Research note

Assessment of heavy metals concentrations in soil and Siam weed

Awolola, G.V [1], Odeyinde A.O[2] and Dosumu O.O[1]

[1]*Department of chemistry, University of Ilorin, Ilorin*

[2]*Institute of Agricultural Research and Training (I.A.R&T). Ibadan*

Abstract

Soils located at sites near road traffic and a waste dump site at Ibadan and leaf samples of *Chromola ena odorata* (Sian weed) at the sites were analysed for Pb, Cd, Zn, Co, Ni, Cu and Fe. Average values (ppm) for the ele ments in the soils were Pb – 28. 87, Cd – 4.31, Zn – 49.38,Cr – 47.35, Co – 30.87, Ni – 17.07, Cu – 52.84 and Fe – 26657.5 0 while that of the plant samples were, Pb. – 12.48, Cd – 1.67, Zn – 27.02, Cr – 5.19, Co – 4.30, Ni – 7.32, Cu, - 15.13 and Fe – 2213.00. The values were less than the critical values. Vehicular traffic and waste dumping tended to increase tha t presence of Pb, Cd, Zn, Co and Ni in soil and plant, and Fe in plant.

Introduction

Environmental pollution is the release of substances in excess of threshold values by human activities into the environment. Many of these pollutants including heavy metals are toxic and are persistent in the environment. The build up of heavy metals into an environment may be due to industrial effluents, automobile emissions and modern farming methods. Metals like arsenic, mercury, lead, chromium, phosphorus and antimony are introduced into the environment by use of chemicals like pesticides, herbicides and fertilizers (Frink, 1993). Lead and related metals found on roadside soils, vegetation and nearby surfaces are discharged from automobiles (Olajire and Ayodele, 1996; Onianwa, 2001). This study was aimed at assessing the heavy metal pollution of Ibadan soil and accumulation of heavy metals in siam weed *(Chromolaena odorata)*. It is also noted that there is scanty information on heavy metal pollution of the tropical ecosystem.

Materials and methods

Five soil sites were selected based on a fore-knowledge of the relative densities of traff ic in the areas and were grouped into

(a.) Site 1 – Representing soils in some v illages in Ibadan environs (control).

(b.) Site 2 – Representing soils around some manufacturing companies in Ibadan environs with traffic densities above 1000 vehicles per hour.

(c.) Site 3 – Representing soils in location s with traffic densities between 250 and 1000 vehicles per hour

(d.) Site 4 – representing soils in locations wi th traffic densities lower than 250 vehicles per hour.

(e.) Site 5 – representing soils in areas used as solid waste disposal site

Soil samples were taken at depth of 0 – 15cm and sampling of *Chromolaena odorata* leaves was also done at each of the sites. Soil sample was digested using the wet digestion method (HNO_3/ $HC10_4$ acids) and the filtrate analyzed for the various heavy metals. Plant sample was also analyzed using the dry ash method, in which the sample was ashed in a muffle furnace and the cool ash dissolved with 50cm^3 of 6M HNO_3 and boiled for about 20 minutes on a hot plate. The resulting

filtrate was analyzed using atomic absorption spectrophotometer (IITA, 1979). The concentration of the metals was determined at their respective resonance lines using standard calibration method.

Analysis of variance was used to assess heavy metal concentration effect and the means were compared at 5% level of probability using the least significant difference.

Result and Discussion

Tables 1 and 2 show heavy metal concentration in surface soil and chromolaena respectively. Table 1 indicates that deposition arising from traffic (sites 2,3 and 4) and dumping of refuse (site 5) caused pollution of soil compared with control site 1. Soils in sites 2, 3, 4, and 5 has higher values of Pb, Cd, Zn Co and Ni. Sites near road traffic had less value of Cd, Cr and Ni compared with waste dump sites. Sites with less traffic densities such as sites 3 and 4 tended to have higher value of Pb, Zn and Cr, than dump site. The above findings indicate that traffic and waste dump increased heavy metal pollution as indicated by presence of Pb, Cd, Zn, Co and Ni. However the values recorded for these elements were generally below the critical levels. This also applies to Cu.

Table 2 indicates that compared with control site, road traffic and waste dump increased presence of Pb, Cd, Zn and Fe in Siam weed. The increases in Pb, Cd, Zn and Fe were significant. Site with heaviest road traffic (site 2) had highest values of plant Pb and Zn. This is attributable to deposition of fume from exhaust of moving vehicles. Few sites near road traffic had higher value of plant Pb than dump site.

