Geophysical Research Abstracts
Vol. 14, EGU2012-11836, 2012
EGU General Assembly 2012

Biochar degradation in different soils

B. Wilske (1), M. Bai (1), C. Eckhardt (2), C. Kammann (2), P. Kraft (1), M. Bach (1), H.-G. Frede (1), and L. Breuer (1)

(1) Dept. Resource Management, Institute of Landscape Ecology and Resource Management, Justus Liebig University, Giessen, Germany, (2) Dept. Experimental Plant Ecology, Institute of Plant Ecology, Justus Liebig University, Giessen, Germany

Current expectations in biochar products (BC) are numerous, e.g., including improved soil fertility & plant growth, support to combat desertification, and an increase in the carbon sequestration of soils. Costs for biochar production & application must be covered by a positive budget of benefits, which may crucially depend on the residence time (or half life $T_{1/2}$, yr) of BC in soils. The objective of the present study was to assess the biodegradation rates of BC in different soils by means of a cost-efficient and standardized laboratory method.

Investigated BC were from the source material of the C4 plant Miscanthus, and converted via (1) pyrolysis (pyrBC) and (2) hydrothermal carbonization (htcBC). The high-labelling of the educt allowed the quantification of degradation by measurement of the $^{13}CO_2$ efflux. The pyrBC and htcBC were mixed with four different agricultural soils ranging in texture from sand to loam and in soil organic carbon (SOC) from 0.63% to 2.53%.

Four samples of each BC-soil combination (1% BC wt/wt in a 300-g sample mixture) and soil-only reference were incubated in 1-L glass bottles at 40% water holding capacity and 25˚C. Biodegradation of BC was monitored weekly over a period of 7 months using an automated open-dynamic chamber system. The system couples the batch of samples to microprocessor- controlled valves, by which flushing is provided for the batch, while individual samples are consecutively connected through to a wavelength scan cavity ring down spectrometer (WS-CRDS). Net $^{13}CO_2$ efflux from BC was obtained by subtracting the $^{13}CO_2$ efflux from "soil-only" samples. $T_{1/2}$ was calculated based on the ln(k)-based algorithm recently suggested by Zimmerman et al. (2010).

Results show an orders-of-magnitude larger $T_{1/2}$ of BC in poor sandy soil than in SOC-richer soils ($T_{1/2}$ up to 10^6 yrs) but not a statistically clear trend of biodegradability along the four-point SOC gradient. This was similar in both BC types, although $T_{1/2}$ was generally shorter for htcBC than for pyrBC.

Results are consistent with the general understanding of which are the main and the contributing drivers of BC degradability. The large variability in $T_{1/2}$ obtained within the individual BC-soil mixtures seems at least as much a product of the algorithm sensitivity as of the samples' preparation, incubation, and measurement together.