



From genes to plant architecture: the shoot apical meristem in  
all its states – 28-30 november, Poitiers (France)

**Temperature heterogeneity at crown scale impact on tree  
architecture after late spring frost**

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## Spatio-temporal variation of temperature

### Increase false spring risk

“The onset of spring plant growth has shifted earlier in the year over the past several decades due to rising global temperatures.”  
Alstadt et al. 2015

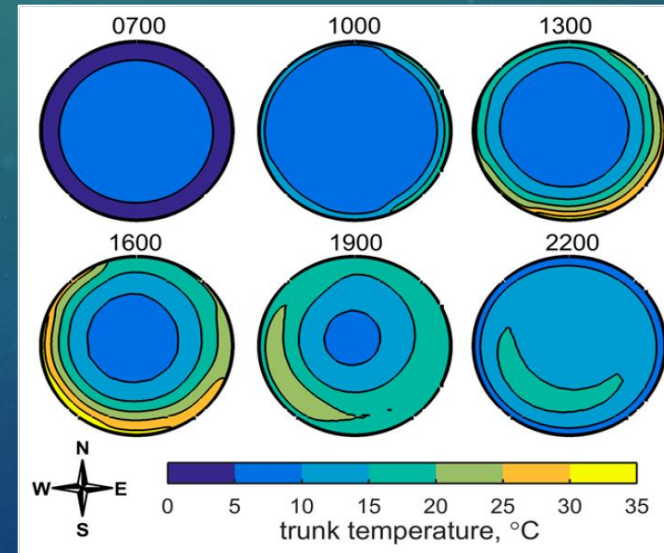
« Warm » winter

+

Late Spring Frost

- Decrease cold hardiness
- Early ecodormancy release
- Damage during early growth

- +10°C greatest difference SW/NE Cherry (Sheppard et al., 2016)
- +15°C for Walnut (lab unpublished data)



(Musselman & Pomeroy, 2017)

Which impact can temperature asymmetries have on tree architecture during a false spring?

➤ Which impact on buds and cambial cell activity?

➤ Can thermal asymmetry within the canopy change its shape?

➤ If not, are there any compensation mechanisms between branches at the tree crown level?

## 2 experiments : 2021 & 2022

Control

Warmed



### Measured parameters:

#### Primary growth

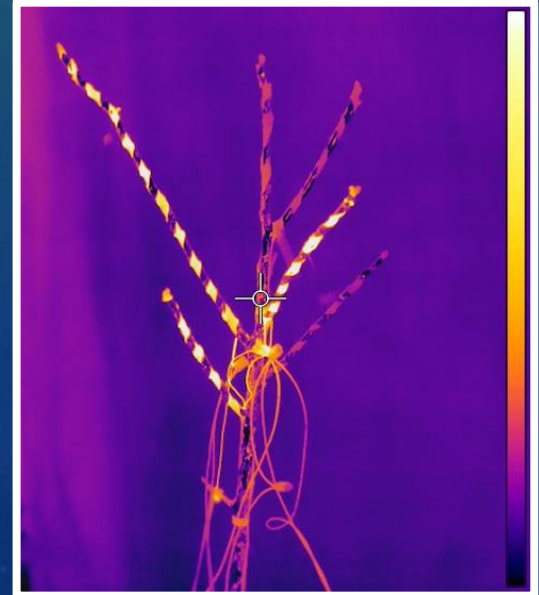
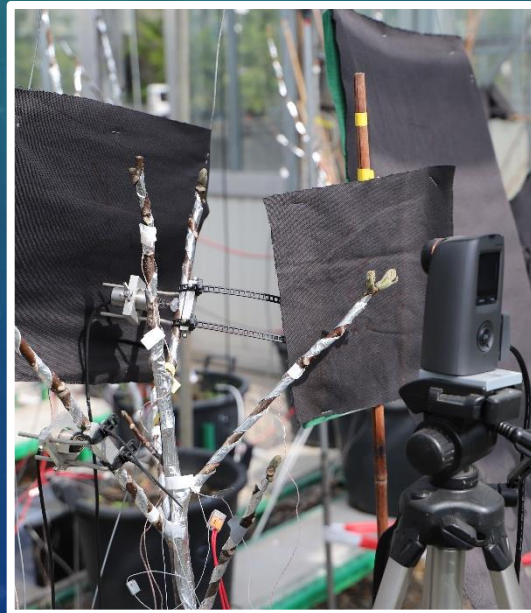
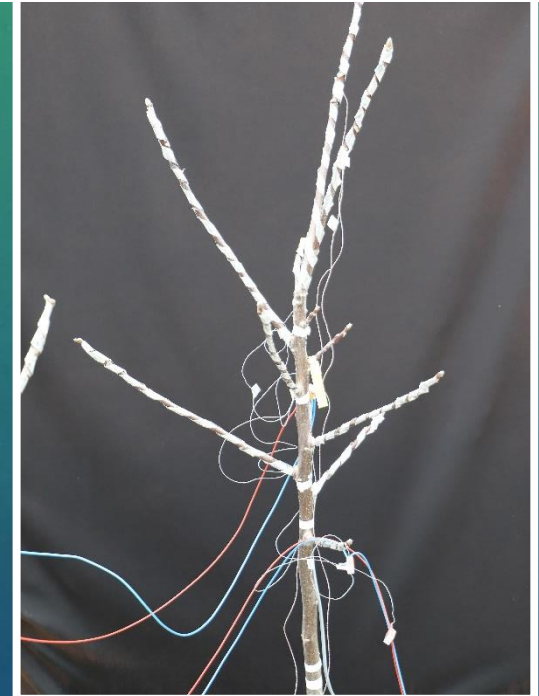
- Timelapse, phenology, height increment

