

October 2014



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Crop development – 15 October 2014 Pergamino

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New Zealand's specialist land-based university



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The website...

Info on:

- Current projects
- Field day presentations
- Scientific publications
- FAQs
- Postgraduate study
- Photo Diary
- Direct link to BLOG

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- ▼ Dryland pastures research
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 - ▶ Scientific publications
 - ▶ **Field Day handouts and presentations**
 - ▶ Postgraduate students
 - ▶ Frequently asked questions
 - ▶ Contact us

Dryland pastures research

Dryland pastures research team:

- Derrick Moot
- Dick Lucas
- Alistair Black
- Annamaria Mills

Related Links

- ▶ Dryland Pastures Blog
- ▶ Agricultural Sciences
- ▶ Faculty of Agriculture and Life Sciences

Research projects:

Dryland Pastures – Technology Transfer Programme

This SFF funded project investigates strategies for dryland livestock farmers to drought proof their farming systems using different species and develop their properties with guidance from Lincoln University staff. The farmers involved will develop practical messages for other farmers to follow.

- Marlborough – Technology Transfer
- MaxClover Grazing Experiment
- Lucerne research

High country forage improvement

Funded by the New Zealand Merino Company Ltd., 'Survive, thrive and make money from...' three stages of pasture legume research aimed at high country pastures. Lincoln University staff and postgraduates are working with several high country farmers to determine which species survive and how to make them thrive in the unique soils and climatic conditions of the South Island high country.

- High country stations
- Lees Valley

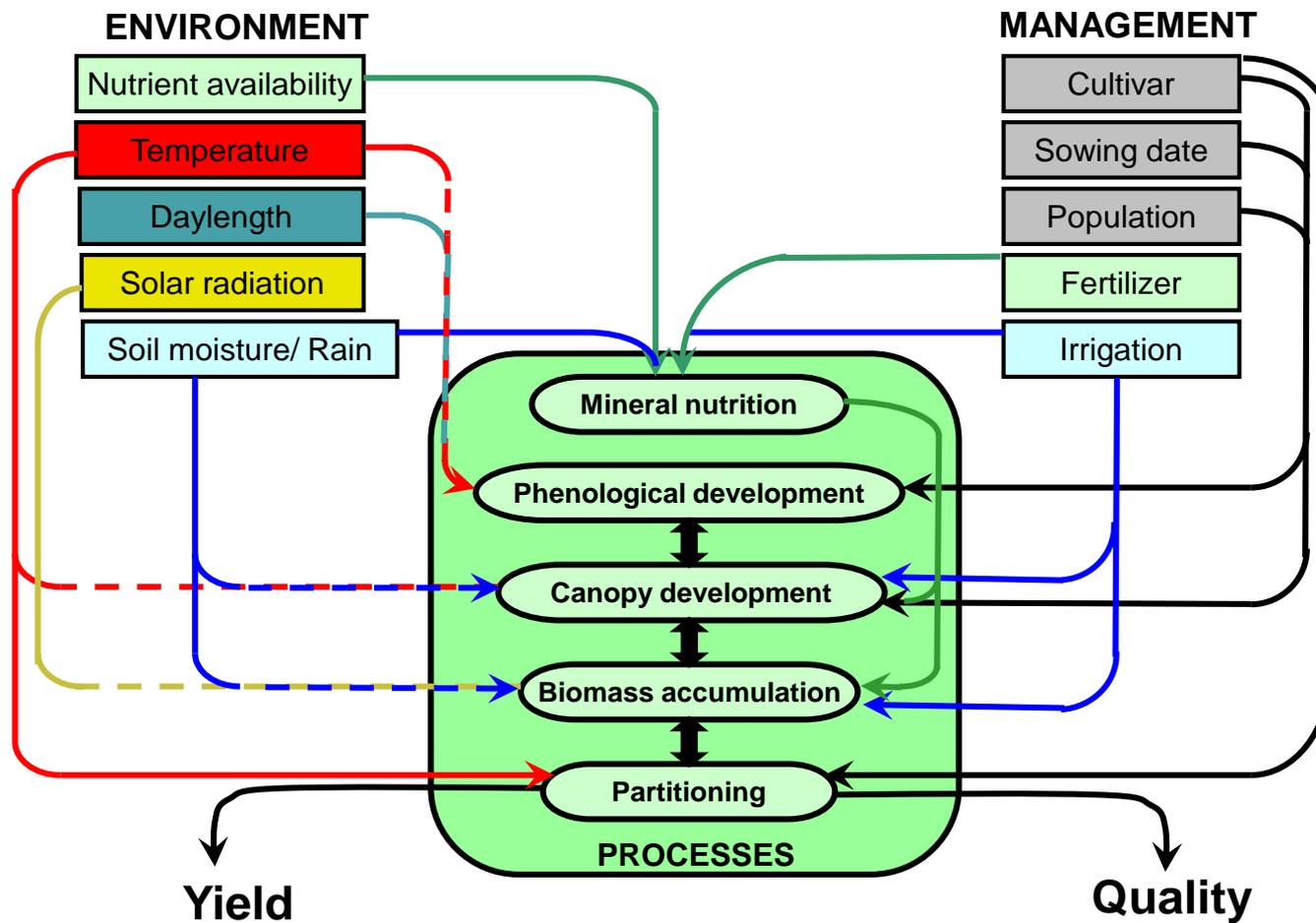
Publications

- Scientific Publications
- Field Day handouts and presentations

Postgraduate research

- Postgraduate student programmes

www.lincoln.ac.nz/dryland



Relationship between environment and management factors and the physiological processes that regulate crop yield and quality. (Source: Hay & Porter 2006).

Growth vs. Development

Growth: an irreversible increase in DM

- function of **light interception** and
- **photosynthesis** and then
- **assimilate partitioning**

Development: irreversible change in the state of an organism

- fixed pattern and reversion is rare
e.g. **silking, flowering, anthesis**

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Main measurements

- Growth and development
- Weekly measurements

Shoots



Crowns and taproots



Leaf appearance & branching

LAI



Measurements

Light environment



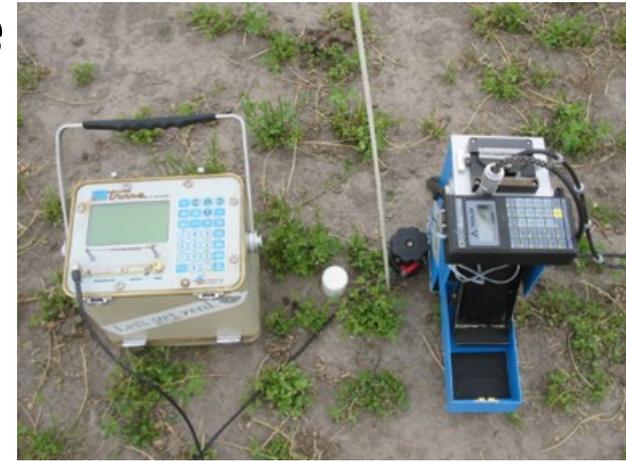
Soil moisture

Chemical Analysis:

