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Heavy Metals Impediments the Crop Yield

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Abstract

Heavy metals are generally defined as metals with relatively high densities, atomic weights, or atomic numbers. A density of more than 5 g/cm^3 is sometimes quoted as a commonly used criterion and is used in the body of this article. Heavy metals affects morpho- physiological and biochemical processes in the plants. Chromium, arsenic, cadmium, mercury, and lead have the greatest potential to cause harm on account of their extensive use, the toxicity of some of their combined or elemental forms, and their widespread distribution in the environment. Application of agro-based chemical fertilizers and pesticides with high heavy metals content should be avoided to keep high quality soils for sustainable use in the reservoir watershed and to prevent human and livestock health hazards and induce agricultural plant productivity.

Introduction

Heavy metals are metallic chemical elements with relatively high density (greater than water density), atomic weight, toxic and poisonous at low concentration. Heavy metals are natural component of earth crusts. Some of the heavy metals do not breakdown by the environment or not easily metabolized, they are remaining in the plants and in the consumer levels. Heavy metals affects morpho- physiological and biochemical processes in the plants. Some heavy metals like iron, copper and zinc acts as cofactor and enzyme activator and some are poisonous resulting in growth inhibition and death of the organisms. Heavy metals have a negative impact on soil microflora. Metals such as mercury, lead, arsenic, cadmium, chromium, nickel, cobalt and selenium are highly toxic even in lower amount. Heavy metals generally through agriculture, pharmaceuticals and industrial enter into human body (Below Table).

To maximize the yield through unlimited use of inorganic fertilizers, manures, waste water and pesticides which can increase heavy metals in the soil and affect plant metabolism. Nitrogenous fertilizer increase cadmium (Cd) concentration in the soil and plants. Phosphate fertilizers increases Cd, Hg, Pb and As in the soil. The uncommon use

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Sl. No.	Name	Source	Standards	
			Food (mg/kg)	Water (mg/ltr)
1	Mercury (Hg)	Native metal, Calomel Cinnabar ore, Montroydite etc	Nil	Nil
2	Lead (Pb)	Boleite, Bournite, Bournonite, Cerussite, Curite, Schultenite, Vanadinite etc.	2.5	0.1
3	Copper (Cu)	Chalcopyrite, Native copper, Copper fume etc.	Nil	Nil
4	Cadmium (Cd)	Hawleyite, Monteponite, Cadmiun fume etc.	1.5	0.01
5	Chromium (Cr)	Chromite, Crocoite, Eskolaite, Uvarovi etc.	20	0.05
6	Iron (Fe)	Hematite, Magnetite, Kamacite and Taenite etc.	Nil	0.03
7	Arsenic (As)	Adamite, Annabergite, Arsenolite, Cobaltite, Erythrite, Heliophyllite, Loellingite, Pharmacooite, Realgar, Tennantite.	1.1	0.05
8	Cobalt (Co)	Bieberite, Cobaltite, Erythrite, Glaucodot Linnaetile etc.	Nil	Nil
9	Manganese (Mn)	Babingtonite, Braunite, Hausmannite, Hauerite, Manganite, Rhodochrosite, Rhodonite, nodules on ocean floor.	Nil	0.1
10	Nickel (Ni)	Bunsenite, Garnierite, Niccolite (NiAs), also called Kupfernickel, Nitrobarite, Pyrrhotite, Kamacite.	1.5	Nil

of insecticides in the agriculture soils significantly increases the heavy metals such as Cu, Mn, Zn, Br, Sr, Ti, Cr, As and Pb. This deposition of metals in the soil causes severe chronic disease such as kidney failure and cancer etc. At low concentration of this metals failure seed germination, plant development and ROS production resulting in cell homeostasis imbalance and decrease glutathione level. The toxic effect of cadmium on water uptake, Photosynthesis, nutrient uptake, necrotic cell death and formation of reactive oxygen species are the negative impact on plants. Similarly lead on chlorophyll synthesis and nickel inhibition of lateral root formation, damage photosynthetic apparatus and plant height.

The antioxidant defense mechanism employed by the plants to protect itself against oxidative damage. The reduction of molecular oxygen results in the production of ROS in chloroplast, mitochondria and peroxisomes etc. The production of ROS such as singlet oxygen, superoxide radicals, hydroxyl radicals, hydrogen peroxide and peroxide radicals are commonly produced at low concentrations in plant. Heavy metals increase the production of ROS at intracellular level and cause the damage to carbohydrate, lipids, proteins and nucleic acids. Thus it is important for a plant cell to detoxify the ROS by the production of antioxidants. The antioxidant defense mechanism comprises of enzymatic and non-enzymatic. The enzymatic antioxidant such as catalase (CAT), peroxidase (POD) and sodium dismutase (SOD) and non enzymatic such as ascorbic acid (AsA), glutathione (GSH), a-tocopherol, carotenoids, flavonoids and proline (Morstein, 2005; Bradl *et al.*, 2005).

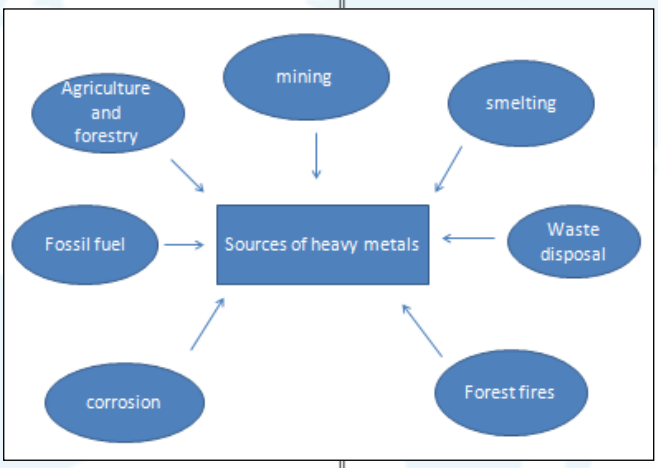

Figure 1: Different source of heavy metals

Conclusion

Heavy metal pollution is emerging in the speedy rate due to industrialization, modern agricultural practices and urbanization. It moving from soil to plant then

to human or animal body and interfere with the biological processes. Water, crop plant vegetation and soil quality monitoring together with the prevention of metals entering the plants. Quality and quantity of applied fertilizers were the important sources leading to different accumulations (Figure 1) of heavy metals in soils. Application of agro-based chemical fertilizers and pesticides with high heavy metals content should be avoided to keep high quality soils for sustainable use in the reservoir watershed and to prevent human and livestock health hazards and induce agricultural plant productivity.

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