Characterization of a variety of laboratory-produced biochars and importance toward soil fertility if amended

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Although the biochar concept has gained widespread attention and agricultural experiments are being carried out, reports of appropriate methods and results of chemical and physical characterizations of biochars have lagged behind. This type of information is needed to optimize the properties of biochar for each desired purpose such as soil C sequestration, soil fertility enhancement, or for pollution control. Biochar was produced from a range of parent biomass types (oak, pine and grasses) and under a range of combustion conditions (250 to 650 ^{o}C, under air and N_2). Surface areas, determined by gas sorptometry (N_2 and CO_2) and were found to increase with increasing combustion temperature and ranged between 1.8 to 426 m^2g^{-1} and 129 to 586 m^2g^{-1}, respectively. The overall pH of the biochars ranged from 1.8 to 9.2 showing increase with increasing combustion temperatures. The CEC ranged from 9.5 to 54.8 $cmol_c$ kg^{-1} and increased with solution pH for lower temperature biochars, while the higher temperature biochars did not show any pH dependency. The isoelectric point of the biochars ranged from pH 1.3 to 1.5 indicating that the biochar surfaces will be predominantly negatively charged at most soil conditions. Column leaching experiments were carried out to understand the nutrients dynamics that might be released by biochars when added to selected soils. These findings indicate that the higher temperature biochars could be used to raise the pH of acidic soils, while lower temperature biochars will increase soil CEC especially at near-neutral pH. However, some CEC increment could be assumed with all biochars at all pH conditions.

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