



Assessment of New Species to cope with the possible Impacts of Climate Change

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Collaborations : WSL

Thematic action concerned : WP2

Context —

In Europe, Oriental beech (*Fagus orientalis*) has been proposed for Assisted Migration, yet little is known about the growth performance and drought tolerance of Oriental beech if it was introduced. Early quantitative studies have indicated that its growth is comparable to European beech. A recent dendroecological study conducted in a provenance trial in Germany indicated that growth of Oriental beech is less sensitive to precipitation changes than in European beech. The two species are closely related – some authors treat them as two subspecies – and hybridize in their zone of contact in the southern Balkans.

As for *F. orientalis*, *Quercus cerris* and *Quercus pubescens* might be able to replace or enrich important economic oak species in Central Europe under drier and warmer conditions. It is known that *Q. cerris* is drought resistant as well as relatively frost hardy.

Objectives —

The principal objective of the NSICC project is to evaluate the relative importance of adaptive mechanisms of water transport in response to drought at different scales of space and time on 3 species *Fagus orientalis* (+ hybrids), *Quercus pubescens* and *Quercus cerris* which might be able to replace important economic species in Central Europe under drier conditions. The comparison will be done with *Fagus sylvatica* and *Quercus petraea*.

Approaches —

Monitoring drought experiment (robot)
Growth and Transpiration
Assessment of physiological performance (gas exchanges)
Assessment of leaf, root and wood morphological performance
Assessment of hydraulic properties

Key results —

- Six oak species were studied: *Quercus cerris*, *Q. faginea*, *Q. frainetto*, *Q. petraea*, *Q. pubescens*, and *Q. vulcanica*.
- Measurements of foliar gas exchange, diameter growth, photosynthetic capacities, and dynamics of stomatal movements related to environmental variables (light and VPD) were conducted at different levels of drought.
- Under drought conditions, radial growth was impacted, reaching 30% of Relative Extractable Water (REW) for *Q. cerris* and 50% for the other species.
 - Drought led to a decrease in stomatal conductance, net CO₂ assimilation, and water use efficiency, except for *Q. cerris*. This reduction in photosynthesis and stomatal closure occurred rapidly for *Q. cerris* at 40% of REW, with *Q. faginea* being the species that closed its stomata at 20% of REW.
- For all six species, drought resulted in stomatal closure, with varying speeds depending on the species and drought threshold. Stomata closed more rapidly in response to a decrease in light than to an increase in VPD.

Main conclusions including key points of discussion —

Q. cerris, in response to drought, has developed a faster closure of its stomata, enabling it to conserve water and achieve better water use efficiency. Additionally, it exhibits a quicker reopening, which allows for additional carbon gain.

Perspectives —

Publication on the oak experiment

Valorization —

(Scientific: publications, book chapter, presentation at conferences...); economic: Soleau envelope, patent, license...; distribution: press release, interview...)

A paper submitted to Forest Ecology and Management : Management "A direct comparison of the radial growth response to drought of European beech and Oriental beech clusters from the Greater Caucasus and Turkish Black Sea coast ". Martin Kohler, Jonas Gorges, David Andermahr, Adrian Kölz, Bertram Leder, Ralf-Volker Nagel, Bernhard Mettendorf, Didier Le Thiec, Georgios Skiadaresis, Mirjam Kurz, Christoph Sperisen, Thomas Seifert, Katalin Csilléry, Jürgen Bausch.

Leveraging effect of the project—

We have been contacted by colleagues from Rennes with whom we have developed an ANR project that has been accepted: "MoniTree."