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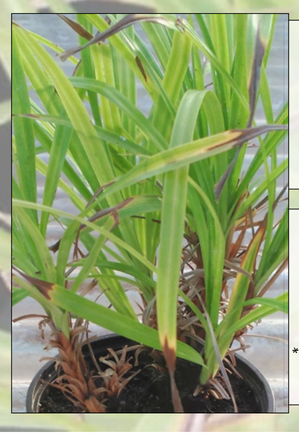

Hydraulic and photosynthesis responses to desiccation and recovery in the resurrection plant *Barbacenia purpurea*

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Introduction

- *Barbacenia purpurea* Hook. (Velloziaceae) is a **poikilochlorophyllous resurrection plant** from tropical and subtropical forests of Brazil. This monocot species inhabits rocky outcrops exposed to frequent drought periods (Meirelles *et al* 1997).
- In resurrection plants, **full xylem cavitation does not imply plant death**, as they are able to completely recover their vegetative tissues after sustaining < 15% relative water content for extended periods (Gaff & Oliver, 2013).
- Leaf hydraulic conductance (K_{leaf}) decline during water stress affects turgor pressure and induces stomatal closure, hence reducing CO_2 assimilation rate (A_n). A common response of K_{leaf}, **stomatal and mesophyll conductances (g_s and g_m)** under water stress might be expected, although their exact **coordination with embolism** varies among species (Flexas *et al* 2018). This has not been explored in detail in resurrection plants.

Objectives

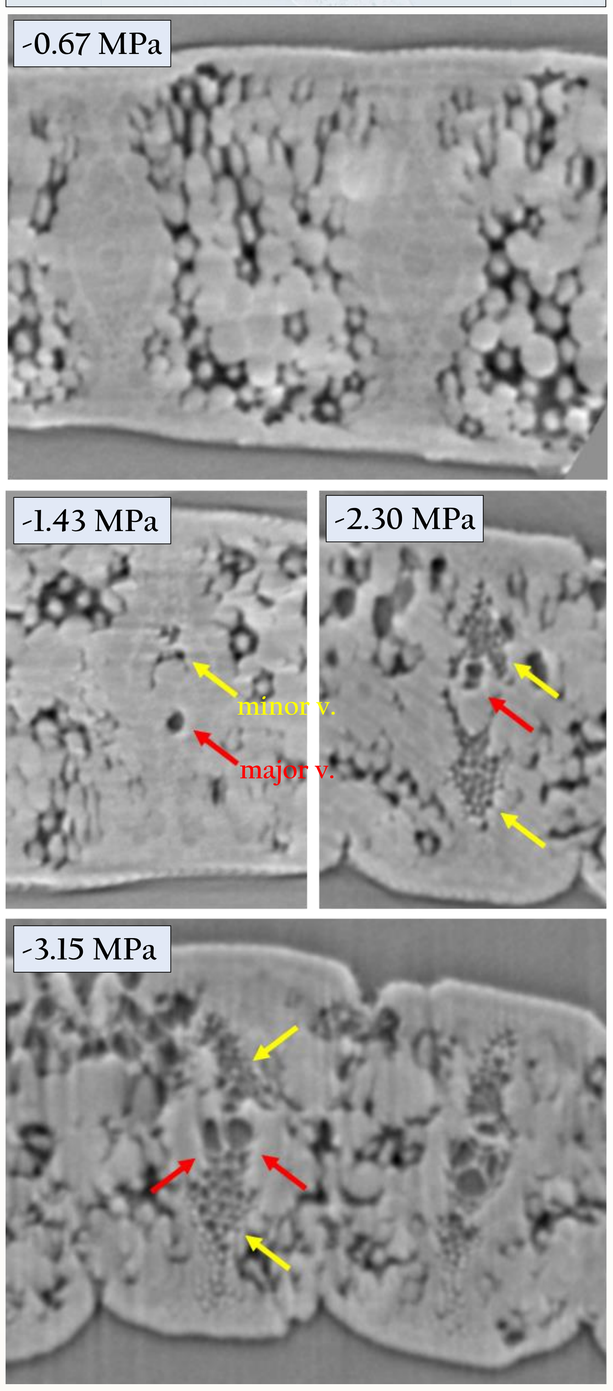
- To characterize **photosynthesis, K_{leaf} and cavitation dynamics** along a complete cycle of dehydration and recovery in *B. purpurea*.
- To discern the coordination between photosynthesis decline and the occurrence of xylem embolism.
- To explore **leaf rehydration and hydraulic recovery** after complete desiccation.

