

Effect of 55 years of different soil management on soil physical properties and stability of soil organic matter

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Streszczenie

The aim of the study was to reveal the effect of agroecosystems management on soil physical properties and stability of soil organic matter (SOM). A 55-year-long-term field experiment in Kaunas, Lithuania, allowed for a comprehensive assessment of the effects of rye and maize monocultures, with and without mineral fertilisation, intensive six-year crop rotation and bare fallow on soil properties in the 0–20 cm layer. Soil physical parameters (soil water retention, water repellency, and aggregate stability) and SOM characteristics, including total organic carbon content (TOC), fractional composition (fulvic acids, humic acids, humin), and molecular properties of humin were examined using elemental analysis, UV-Vis, fluorescence spectroscopy, and ¹³C-CPMAS NMR. The results confirmed that bare fallow reduces aggregate stability and limits TOC content. In contrast, intensive six-year crop rotation increased aggregate stability, water retention and TOC content while plant-available water remained unchanged, highlighting the significant environmental benefits of crop rotation. However, fertilised rye monoculture exhibited a higher amount of plant-available water. Monocultures caused an increase in soil water repellency at low soil moisture. The favourable increase in TOC in response to crop rotation resulted in increased humic and fulvic acids share, while the humin structure in these soils indicated a more aliphatic structure. Humin properties in non-fertilised monocultures, especially rye, was similar to that in fallow, reflecting a higher proportion of well-transformed humic material. The results showed that the integration of legumes, organic fertilisers, and crop diversity is crucial for long-term soil health and resilience to climate stress in agroecosystems.

Słowa kluczowe

Humin fraction, Soil aggregate structure, Soil water retention, Soil hydrophobicity, UV-Vis, Fluorescence, NMR

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