Geophysical Research Abstracts
Vol. 14, EGU2012-11763-1, 2012
EGU General Assembly 2012

Soil biochar amendments: type and dose effects

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Biochar is an organic material produced via the pyrolysis of C-based biomass, which is increasingly being recognized by scientists and policy makers for its potential role in carbon sequestration, reducing greenhouse gas emissions, waste mitigation, and as a soil amendment. Recent studies indicated that biochar improves soil fertility through its positive influence on physical-chemical properties, since not only improves water retention, aggregation and permeability, but its high charge density can also hold large amounts of nutrients, increasing crop production. However, it was observed that combustion temperature could affects the degree of aromaticity and the size of aromatic sheets, which in turns determine short-term mineralization rates. To reconcile the different decompasibility observations of biochar, it has sugested that physical protection and interactions with soil minerals play a significant part in biochar stability. In this context, it has initiated one pilot studies which aims to assess the effects of biochar application on physical and chemical properties of agricultural soil under Mediterranean conditions, such as changes in aggregate formation, intra-aggregate carbon sequestration and chemistry of soil water.

In the present study, different clases of biochar produced from fast, slow and gasification pyrolisis of vegetal (pine, poplar) and dried sludge biomass, were applied at 1% of biochar-C to mesocosmos of an agricultural soil. Preliminary, it must be pointed out that slow and gasification pyrolisis changes the proportion of particles < 2 mm in diameter, from 10% (original materials) to almost 100%. In contrast, slow pyrolisis not modifies significantly biochar granulometry. As a consequence, bulk density of poplar and pine splinters decreases after fast pyrolisis. Regarding to organic carbon contents of biochar, all biochars obtained from plant biomass presented percentagens of total organic carbon (TOC) between 70 – 90%, while biochar obtained from dried sludge by slow pyrolisis has a TOC around of 22%. On the other hand, pH values of biochar depends of the type of pyrolisis as observed in the biochar obtained from poplar biomass, where pH of slow pyrolisis < fast pyrolisis < gasification pyrolisis. When soil aggregate stability was tested, it was observed that biochars from pine biomass obtained by slow and fast pyrolisis trend to increase the water-stable soil aggregates, while the biochars from poplar and thermally-dreid sludge obtained by slow pyrolisis and from pine biomass obtained by gasification trend to the contrary. These differences were not explained by TOC contents or bulk density of bichars, probably because specific resistence to slaking and wettability of each biochar. At least, when measuring pH values of water where soil aggregates were immersed during soil aggregate stability test, it was observed that biochars from thermally-dried sludge obtained by slow pyrolisis and from pine biomass obtained by gasification pyrolisis increased water pH, which corresponded with high pH values of both biochars. In general, increases in the percentage of water-stable soil aggregates corresponded with increases in water pH values, except in the case of biochar from pine biomass obtained by slow pyrolisis.