

Cambisol) from a forested site in southern Germany. On every lysimeter four juvenile Beech trees (*Fagus sylvatica* L.) were grown. In April 2006, after removal of the old litter layer, four lysimeters received ¹⁵N-labelled Beech litter and the other four lysimeters received the same amount of unlabelled Beech litter. In September 2006 all lysimeters were sampled and the upper soil layers (0-2 cm, 2-5 cm and 5-10 cm) were subjected to a physical SOM fractionation. Composition of litter samples and SOM fractions were studied by stable isotope techniques and ¹³C-CPMAS NMR spectroscopy.

We found higher contents of particulate OM (POM) fractions for the soils with ¹⁵N-labelled litter input. In all lysimeters remarkable high losses in O/N-alkyl C were detected with ongoing decomposition from free to inner aggregate POM fractions, leading to over 50% alkyl C for the occluded POM < 20 μm. Furthermore, we found clear increases of alkyl C / O/N-alkyl C ratios within the first 10 cm of soil depth, which implies large vertical SOM heterogeneities on a horizon scale. Sampling on field scales on a horizon basis can therefore be biased by these found heterogeneities. Additionally we could track vertical changes in SOM related to root exudates due to the ¹³C-labelling via gassing of the young Beech trees.

S01.C.04

Does water stress affect composition and stabilization of SON? - A ¹⁵N labelling phytotron experiment

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Nitrogen availability and partitioning in the soil are central factors for growth and development of forest ecosystems, but the knowledge about the proceeding mechanisms for the sequestration of N into the SOM is still deficient.

The prognosticated climate change with higher temperatures and longer drought periods will affect growth and development of beech forests in central Europe and thus will affect quality and quantity of the SON.

We conducted a ¹⁵N labelling phytotron experiment under controlled conditions to study distribution and stabilisation of ON within different soil fractions and to elucidate to what extent water stress affects SON partitioning.

For the experiment, 16 containers, filled with homogenized surface- and subsoil of a Leptic Phaeozem were planted with 2 yrs-old-beech trees (8 x 8 and 8 x 15 beech) and placed in 4 phytotrons for four month. For half the containers, water supply was reduced to simulate water stress. ¹⁵N labelling was conducted through application of a fertilizer solution (¹⁵NH₄, ¹⁵NO₃) and soil samples were taken directly following application and after 4, 7, 13 and 24 days. Soil samples were physically fractionated and were analysed for hydrolyzable N, ¹⁵N content and chemical composition of ON by ¹⁵N NMR spectroscopy.

Within 24 days of incubation, we could already observe a decrease of ¹⁵N in all containers. ¹⁵N-contents in the control containers were generally lower than those in water stress treated containers, maybe due to higher microbial activity and plant growth caused by a better water availability. Chemical degradation studies are expected to give more information about chemical and microbial stability of SON sequestered in the different physical fractions. NMR spectroscopic pre-experiments showed no differences in the quality of immobilized ON, indicating that with respect to alteration of the N-fraction by water stress quantitative factors dominate over qualitative structural changes of the SON.

S01.D.01

Decomposition and stabilisation of soluble vs. structural C fractions from plant residues in soils

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Many agricultural soils have lost a substantial fraction of their carbon during the last decades. Replenishing these stocks is a major challenge for modern soil management techniques. In particular, it is important to determine what type of organic matter is preferentially stabilised in soils, notably in terms of origin and molecular structures.

Stabilised soil organic matter has long been considered as composed of macromolecular structures directly inherited from complex or structural plant molecules such as lignin. Recent isotopic studies require this paradigm to be reconsidered. Lignin monomers have shown a turnover time of about 20 years in French loamy agricultural soils. In contrast, turnover time of soil-extracted polysaccharides can exceed 40 years. Some ¹⁴C incubation studies have indicated that glucose-derived carbon can have a longer residence time in soils than carbon from more complex molecules like cellulose.

The present research was designed to test the hypothesis that carbon derived from soluble plant molecules has a longer residence time in soils than carbon from plant structural molecules. This hypothesis was tested in long-term incubation experiments conducted with labeled plant residues. We used ¹³C pulse labeling to produce a foliar material displaying contrasting isotopic signatures between water soluble and insoluble (structural) molecular fractions. This material was incubated for more than a year in a loamy soil. Mineralized CO₂ and ¹³C-CO₂ signatures were periodically determined. The time-series data were interpreted through a simple three-pool isotopic model, which yields decomposition rates and stabilization yield efficiencies for the soluble and structural components. As expected, the decomposition rate was much higher for soluble than structural compounds. However, results indicate that the stabilization yield efficiency was higher for soluble than for structural compounds. This suggests that, in the long-term, carbon derived from soluble compounds would contribute more to stable SOM than that originating from structural molecules.

S01.D.02

Impact of Calcium cations on the formation of coordinative cross-linking in Soil Organic Matter (SOM)

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Multivalent cations are expected to affect coordinative cross-linking of organic molecules. In SOM cross-linking may form glassy molecular networks. An increasing glassy character of polymers can be shown by the increase of the glass transition behaviour temperature. In SOM a similar behaviour is shown and can be characterized by the step transition like glass transition behaviour temperature (Ts). In this study the behaviour of Ts in SOM with different Ca²⁺ concentration was determined. Our intention was to create soil samples with a high level of networking in SOM by Ca²⁺. Our hypothesis was that different concentration of Ca²⁺ and the manner of addition leads to differences in Ts of an organic layer. We expected increasing Ts with increasing Ca²⁺-concentration in the soil especially for slow addition (in several steps) of Ca²⁺.

We added Ca²⁺ by percolation with a Ca²⁺-soil-solution (5, 8 and 10 mmol/l). Each sample was percolated for four times with the same solution. Between the percolation steps the soil was dried and Ts was measured by Differential Scanning Calorimetry.

In all samples an increase of Ts with final Ca²⁺ content in the soil was observed. Surprisingly the slope of this relation