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Detecting dormancy dynamics in woody plants by characterizing hydraulic connectivity between stem and bud

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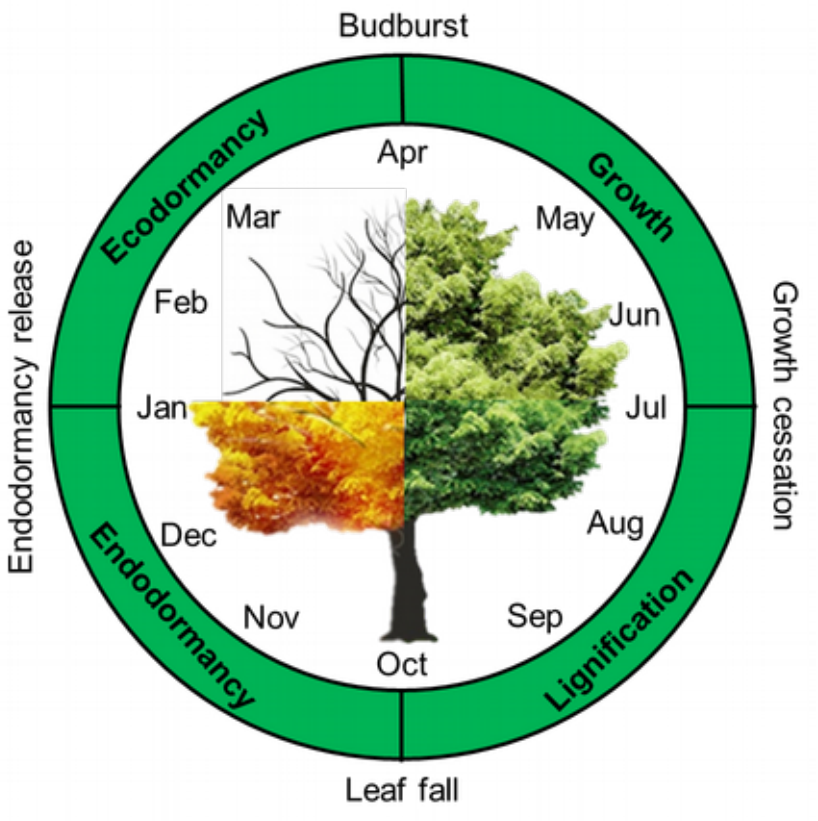
Phenological cycle in woody perennials



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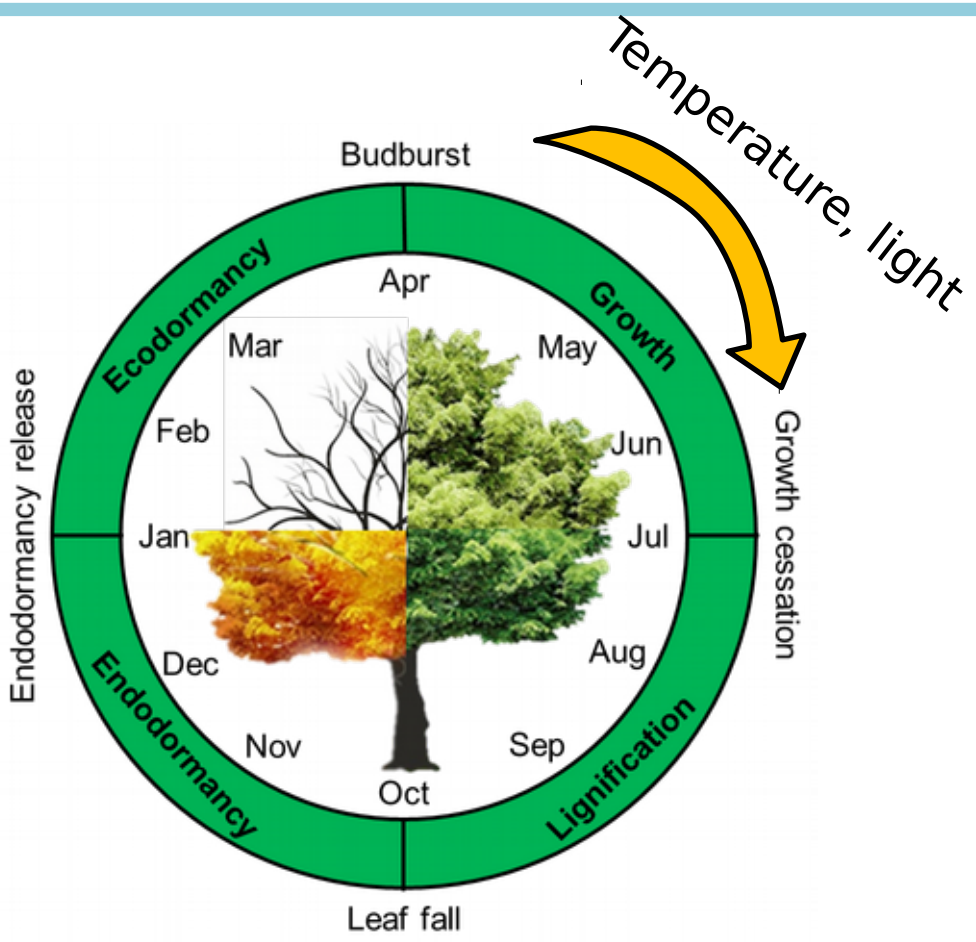

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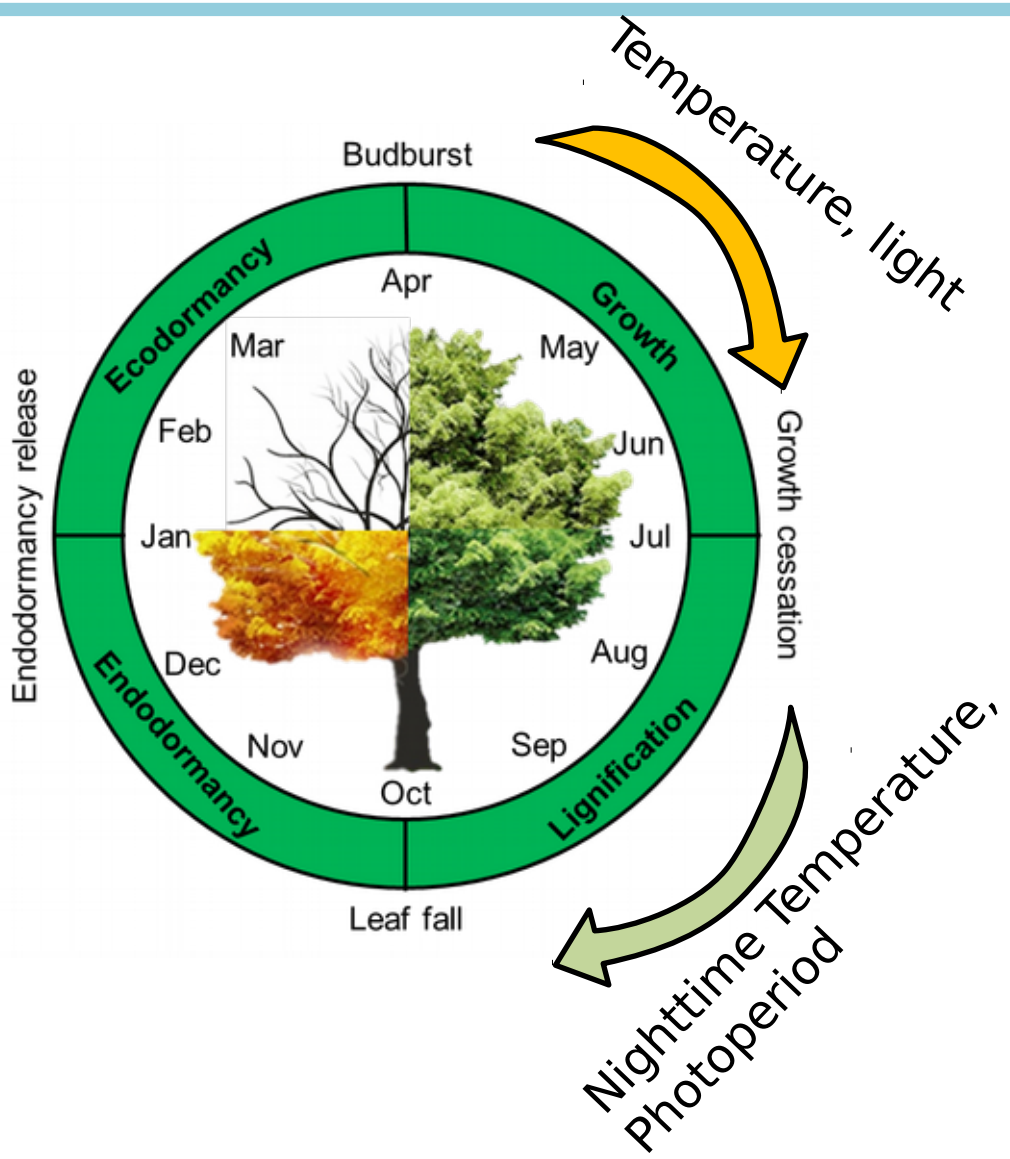

