Control of soil pH on turnover of belowground organic matter in subalpine grassland

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Author(s) Leifeld, Jens; Bassin, Seraina; Conen, Franz; Hajdas, Irka; Egli, Markus; Fuhrer, Juerg
Author(s) at UniBasel Conen, Franz ;
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Grasslands store substantial amounts of carbon in the form of organic matter in soil and roots. At high latitudes and elevation, turnover of these materials is slow due to various interacting biotic and abiotic constraints. Reliable estimates on the future of belowground carbon storage in cold grassland soils thus require quantitative understanding of these factors. We studied carbon turnover of roots, labile coarse particulate organic matter (cPOM) and older non-cPOM along a natural pH gradient (3.9-5.9) in a subalpine grassland by utilizing soil fractionation and radiocarbon dating. Soil carbon stocks and root biomass, turnover, and decomposability did not scale with soil pH whereas mean residence times of both soil organic matter fractions significantly increased with declining pH. The effect was twice as strong for non-cPOM, which was also stronger enriched in N-15 at low pH. Considering roots as important precursors for cPOM, the weaker soil pH effect on cPOM turnover may have been driven by comparably high root pH values. At pH < 5, long non-cPOM mean residence times were probably related to pH dependent changes in substrate availability. Differences in turnover along the pH gradient were not reflected in soil carbon stocks because aboveground productivity was lower under acidic conditions and, in turn, higher inputs from aboveground plant residues compensated for faster soil carbon turnover at less acidic pH. In summary, the study provides evidence for a strong and differential regulatory role of pH on the turnover of soil organic matter that needs consideration in studies aiming to quantify effects of changing environmental conditions on belowground carbon storage.
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