lead is present in the earth crusts with other metals. Lead is not essential element beneficial to humans, animals and plants also it was known as one of the most toxic heavy metals in the environment [1]. Lead poisoning is an important environmental pollution that can have life-long adverse health effects. Lead causes symptoms ranging from the loss of neurological function to death depending upon the extent and duration of exposure [2]. Lead is released from various sources such as municipal wastewater sludge, urban composts, road traffics, atmospheric deposits and agrochemicals such as fertilisers, pesticides, fungicides and so on. Atmospheric emissions tend to be of great concern, because of the quantity, wide spread dispersion, potential and their invisible nature. Environmental pollution of lead from road traffics emissions has attained much attention in the recent past due to their long-term accumulation [3]. Several studies have proved that roadside environments are polluted by heavy metals released during different operations of the road transport. Heavy metal such as lead has been reported to be released into the atmosphere during different operations of the road transport [4-8].

The use of leaded gasoline in cars is one of the major sources of lead pollution in cities around the world [9]. The road traffic is responsible for over a thousand tonnes of lead each year, as a result of lead additives in petrol [10]. Soils, plants and food are major receptacles for these atmospheric emissions. It was reported that 3 % of lead in soil is translocated through the root to the shoot of plants while the rest is through foliage [7]. Lead continuously transferred between air, water and soil by natural processes, physico- chemical such as erosion, precipitation, dry deposition of dust etc. Its exposure in the environment results in a wide range of negative effects, depending from the level of lead and time of extended. As a result, the contamination of soils has influence on the increase of the level of lead in vegetation. Lead-contaminated soil and dust have been identified as important contributors to blood lead levels [11]. The present research was undertaken to determine the metallic lead level in roadside tea cultivated soil and tea leaves to ascertain the influence of transportation activities and application of fertilizers.

MATERIALS AND METHODS

Study Area

This study was conducted in tea cultivation areas located both sides of the national highway NH-37 from Moran to Dibrugarh district of Assam. Dibrugarh district is situated in the eastern part of Assam. The district extends from $27^0 05.38^/$ N to $27^0 42.30^/$ N Latitudes and $94^0 33.46^/$ E to $95^0 29.80^/$ Longitudes. The geographical area covered by Dibrugarh district is 3881 sq km. The area

of Dibrugarh district experienced subtropical monsoon climate with mild winter, warm and humid summer. The average annual rainfall in this district is 276 cm with a total number of 193 rainy days.

Soil and leaves sampling and laboratory analyses

In total of thirty sampling sites were selected. Topsoil (0-20 cm depth) and leaf samples were collected at 100, 200 and 300 m from the road edges at each of the sampling sites during the January 2014. Composite soil samples were taken and prepared for necessary analysis in the laboratory [12]. Samples from the control sites were collected following the same procedure. 1.0 g air dried sieved soil sample was placed in 100 mL beaker with 15 mL of concentrated HCl, 5 mL concentrated HNO_3 and 3 mL concentrated H_2SO_4 and heated at 95-100^{0}C on hot plate. After proper digestion, the digest was made up to 50 mL with deionised water. The extract was analyzed using AAS (Varian Spectra AA 220). Same procedure was carried out on control soil sample. Leaf samples were taken from the same locations and brought to the laboratory, washed with distilled water, dried at 65^{0}C temperatures and ground. Heavy metal lead was then estimated by AAS after proper digestion and analytical procedure [12].

RESULT AND DISCUSSION

The concentration of lead in tea cultivated soil and tea leaves samples at difference distances from the road edge are given in Tables 1 and 2. The concentration of lead in control soil and tea leave samples at difference distances from the road edge is given in Tables 3.

Table 1. Concentrations of lead in roadside tea soils in mg/kg (from Moran to Dibrugarh NH 37, left side & right side).

Variable	Level	Pb (left side)		Pb (right side)	
		Range	SD	Range	SD
Distance	100m	34.72 ± 4.14 (30.58 – 38.86)	5.12	34.02 ± 4.64 (29.38 –38.66)	4.32
	200m	30.16 ± 3.84 (26.32 – 34.00)	4.94	29.54 ± 4.32 (25.22–33.86)	4.14
	300m	28.04 ± 4.74 (23.30 – 32.78)	5.34	27.78 ± 3.16 (24.62 -30.94)	4.64

Table 2. Concentrations of lead in roadside tea leaves in mg/kg (from Moran to Dibrugarh NH 37, left side & right side).