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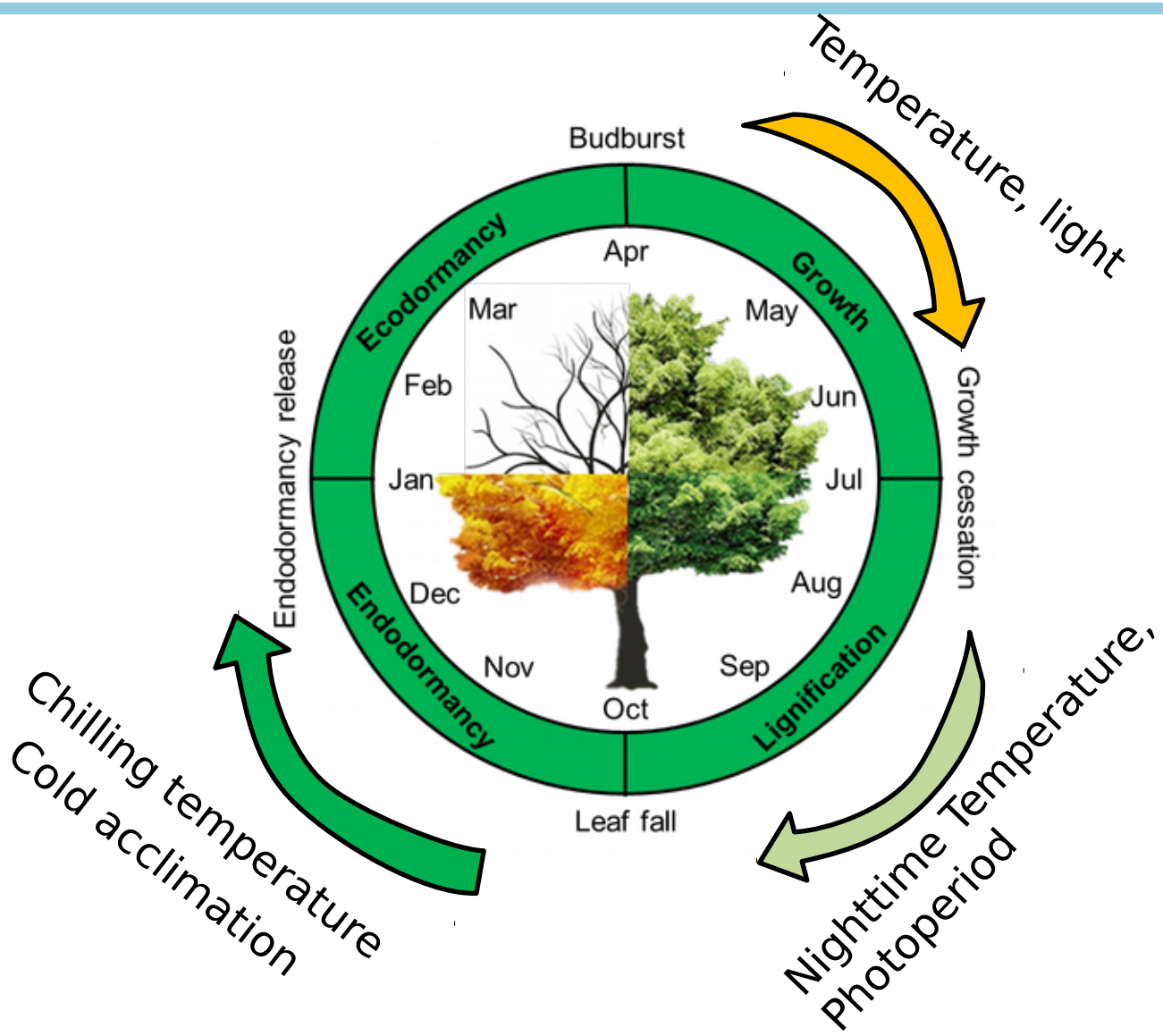

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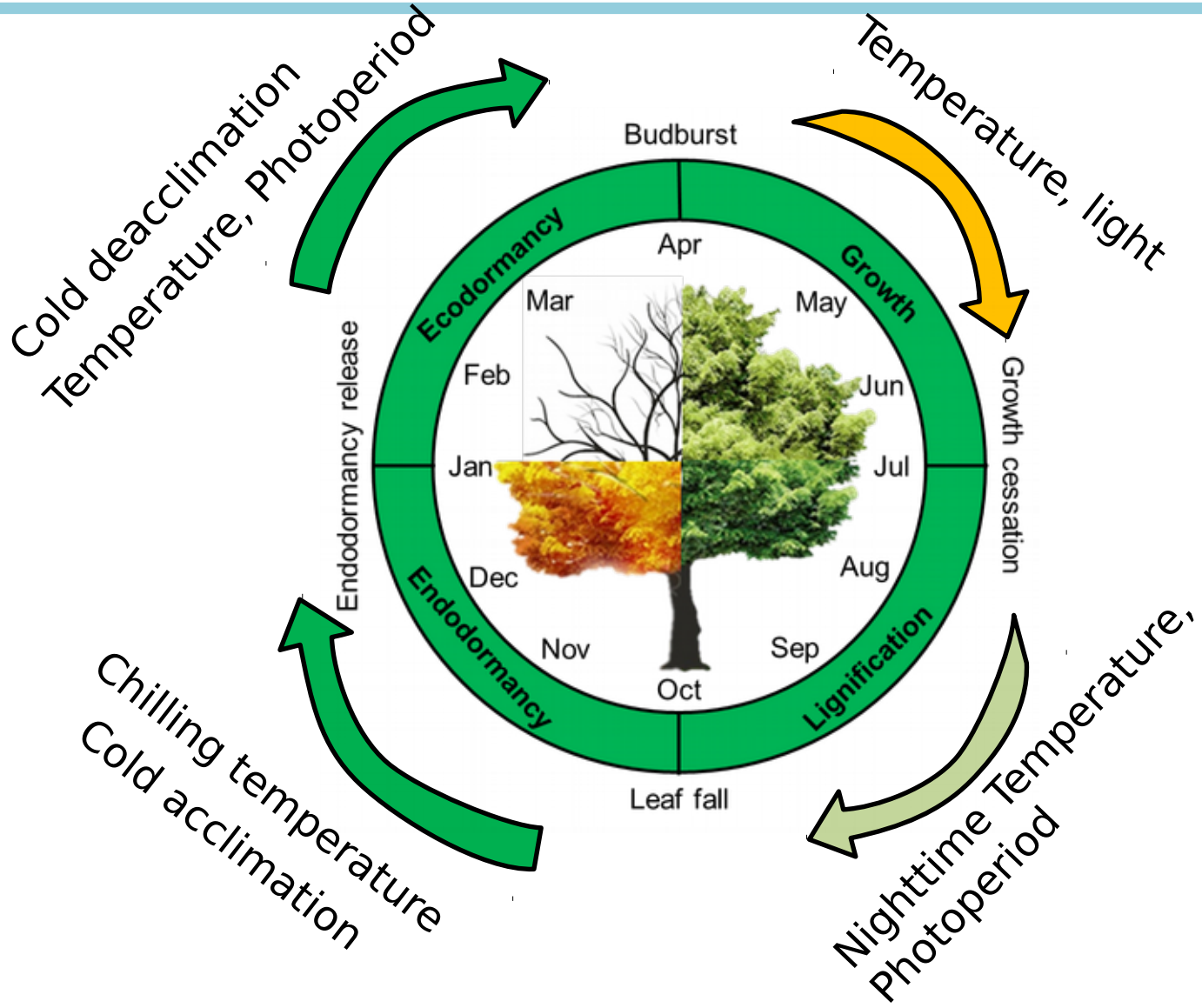

