FARMING PRACTICE
SOIL AMENDMENT WITH BIOCHAR

IMPACT: SOIL PHYSICO-CHEMICAL QUALITY

Reference 1

Albert, HA; Li, X; Jeyakumar, P; Wei, L; Huang, LX; Huang, Q; Kamran, M; Shaheen, SM; Hou, DY; Rinklebe, J; Liu, ZZ; Wang, HL 2021 Influence of biochar and soil properties on soil and plant tissue concentrations of Cd and Pb: A meta-analysis Sci Total Environ. 755:142582. 10.1016/j.scitotenv.2020.142582

Background and objective

The application of biochar to soils contaminated with potentially toxic elements (PTEs) has received particular attention due to its ability to reduce PTE uptake by the plants. Examine and quantify the effects of biochar and soil properties, and processing factors on soil PTEs with the specific concern on Cd and Pb uptake by plant. We hypothesized that 1) biochar would increase soil organic carbon (SOC), pH, CEC, and EC, which can in turn reduce soil Cd and Pb mobility and plant uptake, 2) biochar derived from different feedstocks would have different effects on shoot and root Cd and Pb concentration, and 3) the toxic Cd and Pb concentrations in shoot and root would depend on biochar physical and chemical properties and plant types.

Search strategy and selection criteria

Relevant peer-reviewed scientific journal articles were collected using the search terms such as "biochar and contaminated soil", "soil + potentially toxic metal and biochar", "soil + heavy metal and biochar", and "shoot/root potentially toxic metal concentration and biochar" on Web of Sciences, ScienceDirect, Elsevier, SpringerLink, and Google Scholar. The study mainly targeted on the term "biochar and soil potentially toxic metal or soil heavy metal concentration" was selected. Furthermore, the search was limited to the studies conducted either in the pot or field experiment. However, the studies conducted on soils artificially amended with potentially toxic metals were excluded from this study.

Data and analysis

OpenMEE (Wallace et al., 2017) software for meta-analysis in ecology and evolutionary biology was used to conduct this study. The natural log of response ratio (equation R) was used as the effect size induced by biochar treatment compared to control. The mean effect-sizes and 95% confidence intervals (CI) were generated by building random-effect models with maximum likelihood (RMML) in OpenMEE software (Windows 8 64-bit OpenMEE Windows). The response ratio R was transformed into a percentage. The biochar treatment group was significantly different from the control group if 95% CI generated building RMML in OpenMEE software of change did not overlap with zero in each figure, otherwise, no significant difference between biochar treatment group and control. The significant difference among covariate levels was computed through meta-regression analysis using random effects, maximum likelihood estimator, and mixed-effects models. For a covariate, the total heterogeneity was computed using mixed-effects models.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
65	Vegetables, grass, legume, maize, wheat, rice, and bamboo.	Soil amendment with biochar	No amendment	Metric: Soil cation exchange capacity; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	0.75

Results

- Biochar significantly ($P < 0.01$) increased the soil cation exchange capacity by 48.0%, compared to the control.

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Biochar significantly increased soil cation exchange capacity.