Variable	Level	Pb (left side)		Pb (right side)	
		Range		Range	SD
Distance	100m	24.32 ± 3.02 (21.30-27.34)	4.12	23.86 ± 2.92 (20.94-26.78)	4.62
	200m	21.26 ± 3.42 (17.84-24.68)	4.02	20.46 ± 3.22 (17.24-23.68)	4.28
	300m	19.84 ± 2.98 (16.86-22.82)	4.26	19.18 ± 2.78 (16.40-21.96)	4.52

Table 3. Concentrations of Pb in reference soil and tea leaves sample in mg/kg

Sl. No	Heavy metal	Concentration (soil)	Concentration (leaves)
1	Pb	15.64	12.08

The concentration of lead measured in left and right sides of national highway were 28.04 ± 4.74 to 34.72 ± 4.14 and 27.78 ± 3.16 to 34.02 ± 4.64 mg/kg respectively. The maximum permissible limit of lead concentration in soil [13] is given in table 4.

Table 4 : Allowable limits of lead concentration in soil (mg/kg)

Heavy metal	Austria	Germany	France	Luxembourg	Netherlands	Sweden	United Kingdom
Pb	100	70	100	50-300	40	40	300

The concentration of lead in roadside soil was higher than the level in the control soil. The concentration of lead show a declining trend with the increase of distance to the road edge (Fig 1 and 2). The lead concentration is higher near the roadside soil and gradually decreases as the distance increases. It is evident from these results that roadside tea cultivated soil and tea leaves are contaminated with lead. It was observed that the concentration lead in tea cultivated soil might be increase by the application of fertilizers, animal wastes and fungicides for the improvement of quality and productivity of tea. Similar results were also found in the previous studies [14, 15]. Another possible accumulation of the roadside soil occurs due to continual usage of the road by automobiles. It was reported that soils within 40 m off the motorway having at least 2 to 6 times higher amounts of lead than the background

