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Uncoupling between soil and xylem water isotopic composition: how to discriminate mobile and tightly-bound water?

Paula Martín Gómez (1), Mònica Aguilera (1), Jesús Pemán (1), Eustaquio Gil Pelegrín (2), and Juan Pedro Ferrio (1)

(1) Universitat de Lleida, Crop and Forest Sciences-AGROTECNIO Center, Spain (paula.martin@pvcf.udl.cat), (2) Unidad de Recursos Forestales, Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain

As a general rule, no isotopic fractionation occurs during water uptake and water transport, thus, xylem water reflects source water. However, this correspondence does not always happen. Isotopic enrichment of xylem water has been found in several cases and has been either associated to "stem processes" like cuticular evaporation [1] and xylem-phloem communication under water stress [2,3] or to "soil processes" such as species-specific use of contrasting water sources retained at different water potential forces in soil. In this regard, it has been demonstrated that mobile and tightly-bound water may show different isotopic signature [4,5]. However, standard cryogenic distillation does not allow to separate different water pools within soil samples. Here, we carried out a study in a mixed adult forest (*Pinus sylvestris*, *Quercus subpyrenaica* and *Buxus sempervirens*) growing in a relatively deep loamy soil in the Pre-Pyrenees. During one year, we sampled xylem from twigs and soil at different depths (10, 30 and 50 cm). We also sampled xylem from trunk and bigger branches to assess whether xylem water was enriched in the distal parts of the tree. We found average deviations in the isotopic signature from xylem to soil of 4‰ 2‰ and 2.4‰ in δ^{18}O and 18.3‰ 7.3‰ and 8.9‰ in δ^{2}H, for *P.sylvestris*, *Q.subpyrenaica* and *B.sempervirens* respectively. Xylem water was always enriched compared to soil. In contrast, we did not find clear differences in isotopic composition between xylem samples along the tree. Declining the hypothesis that "stem processes" would cause these uncoupling between soil and xylem isotopic values, we tested the possibility to separate mobile and tightly-bound water by centrifugation. Even though we could separate two water fractions in soils close to saturation, we could not recover a mobile fraction in drier soils. In this regard, we welcome suggestions on alternatives to separate different soil fractions in order to find the correspondence between soil and xylem water.

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