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# Phytotoxicity of Heavy Metals: Problems and Solutions

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## INTRODUCTION

The term "heavy metals" refers to the group of metals and metal-like elements that have a relatively high density greater than 5 g $cm^{-3}$ and are toxic or poisonous even at low concentration. A surplus of heavy metals in agricultural soils originates very seldomly from geogenic processes (weathering of ores) but anthropogenic activities such as excessive application of fertilizers (organic and inorganic), waste water irrigation, sewage sludge supplementations, metal-based pesticides have led to their elevated levels in the soils. Heavy metals added to soils from anthropogenic sources are generally more mobile and therefore, easily bioavailable. Some heavy metal ions in a normal concentrations are essential for plants such as copper, manganese, iron, zinc etc., as they play important role in biochemical and physiological functions in plants. Whereas, some are nonessential elements, which are highly toxic elements such as lead (Pb), mercury (Pb), arsenic (As), cadmium etc. Plants growing in heavy metal-contaminated sites generally accumulate high amounts of heavy metals which lead to phytotoxicity.

### Phytotoxicity

Phytotoxicity is a phenomenon whereby a potentially harmful substance (such as heavy metals) has accumulated in the plant tissue to a level affecting optimal growth and the development of the plant. As soon as a critical concentration is achieved or surpassed the heavy metal can lead to phytotoxicity. Phytotoxicity of heavy metals is the result of the imbalance between the uptake of an element and the incapability of the metabolism to cope with its cellular, especially cytosolic concentration.

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**Effect of heavy metals on plants**

For non-adapted plants heavy metal enriched soils may be hazardous or even toxic. Such plants growing in heavy metal-contaminated sites generally accumulate high amounts of heavy metals. The higher levels of heavy metals within plants causes the increased production of reactive oxygen species (ROS), such as superoxide free radicals ($O_2^{\cdot-}$), hydroxyl free radicles ($OH^{\cdot}$) or non free radicles like hydrogen peroxide ($H_2O_2$ ). The imbalance between the ROS generation and the detoxification of these ROS by enzymatic and non-enzymatic reactions lead to oxidative burst. ROS has high oxidizing activities that can attack biomolecules such as proteins, carbohydrates, lipids, nucleic acids etc. within cell which causes the DNA damage, damage to proteins and lipids and results in cellular damage. Plants exposure to the toxic levels of heavy metals causes the physiological and metabolic alterations, reduction of plant growth, leaf chlorosis, necrosis, reduction in seed germination which ultimately leads to reduction in plant yields.

**Problems**

Heavy metals, following accumulation within plants, enter the food chain and are subsequently transferred to the end consumers, leading to human health problems. As per the WHO list of ten chemicals or groups of chemicals of major public health concern, four are heavy metals: lead, mercury, arsenic and cadmium. These are highly hazardous and negatively affect human health. Cadmium toxicity leads to kidney and bone damage. Mercury is toxic both in the elemental and inorganic forms, but the main concern is associated with the organic compounds, especially methylmercury that accumulates in the food-chain, the main route of human exposure. Lead toxicity leads to developmental and neurobehavioural effects on fetuses, infants and children, and elevate blood pressure in adults. Arsenic in inorganic are highly carcinogenic and can cause cancer of lungs, liver, bladder and skin. Risk associated with the exposure of heavy metals from a specific source such as, plant based food items can be measured in terms of hazard quotient.

**Solutions**

Remediation of polluted soils is essential and need of the hour to minimize the problem of phytotoxicity. Several physical, chemical and biological methods can reduce the bioavailability of heavy metals and their accumulation in the soil and hence in plants. The physical remediation methods of soils contaminated with heavy metals mainly includes froth flotation, physical separation (replacement of soil), thermal desorption of soil. Chemical methods involve chemical leaching, chemical fixation, electrokinetic remediation etc. Biological methods include phytoremediation in which hyper-accumulator plants are used and microbial remediation i.e. the use of microbes for removal of heavy metals from the soil. Some examples of these plants are *Chengiopanax sciadophylloides, Dicoma niccolifera, Pistia spp, Euphorbia cheiradenia* etc. Some generas of microbes that are used in microbial remediation are *Bacillus, Psuedomonas, Azospirillum, Aspergillus, Penicillium, Trichoderma* etc. Beside these remediation methods, heavy metal contamination in soil and plants to some extent can be prevented by avoiding over application of chemicals containing heavy metals, careful examination of water resources for the heavy metal contamination. Manures and bone-derived products can contain relatively high amounts of heavy metals due to biomagnification so they must be carefully used in order to prevent heavy metal toxicity. Keeping the plants properly fed with nutrients can also prevent phytotoxicity of heavy metals as when levels of nutrients dip low, it becomes easier for plants to pull up heavy metals. Studies show that heavy metals with similarities to nutrient cations, compete for absorption at root surface. For example, phosphorus is a chemical analogue of arsenic, and competes for uptake with it. The same holds true for zinc and cadmium.

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## CONCLUSION

Heavy metals are dangerous because they tend to bioaccumulate in plants and cause phytotoxicity which ultimately affect crop yield and quality. Accumulation of potentially toxic heavy metals in plants cause a potential health threat to their consumers including humans. The heavy metal contamination in soil and plants to some extent can be prevented by avoiding over application of chemicals containing heavy metals, careful examination of water resources and soil for heavy metal contamination and through physical, chemical and biological remediation techniques.

## REFERENCES

Syed R, Kapoor D and Bhat AA. 2018. Heavy metal toxicity in plants: A review. *Plant archives* 18 (2): 1229-1238