WHERE DOES STEM CAPACITANCE WATER COME FROM?

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METHODS

5 Different capacitance strategies? between predawn and midday per unit volume of wood (kg m⁻³)

RESULTS

- Capacitancepd-md was not related to parenchyma lumen fraction (Fig. 2) or to any other tissue fraction except for, weakly, to vessel lumen fraction (P<0.1).
- Instead, wood density and luminal volumetric water content (proportion of wood volume that is occupied by water in lumen) were strongest predictors of capacitance (r²=0.44, P<0.0001).

CONCLUSIONS

- Tissue fractions don’t seem to limit capacitancepd-md across the studied species.
- Rather, capacitancepd-md may depend on total stored water, bulk wood properties resulting from wood density (e.g., elastic shrinkage) and tissue connectivity.
- Relative water content values indicate parts of wood are devoid of water.
- Small volume of water released between predawn and midday imply that water could be released from any tissue and more sophisticated techniques need to be used to observe this phenomenon.

BACKGROUND AND QUESTIONS

Stored water can contribute significantly to trees’ daily transpiration stream. But where does this water come from? It is often suggested that parenchyma tissue (Fig. 1) contributes this water, yet there has been no convincing evidence supporting this claim. Parenchyma proportion varies greatly across species (from ~5-90%). So could this variation drive different capacitance strategies?

Figure 1. Cross-section, twig wood, Fagus grandifolia gives mechanical support and transports nutrients. Vessels store and transport nutrients. Ray parenchyma transports water.

Figure 2. Relationship between capacitance and parenchyma lumen fraction (ray-axial). Capacitance is defined as water (kg) released from wood (m³) between predawn and midday per stem water potential change (MPa). This result suggests that high parenchyma fraction may not be required for high capacitance. However, this does not imply that parenchyma doesn’t contribute to capacitance. ‘gle’ three letter code stands for first three letters of the genus in Latin. Have a guess or ask me about them. Diffuse-porous. Semi/ring-porous.

Figure 3. Volumetric and relative water content. Volumetric water content is the volume of water in a fresh wood sample per volume of that entire sample (water:wood). ‘Relative water content’ is the mass of water in a fresh sample per mass of water in a saturated sample. Caution: some of the water may be within cell walls. ‘gle’ three letter code stands for first three letters of the genus in Latin.