

Impact of a damaging spring frost followed by a summer drought on saplings of four temperate species

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Background

Introduction

- Climate warming leads to earlier leaf-out which may put trees at higher risks of late spring frost (LSF) damage.
- Extreme droughts in summer are increasing in frequency and magnitude.
- The probability that a damaging LSF and an extreme summer drought occurs in the same year will therefore increase.
- The response and recovery of trees after a combination of these two stresses remain largely unknown, yet it might be crucial for tree persistence in the future.

Objective

To examine the impact of LSF damage on four species alone or in combination with a summer drought on tree growth and next spring phenology

Materials and methods

Late-spring frost (LSF)

We exposed 2-year-old saplings of four deciduous broadleaf species (*Quercus petraea*, *Quercus robur*, *Fagus sylvatica*, *Acer campestre*) to an artificially LSF shortly after leaf emergence (at the beginning of May).

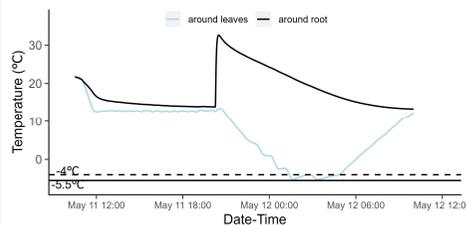


Figure 1. Temperature during LSF exposure

Summer drought

We applied 2-month summer drought treatments during early July to end of August (well-watered vs. drought, 50% reduction of water).

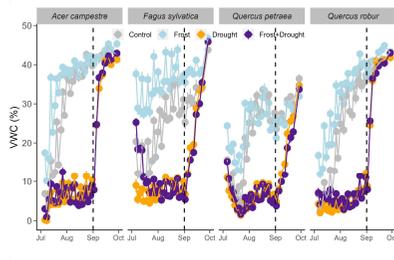


Figure 2. Volumetric water content during summer drought exposure

Results

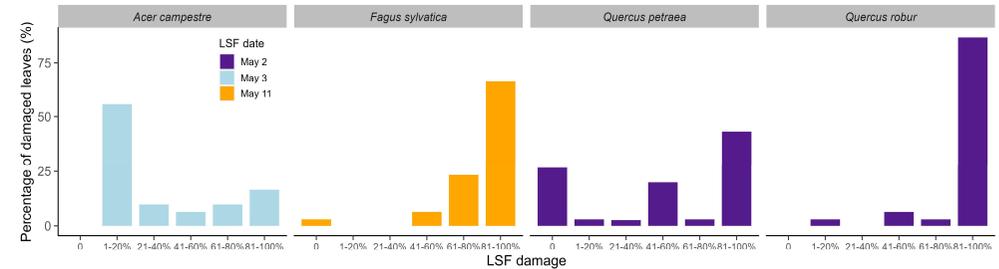


Figure 3. Percentage of leaves damaged after the artificial frost

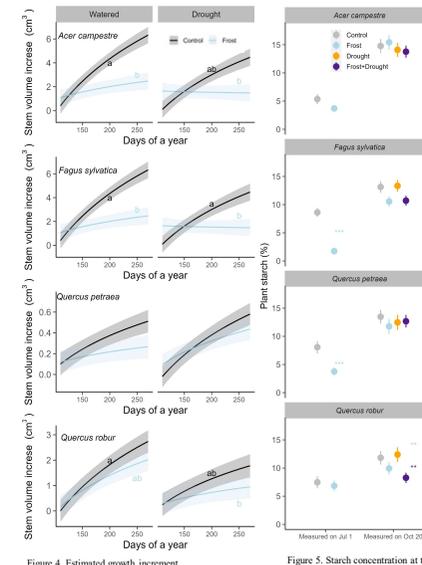


Figure 4. Estimated growth increment

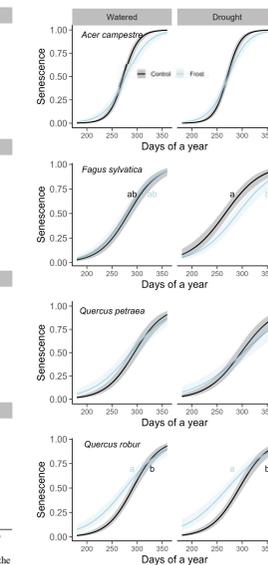


Figure 5. Starch concentration at the beginning and end of summer

Figure 6. Progress of senescence under control and drought treatments for frosted and non-frosted plants

Conclusions

- LSF strongly damaged leaves (Fig. 3) and reduced tree growth (Fig. 4).
- The combination of the two stresses significantly reduced growth for most species (Fig. 4).
- LSF strongly decreased Starch in *F. sylvatica* and *Q. petraea* at the beginning of summer (Fig. 5).
- LSF advanced senescence of *Q. robur*, regardless of water stress (Fig. 6)
- The combination of the two stresses significantly delayed senescence for beech (Fig. 6).



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