Methods

- Drought was imposed in 1-yeard-old plants by withholding water for 3 weeks in a growth chamber (25ºC, 12/12 h photoperiod). Recovery was monitored for 1 week.
- **Gas exchange and Chl fluorescence** were measured using a Li-6400XT. g_m and K_{leaf} were calculated using the variable *J* and the evaporative flux methods, respectively (Flexas *et al* 2013). Pressure-volume curves were used to determine the turgor loss point (π_{tlp}) in well-watered plants.
- Embolism was quantified from **X-ray microCT** measurements, from which the percentage loss of conductivity (*PLC*) and the Ψ at which *PLC* is 50% (P_{50}) were calculated (Torres-Ruiz *et al* 2016).

Results

Figure 1. Representative MicroCT images during dehydration. Leaf Ψ. Arrows indicate embolized veins.



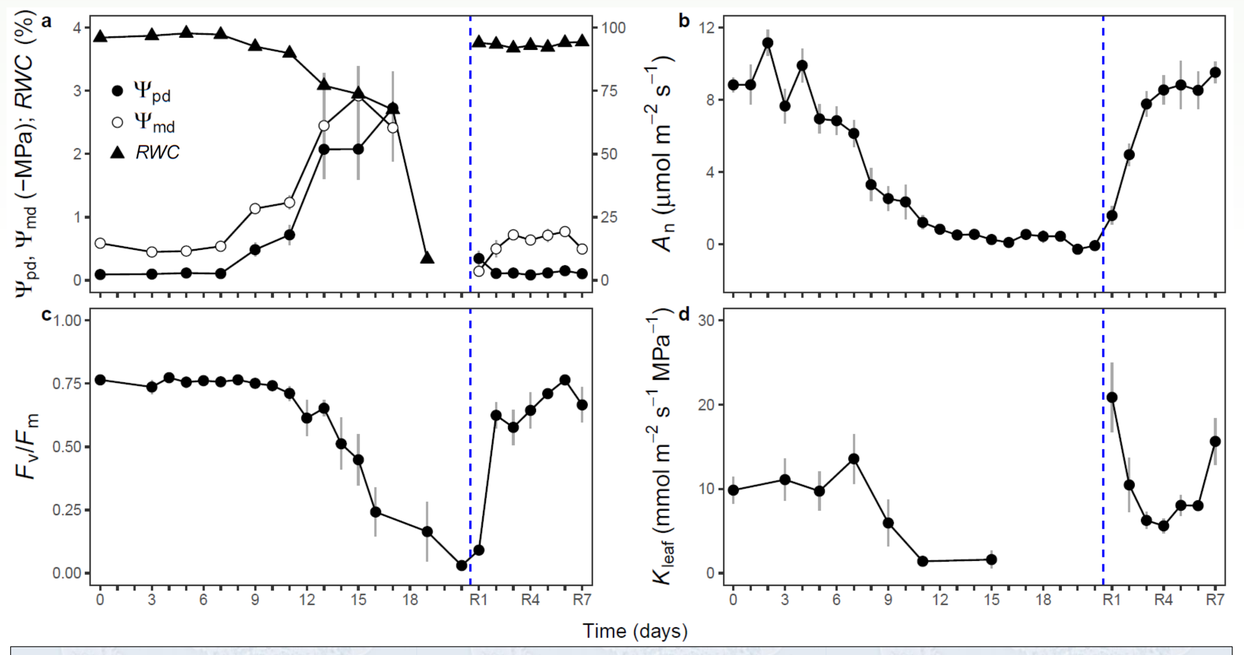


Figure 2. Monitoring of *B. purpurea* plants during dehydration and recovery. (a) Predawn and midday water potential (Ψ_{pd} and Ψ_{md}), relative water content (*RWC*). (b) Net CO_2 assimilation rate. (c) Maximum yield of PSII. (d) Leaf hydraulic conductance. Means ± SE (n = 4–10).

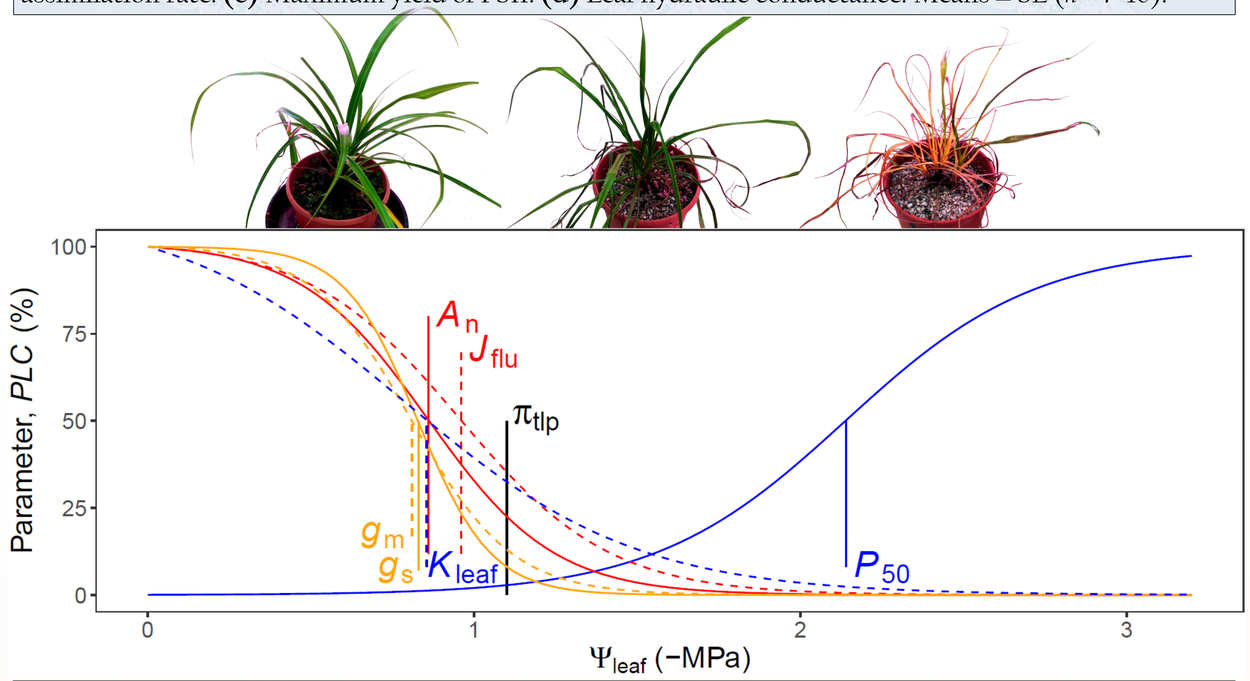
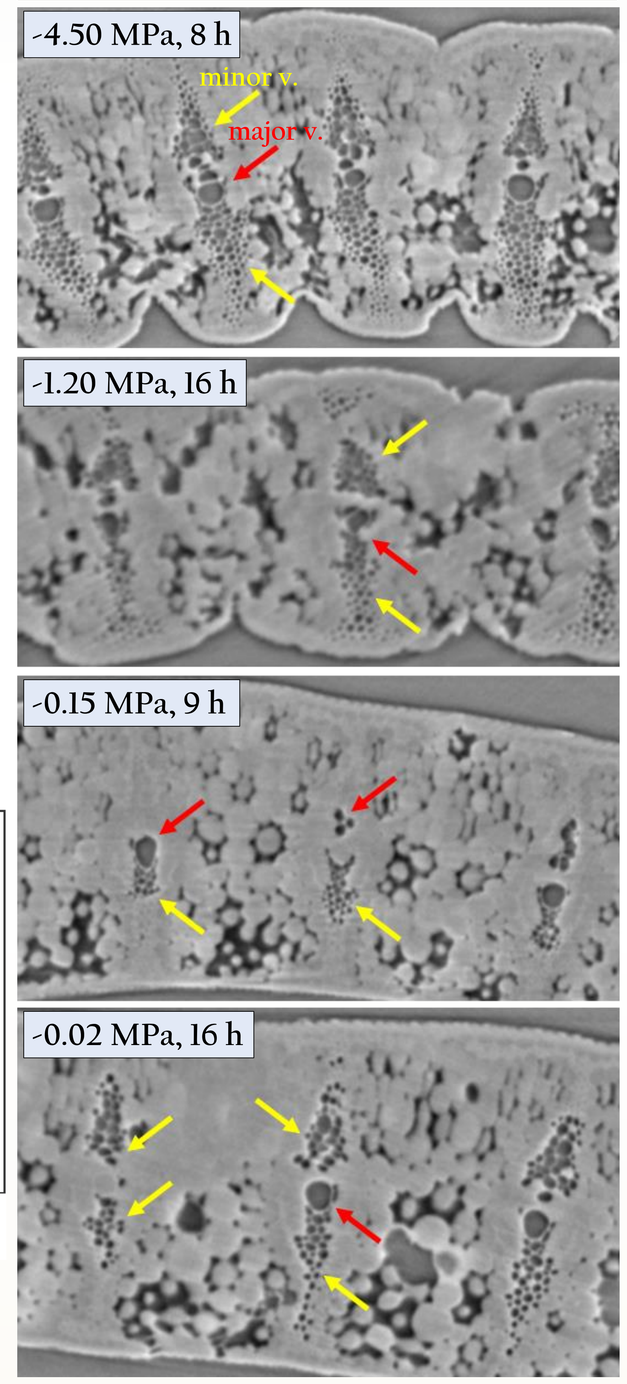


