Review Article

ISSN: 2321-1520

Review on Heavy Metal Toxicity on Plants.

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Received Date: 19-6-2019

Published Date: 15-9-2019

Abstract

Heavy metals are the intrinsic component of the environment with essential and non essential both types. Although many metal elements are essential for the growth of plants in low concentrations, their excessive amounts in soil above threshold values can result in toxicity. Soils polluted with heavy metals have become common due to increase in geologic and anthropogenic activities. It is the unplanned disposal of municipal waste, mining, use of extensive pesticides, insecticides, fungicides, and other agrochemicals uses were significant causes of environment pollution and causes of most concern.

Keywords:Heavy metals, Toxicity, Anthropogenic, environmental pollutants, Threshold.

Introduction

Heavy metals are deûned as the elements having density greater than 5 g cm"3 (Adriano 2001). Some heavy metals namely, cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni) and zinc (Zn) are considered to be essential for plants, whereas chromium (Cr),

and antimony (Sb) are found essential for animals (Misra and Mani 1991; Markert 1993). These metal elements can directly inûuence growth, senescence and energy generating processes due to their high reactivity. Their concentration in soil beyond permissible limits is toxic to plants either causing oxidative stress through free radicals and/or disrupting the functions of enzymes by replacing essential metals and nutrients (Henry 2000; Prasad 2008). Although changes in cell metabolism permit plant to cope with, yet the reduction in plant growth is the primary symptom of metal toxicity.

Among the heavy metals, chromium and cadmium are of special concern due to their potential toxicity to both animals and plants even at low concentrations (Sharma *et al.* 1995; Das *et al.* 1997; Shukla *et al.* 2007). The chromium toxicity in plants varies from the inhibition of enzymatic activity to mutagenesis (Barcelo*et al.* 1993). The visible symptoms include leaf chlorosis, stunting, and yield reduction (Das *et al.* 1997; Boonyapookana *et al.* 2002). Cadmium (Cd) is particularly dangerous pollutant due to its high toxicity and great solubility in water (Pinto *et al.* 2004). Cadmium also inhibits the uptake of elements such as K, Ca, Mg, Fe because it uses the same transmembrane carriers (Rivetta*et al*. 1997). Its accumulation in plants may also pose a serious health hazard to human beings through food chain; however, it poses an additional risk to children by direct ingestion of Cd-contaminated soil (Nordberg 2003).

Effect on Growth and Development

Heavy metals either retard the growth of the whole plant or plant parts (Shaûq and Iqbal 2005; Shanker*et al.* 2005). The plant parts which have the direct contact with the contaminated soils normally the roots exhibit rapid and sensitive changes in their growth pattern (Baker and Walker 1989). Heavy metals mainly affect plant growth through the generation of free radicals and reactive oxygen species (ROS), which pose constant oxidative damage by degenerating important cellular components (Pandey *et al.* 2005, Qureshi *et al.* 2005). The typical symptoms of Cd toxicity of rice plants are wilted leaves, growth inhibition, progressive chlorosis in certain leaves and leaf sheaths, and browned root systems, especially the root tips (Das *et al.* 1997; Chugh and Sawhney 1999). In addition, in maize (Zea mays) Cd also reduces plant growth (Talanova*et al.* 2001; Liu *et al.* 2003/2004).

Conclusion

Several heavy metal elements are essential for biological and physiological functions of plants, including biosynthesis of proteins, nucleic acids, growth substances, synthesis of chlorophyll and secondary metabolites, stress tolerance, structural and functional integrity of various membranes and other cellular compounds. However, beyond permissible limits, these metal elements become toxicdependinguponthenatureandspeciesofmetalandplants.Metaltoxicitymayinhibitelectrontransport, reduce CO_2 ûxation, and cause chloroplast disorganization. Heavy metal stress can induce a series of events in plants leading to decrease in number and size of leaves, enhancement of leaf rolling and leaf abscission changes in stomatal size and resistance.

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