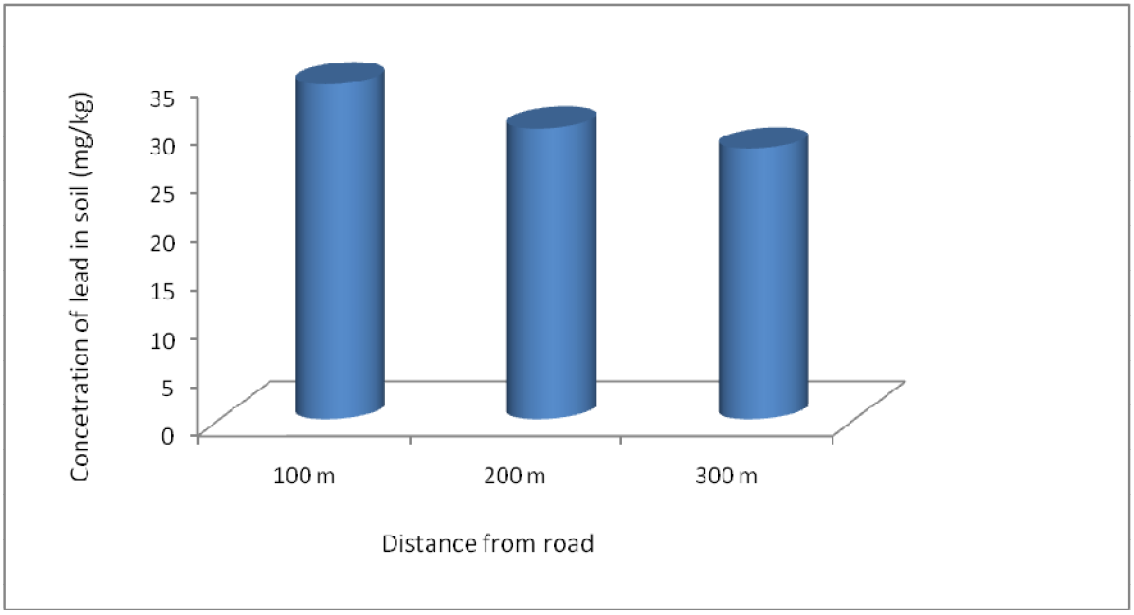

Fig 1. Concentration of lead in mg/kg on the roadside (left) tea cultivated soil

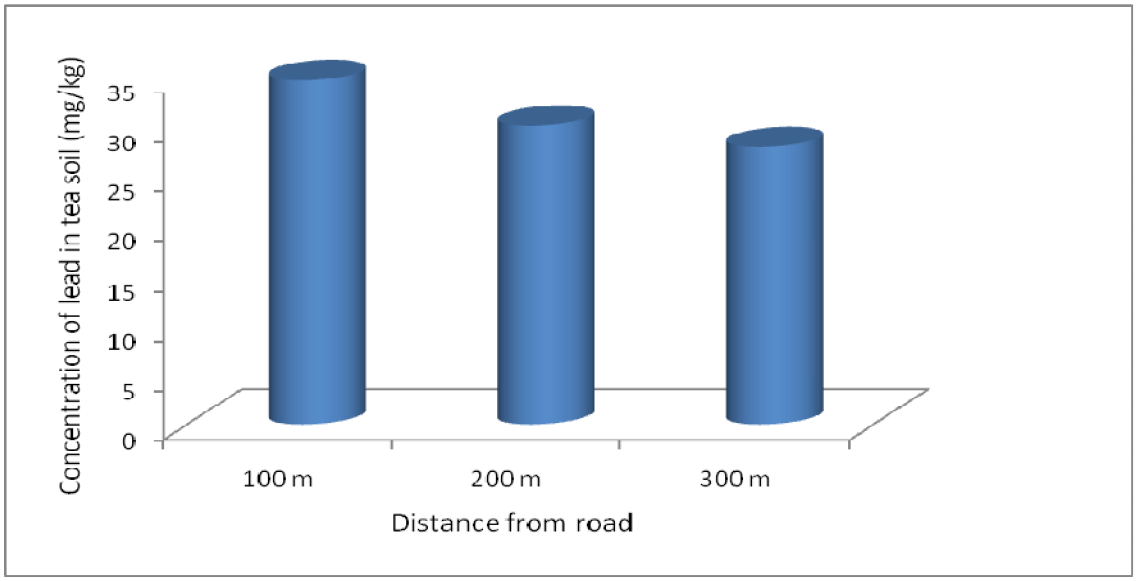

Fig 2. Concentration of lead in mg/kg on the roadside (right) tea cultivated soil

level [16]. Several reports have been given on the use of lead as an anti knocking agent in gasoline results in its release during emissions from fossil combustion [4, 7, 16, 17]. These observations indicate some level of contamination possibly from aerial deposition of lead particulate in roadside environment mainly automobiles. It was reported that trees growing linearly along the roadways can effectively reduce the lead concentration on the roadside agricultural soil [8].

It was also observed that the lead contents in roadside tea leaves is higher than the control tea leaves and gradually decreased with distance from the road edge (Fig 3 and Fig 4) These results

suggest that the tea soil and tea leaves near the road were contaminated with lead and that automobile emissions are the major source of the lead to the soil and the leaves in the areas closer to highways. There were spatial differences in metallic lead levels and tea leaf.

