

Publication

Effects of environmental parameters, leaf physiological properties and leaf water relations on leaf water delta18O enrichment in different Eucalyptus species

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Stable oxygen isotope ratios (delta18O) have become a valuable tool in the plant and ecosystem sciences. The interpretation of delta18O values in plant material is, however, still complicated owing to the complex interactions among factors that influence leaf water enrichment. This study investigated the interplay among environmental parameters, leaf physiological properties and leaf water relations as drivers of the isotopic enrichment of leaf water across 17 Eucalyptus species growing in a common garden. We observed large differences in maximum daily leaf water delta18O across the 17 species. By fitting different leaf water models to these empirical data, we determined that differences in leaf water delta18O across species are largely explained by variation in the Péclet effect across species. Our analyses also revealed that species-specific differences in transpiration do not explain the observed differences in delta18O while the unconstrained fitting parameter 'effective path length' (L) was highly correlated with delta18O. None of the leaf morphological or leaf water related parameters we quantified in this study correlated with the L values we determined even though L was typically interpreted as a leaf morphological/anatomical property. A sensitivity analysis supported the importance of L for explaining the variability in leaf water delta18O across different species. Our investigation highlighted the importance of future studies to quantify the leaf properties that influence L. Obtaining such information will significantly improve our understanding of what ultimately determines the delta18O values of leaf water across different plant species.

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