#### Secondary growth

- LVDT, cytological analysis

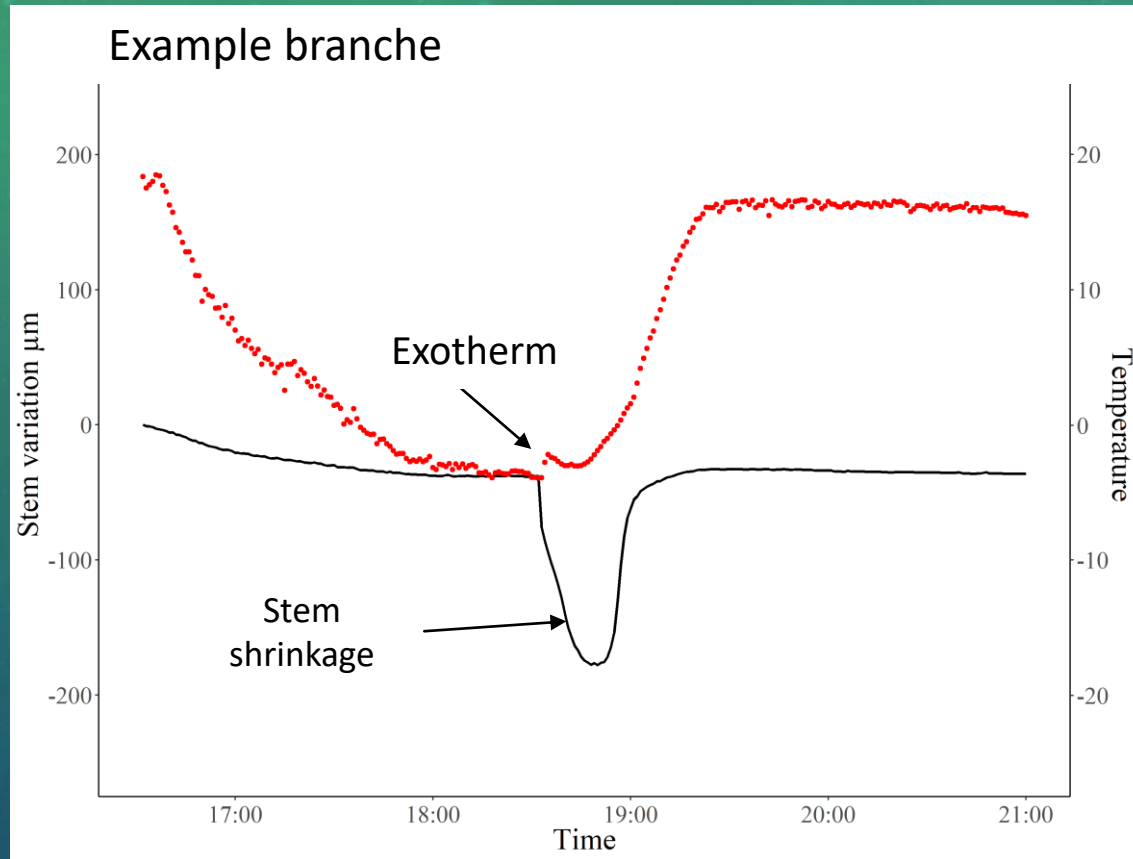
#### Frost hardiness

- Sugar Content, Water Content



## Control frost:

- 5K/h
- From 15 to -5 °C



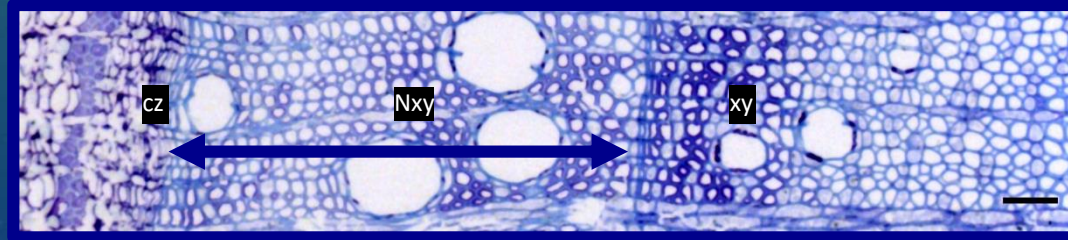
