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Comprehensive insights into microbe-nanomaterial mediated phytoremediation

Xenobiotic pollution is a result of unbridled extension and careless management of industrial, agricultural, and anthropogenic activities that have been an object of concern for decades. The conventional methods of pollutant removal are expensive and time-consuming. Therefore, the implementation of bioremediation can be considered a safe and sustainable technology. Phytoremediation is a popular bioremediation method with low cost, simple operation, esthetic appearance, wide adaptability, and high public acceptance while Phytoextraction is among the most effective and recognized phytoremediation strategy for treating contaminated soil. However, phytoremediation usually needs a long time (several years), and its application is limited by weather conditions, soil quality, and pollutant phytotoxicity Microbe and Nanomaterial mediated phytoremediation is therefore recommended as a more reliable method of removal of contaminants from the environment as they enhance hyperaccumulator biomass production, scavenge pollutants through augmenting antioxidant activities, It provides beneficial aspects corresponding to cost-effectiveness, sustainability, and environmental implications. Hence the present review shed light on the underlying molecular mechanisms involved in microbe-nanoparticle mediated remediation in soil contaminated with heavy metals, as well as the current limitations and challenges that hinder its large-scale application.
Keywords: Phytoremediation, hyperaccumulators, nanotechnology, sustainability

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