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Phytoremediation of Soil and Water by Plants

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Abstract: *Phytoremediation is an eco-friendly and cost-effective biotechnological process that utilizes plants to remove, degrade, or stabilize pollutants from contaminated soil and water environments. This green technology harnesses the natural abilities of certain plant species to absorb, accumulate, or detoxify a wide range of environmental contaminants, including heavy metals, pesticides, hydrocarbons, and excess nutrients. Key mechanisms of phytoremediation include phytoextraction, phytostabilization, phytodegradation, rhizofiltration, and phytovolatilization, each involving different plant processes and pollutant interactions. Fast-growing plants with extensive root systems, such as Brassica juncea, Populus spp., and Vetiveria zizanioides, have demonstrated notable efficiency in remediation efforts. Phytoremediation not only restores ecological balance but also enhances soil fertility, promotes biodiversity, and integrates well with sustainable land management practices. Despite its advantages, the process can be limited by the type and concentration of pollutants, plant tolerance levels, and environmental conditions. Continued research and advancements in genetic engineering and microbial associations are expected to improve the effectiveness and applicability of phytoremediation in addressing global pollution challenges.*

Keywords: Phytoremediation, soil contamination, water pollution, heavy metals, phytoextraction, rhizofiltration, phytostabilization, environmental cleanup, sustainable remediation, pollutant degradation

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