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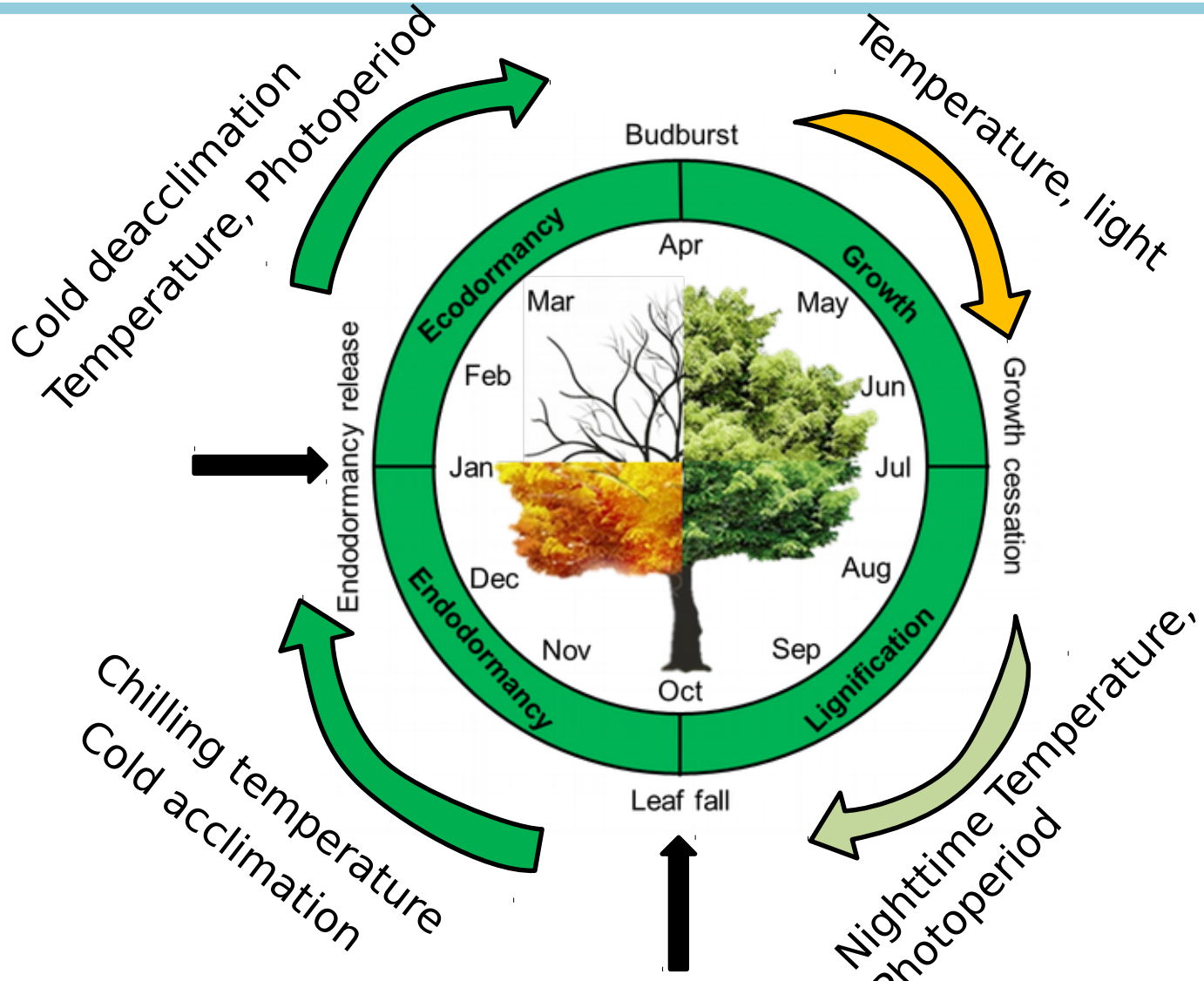
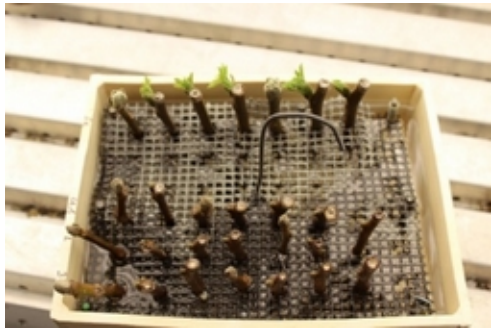
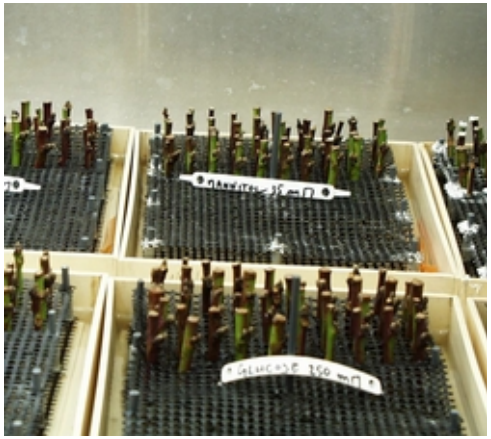


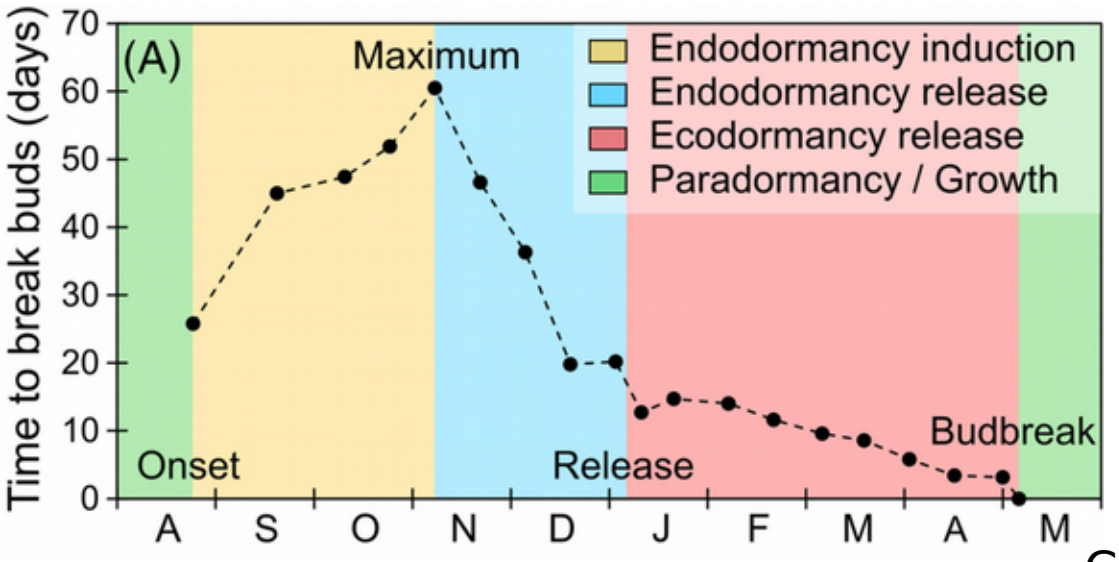
When do the buds actually start to accumulate forcing / chilling temperature?

