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Decadal Nitrogen Fertilization Decreases Mineral-Associated and Subsoil Carbon: A 32-Year Study

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Abstract

Copyright © 2016 John Wiley & Sons, Ltd. Crop residues and manure are important sources of carbon (C) for soil organic matter (SOM) formation. Crop residue return increases by nitrogen (N) fertilization because of higher plant productivity, but this often results only in minor increases of SOM. In our study, we show how N fertilization and organic C additions affected SOM and its fractions within a 32-year-long field-experiment at Puch, Germany. Five organic additions, no-addition (control), manure, slurry, straw and straw + slurry, were combined with three mineral N fertilization rates (no, medium and high fertilization), which resulted in 1·17–4·86 Mg C-input ha -1 y -1 . Topsoil (0–25 cm) SOM content increased with N fertilization, mainly because of the C in free light fraction (f-LF). In contrast, subsoil (25–60 cm) SOM decreased with N fertilization, probably because of roots' relocation in Ap horizon with N fertilization at the surface. Despite high inputs, straw contributed little to f-LF but prevented C losses from the mineral-associated SOM fraction (ρ > 1·6 g cm -3) with N fertilization, which was observed without straw addition. Above (straw) and belowground (roots) residues had opposite effects on SOM fractions. Root C retained longer in the light-fractions and was responsible for SOM increase with N fertilization. Straw decomposed rapidly (from f-LF) and fueled the mineral-associated SOM fraction. We conclude that SOM content and composition depended not only on residue quantity, which can be managed by the additions and N fertilization, but also on the quality of organics. This should be considered for maintaining the SOM level, C sequestration, and soil fertility. Copyright © 2016 John Wiley & Sons, Ltd.

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Keywords

cropland soil, density fractionation, manure and straw slurry, nitrogen fertilizer, soil organic matter

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