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Plant biodiversity positively affects short-term soil carbon storage in experimental grasslands

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Increasing atmospheric CO_2 concentration and related climate change have engendered much interest in the potential of soils to sequester carbon. Here, the link between plant biodiversity and soil carbon storage was investigated in “The Jena Experiment”, a managed grassland experiment on a former agricultural site. Biodiversity gradients ranged from 1 to 60 species belonging to 4 functional groups. Stratified soil samples were taken to 30 cm depth from 86 plots in 2002, 2004 and 2006, and organic carbon concentrations were determined. Land use change induced a decrease in carbon stocks from 7.3 kg C m^{-2} in 2002 to 6.7 kg C m^{-2} in 2004, but by 2006 carbon stocks had recovered to 7.8 kg C m^{-2}. Organic carbon concentration strongly increased in the top 5 cm of soil but decreased below 20 cm depth as a short-term effect of land use change. The average concentration increase was 1.4 g C kg^{-1} soil after 2 years and 2.4 g C kg^{-1} after 4 years in the upper 5 cm and was significantly correlated with sown species number and number of functional groups. Although increasing species diversity resulted in higher biomass production, statistical analyses revealed that species diversity *per se* was more important than biomass production for changes in soil carbon. Below 20 cm depth the presence and proportion of one functional group - tall herbs - significantly reduced carbon losses.

Our short-term analysis suggests that inherited soil carbon degrades with a turnover time of $\sim$10 years and is simultaneously replaced by carbon from the extant ecosystem. Overall carbon stocks are determined by land use and management. However, species richness and certain functional traits can accelerate the build-up of new pools. Consequently, higher biodiversity in a given land use and climate system mitigates carbon losses in the short-term and might lead to higher carbon sequestration in the long-term.