- N (shoots and roots)
- Starch in roots
- Soluble sugars in roots

Temperature

- Air and soil



Photosynthesis

Plant development

A) Vegetative

- Emergence and - temperature
- Leaf appearance rates (phyllochron)- temperature

B) Reproductive

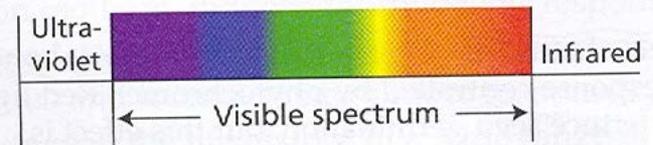
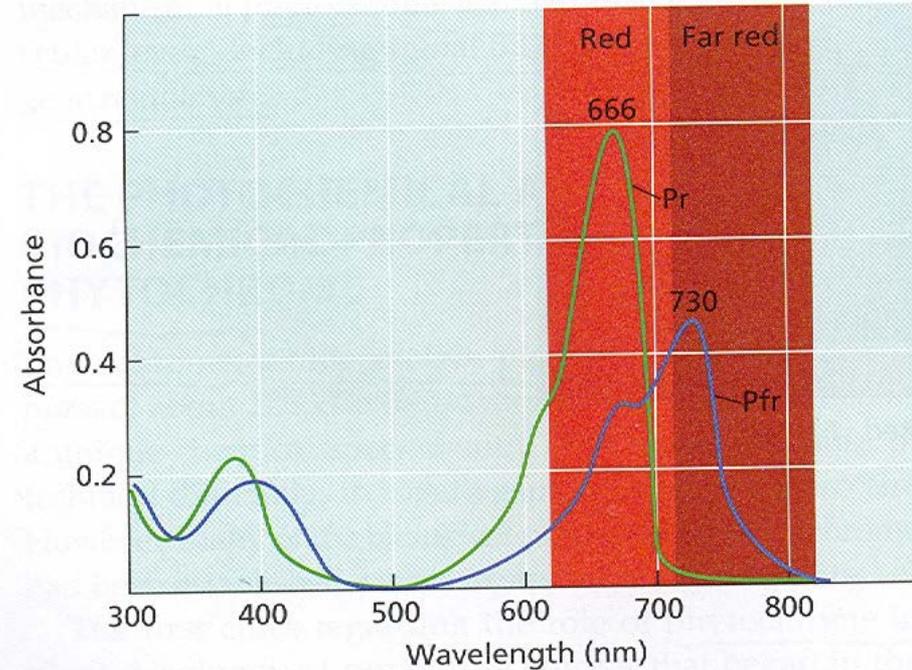
- Time of flowering (anthesis), Temperature and photoperiod
- Duration of grain fill -temperature

Driven by temperature modified by photoperiod and vernalization

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Light

- **Complex & dynamic signal**
- **Quantity of light**
 - photons falling /area/time
- **Quality of light**
 - plant responses



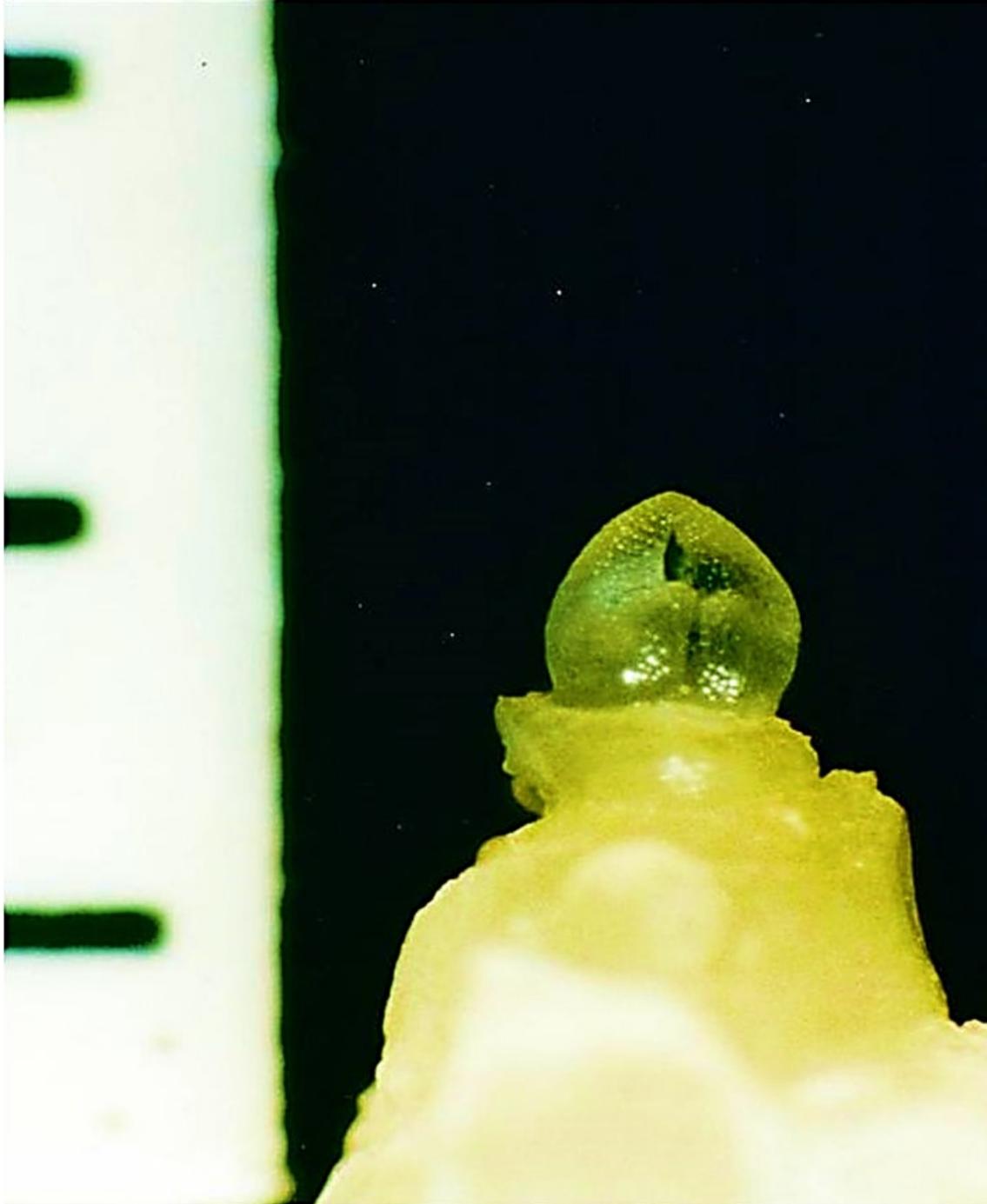
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Development Rate & Environment

Temperature

- i. largest effect on development
- ii. quantified as a rate between two development stages
- iii. approx. linear to a maximum (25-30 °C)
- iv. temperature is perceived by the apex

