Polish Journal of Environmental Studies Vol. 13, No. 2 (2004), 233-235

Letter to Editor

Lead in Particulate Deposits and in Leaves of Roadside Plants

C. Aydinalp[1]*, S. Marinova[2]

[1]Uludag University, Faculty of Agriculture, Department of Soil Science, 16059 Bursa, Turkey.
[2]Nicola Poushkarov Institute of Soil Science and Agroecology, Sofia, Bulgaria.

Received: 7 February, 2003
Accepted 11 July, 2003

Abstract

Lead concentrations were determined for particulates, which were deposited on the leaves of roadside plants in Bursa city of Turkey. The particulates were collected from the leaves and the lead accumulated by the leaves of different species were also measured. A statistically significant correlation was found between the number of passing petrol-fueled vehicles and lead concentrations in the deposits at different designated sites. However, no significant correlation was found between concentration in the deposits and lead accumulated by the leaves. A lead concentration of 32.00 ± 6.8 ppm was the highest concentration in the particulate deposits, while maximum lead accumulated by the leaves was noted as 3.15 ± 1.12 ppm.

Keywords: Bursa region, plants, lead, pollution, deposits

Introduction

Lead has long been known as a potential health hazard [1, 2, 3, 4, 5]. A number of studies have determined lead concentrations in dust, soil, particulates and leaf samples in different urban areas around the world [6, 7, 8, 9, 10, 11]. Dust is a significant source of lead and can raise the blood lead levels in humans, particularly in children [12, 13, 14, 15].

In this research, an attempt was made to study the lead concentrations in the particulates, which were deposited on the leaves of plants over the period from their emergence to senescence. The leaves of the plant species were picked in May 2002 and the lead accumulated by the leaves was studied in this study.

Experimental Procedure

Leaves of three different plant species growing along to the roadsides were picked in this study. *Ficus bengalensis*, *Trifolium pratense* and *Agropyron elongatum* were selected due to their quite intensive occurrence in particular localities along the highways in the region. The leaves were brushed separately for the collection of particulate deposits, using the methods adopted by Archer and Barrat [16], Solomon and Hartford [17]. The particulates were then weighed. The area of all the leaves collected from each location was calculated to determine the weight of the deposits per cm^2 of the leaves. The lead in the particulate deposits and lead accumulated by the leaves of the plants were extracted using the procedures recommended by Harrison and Laxen [18]. Three replicates of the sample from each locality were taken.

The samples were analyzed using an atomic absorption spectrophotometer (flame type), the equipment having been previously calibrated.

Results and Discussion

Lead concentrations in the particulate deposits and lead accumulation by the leaves of different plant species growing along the roadsides of Bursa are presented in Table 1. Sampling point number one recorded the highest lead concentration in its deposits and maximum lead accumulation in the leaf. This was also an intersection through which the highest number of petrol vehicles passed. No

*Corresponding author; e-mail: cumhur@uludag.edu.tr

Table 1. Lead concentration in particulate deposits and in the leaves of roadside plants.

Site Number	Vegetation type	Lead in deposits (ppm)	Lead in leaves (ppm)	Particulate cm^2 leaf
1	*Trifolium pratense*	32.00 ± 6.8	2.38 ± 0.96	11.65
2	*Trifolium pratense*	15.87 ± 2.30	1.56 ± 0.85	12.37
3	*Trifolium pratense*	13.90 ± 2.17	2.22 ± 1.31	9.17
4	*Trifolium pratense*	11.33 ± 1.21	1.98 ± 1.10	11.07
5	*Trifolium pratense*	12.88 ± 1.10	2.30 ± 0.66	9.45
6	*Agropyron elongatum*	20.80 ± 3.90	2.16 ± 1.15	7.64
7	*Agropyron elongatum*	19.91 ± 3.24	1.39 ± 0.96	6.97
8	*Agropyron elongatum*	15.43 ± 1.84	1.87 ±0.81	10.49
9	*Agropyron elongatum*	16.54 ± 1.99	1.46 ± 0.89	7.06
10	*Agropyron elongatum*	15.59 ± 1.30	1.92 ± 0.89	6.19
11	*Agropyron elongatum*	15.07 ± 1.96	2.62 ± 1.28	7.94
12	*Agropyron elongatum*	14.22 ± 2.19	1.49 ±0.82	6.18
13	*Agropyron elongatum*	12.90 ± 3.28	3.10 ± 1.12	8.58
14	*Agropyron elongatum*	10.29 ± 2.04	1.50 ± 1.08	6.94
15	*Agropyron elongatum*	7.67 ± 1.30	1.43 ± 0.94	4.80
16	*Ficus bengalensis*	15.37 ± 1.53	1.29 ± 0.98	16.99
17	*Ficus bengalensis*	12.20 ± 1.59	2.07 ± 1.28	16.71
18	*Ficus bengalensis*	11.34 ± 1.78	2.10 ± 0.76	15.85
19	*Ficus bengalensis*	2.11 ± 0.30	0.29 ± 0.70	5.81
20	*Ficus bengalensis*	16.67 ± 1.86	1.59 ± 0.91	16.91

