



Impact of reduced tillage on the greenhouse gas balance – a meta-analysis

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Minimum tillage and no-tillage has been acknowledged as human induced measure for climate mitigation due to its potential to sequester additional soil carbon. However, there is increasing evidence that reduced tillage affects the vertical distribution of carbon in the soil profile, but hardly increases soil carbon stocks. Additionally, reduced tillage may increase the N₂O emissions that would counterbalance the positive effects of soil carbon sequestration.

Here we present a new meta-analysis on the full field scale effect of reduced tillage and no-tillage for the temperate zone including soil organic carbon, N₂O and diesel derived fossil fuel emissions for field management. This analysis was performed using strict selection criteria and included data from more than 115 sites on soil carbon stock changes and from more than 30 sites with measured N₂O fluxes on paired fields with conventional and reduced tillage.

Soil organic carbon stocks did hardly increase (mean \pm standard deviation: 2 ± 11 Mg C ha⁻¹) under no tillage as compared to moldboard ploughing. At 38% of all sites decreasing soil carbon stocks were detected under no-tillage as compared to conventional tillage. On the other hand, N₂O emissions increased by around 40% on no-tillage fields with large deviations between sites. Thus, the total greenhouse gas balance turned out to be more negative for most no-tillage fields as compared to conventional tillage fields. The large observed scatter and deviations between sites and their controlling factors are discussed.