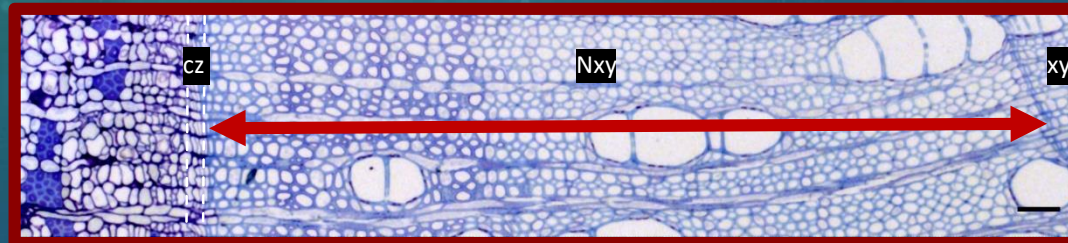
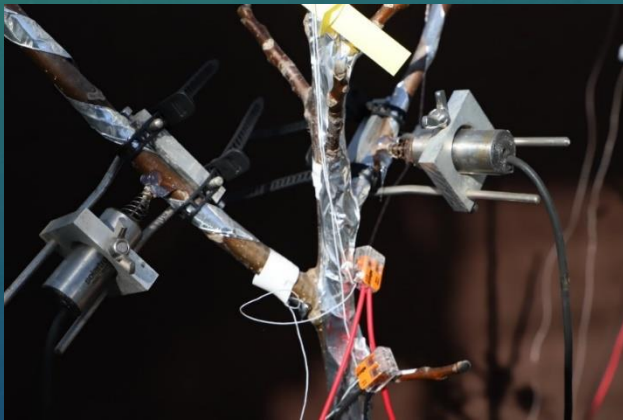
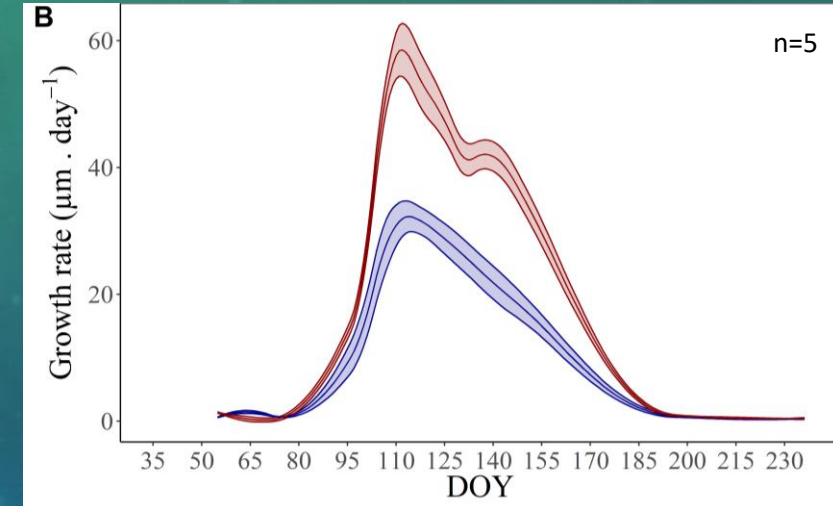
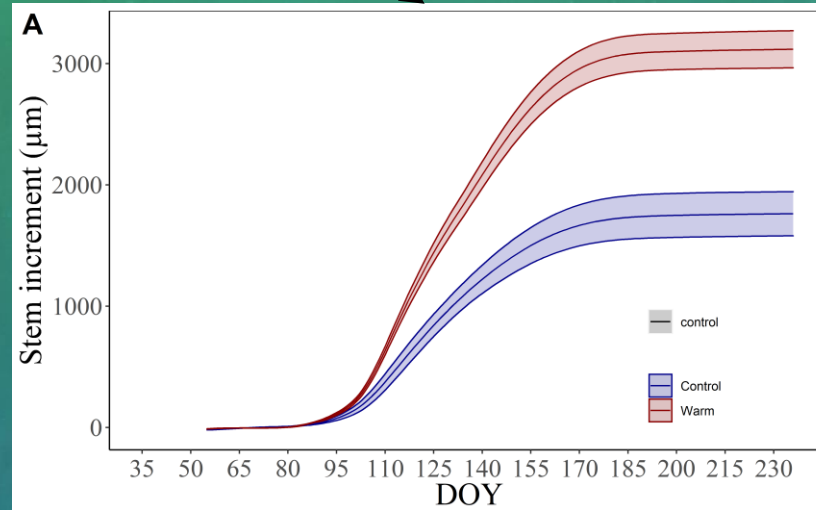
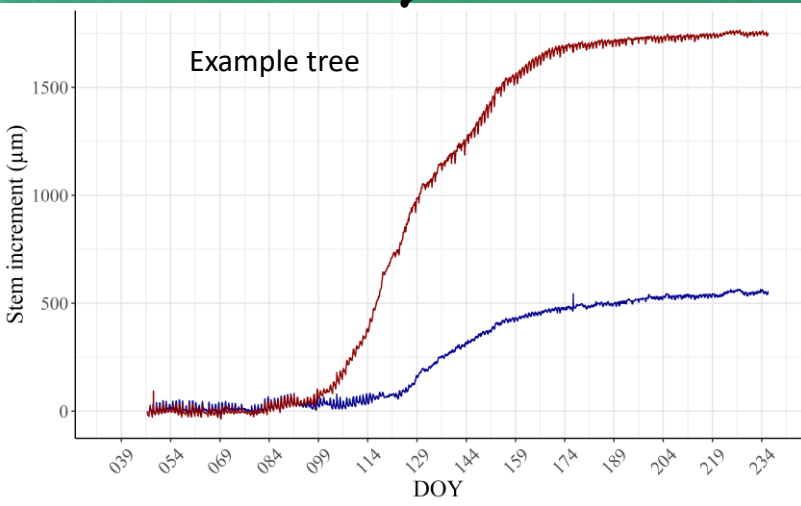
Late springs frost after first signs of bud break on warmed branches



