Università degli Studi di Padova | TESAF

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Multiscale Plant Vascular Biology

Gordon Research Conferences — *Frontiers of Science*

The lesson learnt from two long-term precipitation exclusion experiments: xylem/phloem plasticity is not a real option in trees

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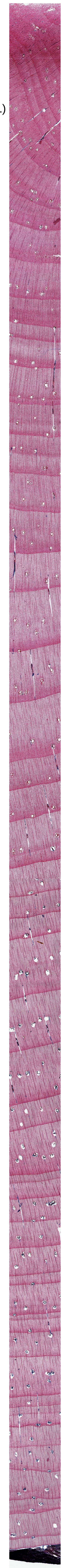


INTRODUCTION AND BACKGROUND

- Droughts and heatwaves are increasing duration and intensity due to climate change, limiting plant's physiological processes and possibly leading to vigor decline and mortality.
- Mechanisms of acclimation and adaptation to drought play a critical role for the survival of standing vegetation.
- Throughfall exclusion experiments may give great insights about all the possible reactions to drought.

HYPOTHESIS AND OBJECTIVES

Long-term drought should induce anatomical changes in xylem and phloem.

1) Test anatomical axial patterns in xylem/phloem conductive elements   **2) Test possible plastic adaptation of xylem and phloem to drought**

MATERIALS AND METHODS

- 2m long apical branches.
- Segments of apical branches taken at different distances from the branch apex.
- Wood cores extracted from the stem at breast height.
- Samples are cut with a rotary microtome at ~10 µm.
- Wood sections are stained with a mixture of saphranine and Astrablue.
- Image analysis of wood sections is performed with ROXAS software.