Measurement of dormancy

One node cuttings in forcing conditions







Charrier, 2022

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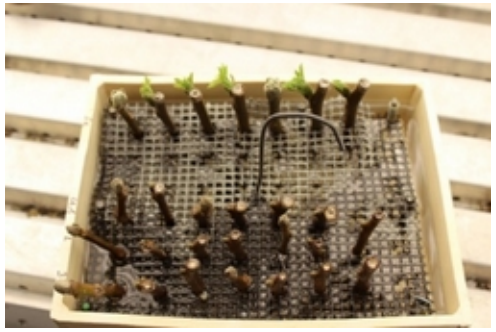
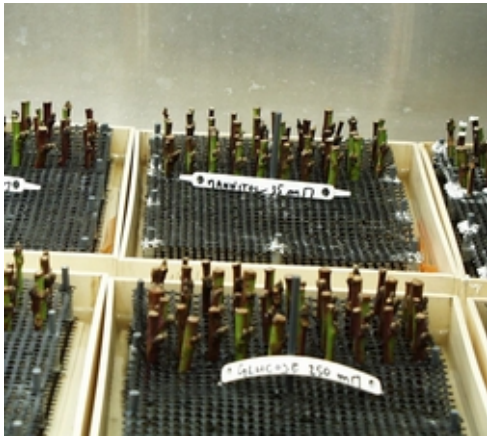
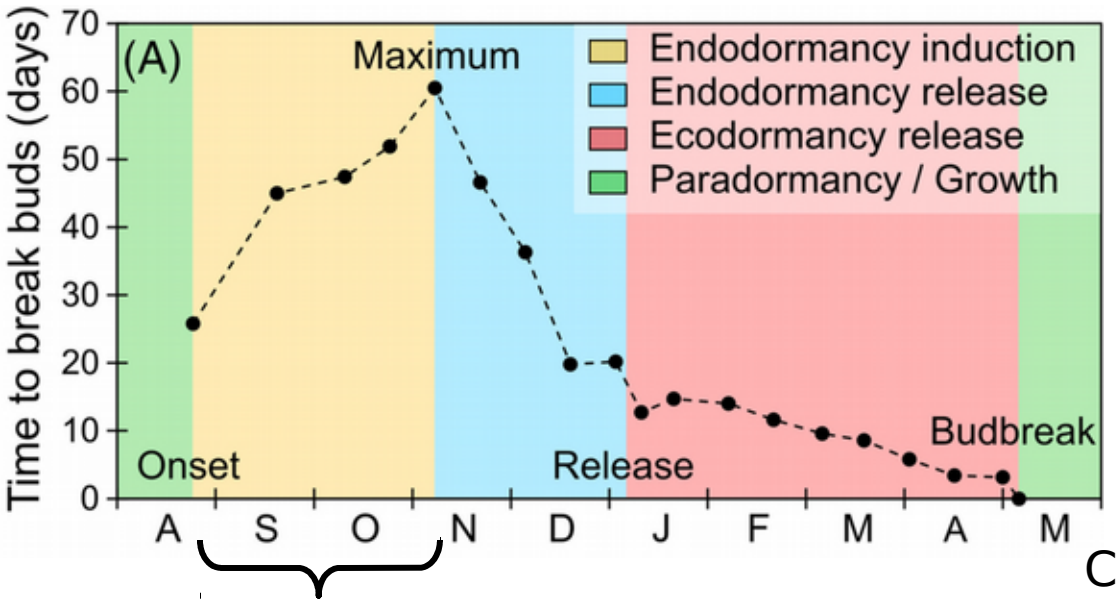


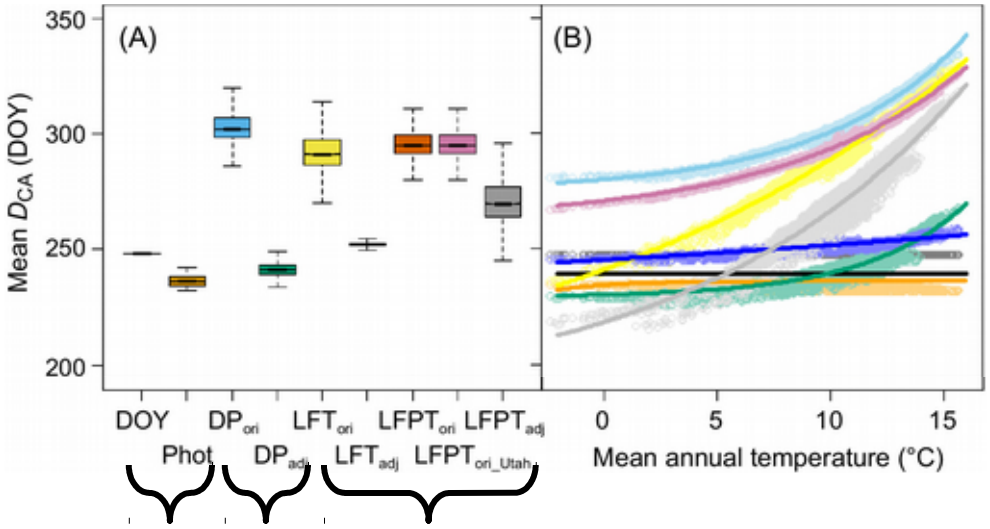




Charrier, 2022

When do the buds actually start to accumulate forcing / chilling temperature?

Can phenological model help?



Photoperiod

Leaf fall models

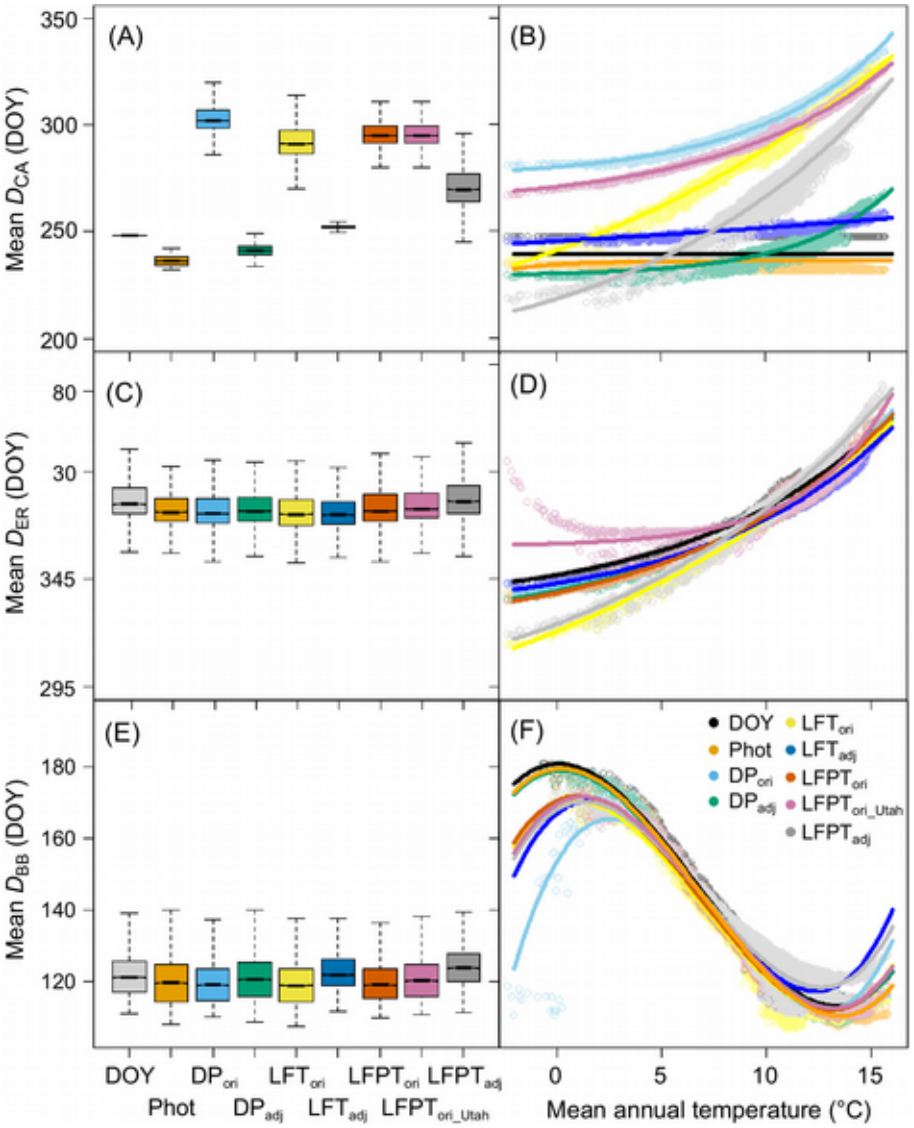
Photoperiod x temperature

Can phenological model help?

