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Long-term tillage and cropping sequence influence on dryland soil aggregate-carbon dynam

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Sequestration and transformation of soil C as a result of long-term management practices occur mainly in aggregates. This study evaluated the 21-yr effect of tillage and cropping sequence combinations on dryland soil C sequestration and transformation into various C fractions in aggregates at the 0-20 cm depth in eastern Montana, USA. Tillage and cropping sequences were no-tilled continuous spring wheat (NTCW), spring-tilled continuous spring wheat (STCW), fall- and spring-tilled continuous spring wheat (FSTCW), fall- and spring-tilled spring wheat-barley (1984-1999) followed by spring wheat-pea (2000-2004) (FSTW-B/P), and spring-tilled spring wheat-fallow (STW-F). Carbon fractions were soil organic C (SOC), particulate organic C (POC), microbial biomass C (MBC), and potential C mineralization (PCM). Total amount of crop biomass (stems + leaves) residue returned to soil from 1984 to 2004 was lower in STW-F than in other treatments. Aggregate proportion was greater in NTCW than in FSTCW in 4.75-2.00 mm aggregate-size class at 0-5 cm but was greater in STW-F than in STCW in 2.00-0.25 mm size class at 5-20 cm. The SOC and POC were greater in NTCW and STCW than in STW-F in all aggregate-size classes at 0-5 cm and greater in NTCW than in STW-F in 4.75-2.00 mm and <0.25 mm size classes at 5-20 cm. The PCM was greater in STCW and FSTCW than in STW-F in all aggregate-size classes at 0-5 cm and greater in STCW than in NTCW, FSTCW, and STW-F in 4.75-2.00 mm size class at 5-20 cm. Similarly, MBC was greater in NTCW and STCW than in STW-F in <2.00 mm size class at 0-5 cm and greater in STCW and FSTCW than in STW-F in 4.75-0.25 mm class size at 5-20 cm. No-till increased aggregate proportion and POC but reduced PCM and MBC compared with tilled practices in the continuous spring wheat system in 4.75-2.00 mm size class. Aggregate proportion was greater in 2.00-0.25 mm size class than in other aggregate-size classes. The SOC, POC, and PCM were greater in 4.75-2.00 mm than in <0.25 mm at 0-5 cm but MBC was greater in <0.25 mm than in 4.75-0.25 mm size class at both depths. Reduced tillage with annual cropping increased crop residue production, soil aggregation, C sequestration, and microbial biomass and activities in 4.75-0.25 mm size class compared with the conventional system, such as STW-F. Because of greater aggregate proportion and C concentration between 4.75-2.00 mm and <0.25 mm, C sequestration occurred mainly in 2.00-0.25 mm size class but C transformation varied among aggregate-size classes in the dryland cropping system.