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Changes in root hydraulic conductance of deciduous trees exposed to elevated atmospheric humidity

Arne Sellin, Annika Meitern, Katrin Rosenvald, Eele Öunapuu-Pikas

Institute of Ecology and Earth Sciences, University of Tartu, Lai 40, 51005 Tartu, Estonia, arne.sellin@ut.ee

The hydraulic transport capacity and stomatal openness are closely linked in vascular plants. Moreover, the structure and function of the water transport system govern the productivity and survival of land plants, because the vascular architecture places physical limits on plant functioning (according to the hydraulic limitation hypothesis). We performed our studies at the FAHM site on saplings of silver birch and hybrid aspen, and got inconsistent results for the two species. Root hydraulic conductance of silver birch expressed per unit leaf area (KR) changed with the experimental manipulation regardless of the trends in tree size: mean KR increased from 4.33×10⁻⁴ kg m⁻² s⁻¹ MPa⁻¹ in control plots to 6.85×10⁻⁴ kg m⁻² s⁻¹ MPa⁻¹ in humidified plots. The increase in KR observed in humidified trees is primarily attributable to morphological modification of fine roots: trees grown under elevated relative humidity exhibited smaller EcM short-root diameter and greater specific root length, specific root area and short-root length. In hybrid aspen the humidity manipulation did not influence the hydraulic efficiency of root systems (KR:1.95×10⁻⁶ kg m⁻² s⁻¹ MPa⁻¹).

In hybrid aspen saplings the absolute hydraulic conductance of root system (KRabs) increased with tree size, but in silver birch did not. We suppose that the difference results from the species-specificity as the hydraulic efficiency of root system (hydraulic conductance expressed per unit xylem area or per unit leaf area) of silver birch exceeds that of hybrid aspen by 2-3 orders of magnitude. So root systems of birch saplings are characterised by remarkable hydraulic redundancy, assuring secure water supply to promote successful plant establishment in the stand. This is a vital issue for young birch trees if to consider the strong competition exerted by vigorous herb layer at the FAHM site. This is probably associated with the general strategy of silver birch, i.e. with isohydric behaviour.

References