Optimization of tillage rotation and fertilization increases the soil organic carbon pools and crop yields in a wheat-maize cropping system on China's Loess Plateau

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Abstract

Long-term application of high rates of nitrogen and phosphorus fertilizers and mono-tillage practices can adversely affect soil health, carbon sequestration and crop growth. A 10-year field experiment was conducted in a wheat-maize cropping system on China's Loess Plateau to explore fertilization and tillage methods that improve SOC sequestration and crop yields. We evaluated the effects of (1) fertilization (balanced fertilization (BF), low fertilization (LF), and conventional fertilization (CF)) and (2) alternating years of different tillage (no tillage and subsoiling (NS), subsoiling and plowing (SP), plowing and no tillage (PN)) or continuous plowing tillage (PP) on input-C, SOC pool, and crop yields. BF and rotational tillage (NS, SP, and PN) increased the amount and stabilization rate of input-C. BF increased SOC storage compared to CF. Simultaneously, BF produced higher contents of SOC, readily oxidizable C (ROC), dissolved organic C (DOC) and particulate organic C (POC) and C pool management index (CMI) at 0-10 cm depth. For tillage, SOC storages were increased by rotational tillage, the highest was in NS. Rotational tillage increased SOC content, labile C contents and CMI at 0-10 cm depth. Moreover, NS also had positive effect on these parameters at 35-50 cm depth, which improved soil quality. Crop yields were positively correlated with SOC, labile C, and CMI. Crop yields were increased by BF and rotational tillage, the highest were in BF+NS treatment. Therefore, NS combined with BF may be the best management for increasing SOC storage, improving soil quality and productivity on China's Loess Plateau.

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