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Xylem sap flow as a major pathway for oxygen supply to the sapwood of birch (Betula pubescens Ehr.)

D. GANSERT
Institut für Ökologische Pflanzenphysiologie und Geobotanik, Universität Düsseldorf,
Universitätsstraße 1, D-40225 Düsseldorf, Germany

Abstract:

The role of xylem sap flow as an aqueous pathway for oxygen supply to the wood parenchyma of *Betula pubescens* saplings was investigated. Using micro-optode sensors the oxygen status of the sapwood was quantified in relation to mass flow of xylem sap. Sap flow was gradually reduced by an increasing oxygen depletion in the root space. The effect of sap flow on radial O_2 transport between stem and atmosphere was assessed by a stoichiometrical approach between respiratory CO_2 production and O_2 consumption. Restriction of sap flow set in 36.5 h after the onset of O_2 depletion, and was complete after 71h. Interruption of sap flow drastically increased the O_2 deficit in the sapwood to 70%. Sap flow contributed about 60% to the total oxygen supply to the sapwood. Diurnal O_2 flow rates varied between 3 and 6.3 nmol O_2 m^{-2} leaf area (LA) s^{-1} during night- and daytime, respectively. Maximum O_2 flow rates of 20 nmol O_2 m^{-2} LA s^{-1} were reached at highest sap flow rates of 5.7 mmol H_2O m^{-2} LA s^{-1}. Sap flow not only affected the oxygen status of the sapwood but also had an effect on radial O_2 transport between stem and atmosphere.

Key-words: Aquaporins, hypoxia, respiration, roots, sap flow, stem heat balance