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Revitalisation of metal-contaminated, EDTA-washed soil by addition of unpolluted soil, compost and biochar: Effects on soil enzyme activity, microbial community composition and abundance

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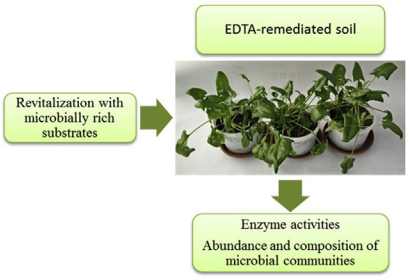
HIGHLIGHTS

- Pb was efficiently EDTA-washed from acidic and calcareous contaminated soils.
- Soil enzymes and microbial community were assessed as soil-health indicators.
- Higher EDTA doses required in calcareous soil deteriorated microbial life.
- Soil and compost amendments efficiently revitalised remediated calcareous soil.
- Amendments to less EDTA-impeded acidic soil were inconsistent and inefficient.

GRAPHICAL ABSTRACT



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ABSTRACT

Soil remediation mitigates hazards from contaminants but could deprive soils of initial biota and enzymes. Historically contaminated acidic soil from Arnoldstein (Austria) and calcareous soil from Meza (Slovenia) were washed with 30 and 100 mmol kg^{-1} ethylenediaminetetraacetate (EDTA) to remove 78 and 60% of Pb as a main pollutant. Remediation of the Arnoldstein soil decreased urease activity and increased β-glucosidase activity, measured in a 15-week experiment. The dehydrogenase activity and microbial gene abundances were not significantly impeded compared to the original soil. Conversely, the use of a high dose of EDTA in the Meza soil, necessary for effective remediation of calcareous soils, resulted in pronouncedly decreased enzyme activities (3.2 times on average) and repressed fungal ITS and increased bacterial 16S rRNA gene abundance. Remediation shifted the microbial community composition in both soils. For revitalisation, the remediated soils were amended with compost, inocula of un-contaminated soil and (Arnoldstein soil) biochar enriched with soil extract. Amendments inconsistently affected the Arnoldstein soil: compost increased the dehydrogenase activity and altered the microbial community composition, biochar enhanced the β-glucosidase activity, and all amendments decreased the microbial abundance (1.6 times on average). In contrast, amendments efficiently revitalised the remediated Meza soil; compost and soil inoculum returned the enzyme activities back to the baseline in the original soil, increased the fungal abundance above that in the original soil and restored the microbial community composition.

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