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No effect of pyrolysis temperature and feedstock type on biochar hydraulic properties

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Biochar has been lauded as a cure-all for improving water availability in soils. Yet the effect of pyrolysis temperature and feedstock type on biochar hydraulic properties and its subsequent effects on soils are not well known. We therefore systematically studied water retention, saturated hydraulic conductivity (Ksat) and hydrophobicity of 12 standard biochars (six feedstocks and two pyrolysis temperatures) developed by the UK Biochar Research Centre. The hydraulic properties were determined for pure crushed biochar as well as for a sandy soil amended with 10 t ha-1 biochar (assessed three times over a period of 15 months). For pure biochar, the effect of feedstock-temperature treatments on the water retention curve was negligible. Rice husk at a pyrolysis temperature of 700°C had a significantly lower saturated water content, plant available water content and Ksat than all other biochar treatments. This can be attributed to its severe hydrophobicity: while all other treatments were non-hydrophobic and rice husk 550°C and Miscanthus straw 550°C were both strongly hydrophobic, rice husk 700°C was severely hydrophobic. In the field biochar did not significantly influence soil water retention, saturated hydraulic conductivity and hydrophobicity of a sandy soil. There were also no significant differences between the biochar treatments. Results indicate that except for rice husk 700°C the different biochar feedstock types and pyrolysis temperatures yield surprisingly similar material in terms of hydrologic behavior. In the field, hydrology should not be a main reason to apply biochar when the aim is to improve agricultural productivity of a sandy soil, but if biochar is applied differences in hydrophobicity should be considered.