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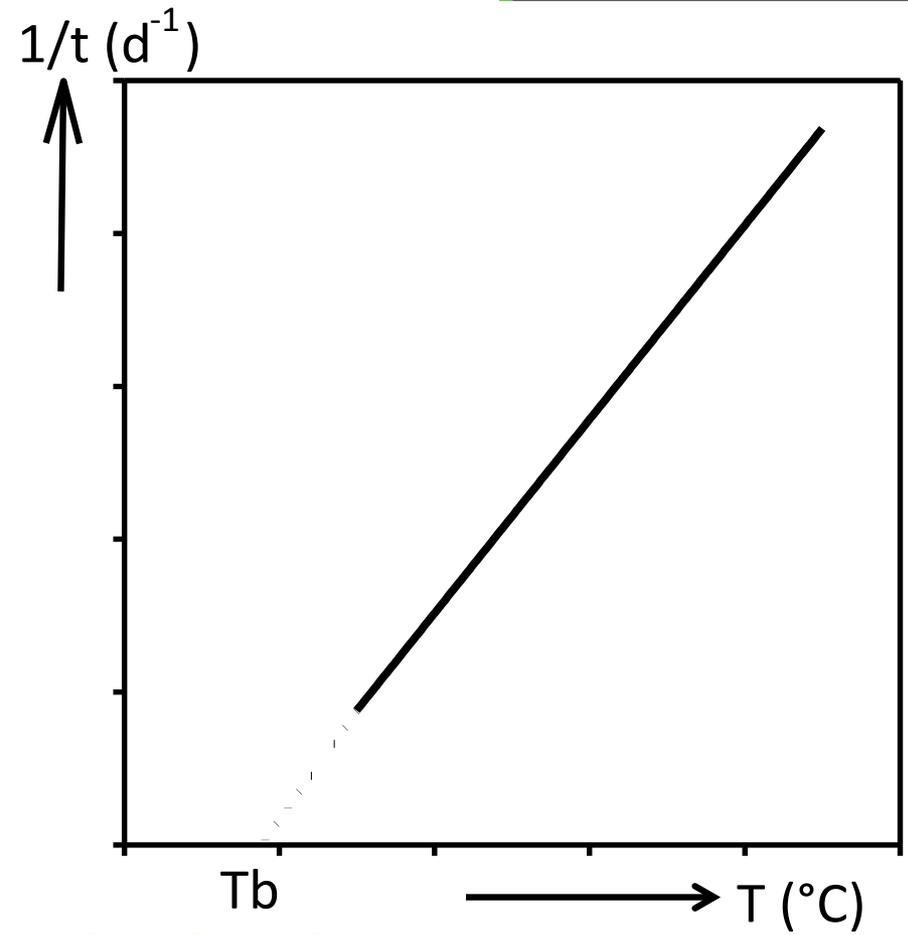
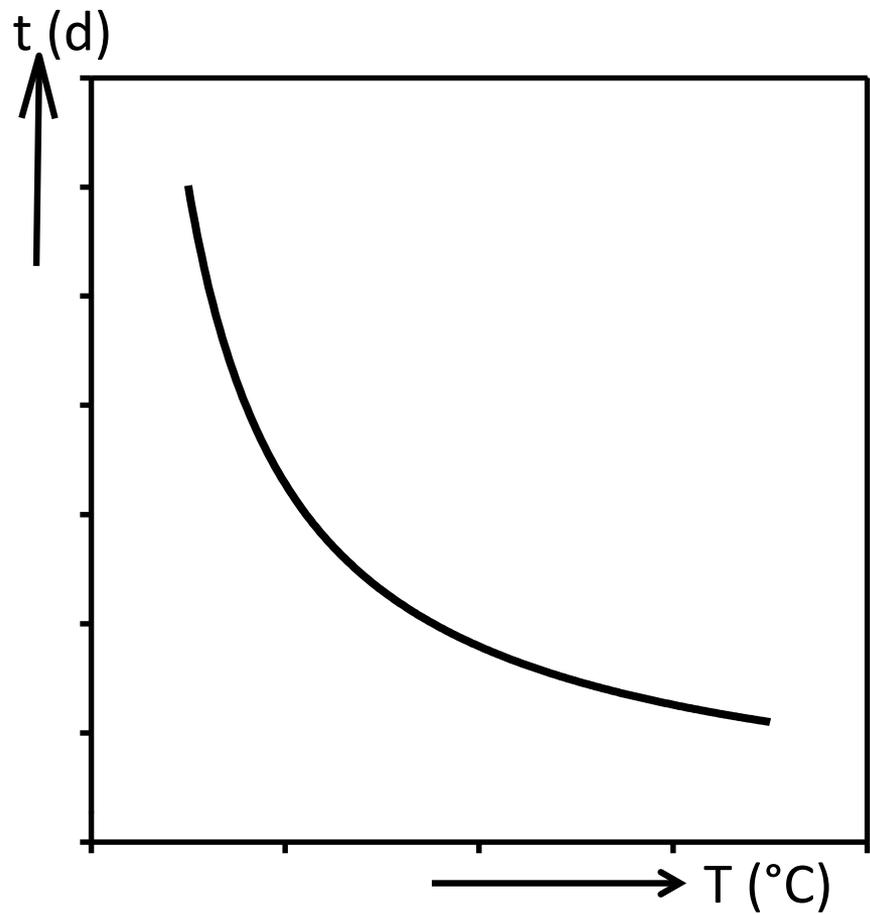


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Development Rate & Environment



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Quantifying thermal time

(using mean daily temperatures)

1) Simplest:

$$T_t = \frac{T_{\min} + T_{\max}}{2} - T_b \quad (^\circ\text{Cd})$$

- good for short periods
- need similar day and night temperatures
- inaccurate for low/high extremes
- temperature cycles through a day

