International Symposium “Root Research and Applications”
RootRAP, 2–4 September 2009, Boku – Vienna, Austria

Drought-induced plasticity of root specific conductivity and vulnerability to cavitation

Boris Rewald and Christoph Leuschner

Plant Ecology, University of Göttingen, Untere Karspüle 2, 37073 Göttingen, Germany

Contact: Boris Rewald, e-mail: brewald@rootecology.de

Studies concerning plant adjustment to drought have highlighted the importance of plastic xylem adaptations. However, few comparisons of tree species grown under contrasting moisture regimes exist; our knowledge is particularly limited regarding the adjustment of tree root hydraulic properties. The aims of this study were to test if (i) fine roots are more vulnerable to cavitation than shoots, (ii) root specific conductivity decreases upon drought stress, and (iii) the root systems of Quercus are better adapted to drought stress than those of Fagus.

We studied specific conductivity (ks), xylem anatomy and vulnerability to embolism in roots of saplings and mature trees of drought-sensitive Fagus sylvatica L. and relatively drought-tolerant Quercus petraea (Matt.) Liebl. which were exposed to experimental summer drought.

Mature Fagus and Quercus trees had 3 to 15× higher ks values than saplings, indicating a large increase in root specific conductivity with age. Axial root conductivities of water-stressed Quercus saplings were more variable than Fagus saplings’ roots ks. Roots of both species were much more vulnerable to cavitation (water potentials causing 50% conductivity loss, ΨPLC50: -0.3 to -0.5 MPa) than shoots (-2 to -3 MPa). Furthermore, water-stressed Quercus roots cavitate earlier than well-watered roots. In Quercus, drought led to an increase in root ks, which contrasts with shoots where conductivity generally decreased. A decrease in root conductivity was found in severely water-stressed Fagus saplings and adult trees.

Small-diameter roots of Fagus and Quercus with their high cavitation susceptibility are much more drought-sensitive than shoots and are thus likely to act as hydraulic ‘fuses’ in the soil-plant-atmosphere continuum. Root ks can adapt to soil drought, but magnitude and direction of these adaptations are more variable than in shoots. Drought-adapted tree species such as Quercus petraea seem to be capable of partly compensating for drought-induced root conductivity losses by increasing axial root conductivity.

Keywords: Axial conductivity, Fagus sylvatica, Quercus petraea, roof experiment, summer drought, vulnerability to cavitation