Endodormancy induction

Endodormancy release

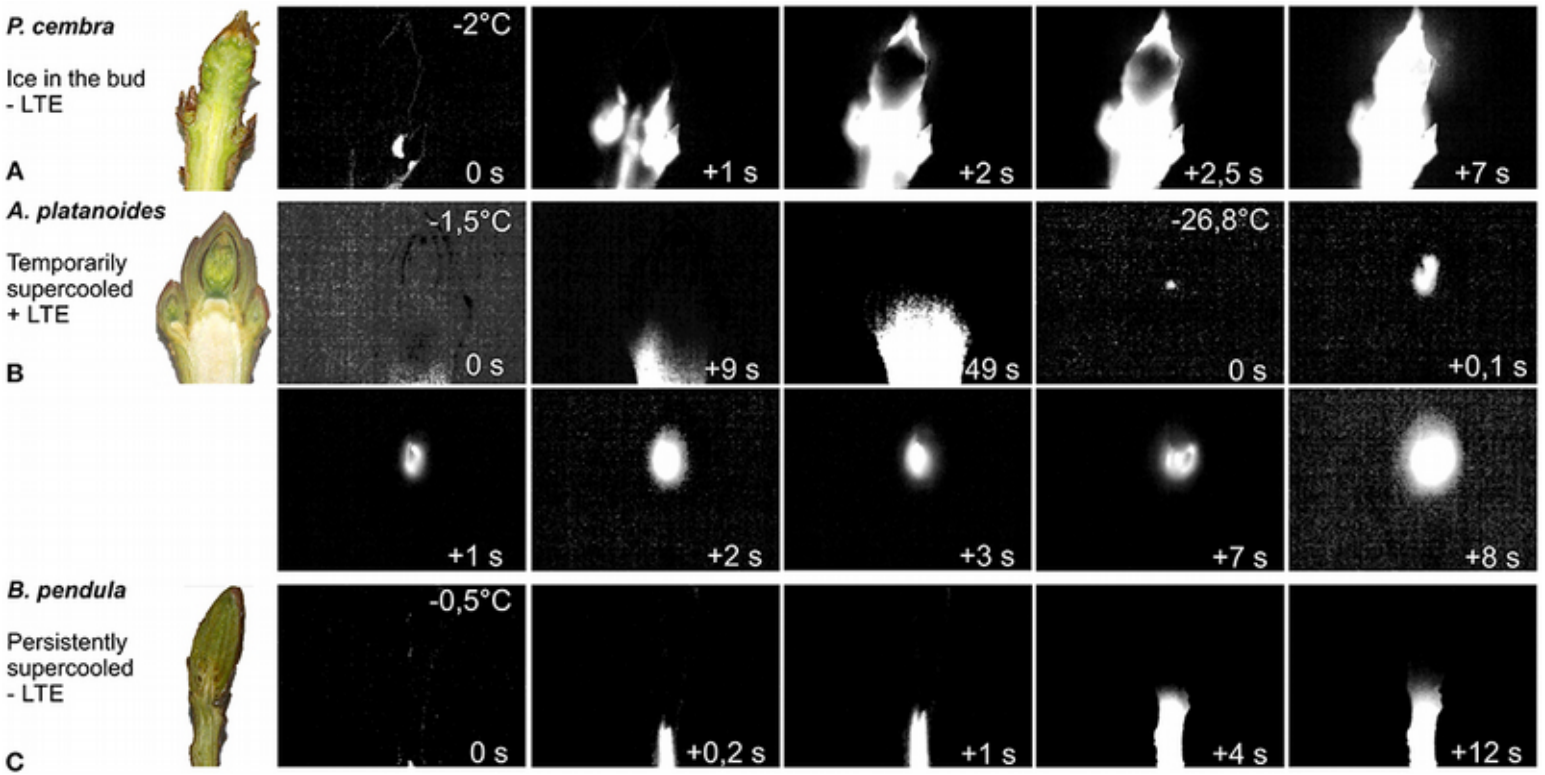
Ecodormancy release = budbreak



Charrier, 2022

Hypothesis

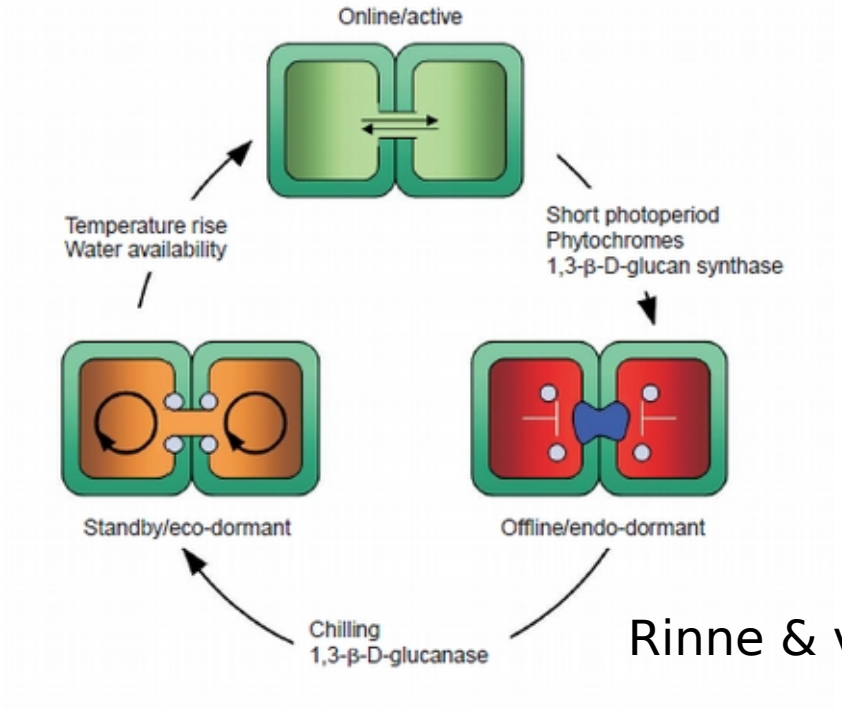
- Formation of ice barriers between stem and bud



Neuner *et al.*, 2019

Hypothesis

- Formation of ice barriers between stem and bud
- Glycan deposition above plasmodesmata during dormancy

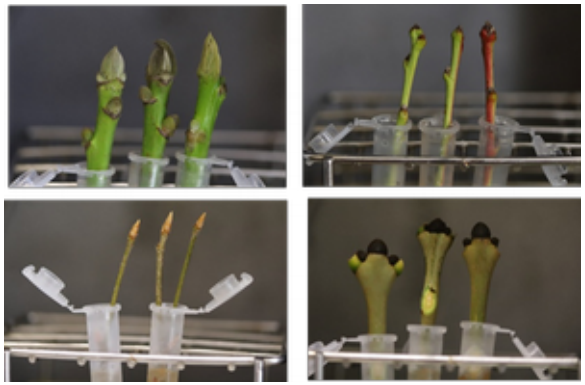


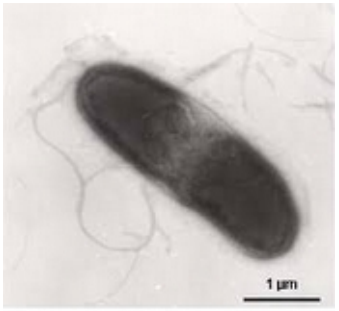
Rinne & van der Schoot, 2003

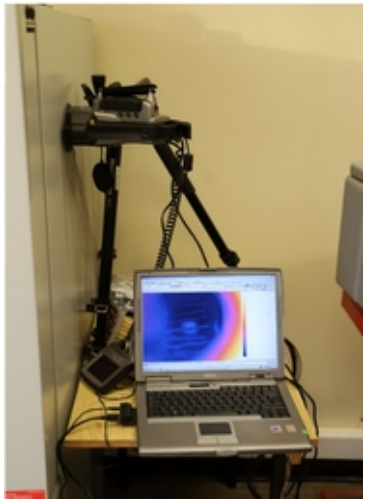
Can we detect dormancy status by the change in connectivity between stem and bud?

