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Tete Severien Barigah, M.E. Fernandez, A.S. Sergent, S.A. Varela, Hervé Cochard, Sylvain Delzon, G. Dalla-Salda, A. Martinez-Meier, Philippe Rozenberg, Nicolas Martin-StPaul, et al.

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APPLICATION OF PNEUMATIC METHOD TO BUILD VULNERABILITY CURVES IN SOLITARY VESSELLED TREES:

Assesment of vulnerability to cavitation of three *Eucalyptus* mature tree species

Barigah TS¹, Fernández ME^{2,3}, Sergent AS^{2,4}, Varela SA⁴, Cochard H¹, Delzon S⁵, Dalla-Salda G⁴, Martinez-Meier A⁴, Rozenberg P⁶, Martin-StPaul NK⁷ & Gyenge J^{2,3}

tete-severien.barigah@inra.fr

¹ INRA, UMR0547 Physique et physiologie Intégratives de l'Arbre en environnement Fluctuant (PIAF) Clermont-Ferrand, France

² CONICET, Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina

³ INTA, Instituto Nacional de Tecnología Agropecuaria, Ecología Forestal, AER Tandil - EEA Balcarce, Argentina

⁴ INTA, Instituto Nacional de Tecnología Agropecuaria, Ecología Forestal, EEA Bariloche, Argentina

⁵ INRA, UMR1202 Biodiversité Gènes et Communautés France (BIOGECO) Bordeaux, France

⁶ INRA, INRA, UMR0588 Biologie intégrée pour la valorisation de la diversité des arbres et de la forêt (BioForA), Orléans, France

⁷ INRA, UR629 Ecologie des Forêts Méditerranéennes (URFM), Avignon, France

Introduction

Air entry in the plant water-transport system leads to vascular embolism that has a major impact on plant water relations by disrupting the water-transport capacity, impairing its functioning and even triggering the plant death. Forestry tree species should exhibit both high survival and fast growth rate. From this point of view, *Eucalyptus* is an interesting genus since it inhabits a wide diversity of climatic and environmental conditions and covers more than 20 million planted hectares worldwide. This genus presents solitary vessels, i.e. not directly connected to other vessels but surrounded by different imperforate tracheary elements and parenchyma that participate in a less known form in xylem safety and hydraulic efficiency.

Aim

The aim was to use a recently issued pneumatic device (Pereira et al., 2016) to establish vulnerability curves for long and solitary vesselled plant species, mainly in *Eucalyptus camaldulensis*, *E. globulus* and *E. viminalis*.

Material and methods

Measuring embolism with traditional hydraulic methods is usually time-consuming and could be impaired by artifacts (Cochard et al., 2013). Thus, we relied on the pneumatic method that directly quantifies the amount of embolism inside the xylem as changes in xylem air content instead of the stem hydraulic methods that measure loss of xylem hydraulic conductance due to embolism formation.

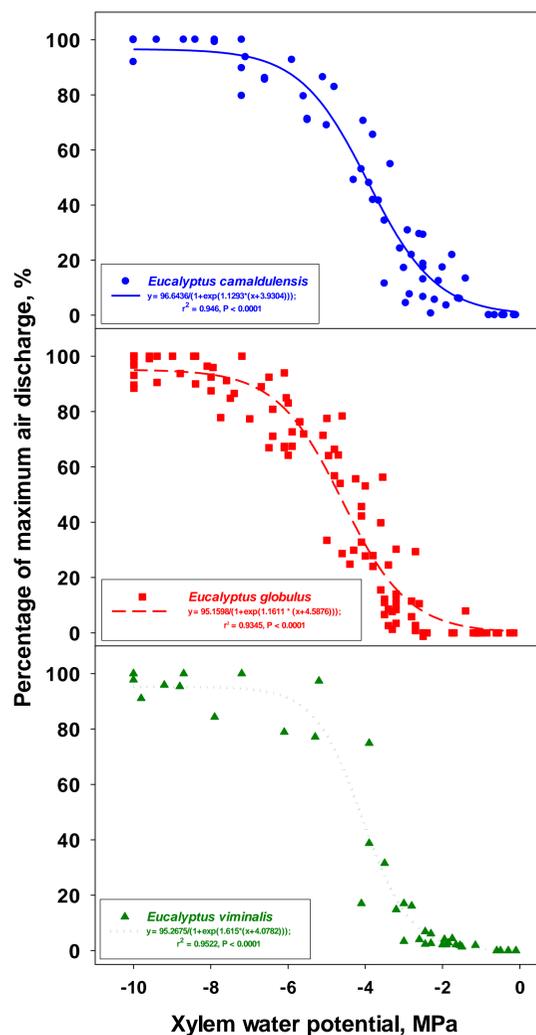
We severed on average 10 terminal branches of ~1.5 m long from mature trees at predawn. We kept them wet in black plastic bags and brought them into the laboratory for processing and measurements. Maximum vessel length varies between 50 to 72 cm (Barotto et al., 2016). We measured the xylem water potential concurrently with an estimation of the air volume that accumulates into a branch while it dehydrates in the air.



