ASSESSMENT OF ACTIVATED CARBON AND COMPOST FOR THE REMEDIATION OF A MINE IMPACTED SOIL.

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Introduction

Soils affected by mining activities usually present high concentration of heavy metals and generally poor physico-chemical properties (Alvarenga et al. 2012). The recovery of these soils should thus focus on minimize metal leachability and bioavailability as well as restore soil functions (Vangronsveld et al. 1995). In this sense, the use of composted materials as amendments has shown to not only act on metal(oid) mobility, but also to improve soil health and promote plant growth (Pardo et al., 2014). Carbonaceous materials, such as activated carbon, have also shown to efficiently immobilize metals in soils and waters (Kobya et al. 2005; Beesley et al., 2011). Therefore, the combination of these materials could enhance their individual benefits to be used as a sole amendment for the remediation of contaminated soils.

The aim of this work was to assess the effectivity of three activated carbons, alone or in combination with olive mill waste compost, to immobilize trace elements in a multi-contaminated soil. In order to evaluate their effects on soil toxicity, toxicological tests were also performed.

Methods

A microcosm experiment was carried out using an acidic soil from an ancient silver mine. This soil presents low content of organic matter and is highly contaminated with As, Cu, Cd, Pb and Zn.

The soil was mixed in a dry soil weight basis with three different activated carbons (AC), alone or in combination with olive mill waste compost (OMWC), to result in the following treatments (x4): AC1 1% (**AC1**); soil +AC1 1% + OMWC 2% (**AC1+C**); soil + AC2 1% (**AC2**); soil + AC2 1% + OMWC 2% (**AC2+C**); soil + AC3 1% (**AC3**); soil +AC3 1% + OMWC 2% (**AC3+C**). The unamended soil was included as a control (**Control**). Soils were incubated for 35 days in plastic containers at room temperature. At the end of the incubation period soil pore water was collected using a rhizon sampler. Concentration of dissolved organic matter (DOC), heavy metals and As in pore water was analyzed to evaluate differences in their solubility. In addition, responses of *Lactuca sativa* germination and luminescence inhibition of *Vibrio fischeri* were assessed for each treatment to evaluate potential toxicity risks.

Results

In general, the combination of AC and compost efficiently reduced As and heavy metals mobility, as shown by their lower concentration in pore water with ACs+C treatments (Table 1). The co-application of these amendments also resulted in an increase of soil pH, which also represents a benefit in terms of soil toxicity. Germination of *L. sativa* was possible just when AC was applied together with compost, which also decreased toxicity towards *V. fischeri* (data not shown).

Table 1. Soil pH and concentration (mg L^{-1}) of trace elements in pore water of *Experiment S1*. Mean (n=4) ± SE. Different letters in each column indicate significant differences ($P<0.05$) among treatments.

Treatment	pH	As	Cu	Cd	Pb	Zn
Control	2.63 ±0.01^{a}	0.64 ± 0.01^{c}	42.12 ± 1.50^{d}	2.97 ± 0.08^{d}	0.378 ± 0.010^{d}	326 ± 13^{b}
AC1	2.67 ± 0.01^{ab}	0.57 ± 0.02^{bc}	25.40 ± 0.36^{c}	2.69 ± 0.04^{c}	0.273 ± 0.005^{c}	305 ± 5^{b}
AC1+C	4.15 ± 0.02^{d}	0.51 ± 0.04^{b}	0.11 ± 0.01^{a}	0.21 ± 0.01^{a}	0.040 ± 0.001^{a}	33 ± 4^{a}
AC2	2.68 ± 0.01^{b}	0.57 ± 0.02^{bc}	38.23 ± 1.31^{d}	3.25 ± 0.04^{e}	0.355 ± 0.009^{d}	354 ± 18^{b}
AC2+C	4.10 ± 0.06^{d}	0.52 ± 0.04^{bc}	0.17 ± 0.05^{a}	0.28 ± 0.06^{a}	0.043 ± 0.003^{a}	43 ± 6^{a}
AC3	3.03 ± 0.03^{c}	0.36 ± 0.04^{a}	17.72 ± 0.47^{b}	2.02 ± 0.07^{b}	0.213 ± 0.005^{b}	279 ± 9^{b}
AC3+C	4.23 ± 0.06^{d}	0.48 ± 0.02^{ab}	0.09 ± 0.03^{a}	0.18 ± 0.04^{a}	0.040 ± 0.004^{a}	24 ± 3^{a}

Conclusion

Combining activated carbons and compost represents a suitable tool for the remediation of multi-contaminated soils, as their co-application results in metal(oid)s immobilization besides reducing soil toxicity.

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