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Conservation tillage practices facilitate soil organic carbon sequestration and aggregate stability via fungal abundance and necromass

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Conservation tillage has been widely applied to improve soil health, sustain crop production, and promote carbon (C) sequestration in soil. Positive effects often depend on the degree of tillage intensity and time of adoption. This study was thus aimed to determine temporal changes of selected soil health indicators under different tillage intensities in a long-term tillage trial.

Accordingly, bulk and rhizosphere soil samples were taken after 8 and 13 years of adoption from topsoil under four different tillage systems ranging from conventional (high intensity), reduced, minimum, to no-tillage (low intensity). Aggregate stability and soil fungal indicators (ergosterol and glomalin-related soil protein) were analysed. Soil organic carbon stocks were assessed at 10 and 13 years of adoption. To determine long-term effect of tillage on soil microbial necromass accumulation, amino sugars were measured after 13 years of adoption.

Aggregate stability and soil fungal indicators increased with lower tillage intensity for both sampling time points. Conservation tillage practices promoted the accumulation of soil organic carbon and microbial necromass. Interestingly, among conservation tillage practices, the soil fungal indicators showed highest values for reduced and minimum tillage compared to no-tillage at 13 years of adoption. This suggests that fungal growth could potentially benefit from slight soil disturbance in the long-term. Therefore, reduction of tillage intensity evidently improved soil health by promoting soil carbon sequestration and aggregate stability via fungal growth as well as soil microbial necromass accumulation.

Conventional tillage is most detrimental to soil health indicators, while reduced tillage seem to promote soil biological processes via gentle mixing of soil substrate. Instead, no-tillage is most beneficial to aggregate stability but not for fungal indicators.