# Secondary growth: LVDT spline fit

Spline fit

derivative



No difference in start and arrest

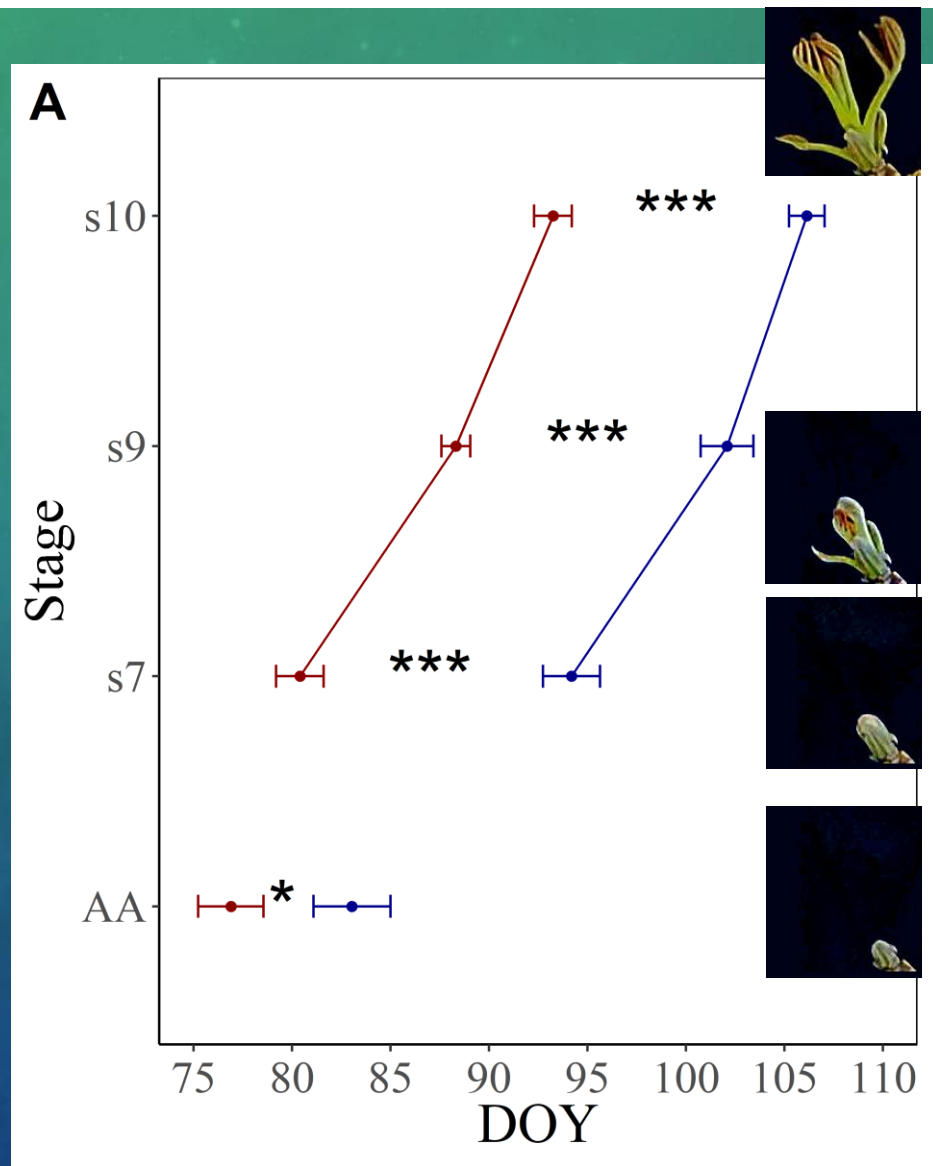
More cambial activity

Lack of compensatory effect



could impact long term architecture

# Primary growth: bud burst

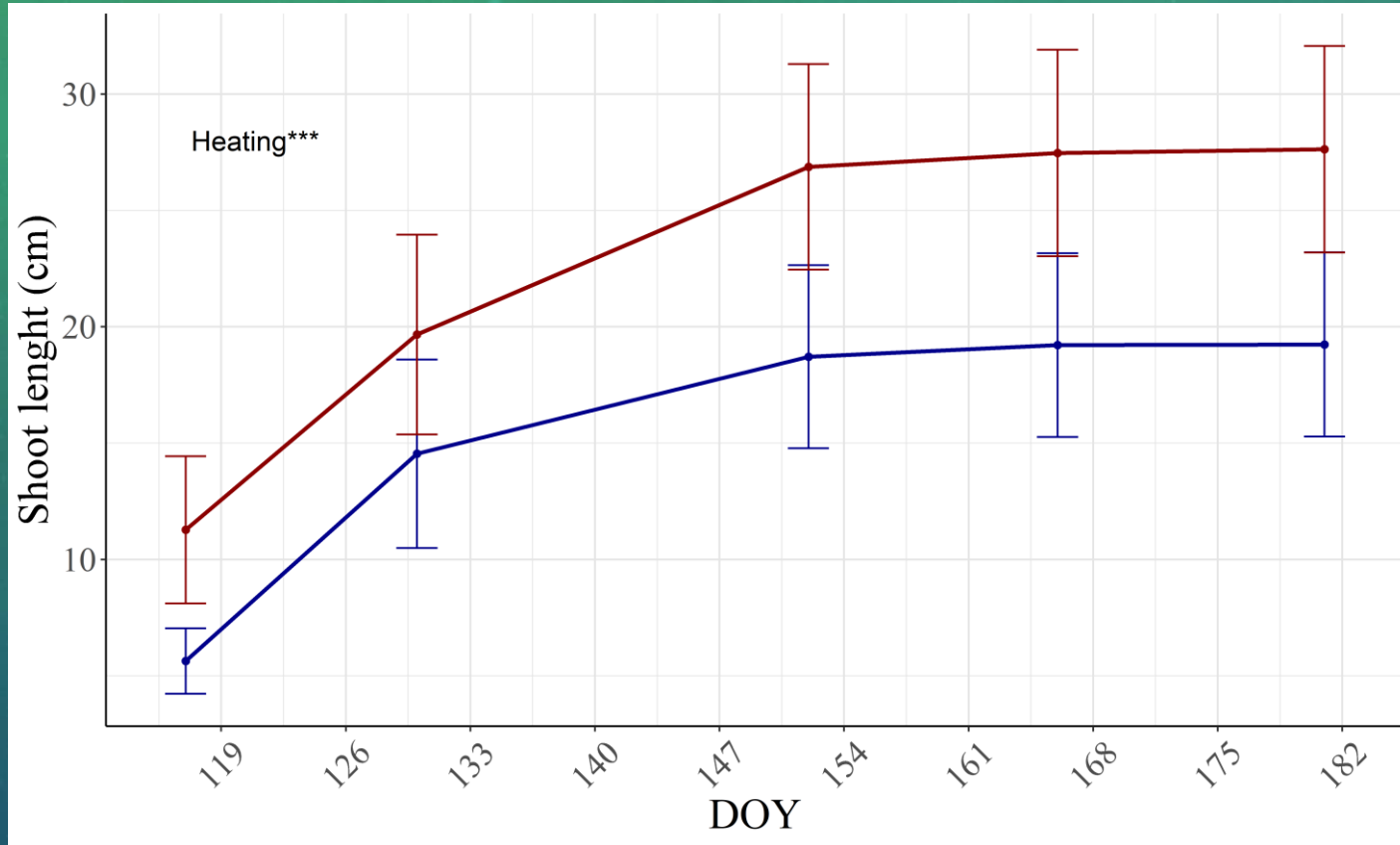


10 days of difference



