# 1 SOMPACS (ID 7)

## Soil management effects on soil organic matter properties and carbon sequestration

**Coordinator**

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**Project partners**

| Country | Organization |
|---|---|
| **Germany** | University of Rostock |
| **Germany** | University of Goettingen |
| **Ireland** | Univeresity of Limerick |
| **Italy** | Università degli Studi di Napoli Federico II |
| **Lithuania** | Vytautas Magnus University |
| **Poland** | Warsaw University of Life Science SGGW |
| **Poland** | Grupa Producentów Rolnych TERRA sp. z o.o. |
| **Poland** | West Pomeranian University of Technology in Szczecin |
| **Poland** | Institute of Agrophysics, Polish Academy of Sciences |
| **Poland** | University of Wrocław |
| **United Kingdom** | Rothamsted Research |
| **United States** | University of Wyoming |

**Summary**

The objectives of the SOMPACS proposal are to disclose management practices enriching soils with the organic matter pools which are most resistant to microbial decomposition, and to specify these practices for various soil and climate conditions through Europe. Every soil, even intensively and organically fertilized for a long time, finally reaches an equilibrium state of soil organic matter (SOM) level, in which it content gains plateau. This equilibrium, however, depends on the SOM quality and may be raised by the pools most resistant to decomposition. The planned research will also aim on soil organic C balance, which is to optimize with the agrotechnical methods, as well as to identify the SOM stability depending on management and climatic conditions.

For this purpose, soil samples from eight long-term field experiments with different soil management and cultivation systems (conventional tillage vs. no-tillage; mineral vs. organic fertilization; management with and without catch crop; arable land vs. grassland; and cultivated vs. noncultivated soils) will be investigated. Field experiments will include trials of increasing duration: 22-year (Lithuania); 26-year (Italy); 30-year (Poland, Ireland); 46-year (Poland); 54-year (Lithuania); 100-year (Poland) and 178-year Broadbalk experiment (UK). Experiments will be also conducted on production fields, where, apart from most innovative cultivation methods, additives stimulating the root growth and at the same time providing very stable C will be applied (commercial humic products, biochar and biogas digestate). The effects of these additives on the SOM content and properties will be investigated in plots of the long-term field experiments, as well as incubation studies on microbial decomposition of SOM and these additives.

Parallel to soil sampling, plant productivity will be measured in all field experiments. Basic soil properties (texture; pH; TOC; TC; TN; TP; CEC; acidity; plant-available P, K, Mg) will be supplemented by the following investigations based on the state-of-the-art approaches: composition and stability of SOM by Py-MS; aggregate size classes and C pools of increasing physico-chemical protection; microbiological properties (community-level physiological profiling, selected functional genes involved

in C and N cycles, microbiome and mycobiome analyses via next-generation sequencing, genetic diversity using terminal restriction fragment length polymorphism); analysis of δ13C and δ15N of the separated SOM pools; enzymatic activity; soil water retention and soil water repellency; mineral composition of clay fraction; soil structure stability. The most resistant SOM pools (humin) will be isolated by different methods (extraction vs. separation in a stable state) and examined for chemical composition and structure, using spectrometric and spectroscopic techniques (mass spectrometry, NMR, FTIR, EPR, UV-Vis-NIR, fluorescence). The C stocks in the soil will be evaluated and cold water extractable C will be determined to assess the potential C leaching and microbial availability. CO2 emissions from the soil will be measured directly under field conditions.

The conducted research will allow us to broaden the knowledge towards a better understanding of SOM transformation processes, with particular emphasis on the formation of pools most resistant to microbial decomposition. A closer understanding of the SOC persistence in top- and subsoil, as well as identifying site and climate-specific management practices that contribute to minimizing greenhouse gas emissions will show the possibilities to increase the stable SOM pools, thus improving the potential of C sequestration. The results obtained will be considered to link the humanistic/legal/socio-economic dimension, bringing natural sciences knowledge into the policy.

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