

EFFECTS OF BIOCHAR ON THE IMOBILIZATION AND PHYTOTOXICITY REDUCTION OF HEAVY METALS IN SERPENTINE SOIL

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Serpentine soil derived from Ultramafic rocks may release elevated concentrations of toxic heavy metals including Ni, Cr and Mn into the environment. The main objective of the present study was to investigate the potential of woody biochar (BC), a waste byproduct of Dendro power industry at Thirappane in Sri Lanka, as a soil amendment to immobilize and reduce the phytotoxicity of bioavailable Ni, Cr and Mn in serpentine soil. Metal release experiments were carried out to investigate the release kinetics of Ni and Mn in BC amended/unamended serpentine soil. A pot experiment was conducted using tomato (*Lycopersicon esculentum* L.) to evaluate the effects of BC on reducing phytotoxicity of heavy metals in serpentine soil. Three BC applications 1.0, 2.5 and 5.0 % (w/w) were used for both metal release and pot experiments. The bioavailability of Ni, Cr and Mn was assessed by 0.01 M CaCl₂ extraction. Sequential extractions were utilized to evaluate solid phase metal fraction in soil. Metal release experiments demonstrated that both Ni and Mn leach rapidly from BC amended and unamended serpentine soil during first 60 min and equilibrium is reached after 120 min. The 5.0 % BC amendment decreased the release of Ni and Mn by 52 and 36 % respectively, compared to the BC unamended soil. The released amounts of both metals decreased with increasing BC application. The release of both Ni and Mn was better described by the simple Elovich model, suggesting a heterogeneous diffusion of metals involving chemisorption mechanisms. The biomass of tomato plants grown in 5.0 % BC amended soil was about 40-fold higher than that of the BC unamended soil. Bioaccumulation of Cr, Ni and Mn decreased by 93-97 % in plants grown in 5.0 % BC amended soil compared to the BC unamended soil. The CaCl₂ extractable Cr, Ni and Mn indicated that the bioavailability of metals in the 5 % BC amendment decreased by 83-92 % compared to that of the BC unamended soil. Similarly, sequentially extracted amounts of Cr, Ni and Mn in the exchangeable fraction decreased by 95, 61, and 42 % respectively, in the 5.0 % BC amendment. Results suggest that the use of BC as a soil amendment could be an alternative and economically viable strategy to immobilize and reduce the phytotoxicity of bioavailable Ni, Cr and Mn in serpentine and other metal-enriched soil.