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Characterization of biochar obtained from different feedstocks and pyrolysis temperatures for their use in agriculture

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Biochar can be used for soil amendment and carbon sequestration. However, the physical and chemical properties of the biochar are influenced by the feedstock and the pyrolysis temperature. Combustion produces volatilization, as well as alterations in elemental composition (C, N, H, O and nutrients), organic composition, pH and others.
In this study we investigate the influence of five feedstocks (sugarcane bagasse, sugarcane straw, and sawdust and woodchip of pine and woodchip of eucalypt). They were pyrolyzed at 300 and/or 600 ºC for 5h, in addition two size-particle was used fine (< 4mm) and coarse (> 4mm). Elemental composition, total and extractable elements, pH, electrical conductivity, and cation exchange capacity (CEC) were determined. Elemental composition, CPMAS 13C-NMR spectrometry, differential scanning calorimetry (DSC) and Fourier-transformed infrared spectroscopy (FTIR) were conducted to obtain information on biochars and to complement their physical and chemical characterisation reported by Pérez et al., (2012). The morphological characteristics of biochars were observed by scanning electronic microscopy (SEM).
The type of feedstock and size-particle, but in a lower extent the pyrolysis temperature, determined the C/N ratios, in the same way that total and extractable major elements, the CEC, extractable elements and the ash content of the biochars. However there are some exceptions to this behaviour. The highest ash contents and extractable elements were found in straw sugarcane and eucalypt-derived biochars (22-28 %). The C/N ratios ranged between 17 (pine sawdust) and 400 (pine woodchip).
The CPMAS 13C-NMR, DSC and FTIR analysis showed the loss of carbohydrates and aliphatic constituents and the formation of aromatic compounds. However the feedstock determined important differences in molecular composition. High concentration of recalcitrant compounds were found in the pine sawdust-derived biochar; whereas eucalypt and sugarcane straw showed significant contents of labile compounds. The results demonstrate the important differences in the properties of biochars determined by the feedstock, size-particle and the pyrolysis temperature, which surely greatly affect the properties of soils and the response of crop in biochar-amended soils.

Pérez-González, G.; Hidaldo, C.M; Etchevers, B.; Riegelhaupt. E. (2012). Elaboración y caracterización de biocarbones (biochar) de residuos de aserrin y caña de azúcar. SMCS, AC (Zacatecas, México)