2015

Differential Effects of Biochar on Soils Within an Eroded Field

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Recommended Citation
EGU General Assembly 2015, held 12-17 April, 2015 in Vienna, Austria. id.7832

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Geophysical Research Abstracts
Vol. 17, EGU2015-7832, 2015
EGU General Assembly 2015

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Future uses of biochar will in part be dependent not only on the effects of biochar on soil processes but also on the availability and economics of biochar production. If pyrolysis for production of bio-oil and syngas becomes wide-spread, biochar as a by-product of bio-oil production will be widely available and relatively inexpensive compared to the production of biochar as primary product. Biochar produced as a by-product of optimized bio-oil production using regionally available feedstocks was examined for properties and for use as an amendment targeted to contrasting soils within an eroded field in an on-farm study initiated in 2013 at Brookings, South Dakota, USA. Three plant based biochar materials produced from carbon optimized gasification of corn stover (Zea mays L.), Ponderosa pine (Pinus ponderosa Lawson and C. Lawson) wood residue, and switchgrass (Panicum virgatum L.) were applied at a 1% (w/w) rate to a Maddock soil (Sandy, Mixed, Frigid Entic Hapludolls) located in an eroded upper landscape position and a Brookings soil (Fine-Silty, Mixed, Superactive, Frigid Pachic Hapludolls) located in a depositional landscape position. The cropping system within this agricultural landscape was a corn (Zea mays L.) and soybean (Glycine max L.) rotation. Biochar physical and chemical properties for each of the feedstocks were determined including pH, surface area, surface charge potential, C-distribution, ash content, macro and micro nutrient composition. Yields, nutrient content, and carbon isotope ratio measurements were made on the harvested seed. Soil physical properties measured included water retention, bulk density, and water infiltration from a ponded double ring infiltrometer. Laboratory studies were conducted to determine the effects of biochar on partitioning of nitrate and phosphorus at soil surface exchange complex and the extracellular enzymes activity of C and N cycles. Crop yields were increased only in the Maddock soil. Biochar interacted with each soil type to alter physical and chemical properties. However the pattern of interaction depended on soil and biochar type.