Biochar-Mediated Remediation of Metal-Contaminated Soils

Impact on Cadmium, Zinc & Lead Mobility

Gabrijel Ondrasek,[1]*Jonti Evan Shepherd [1] , Jelena Horvatinec[1]

[1]Faculty of Agriculture, The University of Zagreb,
Svetosimunska c. 25, 10000 Zagreb, Croatia, European Union
*Correspondance: gondrasek@agr.hr

Background

Metal contamination of soil poses a severe threat to human health through natural resources and food production practices, due to the accumulation of heavy metals and metalloids from rapidly expanding industrial emissions. The addition of organic matter, such as biochar, to metal-contaminated soils could significantly impact the mobility and chemistry of commonly found metals like Cadmium (Cd), Zinc (Zn), and Lead (Pb), while creating suitable conditions for non-edible agricultural plants to be used in bioremediation practices.

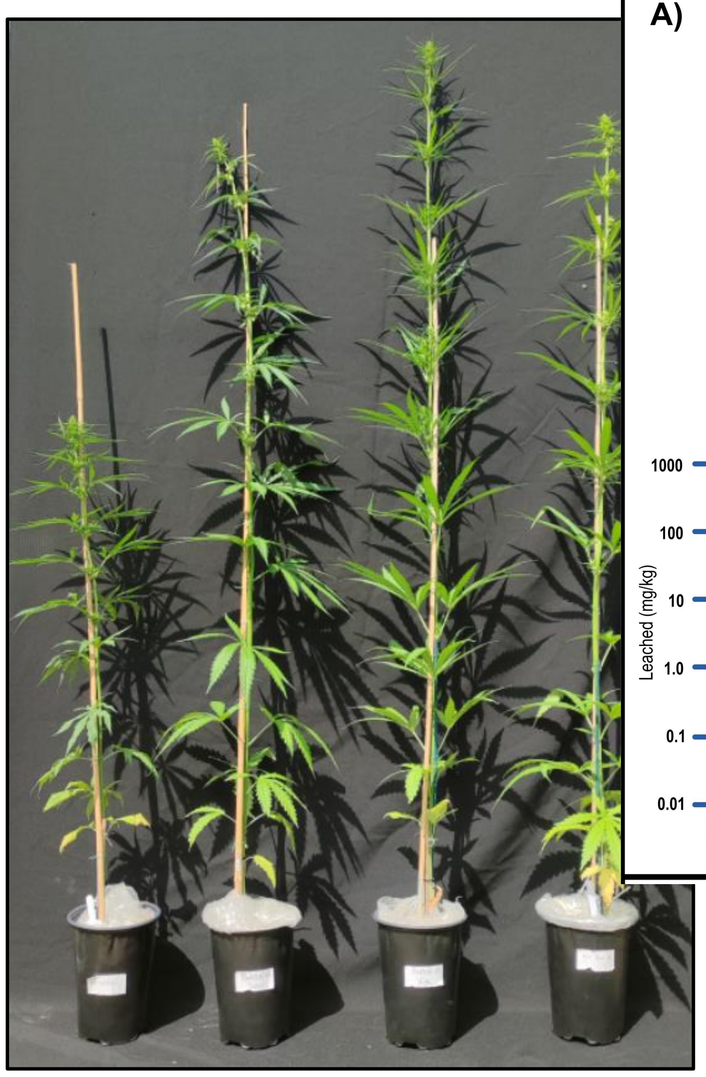
Results & Discussion

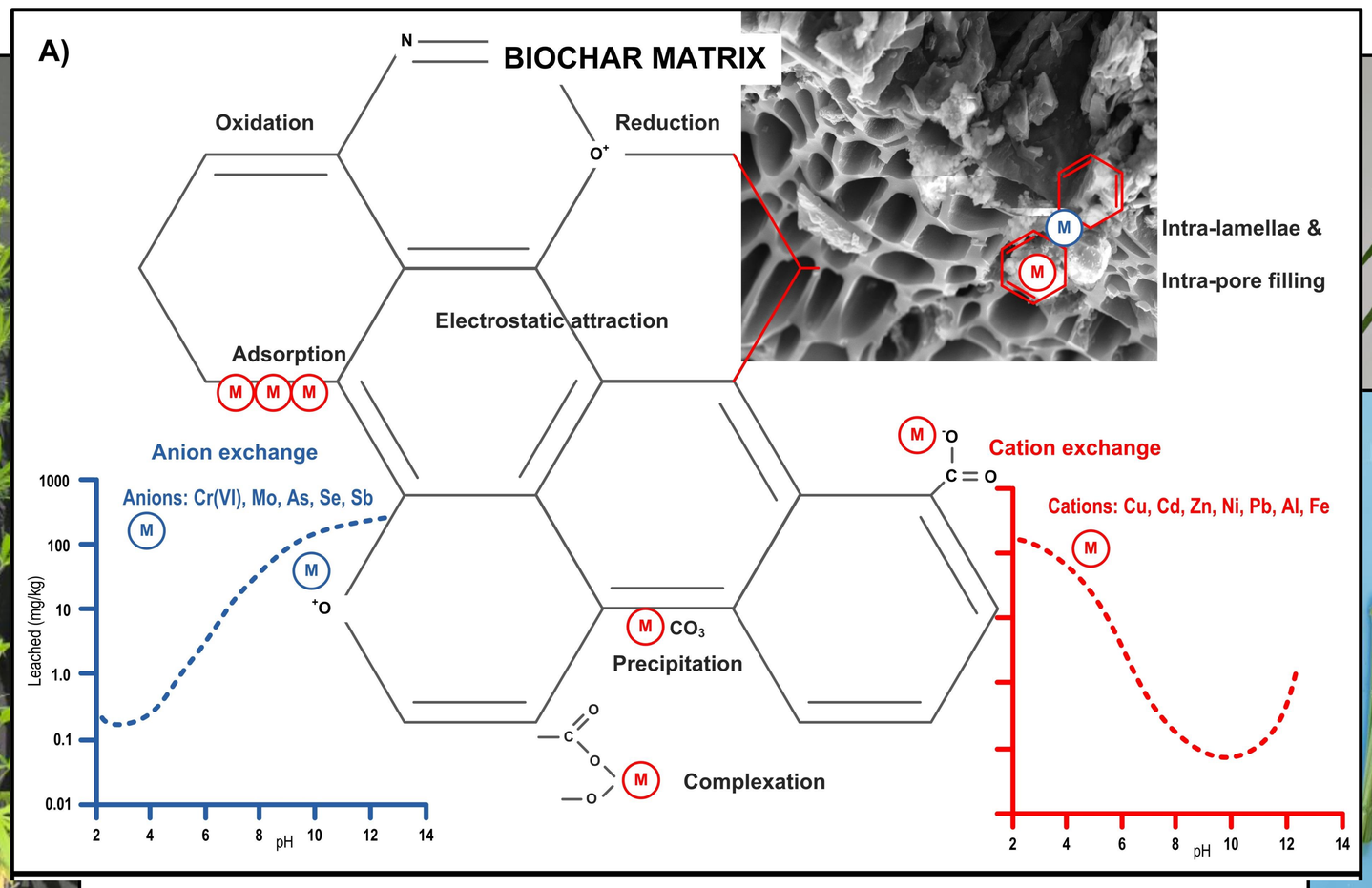
This study utilized two types of biochar: 1) derived from wood chips (BC1), and 2) derived from horse manure (BC2), at two application rates (1% and 4% w/w), as amendments to metal-contaminated soil (MCS). An in-depth physicochemical investigation of the MCS and the tested biochars was conducted, comparing the metal chemistry in the MCS before and after the addition of biochar. Prior to the biochar treatments, all three metals exceeded global average values for soil metals: Cd by 25-fold, Zn by 56-fold, and Pb by 127-fold. The addition of biochar types resulted in a decrease in metal concentrations within the contaminated soil matrix by approximately 3% for Cd, 34% for Zn, and 93% for Pb. SEM analysis confirmed that the addition of biochar positively altered the micro to nano pore structure, surface area, and gas exchange capacity of the amended soil. Laboratory analysis showed that both biochar types enriched the soil with organic matter, N, C, P, K, and S, and reduced the heavy-metal concentration within the test crop by 1-3%. Consequently, sowing the test crop with biochar derived from wood chips and horse manure in metal-contaminated soil ameliorated the soil from metals such as Cd, Zn, and Pb.

Conclusions

The amelioration of metal-contaminated soil with specific biochar types could significantly reduce the transfer of metals from a contaminated matrix to food production and water systems, enabling chemical amelioration and bioremediation of natural or artificial ecosystems globally contaminated by heavy metals.

Keywords: Metal contamination, Biochar , Cd, Zn, Pb





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Croatian Science Foundation

Funded by the European Union
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