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Molecular dynamics of lignin and cutin/suberin in soils: implications for root/shoot contribution to soil organic matter

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How the chemical composition of plant biomolecules controls their dynamics in soils at the long-term scale remains largely unknown. Stabilisation mechanisms in soils might depend upon the chemical nature of organic matter. These mechanisms either involve soil mineral constituents or are related to chemical recalcitrance of specific molecules such as lignins. Physical and physico-chemical protection mechanisms may act differently on above- and belowground tissues of plants, leading to contrasting contributions of these tissues to soil organic matter (SOM). Cutins and suberins are specific for above and the belowground tissues of higher plants, respectively. Their molecular constituents can be used as biomarkers of the inputs of these plant tissues to soils. In this study, the molecular turnover of specifically plant-derived constituents in soils were estimated using compound specific isotopic tracer techniques applied to agricultural lands converted from C3 plant to C4 plant cropping. We assessed the specific residence times of lignins, cutins and suberins in soils, in order to compare the contributions of above- and belowground tissues to SOM. Lignin turnover in soil was faster than that of total organic carbon. Contrasting dynamics in soils were observed among lignin monomers as well as among cutin/suberin markers, which might be related to their chemical nature, their position into the polymeric structure and/or to the plant tissue in which they are present. This study, combining compound specific isotope measurements with a long term field trial helped understanding soil carbon

turnover on a molecular level.