Geophysical Research Abstracts
Vol. 21, EGU2019-7894, 2019
EGU General Assembly 2019

Soil organic matter characterization by water-extractable carbon content and FTIR spectroscopy

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Land use and farming management practices have an effect on soil organic matter (SOM) content and its composition. The occurrence of changes in SOM is assumed to require relatively long time before significant effects can be found. Labile organic carbon (C) fractions in soil with rapid turnover rates are sensitive indicators in evaluation of soil quality, because they may reflect impacts of crop and fertilization. The differences in SOM composition can be analyzed with Fourier Transform Infrared (FTIR) spectroscopy which is a powerful tool for identifying the chemical structures of SOM. Soil samples are measured directly and provide the information of SOM structure without using solvents.

The aim of this study was to investigate the composition of SOM by measuring soil organic C (SOC) and water-extractable organic C (WEC) concentrations and associating these results with spectral data measured by FTIR. For estimating SOM lability the proportion of WEC in SOC was calculated.

The soil samples (0-20 cm) were collected from IOSDV long-term experiment located in Tartu, Estonia (established in 1989) in autumn 2017. The experiment consists of a three-field crop rotation (potato-wheat-barley) focused on organic and nitrogen fertilization. The soil type was Stagnic Albeluvisol. Mineral nitrogen (N) was applied at five rates (0, 40, 80, 120, 160 kg/ha in year) and manure (40 t/ha) added once during every three years prior to planting of potatoes.

The results showed that the mineral N fertilization had no effect on SOC and WSC concentrations nor on SOM lability. Only functional groups with absorption peaks in the regions of 1434 and 1635 cm-1 (aliphatic and aromatic C compound, respectively) were affected by N fertilization. The addition of manure increased SOC concentration and decreased SOM lability but did not affect WSC concentration, which was affected only by crop grown prior to soil sampling. The highest WEC concentration and SOM lability was after potato, cereals contributed to the formation of more stable organic matter. The SOM lability decreased with the increase of SOC concentration. In manure treatment the aromatic C compounds had a positive correlation with SOC and a negative correlation with SOM lability. This indicates that stable SOM formation is related to the increase of aromatic C compounds in SOM.

This work was supported by the Estonian Research Council grant PSG147.