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Tillage and cropping effects on soil organic carbon: biodegradation and storage in density and size fractions

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Improvements in management practices can prevent the decline of soil organic carbon (SOC) storage caused by conventional tillage practice in Northeast China. Density and size fractionation can track the transformation of plant residue into SOC and its location in soil matrix. We used a long-term field study in China to evaluate these changes as a result of improved management involving tillage and cropping systems. Experimental treatments included no-till (NT) and moldboard ploughing (MP) under monoculture maize (Zea mays L.) (MM) and maize-soybean (Glycine max Merr.) rotation (MS); these were compared to the traditional management involving conventional tillage (CT) under MM. An incubation study was conducted to evaluate mineralization and the biodegradability of SOC. The soils were also physically fractionated by density (light fraction, LF) and size (sand, silt, clay). With improved management, the SOC storage in the clay showed the largest increase across all fractions. This increase was greater for MS than MM. The NTMS treatment resulted in a decline in silt-OC storage compared to CTMM. The SOC mineralization (mg CO_2-C g^{-1} soil) was affected by tillage and driven by LF-OC and was observed in the order: NTMM (2.06) > MPMM (1.72) ≈ NTMS (1.71) > CTMM (1.52) ≈ MPMS (1.41). Both cropping and depth affected the biodegradability of SOC. Considering the plough layer (0-20 cm), treatments under MM had larger proportion of biodegradable SOC than under MS. We conclude that the significant differences in SOC storage in physical fractions and SOC biodegradation were caused by differences in soil management.