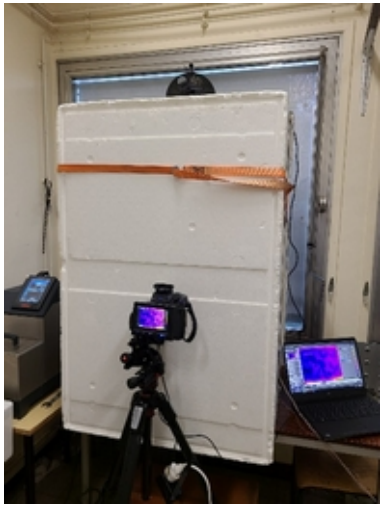
Material and methods

- Species (5 indiv x 3 rep)
  - *Juglans regia*
  - *Prunus persica*
  - *Fraxinus excelsior*
  - *Fagus sylvatica*
- Every month
  from July until March
- Freezing treatment
  - +2 -> -12°C; 5K.h^{-1}
- Control of ice nucleation
  - From the base
- Infra-red thermal analysis
- Forcing tests
  - 20/25°C; LD



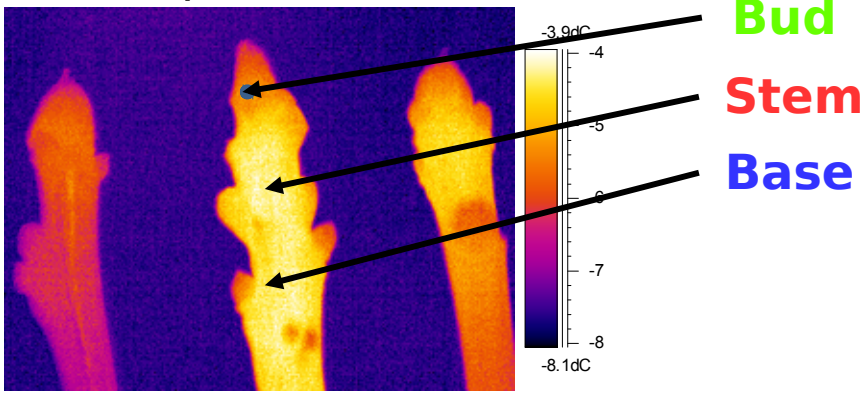




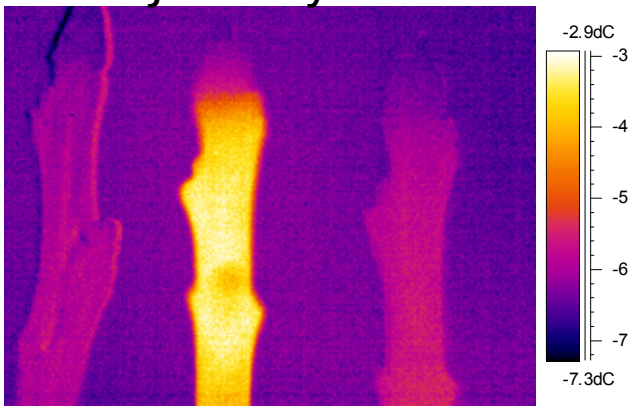


IRT Analysis

September



January



IRT Analysis

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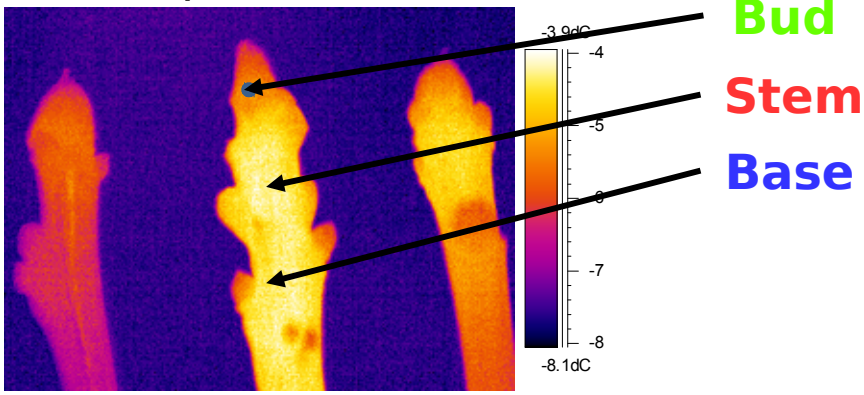

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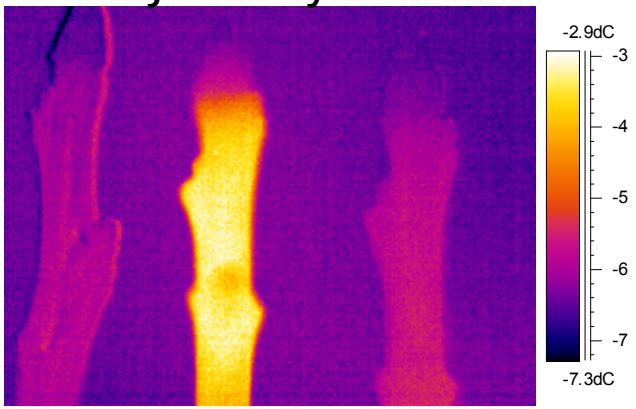

