



Novel approach to identify root system with stable isotope labeling experiment

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For the identification of the distribution of tree root system several methods, in addition to excavation, are available; among them are DNA analyses and hydrogen- or oxygen- stable isotopes. Since there is no isotopic fractionation of water during water uptake by roots, and transpiration tissue (leaves, non-suberized stems) is the primary site of evaporative enrichment. The magnitude of this enrichment is dependent upon humidity gradients, transpiration rate and the isotopic composition of atmospheric water. According to this knowledge, stable oxygen $^{18}\text{O}/^{16}\text{O}$ isotope ratio of water (H_2O) could be used to track water utilization in plants, but sampling techniques are time consuming and destructive, have negative consequences using successive sampling, and directly impact the sampled tree.

Insights from recent studies connected with the transfer of the $^{18}\text{O}/^{16}\text{O}$ isotopes ratio from xylem water into organic matter could be used to develop a non-destructive method to follow where plant utilizes water. Water in the leaf becomes enriched in $^{18}\text{O}/^{16}\text{O}$ isotope ratio during transpiration and this enriched ratio is carried into intercellular CO_2 . Consequently, carbohydrates (produced during photosynthesis) in the leaf carry an integrated $^{18}\text{O}/^{16}\text{O}$ isotope ratio of the leaf water. For the same reason, the CO_2 respired in stem should have a signal of $^{18}\text{O}/^{16}\text{O}$ isotope ratio in carbohydrates which have been transported to plant sinks through the phloem. If water enriched in $^{18}\text{O}/^{16}\text{O}$ isotope ratio is introduced to trees by irrigation, this signal is expected to be seen in xylem water and consequently in carbohydrates, cellulose and in CO_2 derived from carbohydrates consumption.

In this contribution novel approach for tracking soil water uptake and related preliminary data will be presented. In the control environment tree saplings were irrigated with isotope labelled water. Continuous stable isotopic composition measurements of tree stem respired CO_2 , with a radial-circumference-open-dynamic chamber design, were done using Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS) implemented in CCIA-46 instrument (Los Gatos Research, CA, USA). Stable isotopic composition measurements of stem respired CO_2 and tree irrigation with labelled water (highly enriched in $^{18}\text{O}/^{16}\text{O}$ isotope ratio) has a great potential for non-destructive detection of root system.