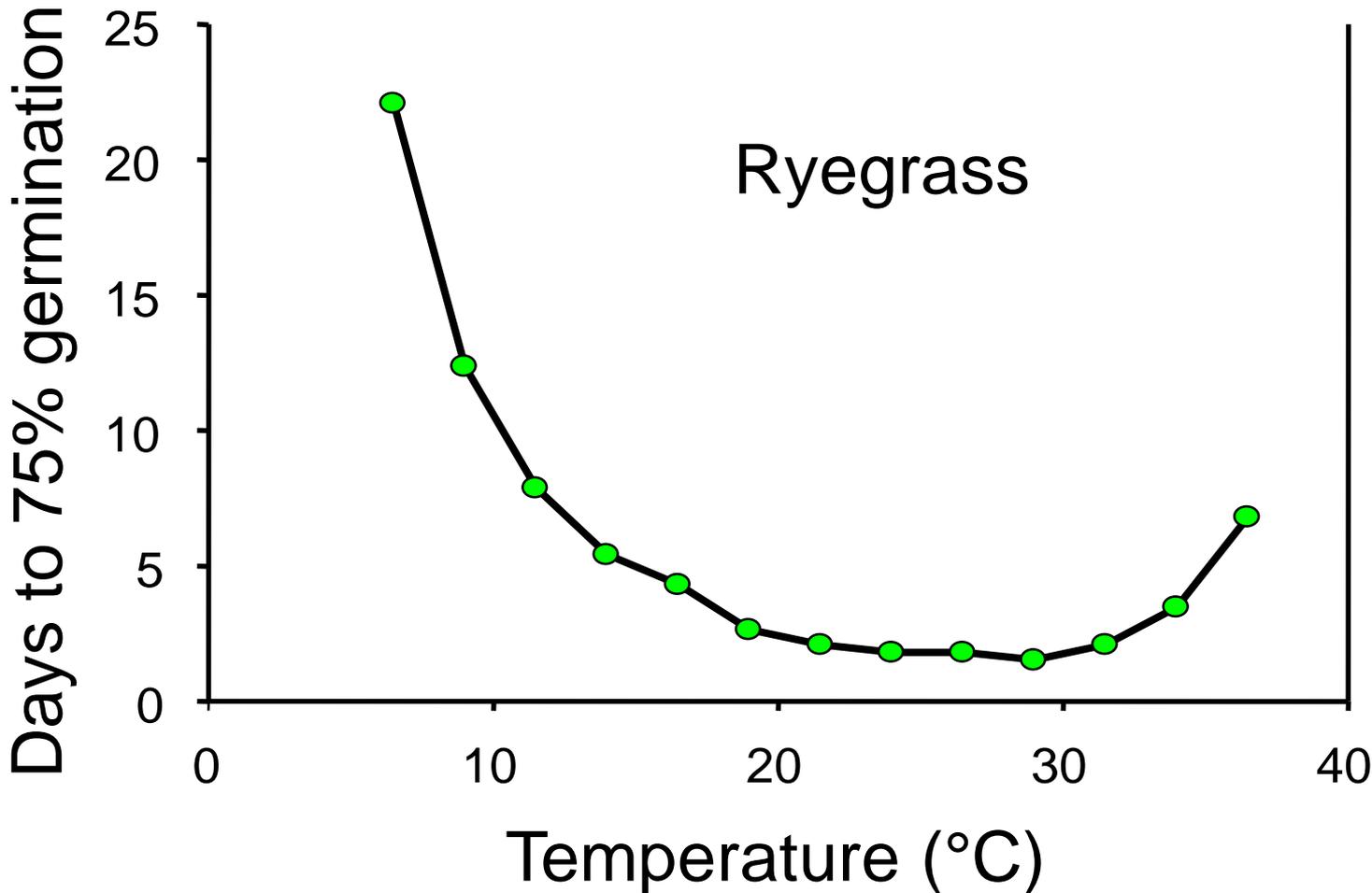
Sowing to emergence



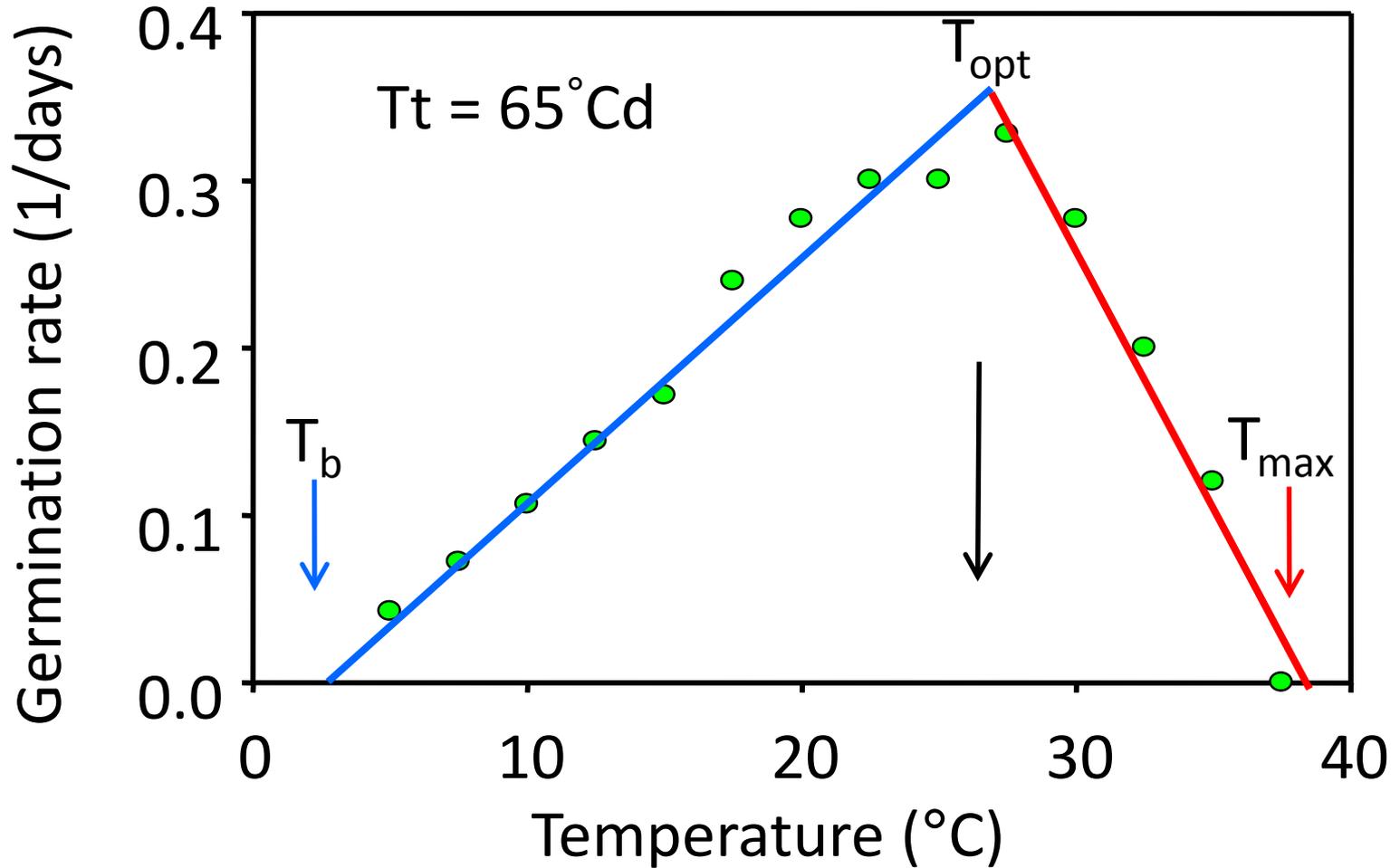
Thermal time

- soil temperature
~ 125-150 °Cd

Time for germination



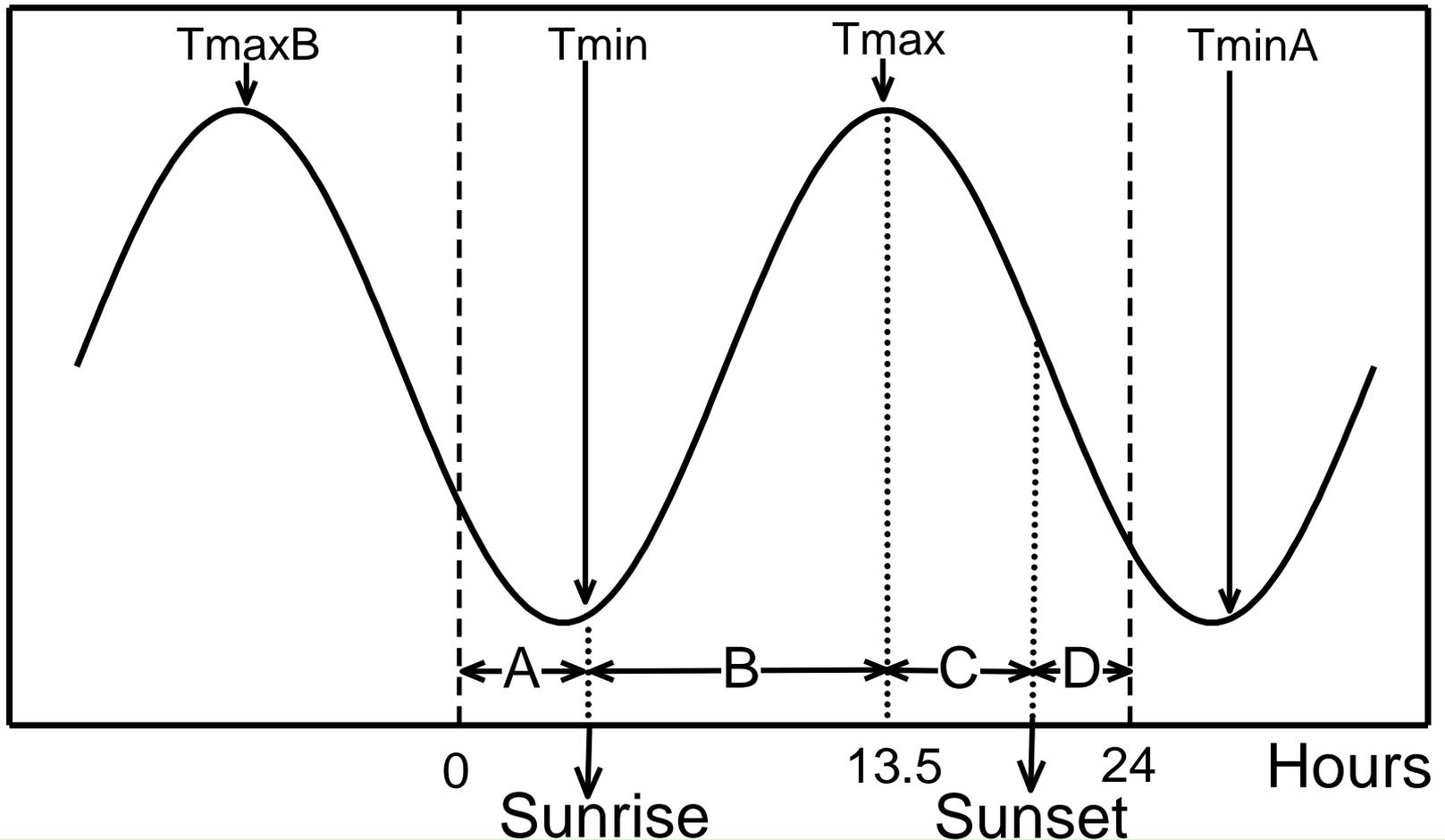
Germination rate



Quantifying thermal time

(using mean daily temperature)

2) Diurnal pattern:



$$Tt = \frac{1}{8} \sum_{r=1}^{r=8} [T_H - T_b] \text{ } ^\circ\text{Cd}$$