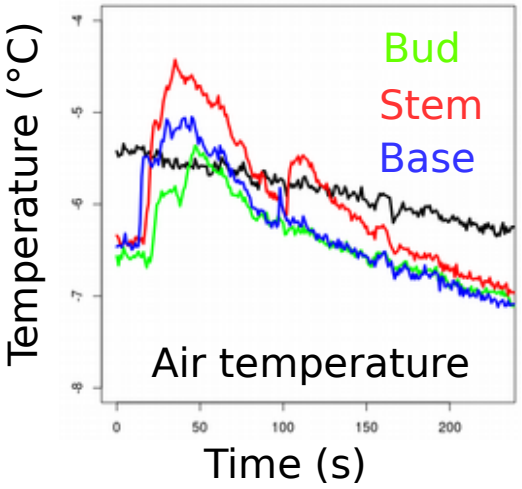

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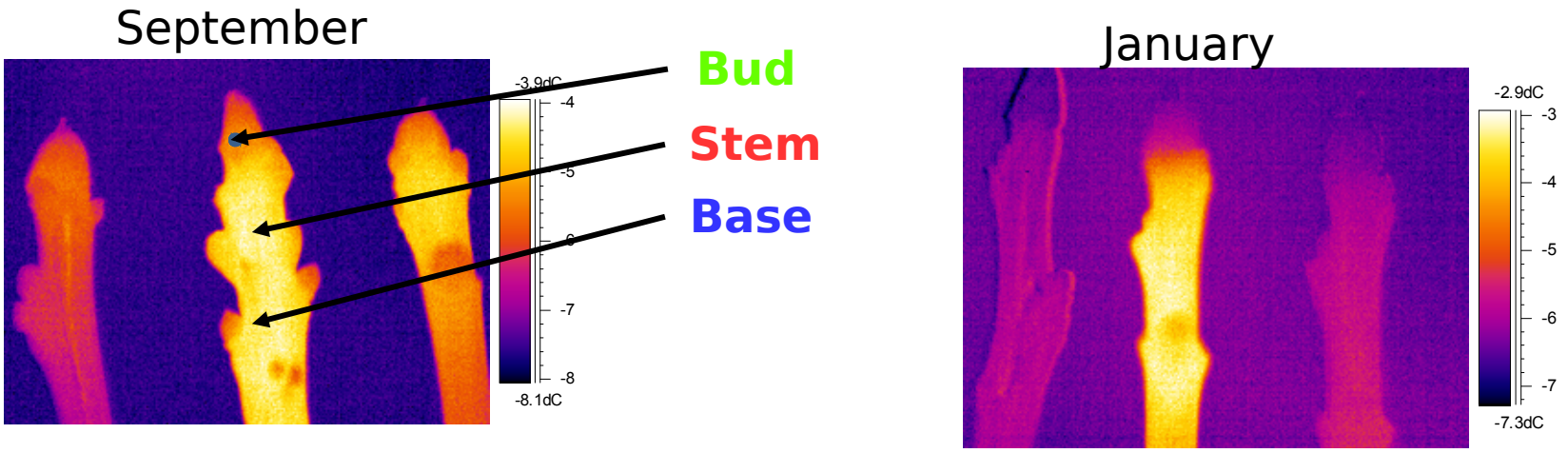
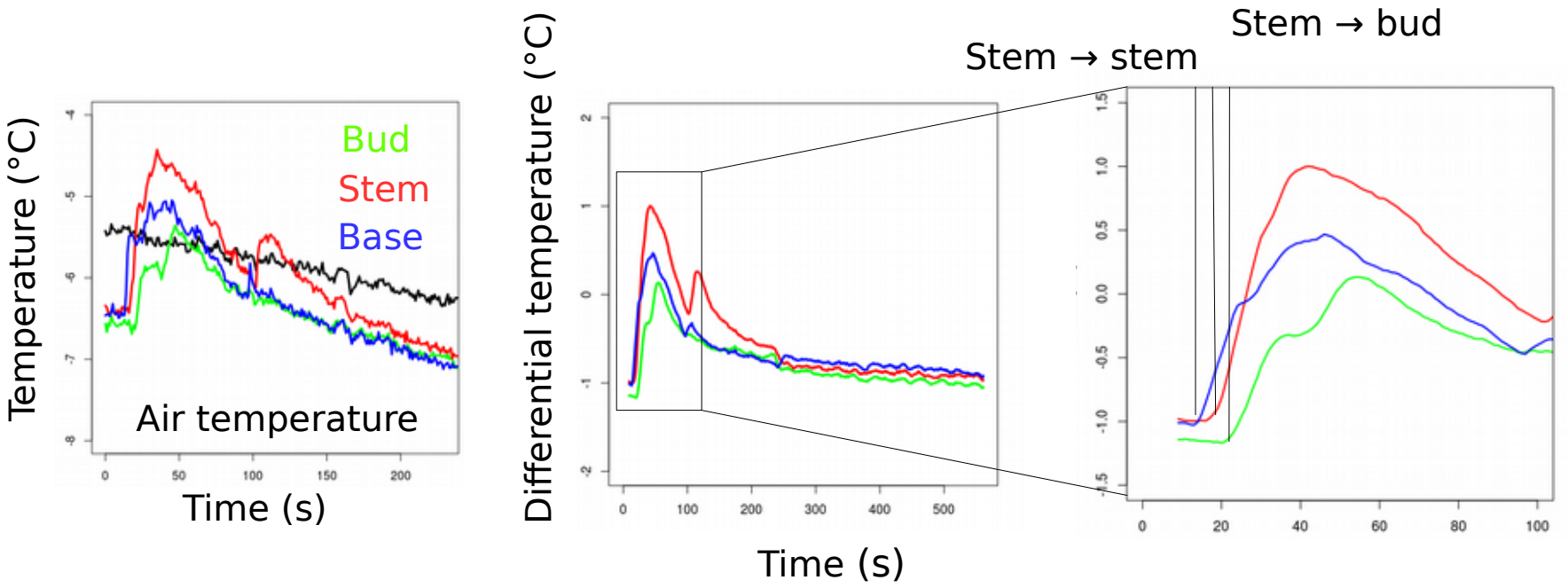
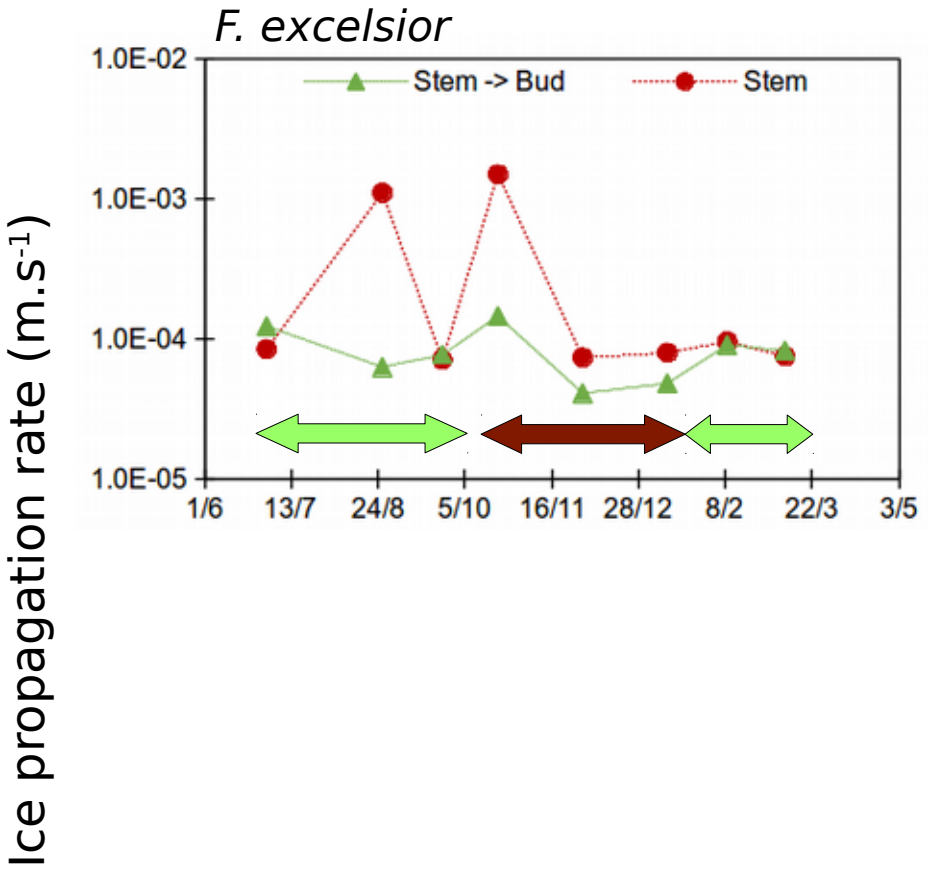




Seasonal change in ice propagation rate



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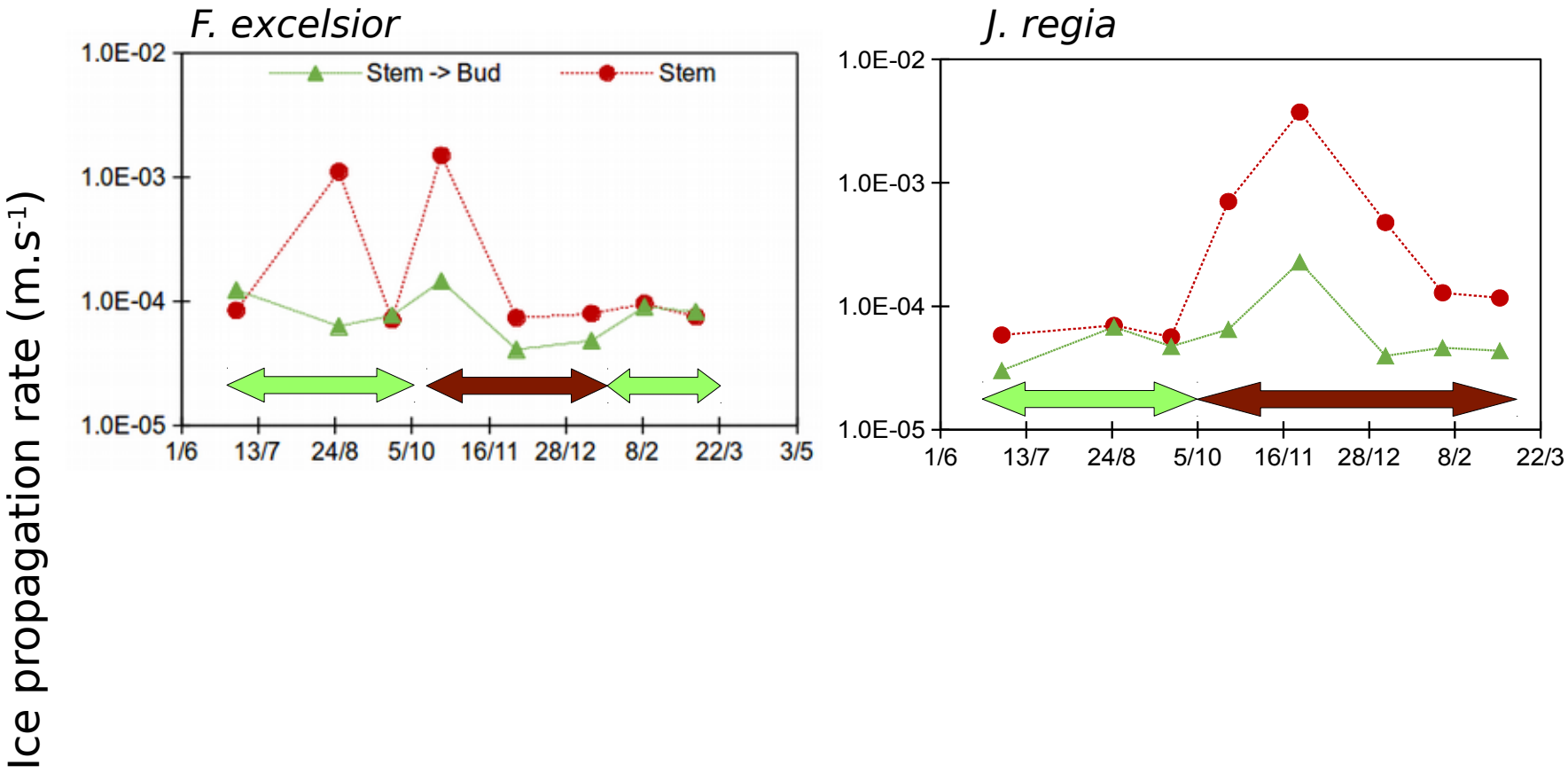

