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Storage, pools, and chemical composition of soil organic matter surplus due to tillage intensity drop

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Intensive tillage operations, especially moldboard plowing, are widely described as one of the leading causes of soil organic matter (SOM) decrease in cultivated topsoils. Experiments proved that afforestation or even dropped tillage intensity might increase the SOM content of the soil within decades. However, little is known about the forms and sequestration mechanisms of the recently produced organic matter under conservation agriculture practices. Thus, the present study aimed to test the following hypotheses on a Chernozem crop field shifted to conservation tillage: (i) SOM increase appears in the uppermost soil layer without any effect in the subsoil layer; (ii) SOM increase affects each (both labile and stabile) SOM pools of the soil; (iii) the increase modifies the SOM composition of the fractions. The investigations were carried out in a long-term field experiment established in 2002 at Józsefmajor, Hungary. The present study compares the SOM amount and composition of the 0-10 cm and 30-40 cm horizons under plowing, deep cultivation, and no-tillage. Decreasing cultivation intensity resulted in a general soil organic carbon (SOC) concentration increase in both the mineral phase associated OM (stable pool), and the aggregate occluded OM fractions (labile pool). This indicates a relevant saturation deficit in both fractions of the topsoil even though the particulate organic matter fraction did not change. The increase is probably due to the above-ground plant residue input surplus as the SOC content in the 30-40cm layer did not change. The SOM surplus stabilized in the soil did not affect SOM composition differences between depth and fractions resulted in a cultivation-independent chemical SOM composition. The only difference was aromaticity, which showed increasing stratification due to tillage intensity mitigation. These results suggest the highlighted role of dissolved organic matter movement in the profile as the possible driving force of differentiation of aromaticity with depth. The results also underline the role of local circumstances in organic matter composition changes, proving the process's complexity and the difficulties of holistic model construction. The present research was supported by the Hungarian National Research and Innovation Office (NKFIH) K-123953, which is kindly acknowledged.