Geophysical Research Abstracts
Vol. 16, EGU2014-13643, 2014
EGU General Assembly 2014

Investigation of biochar effects as a non-structural BMP on soil erosional properties using a rainfall simulator

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Recent studies have shown the potential of biochar for improving overall soil quality including soil aggregation and structure. Erodibility is an inherent soil property that amongst others is highly dependent on soil organic matter content which affects aggregate stability and crusting during runoff events. We hypothesized that erodibility is reduced in biochar-amended soils and tested this in controlled rainfall-runoff simulations. The specific objectives of our study were (1) to compare runoff and sediment generation between a biochar and an unamended control treatment on an arable sandy loam soil and (2) to determine the effect of the biochar treatment on SOC erodibility. A field experiment with eight plots was established at Risø, Denmark, in 2011; four biochar-amended and four unamended control plots. Biochar produced from birch wood at 500 ºC was applied at a rate of 2 kg m-2, and plots had been harrowed and ploughed twice to a depth of 25 cm prior to sampling.
In the laboratory soil samples from (0-20 cm) were analyzed for aggregate stability and soil organic carbon (SOC) content. Soil erosional properties were measured during 3.5 hour rainfall simulations using a round flume setup. Artificial rain was applied with a FullJet nozzle at a rate of 30 mm h-1. Biochar-amended soils showed significantly lower runoff and erosion rates compared to unamended soils, and correspondingly runoff coefficients in biochar-treated soils were lower than in control soils. Less SOC was eroded from biochar-amended soils resulting in lower SOC enrichment ratios in sediment from biochar-amended soils compared to unamended control soils. The results indicated that biochar already after a relatively short incubation period in the field can lead to reduced erodibility due to improved soil aggregation and aggregate stability. The results further suggested a direct biochar effect on surface roughness which leading to lower erosion.