Where;

$$T_H = T_{\min} + \int r(T_{\max} - T_{\min})$$

and;

$$\int r = \frac{1}{2} \left[1 + \frac{\cos 90}{8} (2r - 1) \right]$$

i.e. 8 x 3 hourly calculations summed to give daily $Tt = T_H$

Max or Min outside linear portion

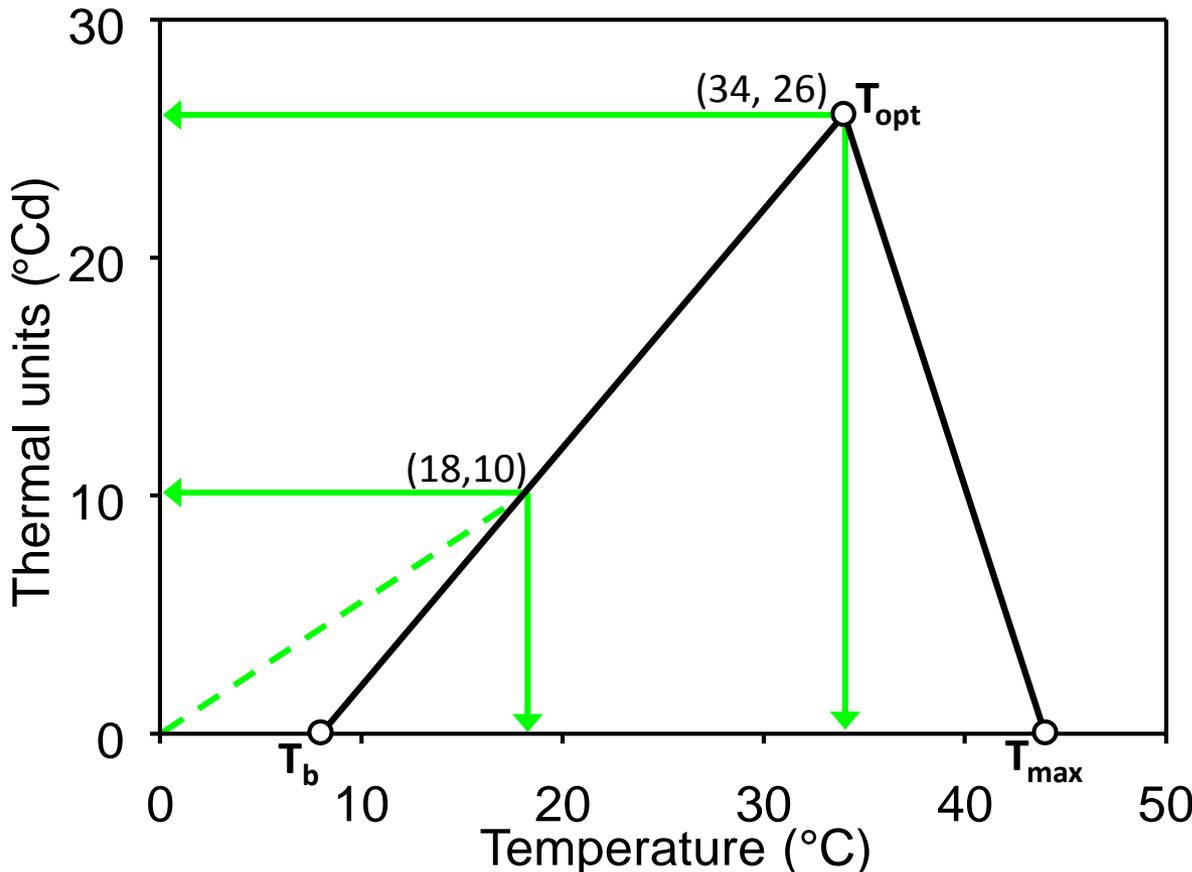


Forage crops

Quantifying thermal time

(using mean daily temperatures)

