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

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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 O₂ transport between stem and atmosphere was assessed by a stoichiometrical approach between respiratory CO₂ production and O₂ consumption. Restriction of sap flow set in 36.5 h after the onset of O₂ depletion, and was complete after 71h. Interruption of sap flow drastically increased the O₂ deficit in the sapwood to 70%. Sap flow contributed about 60% to the total oxygen supply to the sapwood. Diurnal O₂ flow rates varied between 3 and 6.3 nmol O₂ m⁻² leaf area (LA) s⁻¹ during night- and daytime, respectively. Maximum O₂ flow rates of 20 nmol O₂ m⁻² LA s⁻¹ were reached at highest sap flow rates of 5.7 mmol H₂O m⁻² LA s⁻¹. Sap flow not only affected the oxygen status of the sapwood but also had an effect on radial O₂ transport between stem and atmosphere.

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