

Comparison of the lethal water potential of nine temperate tree species submitted to a prolonged water stress

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Abstract:

The threshold of water-stress induced mortality is known to vary with tree species and reflect their ability to withstand an acute drought spell. We exposed potted juvenile trees to a range of water stresses, triggering plant death to evaluate their drying-limits of viability. We relied on 3 hygrophytes (*Salix alba*, *Alnus glutinosa* and *Populus tremula* x *Populus alba*), 3 mesophytes (*Fagus sylvatica*, *Quercus petraea* and *Pseudotsuga menziesii*) and 3 xerophytes (*Quercus ilex*, *Pinus halepensis* and *Cedrus atlantica*). We made a census of predawn (Ψ_p) and midday leaf water potential (Ψ_m), and of the evapotranspiration of the potted trees together with stem X-ray microtomography measurement of some of the focus trees at the end of the growing season. The lethal water potential (Ψ_{let}) calculated as ($\Psi_p - \Psi_m$), differed substantially between some of the study species. The Ψ_{let} ranged from -1.75 +/- 1.05 MPa (*Salix alba*) to -6.97 +/- 0.85 MPa (*Cedrus atlantica*). The results revealed that the threshold of water-stress induced mortality ranged from 5 weeks (*Populus tremula* x *Populus alba* ; *Salix alba*.) to more than 12 weeks (*Pseudotsuga menziesii*).

Species	Xylem water potential inducing 50% PLC (Ψ_{50} , MPa)	Xylem water potential (Ψ , MPa)	Predicted native Percent Loss Conductance (PLC _p , %)
<i>Alnus glutinosa</i>	-2.09 ± 0.02	-2.57	>99.5
<i>Populus tremula</i> x <i>P. alba</i>	-2.79 ± 0.05	-3.17	>95
<i>Salix alba</i>	-2.18 ± 0.06	-2.80	87
<i>Fagus sylvatica</i>	-3.60 ± 0.13	-7.50	>95
<i>Pseudotsuga menziesii</i>	-3.40 ± 0.04	-3.71	72.5
<i>Quercus petraea</i> *	-	-5.41	-
<i>Cedrus atlantica</i>	-5.80 ± 0.09	-7.82	87.6
<i>Pinus halpensis</i>	-6.02 ± 0.16	-6.53	67
<i>Quercus ilex</i> *	-	-7.61	-

Xylem water potential inducing 50% percent loss of hydraulic conductance (PLC) of the study species using the Cavitrone technique. Predicted native (PLC_p) drawn from the vulnerability curve of current year old shoots of the control trees relying on the mean midday xylem water potential measured on 3 to 5 droughted trees of each species.

* No vulnerability curve was built for the long vessel oak species.

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