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How the type of pyrogenic organic matter determines the SOM quality in amended soils

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Charred biomass can be used as an organic amendment and to enhance the C sink capacity of soils. There are two types of by-products containing pyrogenic OM that could be used to improve in agricultural or forestry, biochar and wood ash. Due to their different heating conditions under which it is produced (pyrolysis, combustion and different temperatures, feedstocks,..), the properties of this pyrogenic OM might be highly variable, which could affect the SOM quality and the C sink capacity of the amended soil. The purpose of this study was to assess how SOM quality is influenced by pyrogenic organic matter with different degree of carbonization.

Biochar and bottom wood ash were added to two Atlantic forest soils (Pinus radiata, 12 ºC, 1200 mm) with different texture, clayey loam and sandy loam. The experiment consisted in a randomized block trials, in which different doses of biochar (0, 3, 9, 18 Mh ha-1) and wood ash (0, 1.5, 4.5, and 9 Mg ha-1) were added.
The Biochar applied (pH: 9.8; C: 87 %) was produced by the pyrolysis of Myscanthus sp. at 450ºC in a Pyreg® pyrolysis unit. The bottom wood ash (pH: 10.6; C: 30 %) was produced by combustion in a biomass power plant. The aromatization/carbonization was lightly higher in biochar than in wood ash. This latter by-product, in addition to the black carbon, it also contained mineral ash, as well as unburnt or lightly charred plant biomass.

The evolution of soil chemical and SOM properties were monitored over three years by solid state Differential Scanning Calorimetry (DSC) and 13C CPMAS NMR. These techniques were applied in bulk samples and also in fractions of different densityes. The changes in microbial activity were studied by analysis of microbial biomass C and basal respiration and soil microbial community.
Three years after applications the SOM content increased lightly in the treatment receiving the highest doses of biochar and wood ash, specially in the clay loam soil. SOM in the treated soils displayed a higher degree of aromaticity than in the untreated soils, indicating a gain in more stable SOM compounds probably as a consequence of the charcoal application. Light increases in labile C compounds, probably due to the carbohydrates added through root system, were also detected. Microbial biomass-C and soil respiration increased significantly, probably due to the light pH increases.