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

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Why are we interested in the plant-soil system?

Large carbon sequestration potential, especially in soil organic matter (SOM)

- Fast coupling between photo-synthesis and soil respiration [1]
- Enhanced SOM stabilisation by roots and of root-derived carbon? [2]
- Regulation of plant-to-soil transfer? [3]

How will the system respond to climatic changes (e.g. drought)?

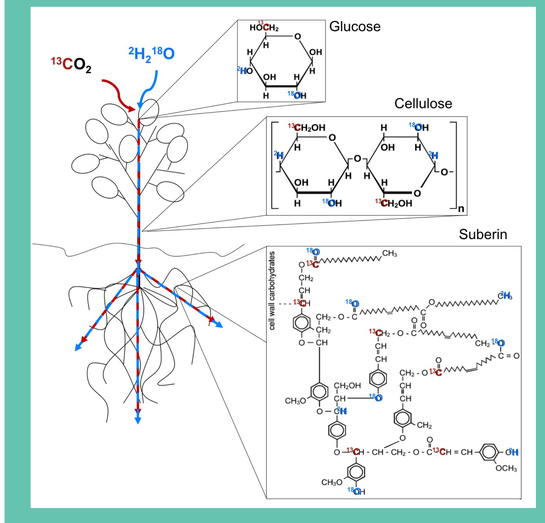

Fig. 1: Isotopic labelling and tracing within the plant- soil system using multiple stable isotopes.

We suggest a new continuous multi-labelling aproach using ^{13}C, ^{18}O and ^{2}H stable isotopes associated with specific compound analysis to trace organic molecules from the leaf into the soil (Fig. 1).

Why labelling with multiple isotopes?

- Better insight in plant physiological processes and on plant-soil organic matter cycling
- Tracing chemical compound classes (e.g. sugars) and biomarkers (e.g. suberin for roots, Fig. 1).

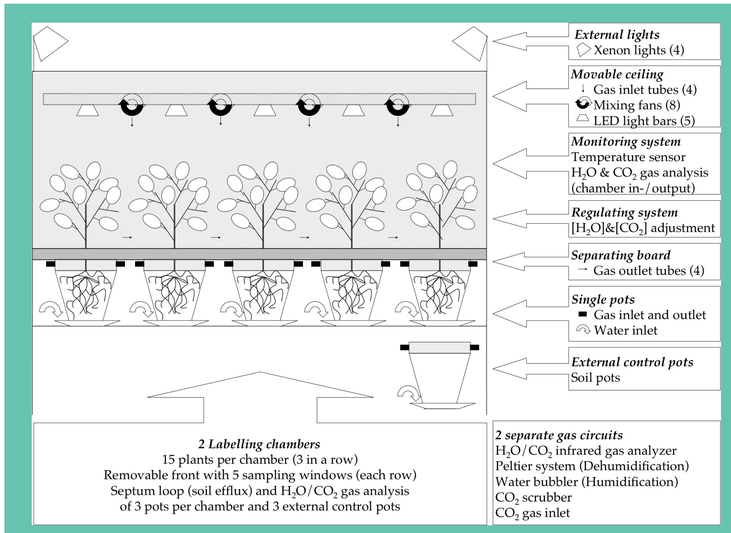

Fig. 2: Scheme of the MICE facility [4]

Climate chamber system

- Two labelling chambers
- 15 pots per chamber
- Hermetical separation of upper and lower plant-soil systems
- Online regulation and monitoring of $[CO_2]$ and $[H_2O]$ in the air
- Online monitoring of soil respiration
- Further features and overview in Fig. 2 and 3

Fig. 3: Chamber 1 of the MICE facility

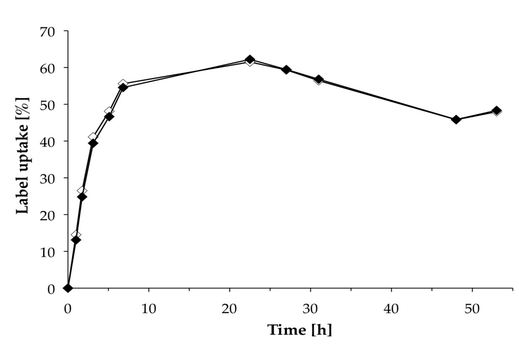

Fig. 4: Relative amount of oxygen (white) and hydrogen (black) atoms within leaf water taken up by stomatal diffusion

^{13}C, ^{18}O & ^{2}H labelling by gases?

- Labelling approach was successfully tested with a single plant [4]
- Continuous labelling with
  - water vapor (-840 ‰ δ^2H, -330 ‰ $\delta^{18}O$)
  - CO_2 (550 ‰ $\delta^{13}C$)
- After 10 h up to 60% of leaf water was labelled (Fig. 4)
- After 1-2 days leaf bulk material was
  - enriched in $\delta^{13}C$ (+265‰)
  - depleted in $\delta^{18}O$ (-33 ‰)

The MICE facility represents a powerful tool to address open questions 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 (de)stabilization processes.

References and Acknowledgements

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