BIOCHAR AND IRON SULFATE AS AMENDMENTS FOR AN As AND Cu CONTAMINATED SOIL

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Introduction

The use of amendments for remediating contaminated soils is a *gentle* remediation strategy that not only acts on the bioavailability of contaminants, but also improves soil structure and fertility (Alvarenga et al., 2009).

The remediation of soils impacted by both metals and metalloids represents a challenge due to their different behavior in soils. The addition of iron amendments such as iron salts, among others, has been proven to be an efficient tool for the stabilization of arsenic in soils. Its supply leads to the formation/accumulation of reactive oxyhydroxides in the soil, which strongly sorb As (Komárek et al., 2013; Kumpiene et al., 2006). Biochar application to soils improves soil physical properties and immobilizes heavy metals, though it often provokes As mobilization (Beesley et al., 2011; Brennan et al., 2014).

Based on the different effects of both amendments, the aim of this work was to investigate the potential use of combining iron sulfate and biochar to remediate an As and Cu contaminated soil. For that, effects of these amendments on As and Cu availability as well as on soil toxicity were assessed.

Methods

An incubation experiment was performed using a soil contaminated with waste tips of an ancient smelting factory that presents high concentrations of As and Cu.

The soil was limed with $CaCO_3$ 0.4% and mixed with two biochars, derived from pine, PB, or willow woodchip, WB, alone or combined with $FeSO_4$. The resulting treatments (x3) were: soil + PB 3% (**PB3**); soil + WB 3% (**WB3**); soil + $FeSO_4$ 1% + PB 3% (**FePB3**); soil + $FeSO_4$ 1% + PB 10% (**FePB10**); soil + $FeSO_4$ 1% + WB 3% (**FeWB3**); soil + $FeSO_4$ 1% + WB 10% (**FeWB10**). The unamended soil was included as a control (**Control**). The soils were incubated for 42 days at room temperature. Pore water was sampled throughout the experiment and the concentration of As and Cu was analyzed. At the end of the experiment soil samples were taken from each replicate and the available fraction of As and Cu was determined by extraction with 0.1 M $(NH_4)_2SO_4$ (1:10, w:v).

Two toxicity tests were also performed on soils and soil leachates, respectively: a germination test using *Lactuca sativa* and the inhibition of luminescence of *Vibrio fischeri*.

Results

As shown in Fig. 1, application of both biochar resulted in a significant increase (P<0.05) of As concentration in pore water, but its application together with $FeSO_4$ overcame this effect. The treatments had no significant effect (P<0.05) on Cu solubility (Fig. 1). A similar trend was observed in the available fraction of both contaminants (data not shown). All treatments improved soil quality in terms of toxicity towards *L. sativa* and *V. fischeri* (not shown).

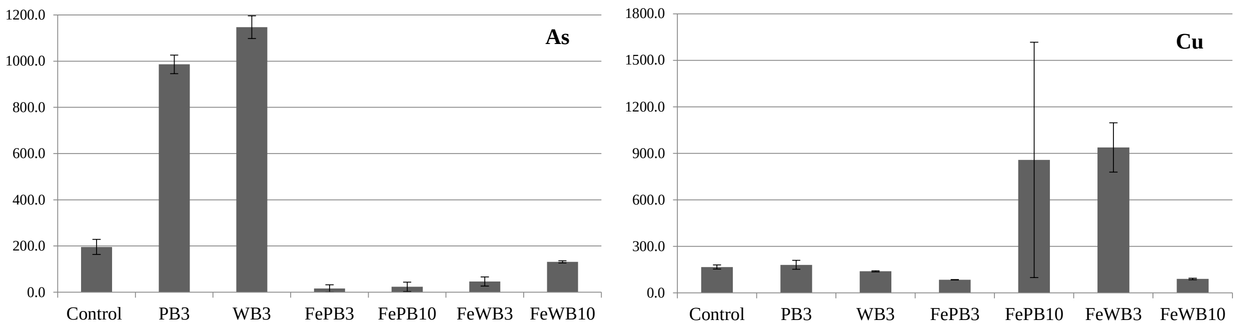

Figure 1. As and Cu concentration (µg L^{-1}) in pore water at the end of the experiment. Mean (n=3) ± SE.

Conclusion

The co-application of biochar and iron sulfate represents a good alternative for the remediation of multi-contaminated soils, as it helps to reduce As dispersion and alleviates soil toxicity.

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