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▶ **To cite this version:**

Frédéric Rees, Cyril Germain, Thibault Sterckeman, Jean-Louis Morel. Increase of Cd and Zn uptake by the hyperaccumulator Noccaea caerulescens grown in biochar-amended soils. 11. ICOBTE 2015: 13th International Conference on the Biogeochemistry of Trace Elements, Jul 2015, Fukuoka, Japan. hal-02793032

HAL Id: hal-02793032
https://hal.inrae.fr/hal-02793032

Submitted on 5 Jun 2020

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Increase of Cd and Zn uptake by the hyperaccumulator *Noccaea caerulescens* grown in biochar-amended soils

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ABSTRACT: Biochar, *i.e.* the solid product of biomass pyrolysis, has recently been investigated as a soil amendment in metal contaminated soils, mostly for its ability to decrease the phytoavailability of trace elements and to support plant growth. Several works have shown its efficiency for limiting the uptake of metals by plants, but the combination of biochar with metal-hyperaccumulating plants has never been tested.

This work was conducted to examine the effects of biochar amendments on metal uptake by a Cd- and Zn-hyperaccumulator (*Noccea caerulescens*), compared to a non-hyperaccumulating plant (*Lolium perenne*). Plants were grown in controlled conditions on one acidic (A) and one alkaline (B) soil contaminated by Cd, Pb and Zn by smelter activities, both amended by a wood-derived biochar at variable rates up to 10 % (w/w).

Biochar amendments in both soils decreased the availability of metals, but also of other major cations such as Ca^{2+}, as shown by the analysis of pore water and soil extracts. This effect was linked to the observed increase of soil pH with increasing biochar dose. While shoot metal uptake of *L. perenne* constantly decreased with biochar addition in both soils, an increase of shoot Cd uptake of *N. caerulescens* with 5% (w/w) biochar was recorded on both soils, and of Zn uptake on soil B. We explain this increase of metal hyperaccumulation by a decrease of competition with Ca for metal uptake. Biochar therefore affects plant metal uptake by decreasing the availability of both cationic trace elements and major cations.

This study reveals that biochar may be used not only as a sorbent or liming agent for decreasing the mobility of metals in contaminated soils, but also as an enhancer of phytoextraction to increase the removal of metals by hyperaccumulating plants.