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Multiple-Isotope labelling (13C, 18O, 2H) in a Controlled Environment (MICE) as a new tool for studying the allocation of organic molecules within the plant-soil system?

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Carbon cycling has become of major interest for the understanding and mitigation of global climatic change. Terrestrial ecosystems have a large carbon sequestration potential, but many processes and fluxes of organic matter cycling within the plant-soil system are not yet well understood [1]. Recent studies have shown that aboveground vegetation and soil organic matter (SOM) processes are closely linked [2], that roots and root-derived carbon play a major role in SOM stabilization [3] and that plants can increase the SOM turnover by stimulating microbial populations (priming effect) [4]. The investigation of these complex interactions between plants and soil is challenging and is asking for new methodological approaches.

We developed a multi-labelling technique to label new assimilates with 13C, 18O and 2H. In order to trace organic molecules from the leaf to the soil and within the SOM the label is added continuously in the gaseous phase (CO2, water vapour) to the plants atmosphere. The multi-labelling technique has been successfully tested in preliminary experiments and a complex chamber system (MICE) has been developed to apply this technique.

The MICE facility consists of two labelling chambers. The upper parts (shoot) of the plant-soil system are separated hermetically from the lower parts (roots, soil) to prevent the diffusion of the label into the soil. Each chamber carries 15 plants in single pots, which can be sampled at 5 sampling dates (3 replicates) with minor disturbance to the labelling atmosphere. Each chamber has a separate upper gas circuits by which the label added is recycled and the CO2 concentration and air humidity within the chambers is automatically regulated and monitored. Thus the two labelling chambers can be used to conduct multi-labelling experiments with controls (background measurements, optimal environmental conditions) for each sampling date. In the lower part of the labelling chamber each pot is aerated to prevent anaerobic conditions. With a combined gas sampling system the total CO2 efflux is monitored and the isotopic signature of the soil respiration can be assessed frequently.

The new multi-labelling approach and the labelling facility developed represent a powerful tool to address still open questions in plant and soil research such as the allocation of organic molecules within the plant-soil system under changing environmental conditions or the influence of plants on soil organic matter stabilization and destabilization processes.

References

[1] Bahn, M., Janssens, I. A., Reichstein, M., Smith, P., & Trumbore, S. E. (2010). Soil respiration across scales: towards an integration of patterns and processes. New Phytologist, 186 (2), 292–296.

[2] Mencuccini, M., & Hölttä, T. (2010). The significance of phloem transport for the speed with which canopy photosynthesis and belowground respiration are linked. New Phytologist, 185 (1), 189–203.

[3] Rasse, D. P., Rumpel, C., & Dignac, M. F. (2005). Is soil carbon mostly root carbon? Mechanisms for a specific stabilisation. Plant and Soil, 269 (1-2), 341–356.

[4] Kuzyakov, Y. (2010). Priming effect: Interactions between living and dead organic matter. Soil Biology and Biochemistry, 42 (9), 1363–1371.