could impact long term architecture

# Primary growth



Heated branches take advance on unheated

Lack of compensatory effect



could impact long term architecture

77 Bud burst 103 Primary growth 150

35 Warming

237

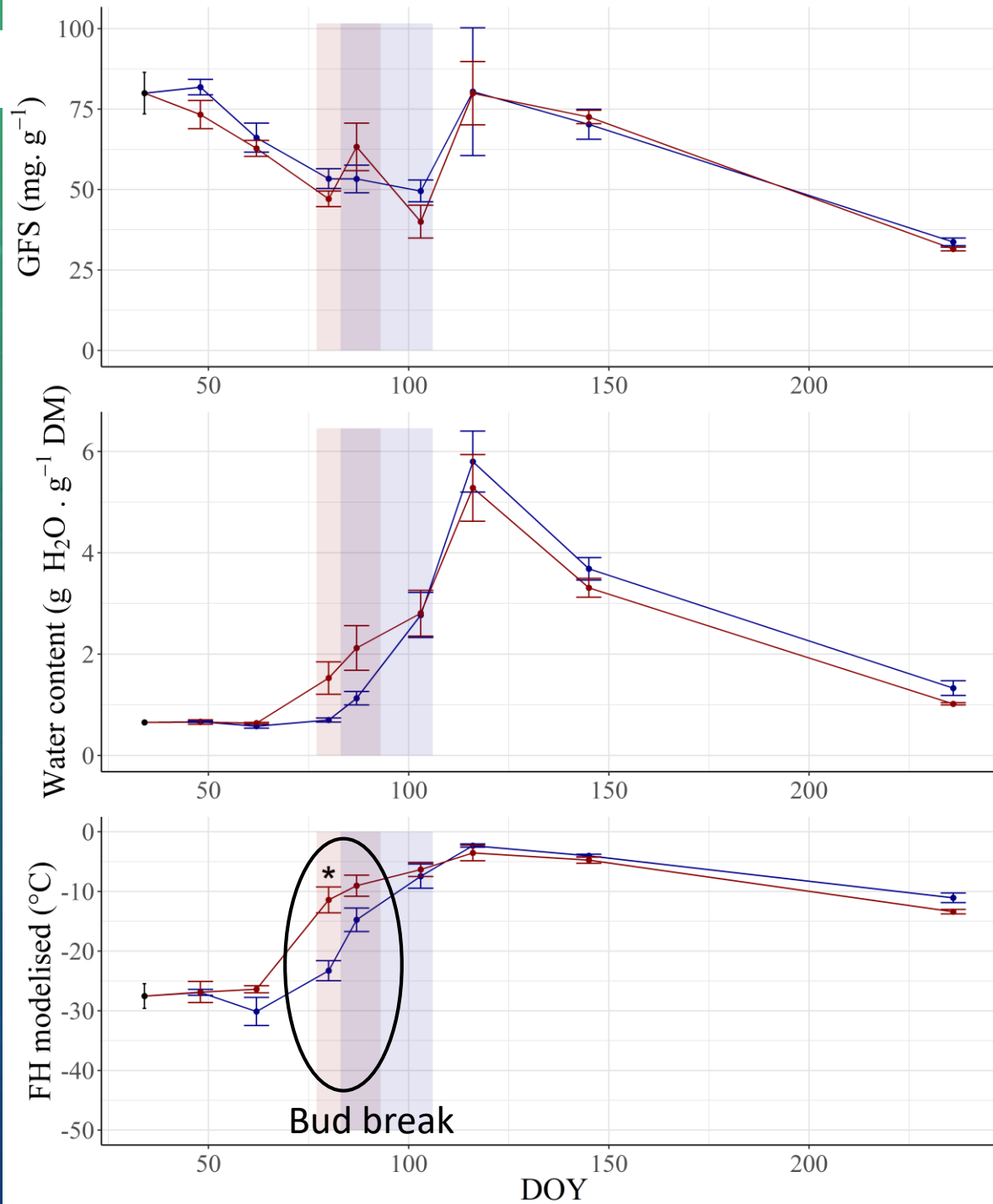
83 Bud burst 115 Primary growth 150



# Frost Hardiness

$$FH = \frac{-4.185 \ln(\text{GFS})}{\text{WC} + 0.845}$$