- Note:
- i) Negative temperatures or $< T_b$ count as zero (0)
 - ii) Function reaches a maximum at 2 pm and minimum at 2 am
 - iii) Not all temperatures contribute equally to development



e.g. Maize:

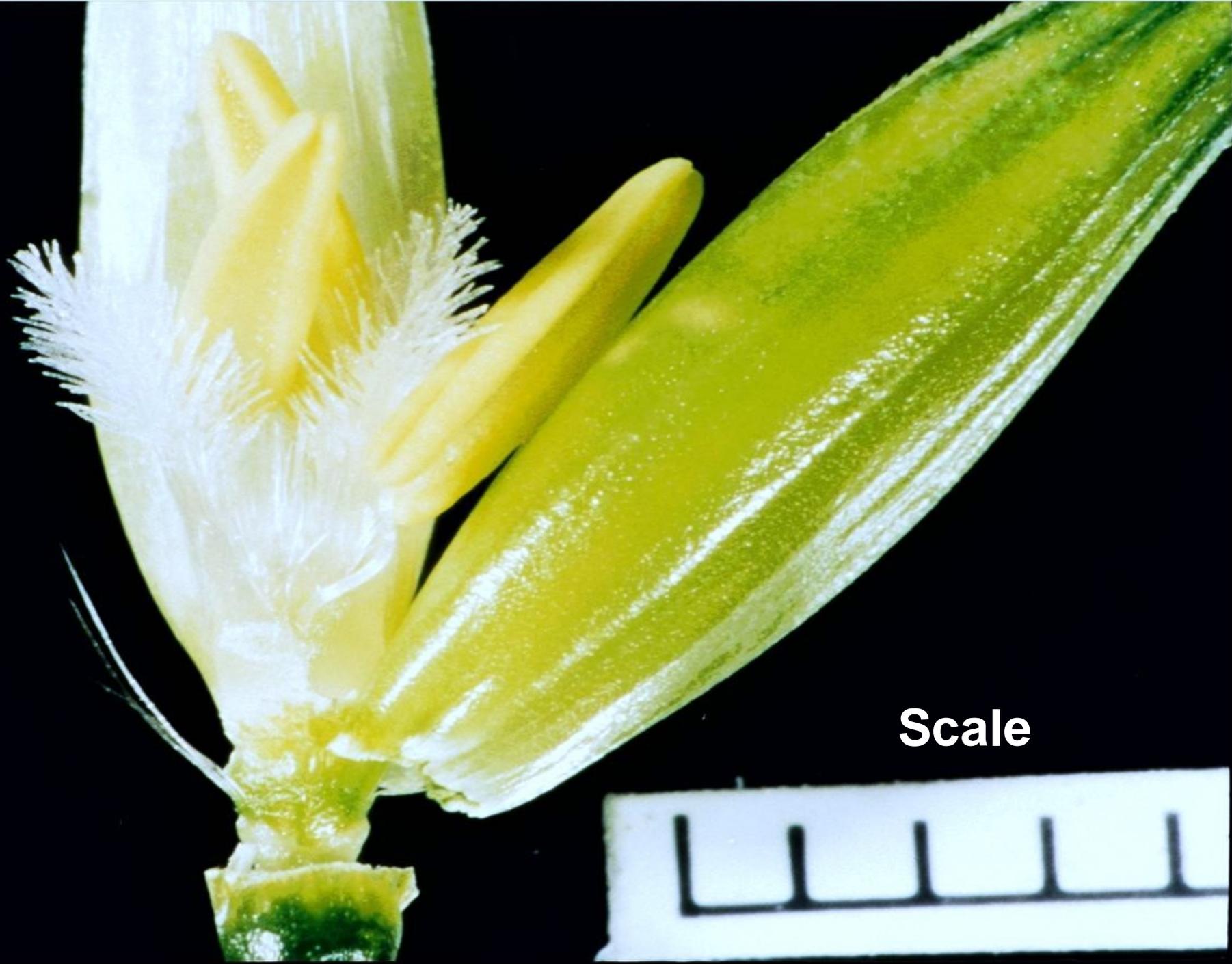
$$T_b = 8 \text{ } ^\circ\text{C},$$

$$T_{opt} = 34 \text{ } ^\circ\text{C},$$

$$T_{max} = 44 \text{ } ^\circ\text{C}$$

Flowering

- Flowering is the crucial moment in development
i.e. shift from vegetative to reproductive priority.
- Growth can occur without development
e.g. Sugarbeet
- Development can occur to induce flowering in
plants of vastly difference dry weight



