Geophysical Research Abstracts
Vol. 13, EGU2011-1962, 2011
EGU General Assembly 2011

Seasonal dynamics of water use in two co-occurring Mediterranean oaks (Quercus ilex and Quercus faginea): an isotopic approach

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In the Iberian Central Plateau and in low-altitude ranges along the Ebro Basin, the evergreen oak (*Quercus ilex* L.) often co-exists with a semi-deciduous oak (*Q. faginea* Lam). These areas are characterised by a continental Mediterranean climate, with hot, dry summers but cold winters. *Q. ilex* is thought to withstand drought better, whereas *Q. faginea* tolerate lower winter temperatures. Current climate scenarios predict both an increase in drought stress and winter temperature, which potentially may favour the evergreen species. The aim of this study was to characterise, over four consecutive years (2005-2008), the seasonal pattern in water use of these two species in a mixed stand close to the distribution limit of *Q. faginea*. The study was performed in an open stand (20% forest cover) with an annual precipitation of 430 mm and average monthly temperatures ranging from 1.7 to 23.9ºC (annual mean: 12.4ºC). Two dominant trees per species were chosen to monitor radial growth and stem flow continuously and perform regular samplings and gas-exchange measurements. The isotopic composition of carbon (δ^{13}C), oxygen (δ^{18}O) and hydrogen (δ^{2}H) was determined in different components (xylem water, leaf total and soluble organic matter, tree-core slices). The evolution of δ^{18}O and δ^{2}H in xylem water suggested that both species generally shared the same water source, both showing a seasonal shift to deeper layers in response to drought, more evident in *Q. faginea*. Leaf δ^{13}C and gas-exchange measurements did not show differences in water use efficiency, but the relationship found in *Q. ilex* between δ^{13}C and δ^{18}O in soluble organic matter suggested a stronger stomatal regulation. Similarly, sap flow densities were more limited at high evaporative demands in *Q. ilex* than in *Q. faginea*. Radial growth was strongly limited in both species ($<$ 1 mm per year), being related to autumn and spring precipitation fluctuations in *Q. faginea*. Intra-annual changes in δ^{13}C of tree rings showed a stronger storage signal in early spring in the semi-deciduous species which also displayed a higher seasonal variability. From these results, we conclude that 1) both species absorb water from similar soil layers, although seasonal changes are stronger in *Q. faginea*, 2) *Q. ilex* shows a tighter stomatal regulation as drought progresses, 3) there is an storage signal in the tree rings of *Q. ilex*, although more diluted than in *Q. faginea*, and 4) climate-related adjustments of tree functioning appear buffered in *Q. ilex* as compared to the deciduous *Q. faginea*, which presents a more plastic response to changes in water availability.

ACKNOWLEDGEMENTS

This work was funded by the Spanish MCINN project CGL2009-13079-C02-01 and Marie Curie European Reintegration Grant MC-ERG-246725. JPF is supported by the Ramón y Cajal programme (RYC-2008-02050).