Chapter 8
Ricinus communis: A Potent Lead (Pb) Accumulator

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ABSTRACT

Contamination of soil and ground water with heavy metals is a great threat to human health, vegetation, and wildlife. Pb is the second most hazardous substance according to ATSDR. The main sources of Pb entering an ecosystem are atmospheric Pb (mainly from automobile emission), paint chips, fertilizers, and pesticides and Pb acid batteries or other industrial Pb products. Phytoremediation could provide sustainable techniques for metal remediation. Roots of Ricinus communis were found to accumulate maximum amount of Pb (275.12mg/kg dry wt,). Depending on soil Pb content, the concentration of Pb in shoots of Ricinus communis *also varied. In most cases only a small part of Pb was translocated in the aerial parts. In 95% of the plant samples collected, the root Pb concentration are much greater than those of the shoot lead content, indicating low mobility of Pb from roots to the shoots. Their ability to accumulate higher amounts of Pb in their roots and considering their rapid growth rate and biomass, this plant has the potential for removal of Pb from contaminated soil.*

INTRODUCTION

Indiscriminate use of different heavy metals has been increased due to rapid urbanization.Heavy metals cannot be destroyed or degraded as they occur as natural constituent of earths crust. These heavy metals enter the body system through food, air, and water and bio-accumulate over a period of time. (UNEP/GPA,2004).

In todays industrialized society heavy metals are ubiquitous environmental contaminants. Heavy metal pollution in soil differ from air or water pollution as heavy metals retain much longer than any other component of the biosphere. (Lasat., 2002)

Heavy metal contaminants in soils emitted through metalliferous mining and smelting, metallurgical industries, sewage sludge treatment, warfare and military training, waste disposal sites, agricultural fertilizers and electronic industries (Alloway1995). For example, mine tailings rich in sulphide minerals

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may form Acid Mine Drainage (AMD) through reaction with atmospheric oxygen and water, and AMD contains elevated levels of metals that could be harmful.

Wild life and human exposed to high level of these heavy metals has adverse effects on both.Natural and anthropogenic activities both are responsible for the heavy metal emission into the environment. Mining operations are the main anthropogenic sources which causes heavy metal emission.(Battarbee et al.,1988; Nriagu, 1989). Even long after mining activities have ceased, the emitted metals continue to persist in the environment. Heavy metals are emitted both in elemental and compound (organic and inorganic) forms in the environment. Various former and present mining sites,foundries and smelters, combustion by products are the anthropogenic sources of emission. These metals dissolve with rain water leached out in sloppy areas, and are carried by acid water downstream or run-off to the species in water or as an integral part of suspended sediments (dissolved species in water have the greatest potential of causing the most deleterious effects). These heavy metal rich sediments may then be accumulated in river bed sediments or seep into the underground water and thus contaminate water from underground sources, particularly wells; and the extent of contamination will depend on the nearness of the well to the mining site. Wells which are located near mining sites have been reported to contain heavy metals at levels that exceed drinking water criteria (Garbarino et al., 1995; Peplow, 1999).

Table 1. United State Environmental Protection Agency (USEPA) maximum contamination levels for heavy metal concentration in air, soil and water

Heavy Metal	Max.Conc.in air (mg/m^3)	Max.Conc. in Sludge (Soil)(mg/kg or ppm)	Max.Conc in Drinking water (mg/L)	Max Conc, in water supporting aquatic life(mg/L or ppm)
Cd	0.1-0.2	85	0.005	0.008^{δ}
Pb	--	420	0.01^{π}(0.0)	0.0058^{δ}
Zn^2	1.5*	7500	5.00	0.0766^{δ}
Hg	--	<1	0.002	0.05
Ca	5	Tolerable	50	Tolerable > 50
Ag	0.01	--	0.0	0.1
As	--	--	0.01	--

(Value in bracket is the desirable limit; WHO ; 1adapted from U.S. – OSHA; 2 EPA, July 1992; _USEPA, 1987; Georgia Code,1993; Florida Code, 1993; Washington Code, 1992; Texas Code, 1991; North Carolina, 1991; *1 for chloride fume, 5 for oxide fume; - - no guideline available).

In the 3rd world countries importance has been given mainly for the establishment of the industries but the issues of protection of environment remain neglected. Thus a number of factories were developed in a unplanned manner, it increases generation affluents from the factories. These affluents are often mixed with heavy metals.The problems of urbanization, population explosion and the increased use of automobiles have become very common. It is well known that environmental pollution is a product of urbanization and technology, and other associated factors of population density.

Depending on the type of industries in the vicinity different metals such as As, Pb, Cd, Cu, Cr, Ni etc are deposited in the soil. Among these some metals are needed for biological function such as Cu, Zn whereas Pb, Cr, As, Hg have no known biological role. All these metals, when present in very low

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