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Neutron radiography to visualize and quantify water flow in soil and plants

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Water transport from soil towards roots is fundamental in both soil and plant sciences, despite its importance there are only a few studies measuring its dynamics and locations along root systems. The lack of experimental data is largely due to the technical problem of measuring water fluxes in soil and roots in living plants growing in soils. This study aims at developing a non-destructive method to quantitatively monitor water flow towards and along roots. To this end we used neutron radiography to trace deuterium oxide (D₂O) in soil and roots. We grew lupins in 30 x 15 x 1 cm containers, which were filled with fine sand and a thin layer of coarse sand as capillary barrier to stop D₂O diffusion in soil. The results showed that after D₂O injection, neutron attenuation inside the roots decreased due to D₂O entering the roots. By comparing day and night measurement for the same roots, we were able to quantify the net root water uptake along different roots. We conclude that neutron radiography combined with D₂O injection is a promising technique to investigate root permeability and water fluxes in soil and plants and will provide important data for validating existing models.

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Imaging

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