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NMR spectroscopy approach to study soil organic matter formation under different plant composition during 50 years

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The aim of this research was to study the effect of different plants on soil organic matter (SOM) composition. The composition of SOM was studied in a field experiment established in 1964 on a carbonaceous glacial till soil with very low initial SOC concentration (1.28 g kg^{-1}). The effects on SOM composition of bare fallow, barley, grasses, and clover-grasses mixture, were studied using ^{13}C nuclear magnetic resonance (NMR) spectroscopy which is a common tool to characterize SOM. In 2014 the soil samples were collected from 0-5 cm soil layer, air-dried samples sieved through a 2-mm sieve and pretreated with 10% HF solution before NMR spectroscopy analysis. Samples of bulk soil and density fractionated mineral fraction (John et al., 2005) were analyzed. Also, a sample from barley treatment collected in 1966 was analyzed.

O/N-alkyl C was the most abundant C type at the start of the experiment and also in all treatments after 50 years. During 50 years the proportions of O/N-alkyl C and alkyl C increased but contributions of carboxyl C and aromatic C decreased. The ratio of alkyl C/O-alkyl C, which describes the degree of soil organic matter decomposition, decreased from 0.47 (in 1966) to 0.40-0.44 in treatments with plants. In bare fallow treatment, the SOM decomposition stage did not change a lot during the time. In soil mineral fraction the differences between treatments appeared more clearly and the degree of decomposition decreased in line: bare fallow > barley > clover-grasses > grasses ($0.49 > 0.40 > 0.36 > 0.34$) and this was due to higher O/N-alkyl-C content in treatments with plants. The higher O/N-alkyl C contribution in soil heavy fraction can be attributed to microbially synthesized carbohydrates (Yeasmin et al., 2020) and depended on the amount and properties of C input into the soil in different treatments.

In conclusion, the SOM composition was influenced by plant composition and the effect was more pronounced in soil mineral fraction. The SOM degree of decomposition was higher in treatment with annual crop (barley during 50 years). Under perennial grasses and clover-grasses mixture, the soil organic matter decomposition degree was lower.

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