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Method to evaluate the long-term soil improving effect of biochar

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Introduction

In Belgium soil fertility is threatened by declining organic carbon content. This is caused by increasing plowing depth, less plowing in of crop residues and the strict manure decree. Reverting the trend of decreasing carbon contents requires innovative and sustainable solutions. Biochar could provide a possible answer to this challenge. Evidence exists that addition of biochar to the soil results in higher crop yields, but this has only been proven for a small number of soil/crop combinations and mainly in tropical soils. More research is needed in temperate regions such as Belgium in order to assess potential advantages of biochar for European agriculture. Moreover, most of the pot trials designed to assess the soil improving effect of biochar and the resulting crop response do not allow distinguishing between short- and long-term effects. It can be expected that there is a short term effect of biochar caused by the nutrients present in biochar and by its labile carbon fraction, which could cause the observed nitrogen immobilization on the short term [1] due to a high C/N ratio.

The objective of our study is twofold:

1. To study the effect of two biochar types on the N-cycle in short- and long-term;
2. To develop a protocol to test if a given biochar type works as a soil improver in the long-term.

In this abstract, an overview is given of the material and methods to reach this objective.

The two biochartypes used are produced during pyrolysis (horizontal screw reactor) of silage maize at 350°C and 550°C. These temperatures are chosen in order to study a biochar type with a high and one with a low labile carbon fraction. Residence time was 30 minutes.

The size of the labile carbon fraction will be determined by means of incubating biochar with quartz sand with and without microbial inoculation, while measuring headspace CO_2 by means of gas chromatography (GC-TCD). In this way, biotic and abiotic carbon mineralization can be distinguished.

The presence of a labile carbon fraction in fresh biochar can cause biotic N immobilization, through which a different effect from biochar in the short- and the long-term can be expected. To determine if biochar causes biotic and/or abiotic nitrogen immobilization and/or delayed mineralization, a ^{15}N tracing experiment is conducted. Pool specific N transformation rates will be simulated [2, 3]. To obtain insight in the effect of biochar on the N-cycle in the long-term, the same experiments will be repeated after incubation of the same soil and biochar under field circumstances during one year. It is expected that in the short-term, both biotic and abiotic nitrogen immobilization will occur, while in the longer term, the labile carbon fraction will be mineralized and only abiotic immobilization occurs. If the effect of biochar on the N-cycle differs in the short- and the long-term because of the presence of a labile carbon fraction, this fraction should be removed before the soil improving effect of biochar in the long term can be assessed correctly. Therefore, it is tested whether this fraction can be reduced in a fast way without changing the structural biochar characteristics.

A second condition to test the long-term effect of biochar in the soil is removing its accompanying nutrients to avoid that an improved crop response due to biochar addition is caused by the presence of nutrients (fertilizer effect). A leaching method is therefore tested to reduce the nutrient content of biochar.

When the labile carbon fraction and the nutrient content of biochar is reduced, the biological recalcitrant carbon fraction remains and its long-term soil improving effect can be studied when mixing the modified biochar with soil in a pot-experiment.

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[1]Ryckaert, B. 2009. Biochar, koolstofsekwestratie gecombineerd met een bodemverbeterende werking. Masterproef voorgedragen tot het behalen van de graad van Bio-ingenieur in de Landbouwkunde, UGent, Faculteit Bio-ingenieurswetenschappen, Labmet. 105p.

[2]Müller, C.; Rütting, T.; Kattge J.; Laughlin, R.J.; Stevens, R.J. 2007. *Soil Biol. Biochem. 39*:715-726.

[3]Huygens, D.; Rütting, T.; Boeckx, P.; Van Cleemput, O.; Godoy, R.; Müller, C. 2007. *SoilBiol. Biochem. 39*:2448-2458.