Soil management effects on soil organic matter properties and carbon sequestration (SOMPACS)

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Abstract

SOMPACS is a project recommended by EJP SOIL for funding under the 1st External Call "Towards Healthy, Resilient and Sustainable Agricultural Soils". The goal of this project is to assess management practices that enrich organic matter pools that are resilient to rapid microbial decomposition. The project started in 2022 as a consortium of 12 research institutions from Poland, Germany, Ireland, Lithuania, UK, Italy and USA for a period of three years.

Soil and vegetation samples from eight long-term experiments that differ in soil management practices (i.e., conventional vs. no-tillage; mineral vs. organic fertilization; with and without catch crop; and arable land vs. undisturbed grassland) are investigated. Study sites include: 22- and 54-year long experiments in Lithuania; 26-year long experiment in Italy; 30- and 40-year long experiments in Ireland; 30- and 46- and 100-year long experiments in Poland; and 178-year long Broadbalk experiment in Great Britain. Additional experimentation includes assessing the impact of root growth promoting amendments (commercially available humic substances, biochar and biogas digestate) on stable organic matter pools. In parallel with soil sampling, plant productivity are measured in all field experiments. This investigation is couples fields studies with small-scale experimental plots and laboratory incubations under controlled conditions. In addition to assessing basic soil properties, the following state-of-the-art analyses are conducted:

1. SOM composition and stability by Py-GC-MS;

2. fractionation of aggregate size classes and C pools of increasing physicochemical protection;
3. isotopic analysis of δ13C and δ15N performed on different SOM pools;
4. microbiological properties (community-level physiological profiling, selected functional genes involved in C and N cycles, microbiome and mycobiome analyses by next-generation sequencing, genetic diversity using terminal restriction fragment length polymorphism);
5. enzymatic activity;
6. soil water retention and soil water repellency;
7. mineral composition of clay fraction; (8) soil structure stability.

The most resistant SOM pool (humin) are isolated by different methods (isolation vs. extraction) and examined for chemical composition and structure, using spectrometric and spectroscopic techniques (mass spectrometry, NMR, FTIR, EPR, UV-Vis-NIR, fluorescence). The carbon stocks in the soil profile will be evaluated and the carbon extractable in cold water will be determined to assess the potential carbon leaching and microbial availability. Additionally, in-field soil carbon dioxide (CO_2) fluxes from selected experiments is monitored.

Thus far, soil samples (0-100 cm depth) were collected and the humin fraction from surface A horizon was isolated for spectroscopic studies. Crop yield and vegetation productivity was also assessed.

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Keywords

soil management; soil properties; humin; spectroscopic properties; carbon sequestration

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Conflicts of interest

The authors have declared that no competing interests exist.