Scale

Grain-filling: constant in thermal time – air temperature



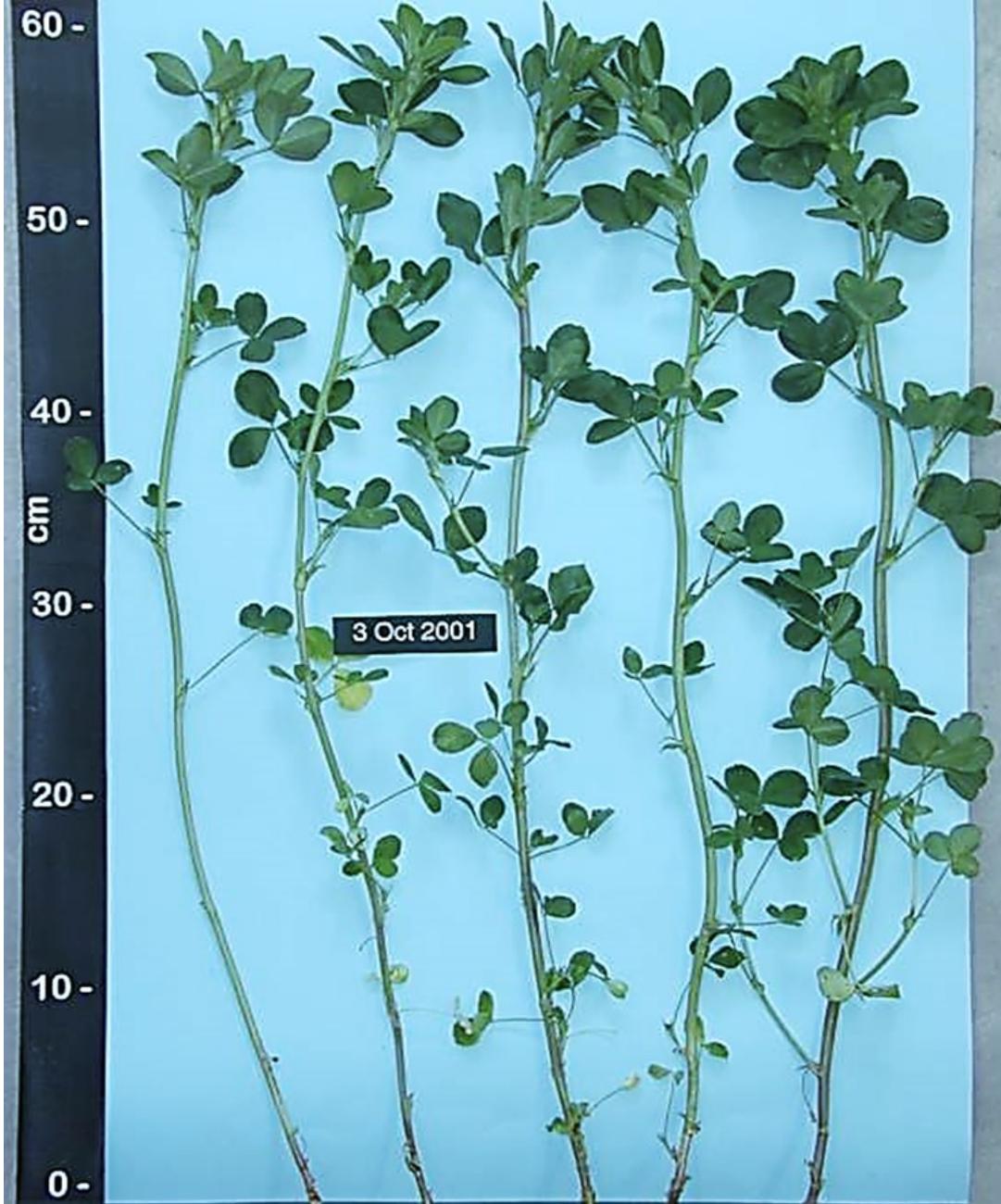


Plot: 19
Date: 26/2/06
Site: 19





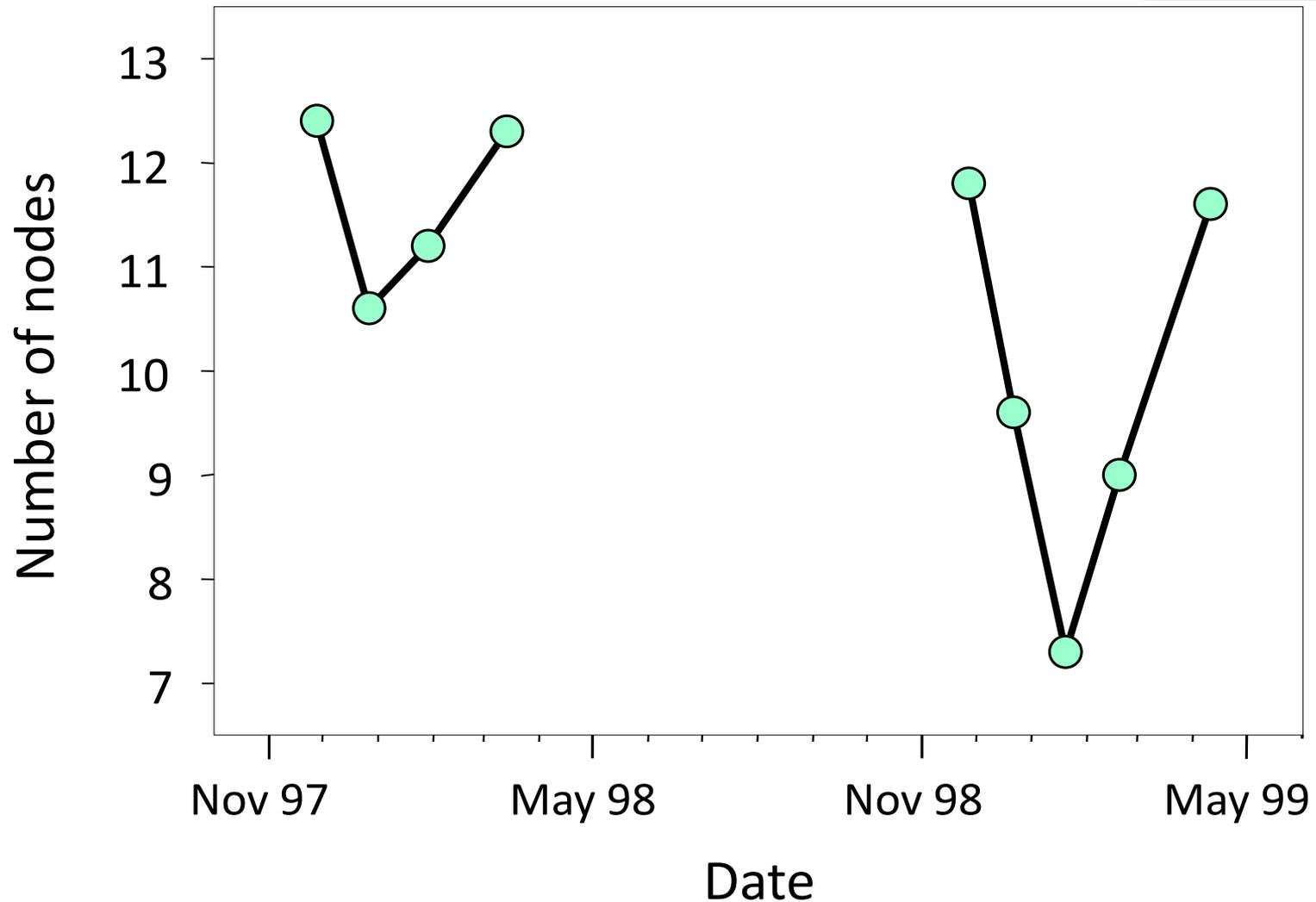
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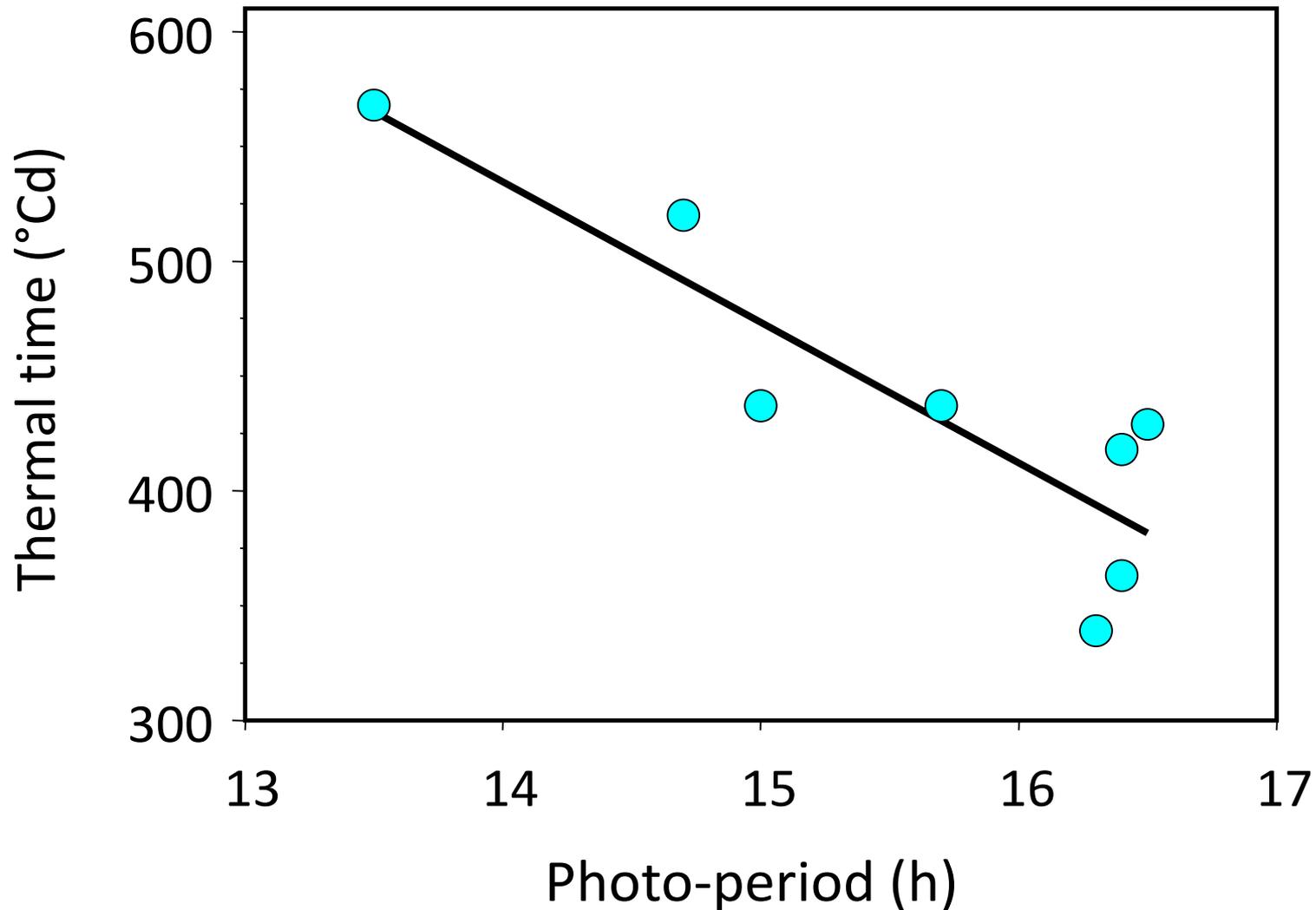
Stem height

