

EFFECT OF HEAVY METALS (Pb, Cd and Hg) ON BIOCHEMICAL CHANGES IN PLANT CELLS

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Today, the rapid development of industry and the uncontrolled use of chemical fertilizers in agriculture have led to the contamination of soil and water with heavy metals. Metals such as Pb, Cd and Hg do not decompose in the soil and have the property of bioaccumulation (accumulation). This not only endangers the plant world, but also human health through the food chain, which determines the relevance of the topic on a global scale.

Environmental pollution is a major obstacle to sustainable agriculture. Soil and water can be contaminated with heavy metals, pesticides and excessive fertilizers, which harm soil health, reduce biodiversity needed for pest control and pollination, and pose a threat to food security. Pollution also exacerbates climate change, with extreme weather events damaging crop yields and water resources. Much of this degradation comes from point source pollution associated with mining, foundries, smelters and other metallurgical industries[1]. Heavy metals, which are characterized by a higher density than water,[2] have a significant impact on sustainable agriculture. They enter the environment through corrosion, atmospheric deposition, erosion, groundwater leaching, sediment resuspension and water evaporation[3]. Production in the plastics, textiles, microelectronics, wood preservation, and paper industries, as well as operations in nuclear power plants, power lines, coal and oil combustion, and metal processing, are major industrial sources of heavy metals[4,5].

Heavy metals such as Cd, Pb, As, Hg, Cr, and Ni pose a serious threat to plant health by disrupting physiological, biochemical, and molecular processes (Table 1). These metals are not biodegradable and persist in the environment, leading to chronic toxicity to plants when present in high concentrations.

Phytoremediation is a plant-based method used to remove, degrade, or stabilize contaminants in soil and water. The process involves plants absorbing contaminants into their tissues, sequestering them in their roots, facilitating their degradation by associated microorganisms, or rendering them harmless through mechanisms such as phytoimmobilization and phytostabilization.

Table 1

Toxic effects of heavy metals on plants.

| Metal | Main effect | External signs (Symptoms) |
|--------------|--|--|
| Lead (Pb) | Inhibits enzyme activity and photosynthesis | Root growth arrest, yellowing of leaves (chlorosis) |
| Cadmium (Cd) | Disrupts absorption of water and minerals, damages DNA | Stunting of the plant, drying of the leaf edges (necrosis) |
| Mercury (Hg) | Disrupts cell membranes and metabolism | Sharp decrease in photosynthesis, rapid wilting of the plant |

The selection of plant species adapted to local agroclimatic and soil conditions is one of the important factors determining the effectiveness of the phytoremediation process. In most scientific works, it is recommended to use plant species that have been studied abroad or have shown high results in laboratory experiments for phytoremediation.

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