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Chemical transformation and bioavailability of chromium in the contaminated soil amended with bioamendments

M. Sinduja[a], V. Sathya[b], M. Maheswari[a], P. Kalpana[c], P. Dhevagi[a], G. K. Dinesh,[d] and T. Chitdeshwari[e]

[a]Department of Environmental Sciences, Tamil Nadu Agricultural University, Coimbatore, India; [b]Environmental Science, National Agro Foundation, Research & Development Centre, Anna University Taramani Campus, Chennai, India; [c]National Agro Foundation, Research & Development Centre, Anna University Taramani Campus, Chennai, India; [d]Division of Environment Science, ICAR – Indian Agricultural Research Institute, New Delhi, India; [e]Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore, India

ABSTRACT

The biotoxicity of chromium (Cr) present in the soil is determined by the transformation and bioavailability of chemical species. A better understanding of these factors aids in developing appropriate remediation strategies for Cr contaminated soils. The present work studied the transformation of Cr in soil and the effect of bioamendments by conducting a laboratory closed incubation experiment of 60 days (duration). The physical properties of the contaminated soil were enhanced by the addition of bioamendments such as farmyard manure, composted poultry manure, pressmud compost, and biochar with two moisture conditions. The biochar reduced the bioavailable fractions of Cr due to the high surface area. Therefore, it facilitates a higher adsorption rate, whereas poultry manure and pressmud compost increased the bioavailability of Cr. The pH ranged from 7.04 to 8.25 throughout the experiment in both the condition. Comparing the other fractions, higher concentration was recorded in the residual fractions of 89.85 to 124.77 mg Kg^{-1} in the field capacity condition and 93.85 to 114.29 mg Kg^{-1} in alternate wetting and drying conditions. FTIR analyses of bio-amendments demonstrated similar variations in physicochemical characteristics wherein higher concentration was observed in biochar (3700–3200 cm^{-1}). A significant reduction of bioavailable fractions of chromium was observed in biochar (80%) amended soil, followed by farmyard manure (70%). The lowest reduction was observed in the pressmud amended soils (55%). Biochar amended soil significantly reduced the fractions of Cr and increased the organic carbon; thus, it demonstrating the impacts of bioamendments on the mobilization or immobilization of Cr in the contaminated soil, and this can be effectively used in the bioremediation of Cr contaminated soil.

KEYWORDS

Bioremediation; fractions of chromium; FTIR analysis; incubation study; sequential extraction