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Phytoremediation of Heavy Metals by the Perennial Tussock Chrysopogon Zizanioides Grown on Zn and Cd Contaminated Soil Amended with Biochar

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Abstract : Bioaccumulation of heavy metal contaminants due to intense anthropogenic interference degrades the environment and ecosystem functions. Conventional physicochemical methods involve energy-intensive and costly methodologies. Phytoremediation, on the other hand, provides an efficient nature-based strategy for the reclamation of heavy metal-contaminated sites. However, the slow process and adaptation to high-concentration contaminant sequestration often limit the efficiency of the method. This necessitates natural amendments such as biochar to improve phytoextraction and stabilize the green cover. Biochar is a highly porous structure with high carbon sequestration potential and containing negatively charged functional groups that provide binding sites for the positively charged metals. This study aims to develop and determine the synergy between sugarcane bagasse biochar content and phytoremediation. A 60-day pot experiment using perennial tussock vetiver grass (Chrysopogon zizanioides) was conducted for different biochar contents of 1%, 2%, and 4% for the removal of cadmium and zinc. A concentration of 500 ppm is maintained for the amended and unamended control (CK) samples. The survival rates of the plants, biomass production, and leaf area index were measured for the plant growth characteristics. Results indicate a visible change in the plant growth and the heavy metal concentration with the biochar content. The bioconcentration factor (BCF) in the plant improved significantly for the 4% biochar content by 57% in comparison to the control CK treatment in Cd-treated soils. The Zn soils indicated the highest reduction in the metal concentration by 50% in the 2% amended samples and an increase in the BCF in all the amended samples. The translocation from the rhizosphere to the shoots was low but not dependent on the amendment content and varied for each contaminant type. The root-to-shoot ratio indicates higher values compared to the control samples. The enhanced tolerance capacities can be attributed to the nutrients released by the biochar in the soil. The study reveals the high potential of biochar as a phytoremediation amendment, but its effect is dependent on the soil and heavy metal and accumulator species.

Keywords : phytoextraction, biochar, heavy metals, chrysopogon zizanioides, bioaccumulation factor
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