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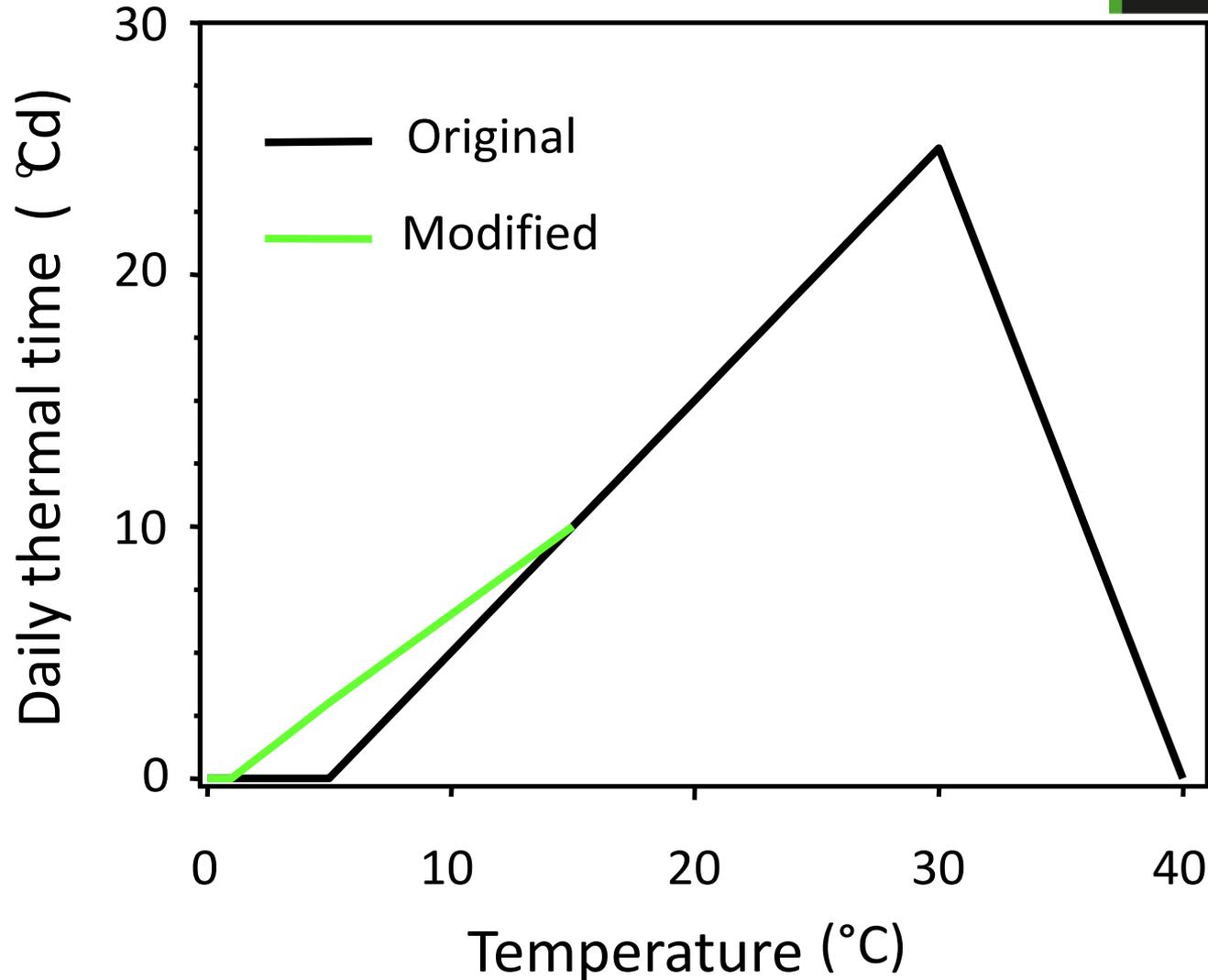
Nodes to first flower



Thermal time to early-bud



Thermal time response



Conclusions

- **Development - driven by temperature
- modified by Pp**
- **Alfalfa - flowering – Pp change**
- **Alfalfa - Tb (air) modified below 15 °C**
- **Measuring the correct temperature matters**

***Understand crop growth and development as a
basis for agronomy and plant breeding.***

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References & Links



Dryland Pastures Website: <http://www.lincoln.ac.nz/dryland>

Dryland Pastures Blog: <http://www.lincoln.ac.nz/conversation/drylandpastures/>

Lincoln University student website: www.lincoln.ac.nz

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