



**HAL**  
open science

## Hydraulic efficiency and safety of conifer needles

Katline Charra-Vaskou, Eric Badel, Régis Burlett, Hervé Cochard, Sylvain Delzon, Stefan Mayr

► **To cite this version:**

Katline Charra-Vaskou, Eric Badel, Régis Burlett, Hervé Cochard, Sylvain Delzon, et al.. Hydraulic efficiency and safety of conifer needles. 2nd ISHS Symposium Woody Ornamentals of the Temperate Zone, Université de Liège (ULiège). Ghent, BEL., Jul 2012, Ghent, Belgium. 1 p. hal-01191352

**HAL Id: hal-01191352**

**<https://hal.science/hal-01191352>**

Submitted on 6 Jun 2020

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Hydraulic efficiency and safety of conifer needles



Katline Charra-Vaskou, Eric Badel, Régis Burlett, Hervé Cochard, Sylvain Delzon, Stefan Mayr  
 Institute of Botany, University of Innsbruck, Austria / INRA Clermont-Ferrand UMR PIAF, France

Leaves, representing the distal section of the soil-plant-atmosphere-continuum, are exposed to lowest water potentials and thus highest drought stress intensities within the plant. In contrast to angiosperm leaves, insight into the hydraulic architecture of conifer needles is poor.

Methods:

## Hydraulic efficiency

- Needle xylem and stem xylem hydraulic conductivity ( $k_s$ ): Specific hydraulic conductivity method / Cavitrion method
- Needle hydraulic conductance ( $k_{leaf}$ ): Rehydration kinetics method

## Hydraulic safety

- Needle xylem and stem xylem vulnerability ( $P_{50}$ ): Cavitrion / Ultrasonic method
- Needle vulnerability ( $P_{50}$ ): Rehydration kinetics measurement

Main results:

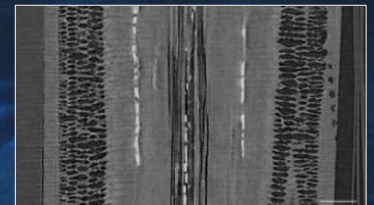
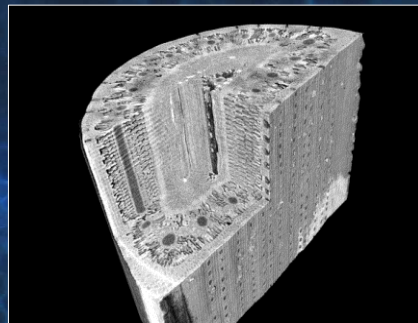
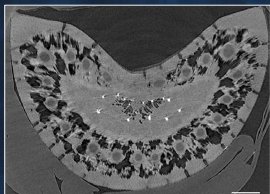
## Needle xylem vs. Stem xylem

| Species               | $k_s$ axes xylem<br>$m^2 s^{-1} MPa^{-1} 10^{-4}$ | $k_s$ needle xylem<br>$m^2 s^{-1} MPa^{-1} 10^{-4}$ |
|-----------------------|---|---|
| <i>Picea abies</i>    | $5.11 \pm 0.27$                                   | $3.50 \pm 0.66$                                     |
| <i>Pinus pinaster</i> | $7.74 \pm 0.56$                                   | $2.03 \pm 0.08$                                     |
| <i>Pinus mugo</i>     | $3.98 \pm 0.26$                                   | $0.90 \pm 0.15$                                     |

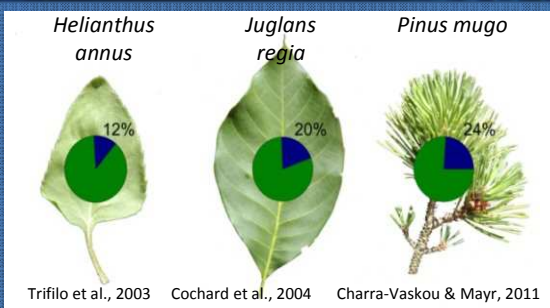
Needle  $k_s <$  Stem  $k_s$

|                        | $P_{50}$ axes (MPa) | $P_{50}$ needles (MPa) |
|------------------------|---------------------|------------------------|
| <i>Pinus pinaster</i>  | $-3.15 \pm 0.09$    | $-1.54 \pm 0.06$       |
| <i>Picea abies</i>     | $-3.45 \pm 0.03$    | $-2.67 \pm 0.03$       |
| <i>Pinus mugo</i>      | $-3.03 \pm 0.03$    | $-1.25 \pm 0.02$       |
| <i>Pinus nigra</i>     | $-3.08 \pm 0.25$    | $-1.39 \pm 0.12$       |
| <i>Pinus ponderosa</i> | $-3.11 \pm 0.32$    | $-1.94 \pm 0.04$       |

Needles: more vulnerable to dysfunction than axes

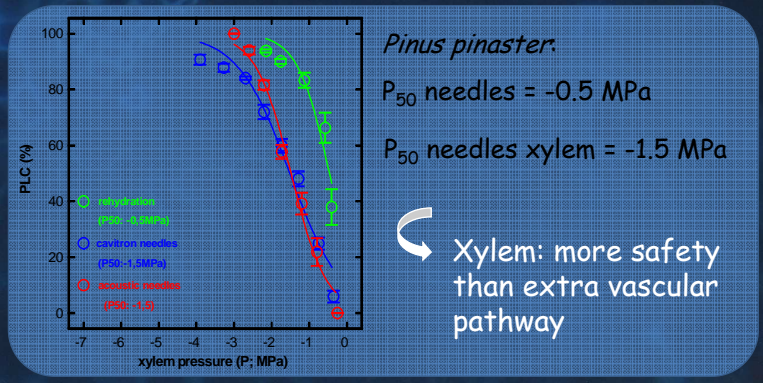


## Within needle: Xylem vs. extra-vascular pathway



■ Extra vascular hydraulic resistance  
 ■ Xylem hydraulic resistance

Xylem resistance < extra-vascular resistance



Conclusion:

Hydraulic pathways in needles contribute a major part to the overall hydraulic resistance of conifers and exhibit a low hydraulic safety. Within needles, the extra-vascular pathway probably has lowest efficiency and safety so that the risk of conductivity losses is highest at the most distal sections of the transport pathway.