SoilCare
SOILCARE FOR PROFITABLE AND SUSTAINABLE CROP PRODUCTION IN EUROPE

SoilCare MSc / PhD Research Information

Research Title

De bepaling van waterextraheerbare koolstof in landbouwbodems na toepassing van bodemverbeterende middelen. (Pieter Bangels)

Determination of hot water extractable carbon in agricultural soils after application of soil amendments.

Abstract

The study was executed in the framework of a Horizon2020-project SoilCare. The overall aim of SoilCare is to identify and evaluate promising soil improving cropping systems and agronomic techniques increasing profitability and sustainability across scales in Europe.

In Flanders several field trials were set up testing different soil iproving cropping systems. In one field trial different organic amendments were incorporated in the field in orde to increase the organic matter content. Specifically in this study, the purpose to investigate the influence of different organic soil amendments on the water extractable carbon fraction in soil. The water extractable carbon is a labile fraction of the total organic carbon (TOC) in soil. This fraction gives an idea of the abundancy of soil microbial life. The labile fraction namely provides the soil microbial life with nutrients and energy. The soil microbial life plays an important role in the mineralization and humification of organic matter. One way to measure this labile carbon fraction in soil samples, is by making hot water extractions of these samples. The carbon released in these extractions is called 'hot water extractable carbon' (HWC). When changes in soil management occur, HWC will be the quickest indicator of those changes.

The importance of soil organic carbon and HWC is explained further in the literature study. It also talks about the general meaning of soil organic matter, where it comes from and what the current situation is in Flanders. Also some of the soil characteristics linked to soil organic matter are discussed.

In this study, we tried to get an image of the microbial soil life. To do this, we had two different ways. On one hand we created a field where different organic soil amendments were applied. In the field we made 6 strips repeated 4 times at random. The strips existed of a compost streak, a woodchip streak, a pig manure streak, a pig manure mixed with basalt streak, a streak with only mineral fertilization and a control streak. In the strips we buried 3 pairs of teabags. One sort in the pair had a relatively low decomposition rate (rooibos tea) whereas the other had a relatively high decomposition rate (green tea). Litterbags with the organic amendments were also buried outside of the treated strips. Every 3 months both the tea- and litterbags should be unburied and weighed to know how much of the material decomposed. Based on the weight loss we can see if there are differences in decomposition rate between the different soil amendments. On the other hand we wanted to measure the amount of HWC. This was measured by making extractions of fresh soil as described by Ghani et al (2003). At first we

tested if the original protocol was comparable with the protocol we wanted to try. In the original protocol, extractions were made with fresh soil whereas we wanted to try dried soil. For the HWC analysis, the original protocol measured the organic carbon fraction by substracting the inorganic fraction from the total hot water extractable carbon (TC-IC). We tried if the nonpurgeable organic carbon (NPOC) analysis was comparable with the TC-IC method. When the modified protocol seemed unequal to the original protocol, we needed to determine how accurate the results of the HWC analysis were. To do this, we had to evaluate the performance characteristics. The characteristics we needed to evaluate were: reproducibility, limit of detection, limit of quantitation and trueness.

The results of the litter- and teabag experiments showed that there were no differences in decomposition rate between the amendments in the first three months. The results of the HWC experiments show that the modified protocol was not comparable to the original protocol. When we examined how accurate our HWC measurements were, we found a reproducibility with a variationcoefficient of 13,74% for the cold measurement and 5,37% for the hot measurement. As limit of detection we found 41,74 µg OC/g soil for the cold measurement and 40,68 µg OC/g soil for the hot measurement. As limit of quantitation we found 83,47 µg OC/g soil for the cold measurement and 81,35 µg OC/g soil for the hot measurement. The determination of the trueness did not take place yet. After al the experiments, we can conclude that our results show that both the litter- and teabag experiments as also the HWC experiments have much potential for further research. The modified HWC protocol did not gave similar results as the original protocol so we needed to use the original protocol by Ghani et al (2003) for our further analyses. To know how accurate the HWC measurements are, the trueness still needs to be determined. On this point we can say that the HWC analysis is a very interesting measurement. In future research there could be investigations on which soil management activities have a positive influence on the amount of HWC. This way, farmers can adjust their soil managament to reach a higher carbon level in their soils.

SoilCare study site

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