significant correlation was found between lead concentration in the particulate deposits and lead accumulation by the leaves. However, a statistically significant correlation ($p<0.05$) was noted between the number of passing petrol vehicles and the lead concentrations in the particulate deposits collected from different designated sites. (It should be mentioned that the data relating to traffic volumes were available for only 15 designated sites from Traffic Bureau information.)

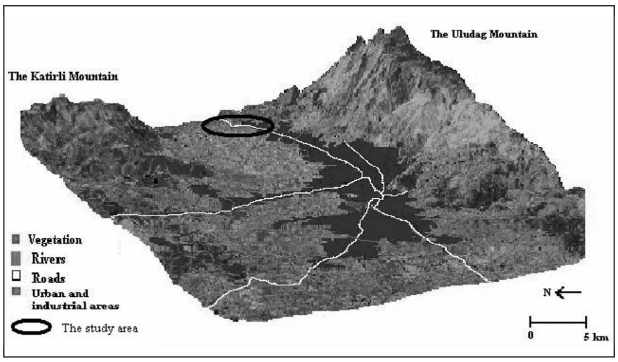

Fig. 1. The location of the study area in the Bursa city, Turkey.

Particulate deposits per unit area of leaf were found to be greatest on the leaves of *Ficus bengalensis*. This may be due to leaf orientation, while the leaves of other species are somewhat more vertically oriented. The leaves of *Ficus Bengalensis* are sticky compared to the other plant species. Lastly, the leaf size of *Ficus Bengalensis* is much larger than that of the other species studied. Horizontally oriented, broad and sticky leaves provide a much better collection opportunity for the atmospheric fallout.

This study was carried out in 2002, a decade earlier and globally gasoline was the major contributor of atmospheric lead from human activity [19]. However, progressive reduction in the lead content in petrol in most of the developed countries has decreased the lead level in the atmosphere, human blood and vegetation [20, 21, 22, 23, 24]. The regulation of lead in petrol is the most widely used strategy to decrease atmospheric lead. For instance, the United Kingdom reduced the legally permitted maximum concentration of lead in gasoline from 0.4 to 0.15 g l^{-1} in 1985 [25, 26]. In the USA these figures changed from 0.42 g l^{-1} in 1975 to 0.12 g l^{-1} in 1984 [27]. In Austria, Canada, Germany, Switzerland and Sweden leaded petrol had been completely phased out by the late 1980s and early 1990s, and is no longer used in on-road vehicles [28].

While in Turkey the amount of tetraethyl lead used as an anti-knock agent in gasoline is much higher than in the aforementioned countries, two types of petroleum distillates are used in gasoline-powered automotive vehicles. 'Super' contains 0.63 g l^{-1} of lead while 'Regular' contains 0.42 g l^{-1} of lead. The consumption of super graded petrol is higher than that of regular grade. It could be concluded from the above figures that burning of gasoline with high lead content is the main cause of the high levels of lead in particulate deposits collected from different designated sites in the study area.