Tables 1 and 2 ascertain that road traffic (and associated emission) and waste dump increased the presence of heavy metals such as Pb, Cd, Zn, Co and Ni in soil and Sian weed, and also Fe in Siam weed. However the values for the heavy metals were below the critical values (WHO standard).

Table 1: Heavy metal concentration (µgÍg) of the soils at Ibadan, Nigeria

Site	Pb	Cd	Zn	Cr	Co	Ni	Cu	Fe
1	13.00^{b}	1.75^{b}	19.55^{b}	46.00^{a}	21.50^{a}	12.75^{a}	55.00^{a}	22675.00^{a}
2	22.92^{a}	4.38^{ab}	44.45^{ab}	43.50^{a}	30.50^{a}	15.05^{a}	52.25	32325.00^{ab}
3	32.20^{ab}	4.23^{ab}	77.60^{a}	42.53^{a}	34.00^{a}	20.45^{ab}	53.50^{a}	10075.00^{b}
4	42.68^{ab}	3.45^{ab}	58.10^{ab}	48.05^{a}	36.60^{a}	13.13^{a}	51.25^{a}	32075.00^{ab}
5	33.55^{ab}	7.73^{a}	47.20^{ab}	56.65^{a}	31.75^{a}	24.07^{ab}	52.18^{a}	36137.00^{ab}
Toxic level	100.00	5.00	300.00	100.00	50.00	100.00	100.00	-

Value with same superscript are not significantly different as shown by Duncan multiple range test at P = 0.05

Table 2: Heavy metal concentration (µgÍg) of the Siam weed

Site	Pb	Cd	Zn	Cr	Co	Ni	Cu	Fe
1	1.31^{b}	0.08^{b}	10.55^{b}	3.81^{a}	3.88^{a}	8.27^{b}	14.88^{a}	570.50^{b}
2	17.90^{a}	1.09^{ab}	1.09^{ab}	4.28^{a}	4.63^{a}	6.98^{a}	15.46^{a}	2567.50^{ab}
3	14.15^{ab}	1.15^{ab}	23.13^{a}	4.56^{a}	4.63^{a}	7.94^{ab}	14.28^{a}	10025.00^{b}
4	11.57^{ab}	1.53^{ab}	33.90^{ab}	3.75^{a}	4.75^{a}	9.33^{a}	15.88^{a}	1606.25^{ab}
5	11.45^{ab}	3.80^{a}	32.98^{ab}	4.87^{a}	3.63^{a}	7.06^{ab}	15.14^{a}	2796.25^{ab}
Toxic level	150.00	5.00	400.00	100.00	5.00	40.00	40.00	1200

The finding above is consistent with recent observation of Moses (2006) that heavy metals concentration in soil are increasing due to dumping of industrial and municipal wastes in top soil and emission from motor vehicles. Fifield and Haires (1995) cited by Moses (2006) reported that addition of heavy metals to soil resulted to their accumulation in top soil. The deposition of heavy metals in soil should have led to enhancement of their uptake by siam weed in the present study. Heavy metals like other metals are absorbed and transported to the whole parts of plant through the xylem. Also through foliar absorption atmospheric heavy metal pollutants adhered to plant leaf and can be absorbed through the cuticle into the entire leaf area (Moses, 2006). Sridhar (1988) had earlier given the possibility of concentrating heavy metals in different aquatic plants.

The present study emphasizes the need to continue to monitor concentrations of toxic heavy metals such as Pb, Zn, Fe and Cd in soil and plant located near roads and dump sites in order to detect their toxicity on time.

Acknowledgement

The effort of Prof. P. C. Onianwa, Department of Chemistry, University of Ibadan is appreciated for the supervision of this research work.

References

Frink, C. R. 1993. A perspective of metals in soils, Journal of soil contamination. 5 :329 -359.

I.I.T.A. 1979. Selected methods for soil and plant analysis. Manual series No. 1, Ibadan, Nigeria, 51pp.

Moses, B. A. 2006. Phytoremedeation of contaminated soils with some heavy metals using *Helianthus annisus* L. and *Tithonia diversifolia* (Hemsley) as influenced by fertilizer applications. Unpublished Ph.D thesis. University of Ibadan: 144pp.

Olajire, A. A. and Ayodele, E. T. 1996. Contamination of roadside soil and grass with heavy metals. International Journal of Environment. 23(1): 91 – 101.

Onianwa, P.C. 2001. Roadside Topsoil concentrations of lead and other heavy metals in Ibadan, Nigeria. Journal of soil and sediment contamination 10 (6): 577 – 591.

Sridhar, M. K. C. 1988. Uptake of trace elements by water lettuce (Pista Stratlotes), Acta. Hydrochim Hydrobiology 16, 293 – 297.