- **Wood cores -> ~6M cells analyzed**
- **Branches -> ~1.5M cells analyzed**

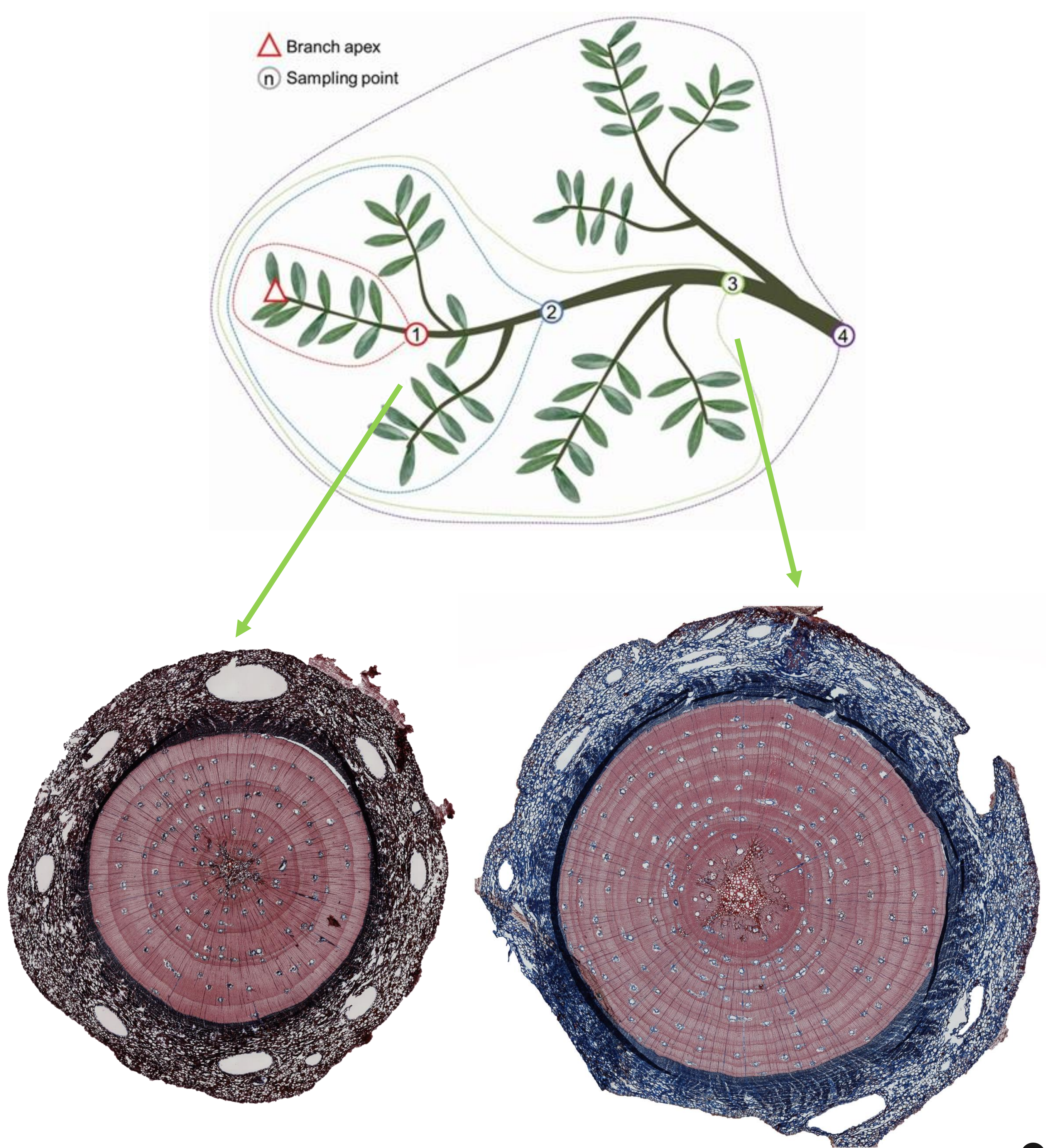


Fig.1 Anatomical sampling carried out at different distances from the branch apex

EXPERIMENTAL SITES

1) KROOF

- "Kranzberg Roof Project" (KROOF) in Bavaria (Germany)
- **2 species** -> Norway spruce (*Picea abies* Karst.) and beech (*Fagus sylvatica* L.)
- **2 treatments**:

CO -> Control   **TE -> Throughfall Excluded 5 years -70%**

2) SEV-LTER

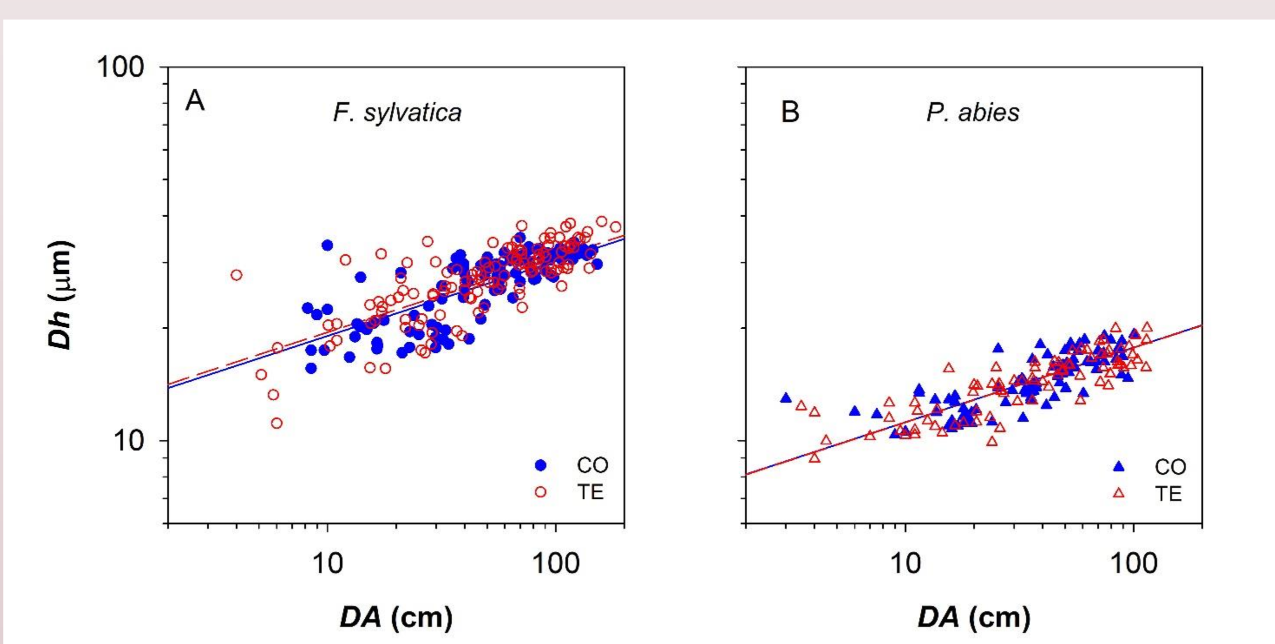
- Sevilleta Long Term Ecological Research (SEV-LTER) in New Mexico (USA)
- **1 species** -> Piñon Pine (*Pinus edulis* Engelm.)
- **2 treatments**:

