Within species diversity of transpiration efficiency in two white oak species

Théo Gérardin, Didier Le Thiec, Cyril Buré, Oliver Brendel

Within species diversity of transpiration efficiency in two white oak species

IUFRO 125th Anniversary congress 2017 - Side event
Seminar "Water use efficiency under drought"
18 September 2017
Centre Inra Grand Est - Nancy, Champenoux, France

Théo GÉRARDIN[1], Didier LE THIEC[1], Cyril BURÉ[1] and Oliver BRENDEL[1]

[1] INRA, UMR Ecologie et Ecophysiologie Forestières, rue d'Amance, F-54280 Champenoux, France

Trees are a major component of the biosphere. Covering many regions of the world as natural forests or plantations, they take an important role in the balance of the ecosystems. Recent studies has shown that some of these ecosystems may already be responding to climatic warming and drought, two main consequences of climate change. Such changes have been hypothesized to be able to impact the WUE (defined as the ratio between carbon assimilation during photosynthesis and the stomatal conductance for water at the leaf level) of forest ecosystems. In such context we focused on the diversity of WUE in two major French oak species : *Quercus robur* L. and *Quercus petraea* (Matt.) Liebl. These two species are largely sympatric however with different ecological requirements. While *Q. petraea* is more frequently found on well drained soils and is more tolerant to drought, *Q. robur* is able to survive and grow on poorly drained soils being the result of a higher tolerance to water-logging (Becker et al. 1982). A few comparative studies have described *Q. petraea* as more efficient than *Q. robur* the later having lower values of leaf level WUE (Ponton et al. 2001, Pflug et al. 2015, Thomas et al. 2000) however these results are not consistent in the literature since other studies showed similar WUE between the two species (Parelle et al. 2016, Hu et al. 2013) or even higher WUE for *Q. robur* (Rasheed-Depardieu 2015). Moreover to our knowledge no comparative studies between the two oak species focused on the transpiration efficiency (TE) (defined as the ratio between total biomass production and total water consumption at the whole plant level) have been conducted, leaving a huge gap on the subject. Therefore we addressed the following questions: Do the differences in WUE at the leaf level result in similar differences at the whole plant TE? Which underlying morphological and physiological traits are related to these differences between species but also which traits are driving the within-species diversity? Hence, in a comparative study between the two oak species we assessed different levels of WUE as well as underlying traits for control and drought plants.

References

Becker, M., Lévy, G., 1983. Le dépérissement du chêne. Les causes écologiques. Exemple de la forêt de Tronçais et premières conclusions. Rev. For. Française 35, 341–356.

Hu, B., Simon, J., & Rennenberg, H. (2013). Drought and air warming affect the species-specific levels of stress-related foliar metabolites of three oak species on acidic and calcareous soil. Tree Physiology, 33(5), 489–504. https://doi.org/10.1093/treephys/tpt025

Parelle, J., Belabbes, S., & Tatin-Froux, F. (2016). Production of micro-cuttings from acorns to test the plasticity of response to contrasting soil water regimes. Journal of Forestry Research, 27(5), 995–1001. https://doi.org/10.1007/s11676-016-0226-1

Pflug, E. E., Siegwolf, R., Buchmann, N., Dobbertin, M., Kuster, T. M., Günthardt-Goerg, M. S., & Arend, M. (2015). Growth cessation uncouples isotopic signals in leaves and tree rings of drought-exposed oak trees. Tree Physiology, 35(10), 1095–1105. https://doi.org/10.1093/treephys/tpv079

Ponton, S., Dupouey, J.-L., Breda, N., Feuillat, F., Bodenes, C., & Dreyer, E. (2001). Carbon isotope discrimination and wood anatomy variations in mixed stands of *Quercus robur* and *Quercus petraea*. Plant, Cell and Environment, 24(8), 861–868.

https://doi.org/10.1046/j.0016-8025.2001.00733.x
Rasheed-Depardieu, C., Parelle, J., Tatin-Froux, F., Parent, C., & Capelli, N. (2015). Short-term response to waterlogging in *Quercus petraea* and *Quercus robur*: A study of the root hydraulic responses and the transcriptional pattern of aquaporins. Plant Physiology and Biochemistry, 97, 323–330. https://doi.org/10.1016/j.plaphy.2015.10.016
Thomas, F. M., & Gausling, T. (2000). Morphological and physiological responses of oak seedlings (*Quercus petraea* and *Q. robur*) to moderate drought. Annals of Forest Science, 57, 325–333.

Keywords
Oak, water use efficiency, *Quercus robur*, *Quercus petraea*, drought, stomatal conductance