References

1. ROWCHOWDHURY A, GAUTUM A.K. Alteration of human sperms and other seminal constituents after lead exposure. Indian Journal Physiology and Allied Science, **49** (2), 68, **1995**.
2. SHEN X.M, ROSEN J.F, GUO D, WU S-M. Childhood lead poisoning in China. The Science of the Total Environment, **181** (2), 101, **1996**.
3. NRIAGU J.O, BLANKSON M.L, OCRAN K. Childhood lead poisoning in Africa: A growing public health problem. The Science of the Total Environment, **181** (2), 93, **1996**.
4. KIM R, ROTNITZKY A, SPARROW D, WEISS S.T, WAGER C, HU H. A longitudinal study of low-level lead exposure and impairment of renal function: A normative aging study. Journal of the American Medical Association, **275** (15), 1177, **1996**.
5. SHANNON M, GRAEF, J.W. Lead intoxication in children with pervasive developmental disorders. Journal of Toxicology and Clinical Toxicology, **34** (2), 177, **1996**.
6. DUGGAN M.J, WILLIAMS S. Lead-in-dust in city streets. The Science of the Total Environment, **7**, 91, **1977**.
7. DUGGAN M. Lead in urban dust: an assessment. Water, Air and Soil Pollution, **14**, 309, **1980**.
8. FERGUSSON J.E, HAYES R.W, YONG T.S, THIEW S.H. Heavy metal pollution by traffic in Christchurch, New Zealand: Lead and cadmium content of dust, soil and plant samples. New Zealand Journal of Science, **23**, 293, **1980**.
9. CASWELL R, LAXEN D.P.H. Lead 'Hot Spots', Traffic-a survey of lead in air and dust in roadside areas in London. Report DG/SSB/ESD/R142, Environmental Sciences Division, Scientific Services Branch, Greater London Council, **1984**.
10. CASWELL R. A. London-wide roadside survey of lead in air and dust. London. Environmental Bulletin, Greater London Council: London, **2**, (4), 4, **1985**.
11. BRANDVOLD L.A., POPP B.R. SWARTZ S.J. Lead contents of plants and soil from three abandoned smelter areas in and near Socorro, New Mexico. Environmental Geochemistry and Health, **18** (1), 1, **1996**.
12. SAYRE J.W. Dust lead contribution to lead in children. In (Lynam, D.R., Piantanida, L.G. and Cole, J.F. eds.) Environmental lead. Academic Press: New York, pp. 23-40, **1981**.
13. DUGGAN M. Lead in dust as a source of children's body lead. In: (Rutter, M. and Russel-Jones, R. eds.) Lead versus health. Wiley: New York, pp. 115-139, **1983**.
14. DUGGAN M. Contribution of lead in dust to children's blood lead. Environmental Health Perspective, **50**, 371, **1983**.
15. LANGLOIS P, SMITH L, FLEMING S, GOULD R, GOEL V, GIBSON B. Blood lead levels in Toronto children and abatement of lead contaminated soil and house dust. Archives of Environmental Health, **51** (1), 59, **1996**.
16. ARCHER A, BARRAT R.S. Lead levels in Birmingham dust. The Science of the Total Environment, **6**, 275, **1976**.
17. SOLOMON R.L, HARTFORD J.W. Lead and cadmium in dusts and soils in a small urban community. Environmental Science and Technology, **10**, 773, **1977**.
18. HARRISON R.M, LAXEN D.P.H. A comparative study of methods for the analysis for total lead in soils. Water, Air and Soil Pollution, **8**, 387, **1977**.
19. UNEP/WHO. Meeting of UNEP/WHO Government experts on health related environmental monitoring. Geneva, held on 12-17 September, **1988**.
20. EISENREICH S.J, METZER N.A, URBAN, N.R, ROBBINS J.A. Response of atmospheric lead to decreased use of lead in gasoline. Environmental Science and Technology, **20** (2), 171, **1986**.
21. JENSEN R.A, LAXEN D.P.H. The effect of the phase-down of lead in petrol on levels of lead in air. The Science of the Total Environment, **59**, 1, **1987**.
22. BELLES M., RICO A, SCHUMACHER M, DOMINGO, J.L, CORBELLA J. Reduction in lead concentration in vegetables grown in Tarragona Province, Spain, as a consequence of reduction of lead in gasoline. Environment International, **21** (6), 821, **1995**.
23. PIRRONE N, KEELER G.J, NRIAGU J.O, WARNER P.O. Historical trends of airborne trace metals in Detroit from 1971 to 1992. Water, Air and Soil Pollution, **88** (1-2), 145, **1996**.
24. RODAMILANS M, TORRA M, TO-FIGUERAS J, CORBELLA J, LOPEZ B, SANCHEZ C, MAZZARA R. Effect of the reduction of petrol lead on blood lead levels of the population of Barcelona (Spain). Bulletin Environmental Contaminants and Toxicology, **56** (5), 717, **1996**.
25. UK GOVERNMENT. The motor fuel (lead content of petrol) Regulations 1981, S.I: 1981/1523, HMSO: London, **1981**.
26. UK GOVERNMENT. The motor fuel (lead content of petrol) (Amendment) Regulations 1985, S.I. 1985/1728, HMSO: London, **1985**.
27. USEPA. Air quality criteria for lead research triangle park, North Caroline, USEPA 600/8-83/028/af, **1986**.
28. UN. The state of trans-boundary air pollution studies 12, report prepared within the framework of the convention on long-range trans-boundary air pollution. United Nations, **1996**.