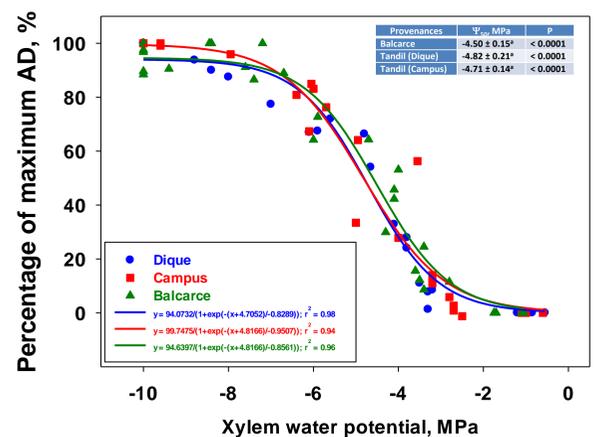
Measurement of air discharge

Measurement of xylem water potential

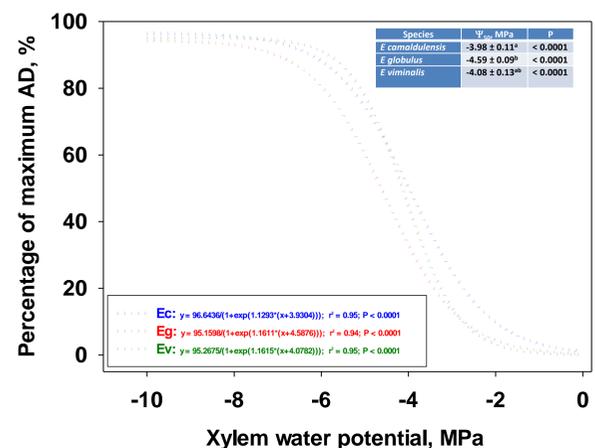
Results



Percentage of maximum air discharged from branches of three *Eucalyptus* tree species versus xylem water potential. All three species displayed a sigmoidal shaped curves.



Percentage of maximum air discharged from branches of *E. globulus* from three sites versus xylem water potential. No statistically difference in embolism resistance rose from the provenances of this species.



Percentage of maximum air discharged from branches of three *Eucalyptus* tree species versus xylem water potential. *E. globulus* was slightly more resistant to embolism than the two other species

Conclusions

For all three species, we obtained "S-shaped" curves and the results were similar to data already published data (Barotto et al., 2016). We showed that there was no significant intraspecific difference between local *E. globulus* provenances in their water potential inducing 50% loss of hydraulic conductivity (Ψ_{50}). From our results, it came out that *E. camaldulensis* and *E. viminalis* displayed similar resistance to embolism and, *E. globulus* was slightly more resistant than the previous ones. Thus, we concluded that the method was suitable for these species especially when comparing the results to the outputs (data not shown) from a centrifugation method (Cavitron; Cochard et al., 2005). Even the results are encouraging, a proof of the pneumatic technique versus an independent method is requested for validation. Future work should aim at consolidating these results for these species relying on other vulnerability to cavitation methods such as bench dehydration, non-destructive X-ray microtomography optical methods or with a cavitron with a rotor diameter longer than vessel length.

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