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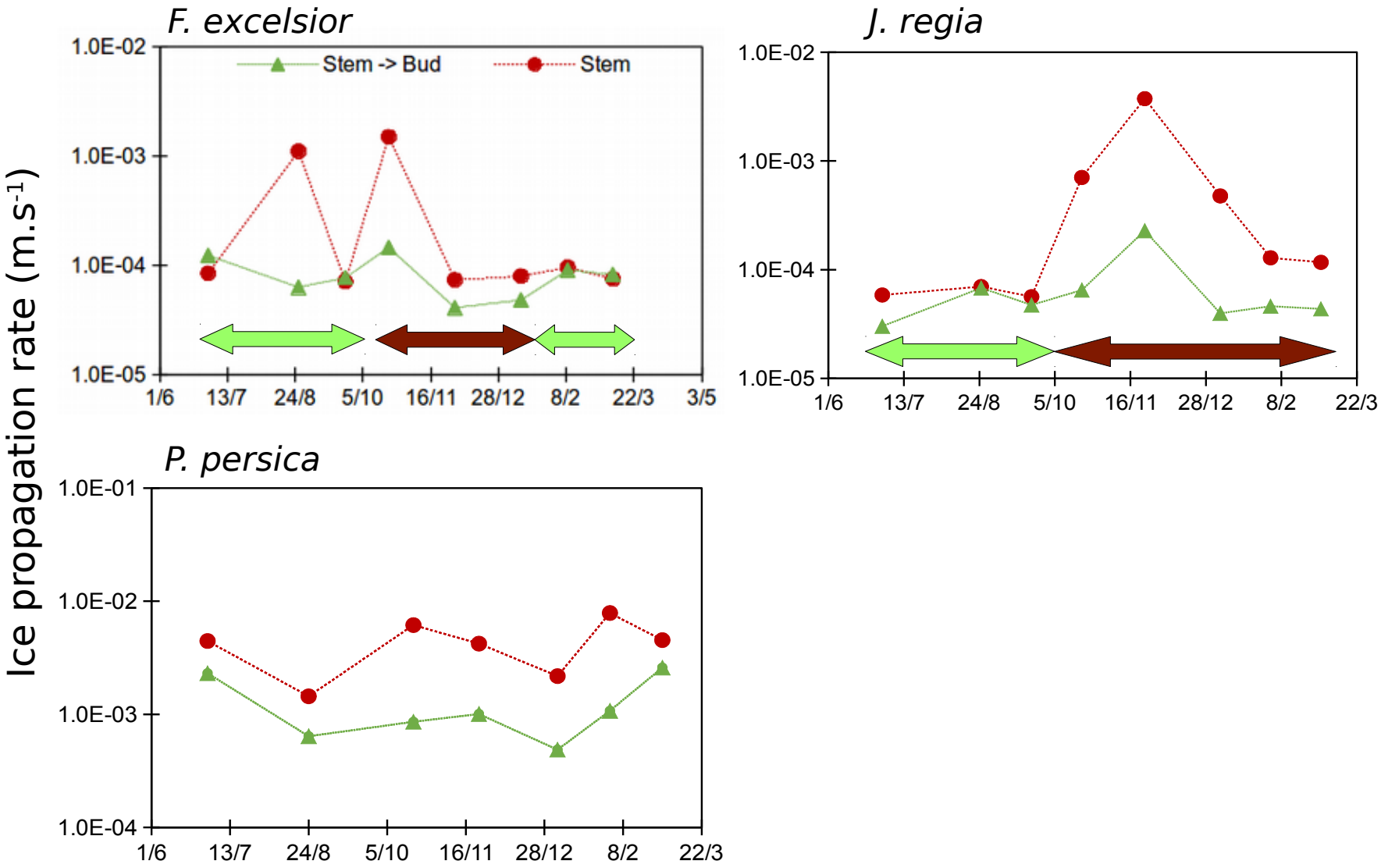

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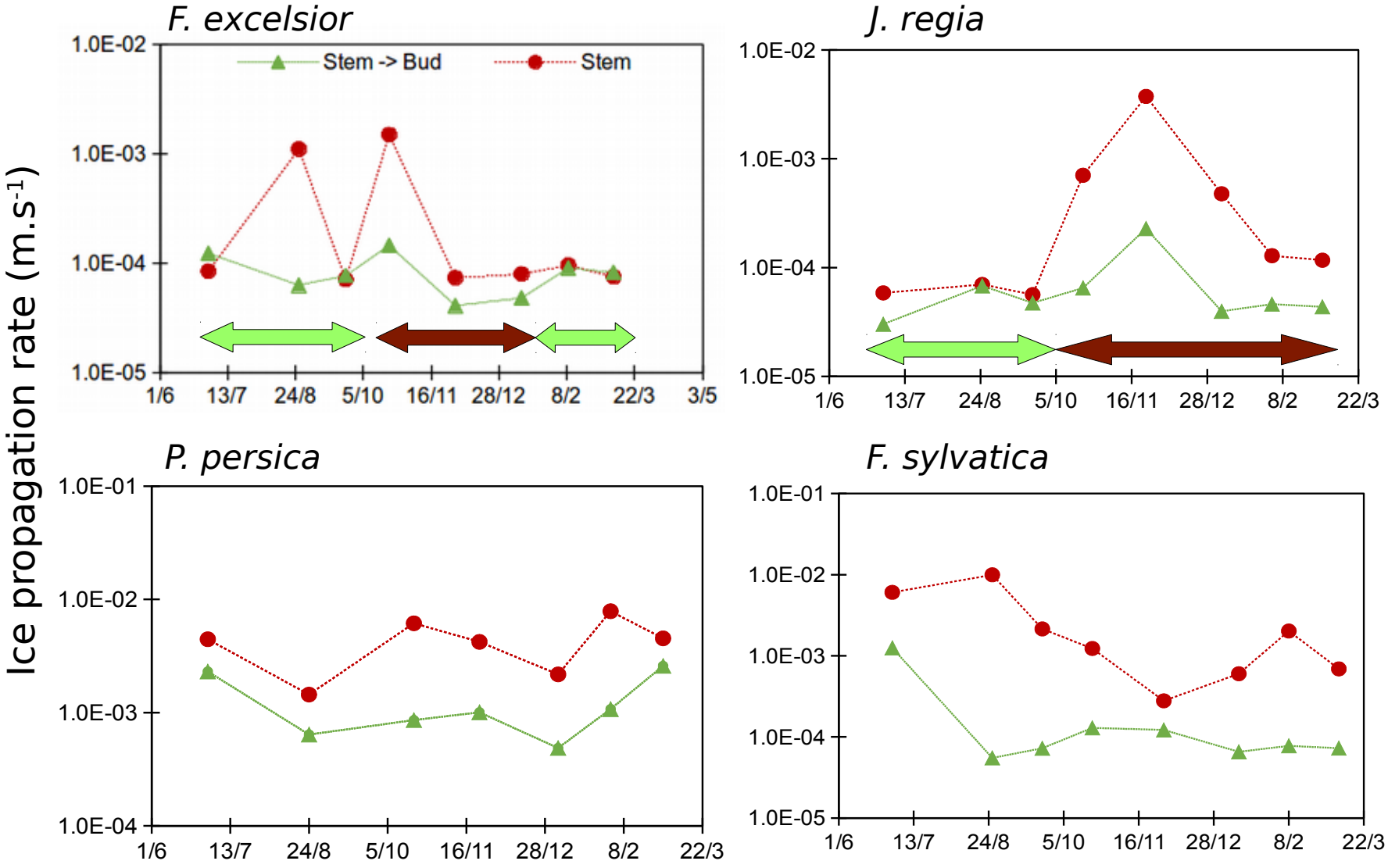

Conclusion and perspectives

- Ice propagates faster within stem than from stem to bud.
- Preliminary results indicate seasonal change in the ice propagation rate
  - from stem to bud
  - within stem
- Large interspecific differences: relation to wood anatomy/ winter embolism?
- Hydraulic disconnexion seems relevant to detect endodormancy induction (*i.e.* formation of an ice barrier) in *Fraxinus sp*, *Juglans sp*, but not *Prunus sp* or *Fagus sp*
- Detection of endodormancy release seems more difficult.
- Work in progress:
  - Improvement of the exotherm detection
  - Characterization of the ice barrier
  - Combination with forcing tests

Thanks to

INRAE