Charrier et al. 2013

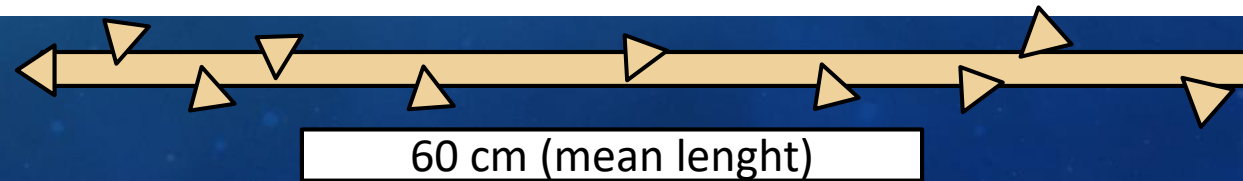
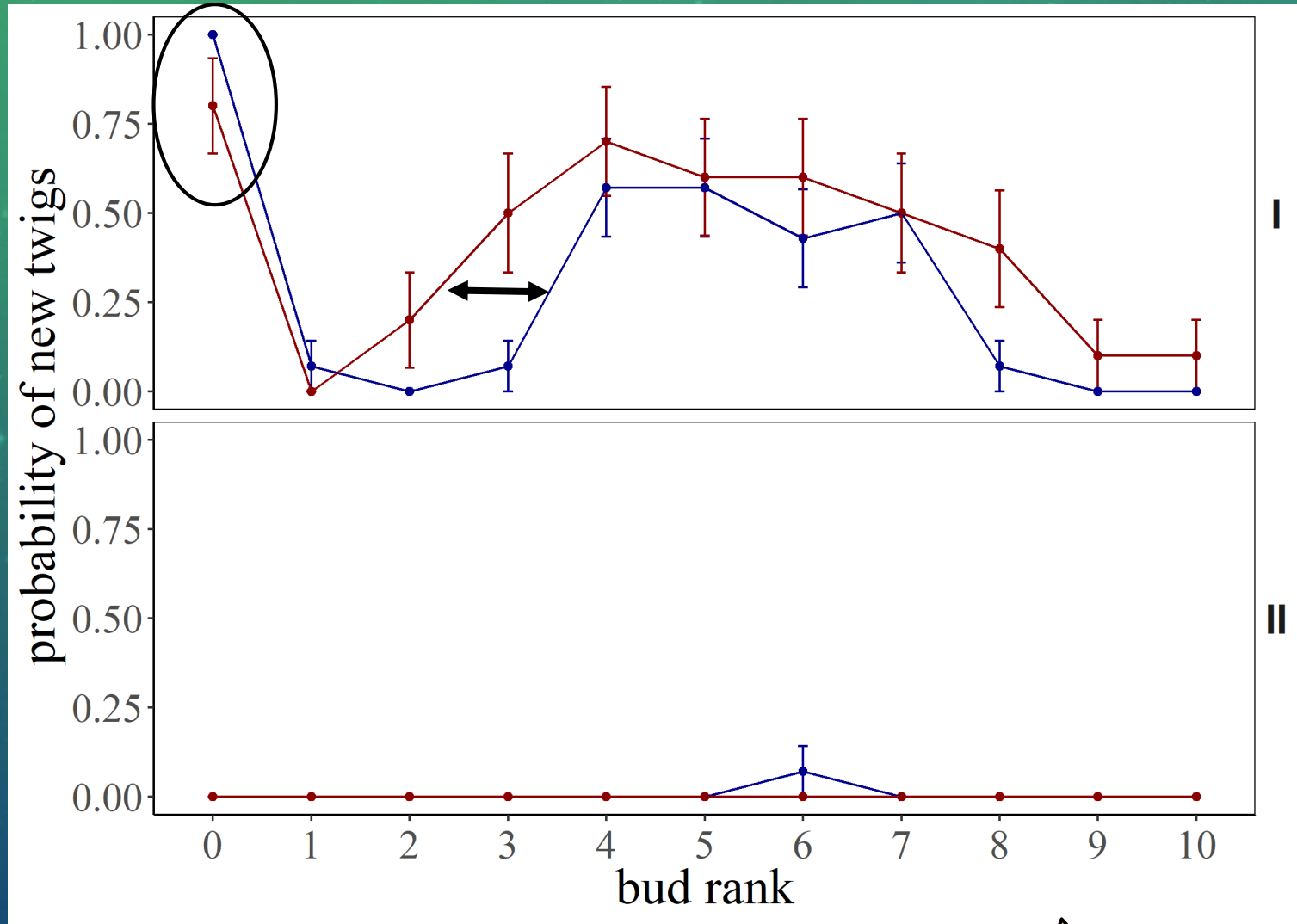


Decreased until bud burst

Increased during bud burst

Shift during budburst

# Architecture consequences

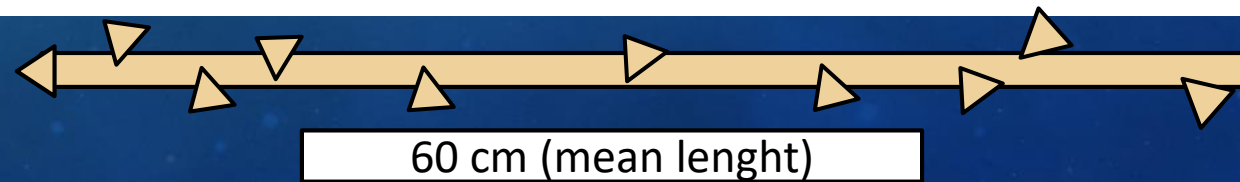
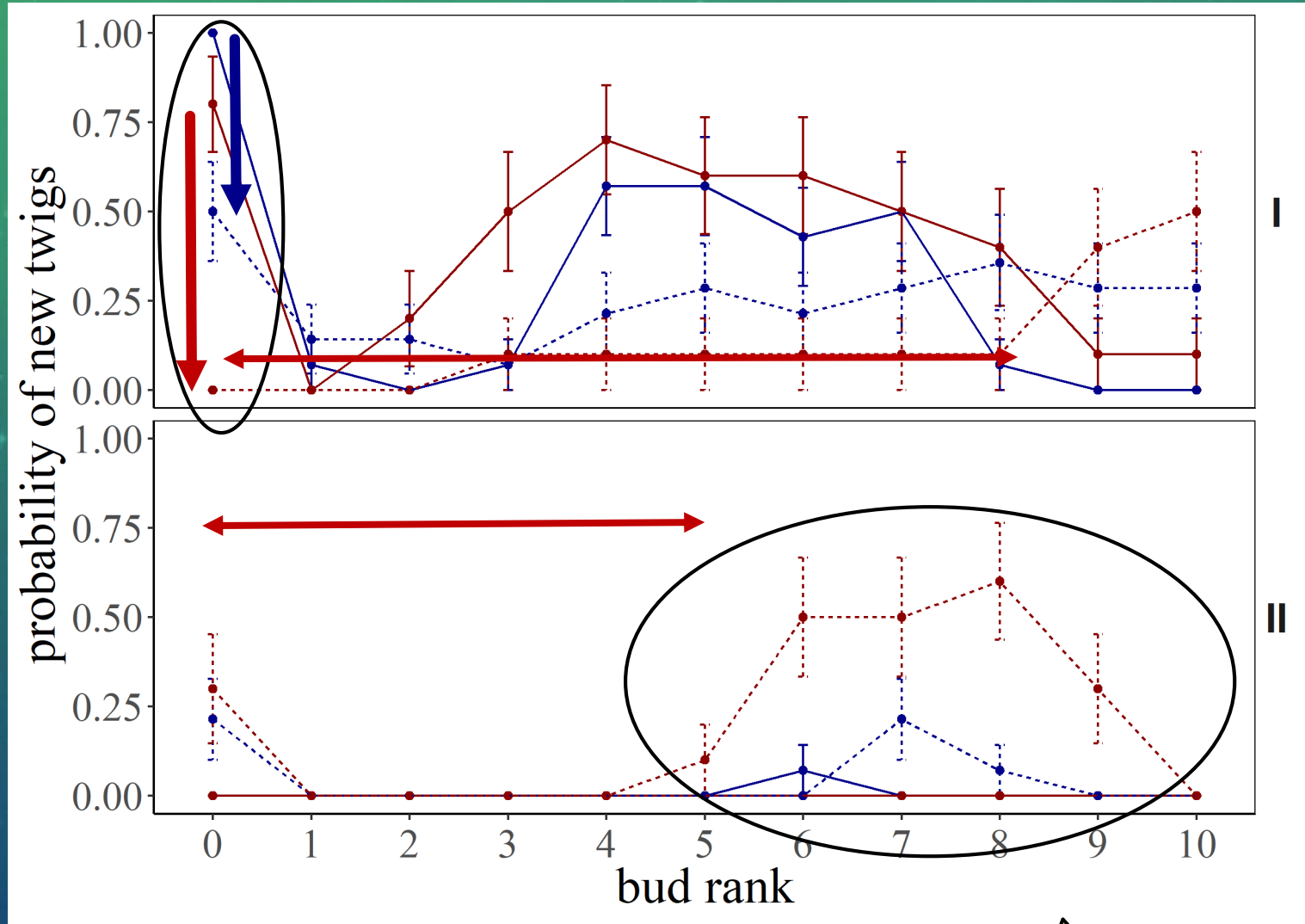


