



Investigating root water uptake dynamics of a grassland species under varying hydro-climatic conditions with non-destructive isotopic monitoring

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Traditional destructive plant and soil water isotopic monitoring has provided important insights into root water uptake changes in drought and evapotranspiration partitioning across scales. Recently, non-destructive isotopic monitoring coupled with laser-based spectroscopy allow a better understanding of these and other questions with a higher spatial and temporal resolution. We investigated the changes in root water uptake profiles and eco-physiological characteristics (e.g. stomatal conductance, leaf water potential) of the grassland species *Centaurea jacea* under varying environmental conditions (i.e. atmospheric demand, soil water availability) with a labeling experiment in fully-controlled laboratory conditions. We measured non-destructively the isotopic composition of soil water and of plant transpiration. With these measurements, daily root water uptake profiles were obtained using a multi-source mixing model embedded in a Bayesian statistical framework. We analyzed the daily changes of these profiles together with changes in environmental conditions and plant physiology-related variables to discover potential adaptation strategies of *C. jacea* to water scarcity. Even in a dry soil (~ 10% soil water content), the studied grassland species was able to sustain high transpiration rates. This was accompanied by a very negative leaf water potential (~-3 MPa). Root water uptake profiles in both dry and wet conditions were very similar: root water uptake was highest in the soil layer 0-15 cm (up to 87%) and second highest (up to 40%) in the soil layer 45-60 cm. Before soil water content dropped below 12%, transpiration rate was mainly controlled by vapor pressure deficit. After this, a reduction of canopy conductance restricted gas leaf exchange. Instantaneous water use efficiency dropped when the soil was very dry, but intrinsic water use efficiency was maintained. Our comprehensive data set of plant-related and environmental variables allowed us to investigate at a 1-cm and daily scales the

plant's response to varying hydro-climatic conditions.