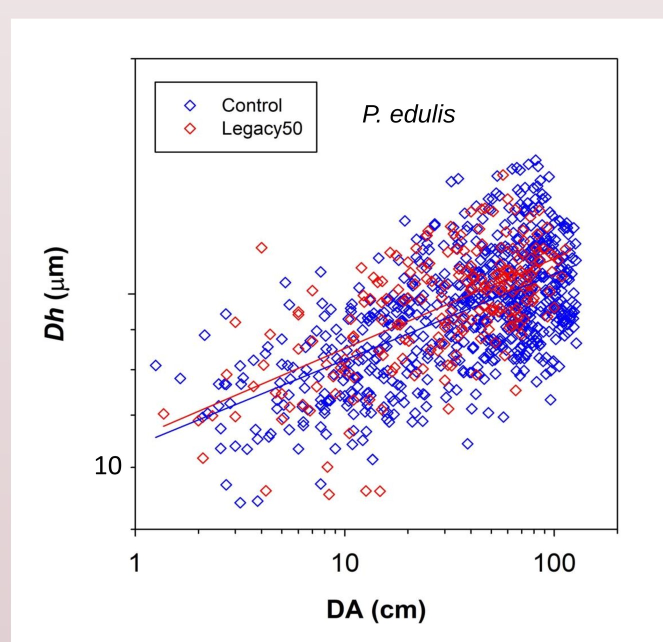
CO -> Control   **Legacy -> -50%rain 12 years**