I

II



# Architecture consequences

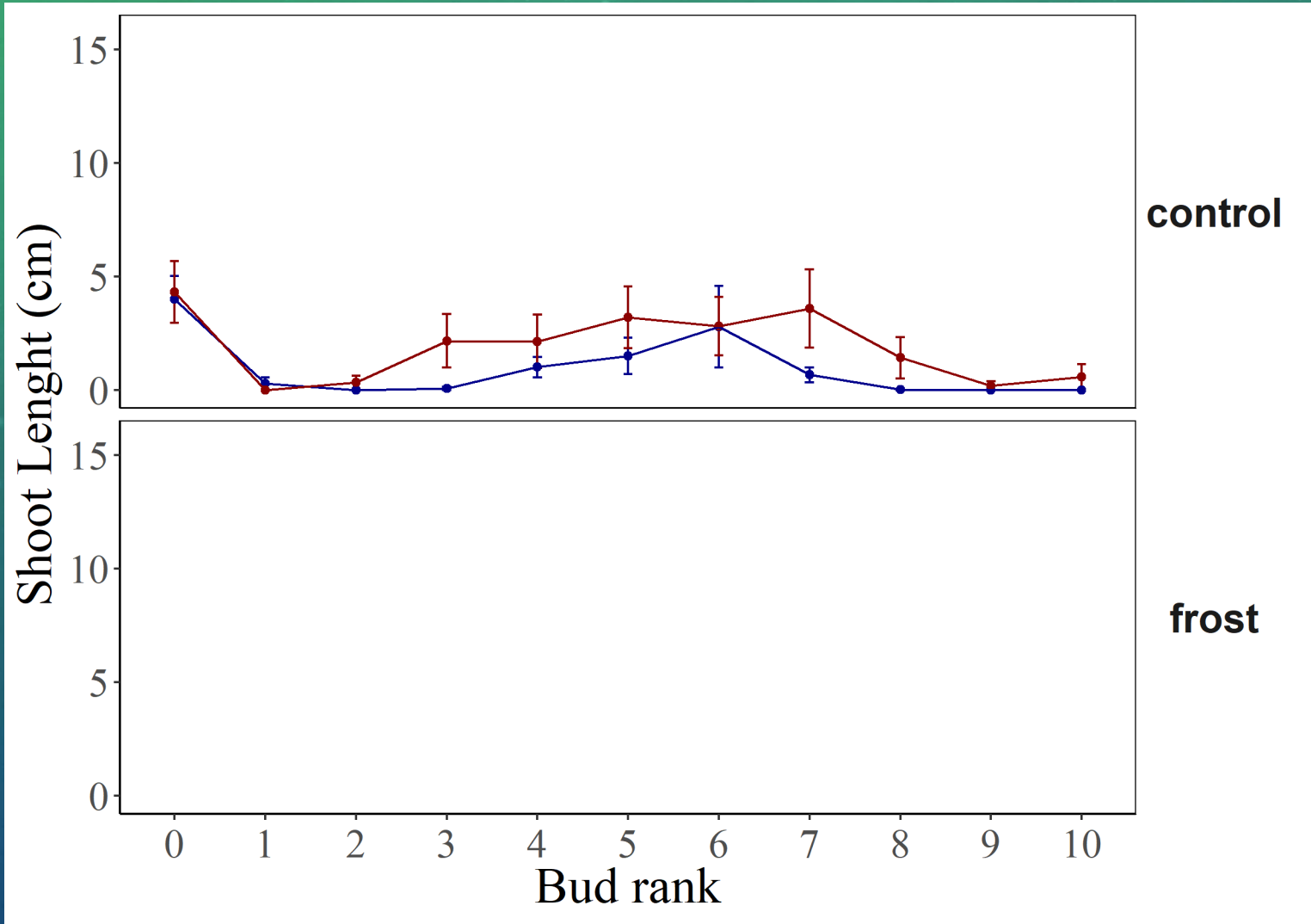


I

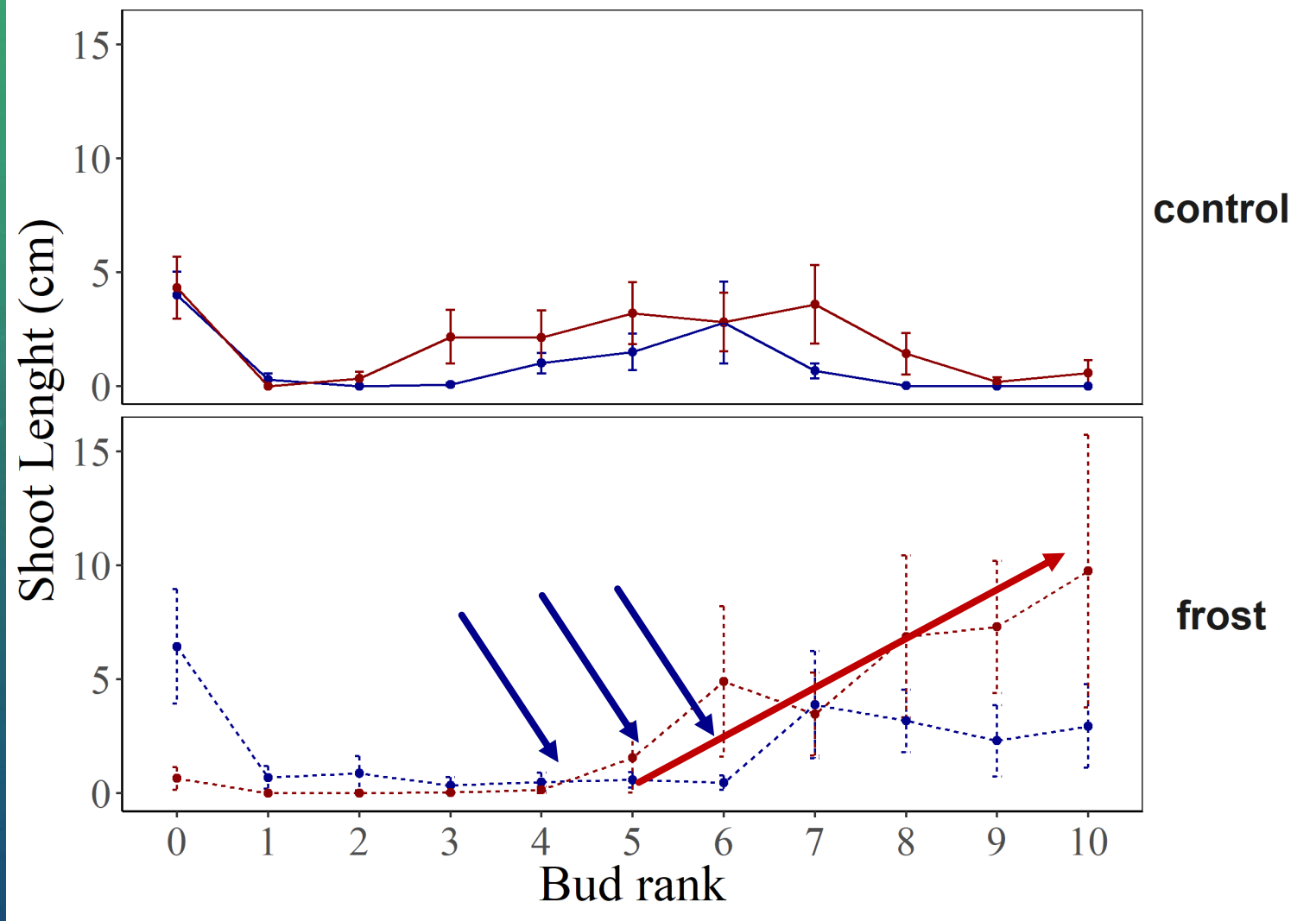
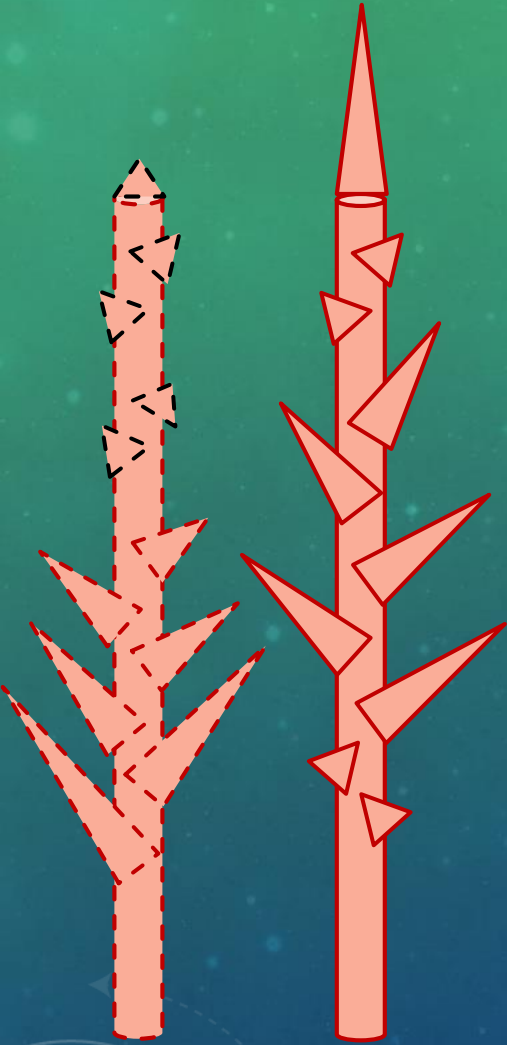
II



# Architecture consequences



# Architecture consequences



Which impact can temperature asymmetries have on tree architecture during a false spring?  
Which impact on buds and cambial cells?

- Shift in primary growth
- No effect in secondary growth resumption
- But faster cellular activity
- Arrest of growth same time

- Bud destruction
- Apical dominancy modification?
- Impact architecture

Lack of compensatory mechanisms at crown level  
Thermal asymmetries could modify tree shape – 2 possibilities:

- Predominance of the warmed part (growth rate)
- Death of warmed part after late spring frost