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Measurements of water transport across soil and root using a root pressure probe and a pressure chamber

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Water uptake by plant roots can be controlled by roots, root-soil interface, and soil. In wet soil, roots have the highest hydraulic resistance and therefore control water uptake. As soil dries, the soil hydraulic conductivity decreases non-linearly and the soil may become the limiting factor for water uptake. In the grey area between these two extremes, the interface between root and soil, the so called rhizosphere, plays an important role. In this study, experimental methods are suggested to measure the hydraulic resistance of the whole system containing root and soil. Root pressure probe and pressure chamber, which are commonly used for plant roots sitting in water, were employed. The validity of these techniques for plants sitting in soil is under examination. Our aim was quantifying the contribution of each hydraulic resistance, i.e. root, rhizosphere, and soil. To separate the effect of changing conductivity in plant roots, due for instance to plant adaptation to drying conditions, an artificial root was placed in quartz sand at varying water contents. A pressure pulse was applied at the top of the artificial root and the pressure relaxation was recorded by the root pressure probe. Positive and negative pressure pulses were applied to investigate effects of flux direction on pressure relaxation. The observed non-symmetric behavior, bigger half time for water inflow into the root, suggests the occurrence of water depletion in the soil next to the root. This observation may be useful in interpreting experiments with real plants, where a rhizosphere with different properties compared to bulk soil may have developed. Quantification of hydraulic resistance of each component is being pursued by assistance of root-soil hydraulic model.