

Soil weathering degree controls silicon bioavailability by increased pH after biochar application

ZIMIN LI^{1*}, DÁCIL UNZUÉ-BELMONTE², JEAN-THOMAS CORNELIS³, CHARLES VANDER LINDEN¹, ERIC STRUYF², FREDERIK RONSSE⁴, AND BRUNO DELVAUX¹

¹ Environmental sciences, Earth and Life Institute, Université catholique de Louvain, Croix du Sud 2, B-1348 Louvain-la-Neuve, Belgium;

² Ecosystem Management Research Group, Department of Biology, University of Antwerp, Universiteitsplein 1C, 2610 Wilrijk, Belgium;

³ BIOSE department, Gembloux Agro-Bio Tech, University of Liege, 5030 Gembloux, Belgium;

⁴ Department of Biosystems Engineering, Faculty of Bioscience Engineering, Ghent University, Coupure Links 653, B-9000 Ghent, Belgium.

***Corresponding author:** zimin.li@uclouvain.be (Zimin Li)

Applying phytolith-rich biochar in agricultural soils increases soil pH, and the contents of plant nutrients and bioavailable silicon (Si). These increase induce positive impacts on plant growth, but hide the ones generated by Si uptake. Here we compare the effects of wollastonite (CaSiO_3) and two biochars on Si bioavailability and mineralomass of plants in a young Cambisol and a highly weathered Nitisol. The biochars were produced from rice straws respectively enriched and depleted in Si. They had identical pH and nutrient contents, but largely differed in Si content (respectively $51.3 \text{ g Si kg}^{-1}$ and 0.3 g Si kg^{-1}). The contents of soil bioavailable and phytolithic Si were assessed through CaCl_2 kinetic extraction and NaOH alkaline dissolution, respectively. Adding biochar markedly increased pH in the Nitisol, from 5 to 7. Phytoliths from phytolithic biochar provide bioavailable Si that increases plant Si uptake, biomass and Si mineralomass. At identical phytolith supply, the mobility of Si in the soil-plant system depends on soil pH and buffering capacity, hence soil weathering degree.

Key words: biochar, phytolith, Si bioavailability, pH, weathering degree