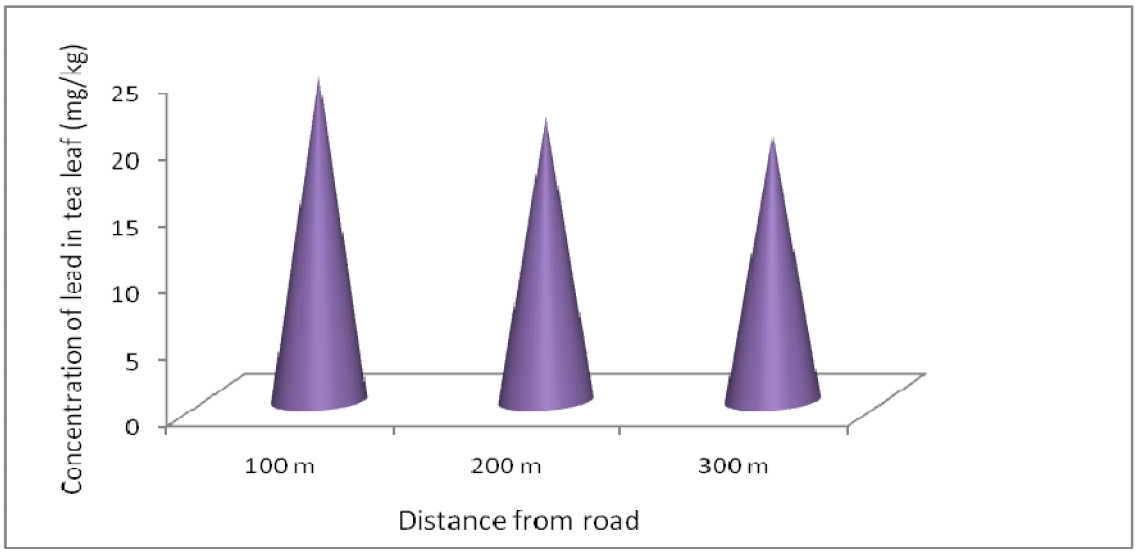

Fig 3.Concentration of lead in mg/kg on the roadside (left) tea leaf

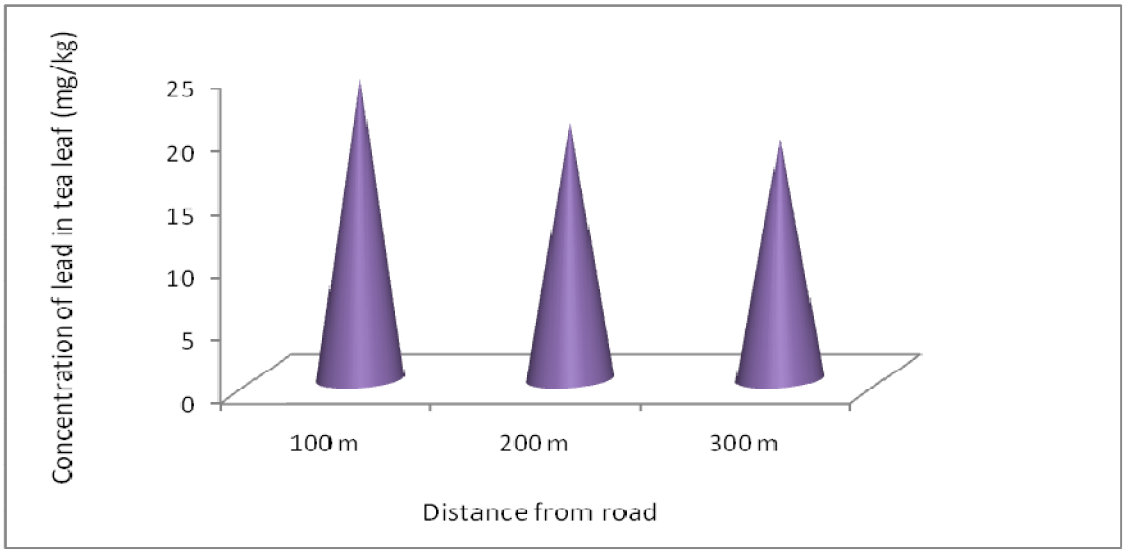

Fig 4.Concentration of lead in mg/kg on the roadside (right) tea leaf

It was found that metallic lead level in tea soil were higher than the tea leaf. Some researchers have reported that lead content of soil to be higher than that in plant samples collected near the highways [9, 17]. The observed difference in metallic lead levels between the tea soil and the tea leaves indicates that only a fraction of the total lead content in the tea cultivated soil was taken by plants. This is in agreement with previous studies [6, 9, 18]. It was reported that lead levels in plants are

determined not only by the concentration in the soil but also by the physic-chemical properties of the soil such as pH, electrical conductivity, cation exchange capacity and total organic matter content of the soil [6-8, 17]. The concentration of lead level of the tea leaves was higher than the levels of the control soil leaves. The relatively high lead level in tea leaves is due to the roadside environment mainly automobiles.