RESULTS AND DISCUSSION

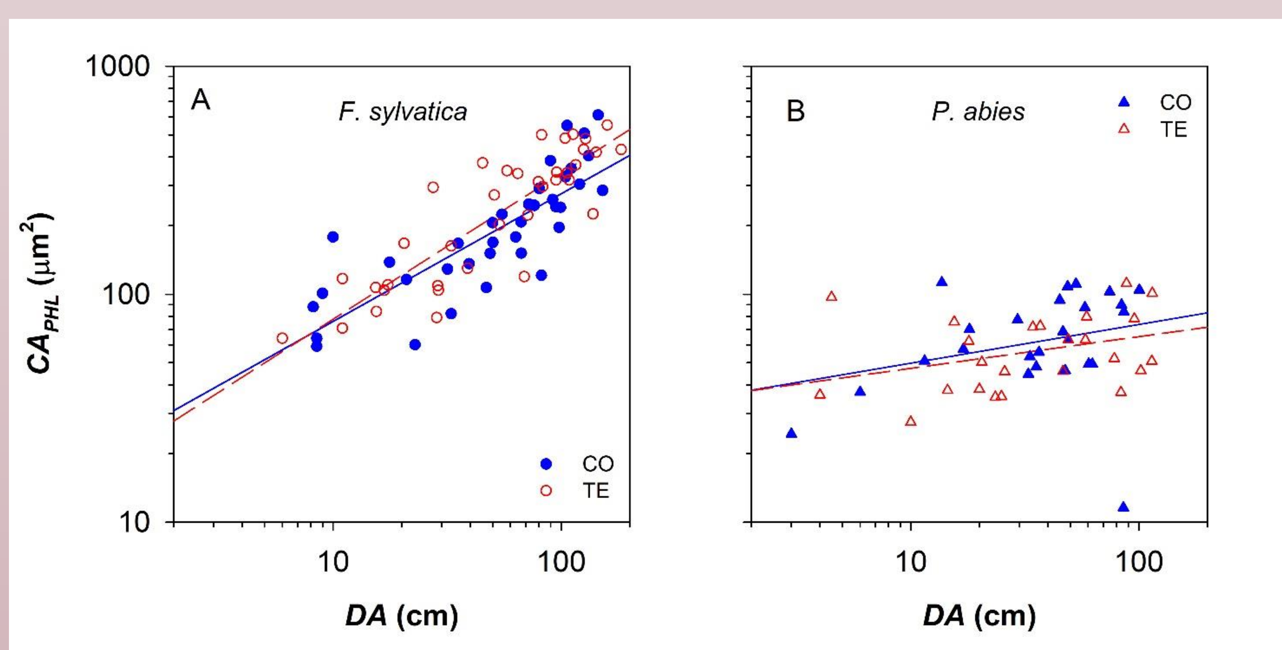
KROOF   **SEV-LTER**

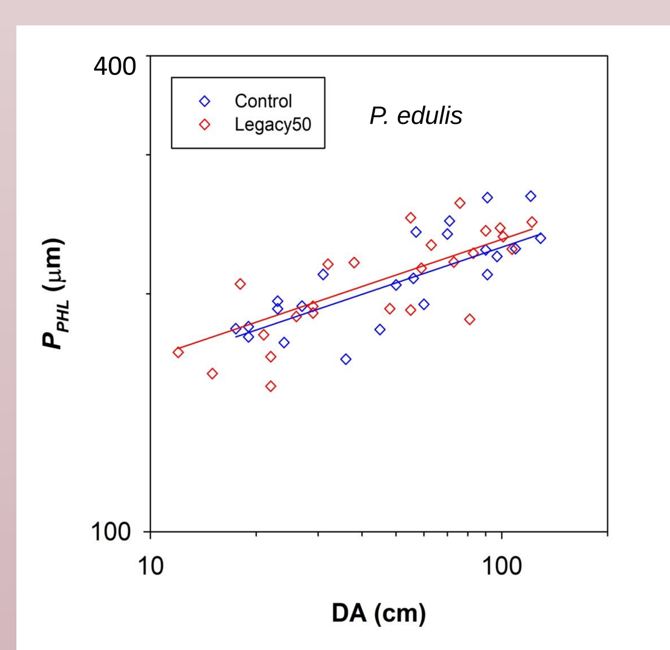
- The overall trend for xylem diameter in the last decade shows no difference between legacy and control. The same trend is seen in the apical branches of KROOF experiment, where for both species the lumen diameter of xylem conduits did not differ between TE and CO trees.





- Phloem sieve elements increased in lumen area (CA_{PHL}) and perimeter (P_{PHL}) axially with increasing DA. The axial scaling slightly differed, but in the range of those reported in literature (b=0.1-0.3). Phloem cell area/perimeter display no statistically significant changes across species and treatments.





These results confirm the clear axial scaling of conductive elements. Therefore, it is necessary to sample at different distances from the apex when carrying out anatomical studies. Our data do not support the hypothesis that acclimation to drought can be achieved by means of the production of a more embolism resistant xylem, possibly exposing the species to a greater risk of mortality.