

Response of soil organic matter (SOM) properties from 180 years of mineral versus organic fertilisation in the Broadbalk experiment at Rothamsted (UK)

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Streszczenie

The aim of this study was to deepen the knowledge on the changes in soil organic matter (SOM) properties under the long-term influence of organic and inorganic fertilization. Particular attention was paid to the humin fraction (HUM), considered to be a particularly stable and long-term sink of atmospheric carbon. The studies were conducted on soil samples from the Broadbalk Winter Wheat experiment running continuously for 180 years, which were analysed using unique chemical and spectrometric methods (^{13}C -CPMAS NMR; C and N K-edge Xanes; EPR; TC-GC/MS; fluorescence; UV-Vis, and others). Long-term manure fertilization treatment confirmed the greatest increase of soil C at a level comparable to permanent grassland. The manuring significantly increased the HUM-C-content in comparison to the inorganically-fertilized NPK treatment and the control (no inputs) (7.02gkg^{-1} , 4.37gkg^{-1} and 1.72gkg^{-1} , respectively). The manuscript documented that the proportion of HUM in total organic carbon (TOC) increased twofold with NPK fertilization and one and a half times with manure fertilization, but surprisingly not after the application of both, shedding new light on the mechanisms of C stabilization. The manuscript indicated for the first time by multivariate statistical analyses that HUM-C enrichments from manure were linked with increasing proportions of heterocyclic N compounds. These findings have profound implications for broader sustainability, directly linking to climate change mitigation and food security. It is concluded that offsetting mineral fertilizer by manure, where this is possible and feasible, is an option for sustainable soil C increase.

Słowa kluczowe

Long-term field experiment, Humin, Spectroscopic properties, ^{13}C -CPMAS NMR, XANES, Fluorescence, UV-Vis

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