CONCLUSION

The results of this work shows that the concentration level of lead in tea soil were higher than the tea leaves. The lead concentration of tea soil and tea leaves samples were found to be below the allowable limits. The lead concentration is higher near the roadside soil and gradually decreases as the distance increases. There was substantial contamination with lead in both tea soil and tea leaves. In the absence of any major industry in the sampling sites these observations suggest that motor vehicles on the roads were the main sources of lead to the roadside soils and tea leaves. Therefore regular monitoring of lead concentration in tea cultivated soil and tea leaves is essential.

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CONFLICT OF INTEREST STATEMENT

The author declared no conflict of interest in this research article.

REFERENCES

1. Demayo A, Taylor M C, Taylor K W, Hodson P V. Toxic effects of lead and lead compounds on human health, aquatic life, wildlife plants, and livestock. Critical Reviews in Environmental Control 1987; 12: 257-305.
2. Mirela A , Nikolla C . Assessment of Lead concentration in the Surface and Profile Soil International Journal of Crop Science and Technology 2016; 2(1): 136-142.
3. Christina M A O , Samuel K. Investigation of heavy metal levels in roadside agricultural soil and plant samples in Adogo, Nigeria. Academic Journal of Environmental Sciences 2012; 1(2): 31-35.
4. Akbar K F, Hale W H G, Headley A D , Athar M. Heavy metals contamination of roadside soils of Nothern England. Soil Water Res 2006; 1(4): 156-163.
5. Eruyogho F I, Okua, J M , Ndiokwere C I. A servey of levels of some heavy metals in Scalp Hair of Urban dwellers : A case study. J.Appl. Sci 2007; 7(3): 465-471.
6. Atayese M O, Eighadon A I, Oluwa K A , Adesodini J K. Heavy metal contamination of

Amaratus grown along major highways in Lagos, Nigeria, Air. Crop. Sci J 2008; 16(4): 225-235.

7. Sharma S , Prasade F M. Accumulation of lead and cadmium in soil and vegetable crops along major highways in Agra (India). J. Chem 2010; 7 (4): 1174-1183.
8. Zhang F, Yan X, Zeng C, Zhang M., Shrestha S, Devkota L P , Yao T. influence of traffic activity on heavy metal concentrations of roadside farmland soil in Mountainous Areas. Int. J. Environ. Res. Public Health 2012; 9(5): 1715-1731.
9. Luilo G B , Othman O C. Lead pollution in urban roadside environments of Dares Salaam city. Tanz. J. Sci 2006; 32(2) : 61-67.
10. Irami S, Ahmed, I , Stuben D. Analysis of mines and contaminated agricultural soil samples for fungral diversity and tolerance to heavy metals .Pak. J. Bot 2009; 41(2): 885-895.
11. Madhavan S, Rosnman K D , Shehata T. Lead in soil: recommended maximum permissible levels. Environ Res. 1989; 49(1):136-142.
12. Gupta P K. Methods in environmental analysis of water, soil and air. Second Edition, Agrobios (India).; 2007, p-306.
13. European Comission Director General Environment, ECDGE. Heavy metals and organic compounds from wastes used as organic fertilizers. Final report, July. WPA Consulting Engineers Inc. Ref. Nr. TEND/AML/2001/07/20, 2010; p-73-74.
14. Rao J . Heavy metal inputs to soil by agricultural activities . Env. Geochemistry 1998; 1 : 15-18.
15. Rao N , Sharma D R R. Trace metals in soil near an industrial belt in Visakhapatram. Poll.Res 1998; 7 (4): 377-380.
16. Oztas T , Sibel Ata S. Distribution patterns of lead accumulation in roadside soils : a case study from Erzorum, Turkey. Int. J. Environ. Pollut 2002; 18(2): 190-196.
17. Onder S, Dursun S, Gezgin S , Demirbas A. Determination of heavy metal pollution in grass and soil of city centre green areas (Kenya, Turkey). Pol. J. Environ. Stud. 2007; 16(1) : 145-154.
18. Othman I, Al-Oudat M , Al-Masri M S. Lead levels in roadside soils and vegetation of Damascus city .Sci. Total Environ 1997; 207(1): 43-48.