Figure 3. Sequence of events during leaf dehydration. Vertical lines indicate 50% decline for a given parameter in relation to its maximum under well-watered conditions. J_{flu}: electron transport rate. *PLC*: blue solid line.

Figure 4. Representative MicroCT images after rehydration. Leaf Ψ, time since rehydration. Arrows indicate embolized veins.



Discussion & Conclusions

- Photosynthesis-related parameters (A_n, g_s, g_m and J_{flu}) and K_{leaf} were **strongly coordinated** during dehydration. **Stomatal closure and photosynthesis cessation occurred prior to the onset of embolism**. Chl was dismantled at the last stage (F_v/F_m decrease), after most vessels showed complete embolism.
- ***B. purpurea* shows a 'water-conservative' or isohydric behavior**, which may be associated with delaying dehydration to prepare the molecular changes required in the desiccated state. These results differ from other resurrection species, where it has been suggested a strategy related to maximizing carbon gain during dehydration (Sherwin *et al* 1988). **Stomata act as safety valves** to protect the vascular system from cavitation (Creek *et al* 2020), **even in a plant able to fully recover after complete embolism**.
- **Rehydration** (leaf Ψ ~0 MPa) **occurred rapidly in the mesophyll** (12–24 h), **whereas complete xylem refilling likely occurred at later stages** (>24 h) after rewatering. Photosynthesis recovery was associated with resuming hydraulic function but also with re-synthesis of Chl and the photochemical apparatus.

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