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► To cite this version:

Eric Badel, Hervé H. Cochard, Aude Tixier, Stéphane Herbette, Nicole N. Brunel, et al.. Model of the mechanical behaviour of pit estimates pit quality involvement in interspecific variability in vulnerability to cavitation. International Symposium on Wood Structure in Plant Biology and Ecology, Apr 2013, Naples, Italy. hal-01000654

HAL Id: hal-01000654

<https://hal.science/hal-01000654>

Submitted on 6 Jun 2020

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Model of the mechanical behaviour of pit estimates pit quality involvement in interspecific variability in vulnerability to cavitation
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Key words: pit membrane thickness, pit membrane strains, air seeding, stiffness, Young Modulus

Xylem sap is transported in vessels under tension through dead xylem conduits. During drought events, then tension level increases and cavitation of the water column may occur leading to air filled and non functional conduits. Since hydraulic failure impairs the wood productivity and the survival of the tree. In a context of changing climate expecting enhancement of frequency and severity of drought events, there is an increased interest in understanding the mechanism of cavitation phenomena in order to find the anatomical driver that could explain the interspecific variability of VC.

Pits represent the most probable air entry point in a vessel. Within angiosperms, the pit structure (pit quality) and the pit area per vessel (pit quantity) are both suggested to explain variation in VC. Pit quality has generally been measured by quantifying the porosity and related thickness of the pit membrane. Here, we propose a mechanical model integrating other morphological parameters of a bordered pit: pit depth, chamber diameter and aperture diameter. These parameters allow us to estimate the quality of a pit from a mechanistic point of view. The model was first used to explain variability in VC for four contrasting species, and was then extended with additional data from literature to perform a broader analysis. Evidence of residual strains after embolism supports the hypothesis that the mechanical behaviour of the pit may be a key point of the cavitation sensitivity.