Geophysical Research Abstracts
Vol. 15, EGU2013-11083, 2013
EGU General Assembly 2013

The impacts of pyrolysis temperature and feedstock type on biochar properties and the effects of biochar application on the properties of a sandy loam

Steve Aston, Stefan Doerr, and Alayne Street-Perrott
Department of Geography, Swansea University, Swansea, Wales, United Kingdom (405537@swansea.ac.uk)

The production of biochar and its application to soil has the potential to make a significant contribution to climate change mitigation whilst simultaneously improving soil fertility, crop yield and soil water-holding capacity. Biochar is produced from various biomass feedstock materials at varying pyrolysis temperatures, but relatively little is known about how these parameters affect the properties of the resultant biochars and their impact on the properties of the soils to which they are subsequently applied.

Salix viminalis, M. giganteus and *Picea sitchensis* feedstocks were chipped then sieved to 2 – 5 mm, oven dried to constant weight, then pyrolyzed at 350, 500, 600 and 800˚C in a nitrogen-purged tube furnace. Biochar yields were measured by weighing the mass of each sample before and after pyrolysis. Biochar hydrophobicity was assessed by using a goniometer to measure water-droplet contact-angles. Cation-exchange-capacity (CEC) was measured using the ammonium acetate method. Biochars were also produced in a rotary kiln from softwood pellets at 400, 500, 600 and 700˚C then ground to 0.4 – 1 mm and applied to a sandy loam at a rate of 50 g kg^{-1}. Bulk densities of these soil-biochar mixtures were measured on a tapped, dry, basis. The water-holding-capacity (WHC) of each mixture was measured gravimetrically following saturation and free-draining. The filter paper method was used to assess how pyrolysis temperature influences the effect of biochar application on matric suction.

For all feedstocks, large decreases in biochar yield were observed between the pyrolysis temperatures of 350˚C and 500˚C. For *Salix viminalis* and *M. giganteus* feedstocks, subsequent reductions in the yield with increasing pyrolysis temperature were much lower. There were significant differences in hydrophobicity between biochars produced from different biomass and mean biochar hydrophobicity decreased with increasing pyrolysis temperature for all feedstocks. Results for CEC and WHC measurements will also be presented. With water contents of 0.04, 0.08 and 0.16 cm^3 cm^{-3}, the mean matric suctions of a sandy loam were higher when biochar was added. However, the differences were only statistically significant at a water content of 0.16 cm3 cm-3, where biochar produced at 500˚C had the highest suction. Biochar additions always lowered the mean bulk density of a sandy loam, but there were significant differences in the extent to which biochars produced at different temperatures did this.

Biochar yields and hydrophobicity vary according to feedstock type and decrease with increasing pyrolysis temperature. Application of biochar can significantly reduce bulk density but the extent of this effect varies according to the pyrolysis temperature at which the biochar is produced. Pyrolysis temperature can have a significant influence on how biochars affect soil suction.

Acknowledgements: This study was funded by a UK Natural Environment Research Council (NERC) Doctoral Training Grant: NE/H525154/1.