Quantitative trait loci associated with the "shade avoidance" type response in *A. thaliana* when grown under oscillating daily summer temperatures.

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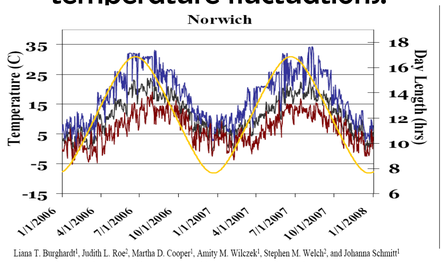
Plants normally experience daily temperature fluctuations.



Liana T. Burghardt[1], Judith L. Roe[2], Martha D. Cooper[1], Amity M. Wilczek[1], Stephen M. Welch[2], and Johanna Schmitt[1]
[1]Brown University, Providence, RI, USA and [2]Kansas State University, Manhattan, KS, USA

These fluctuation can be as narrow as 5°C, but are often well over 10°C, especially in the summer.

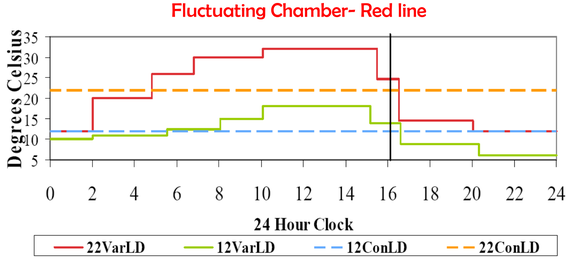
In the lab, *A. thaliana* rarely experiences fluctuations broader than 2°C.

How does this affect our understanding of the growth, physiology and genetics of *Arabidopsis*?

The Treatments

Most *Arabidopsis* are winter annuals, however, in cooler climates, some strains can grow and flower over the summer.

Control Chamber- Orange line
Fluctuating Chamber- Red line



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Plants were grown in Percival I-360 Incubators programmed to simulate summer field conditions in Norwich, UK, at the southern extreme of the normal range for summer growth of *A. thaliana*.

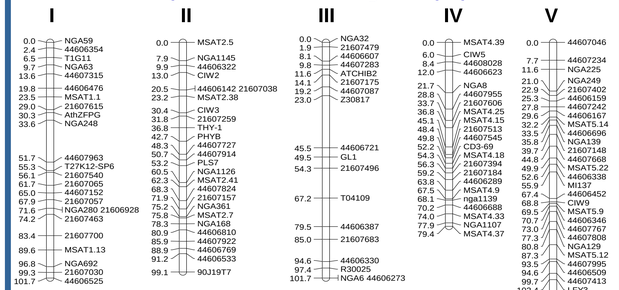
The Plants

92 Kas-1 x Col-gl1 Recombinant Inbred Lines

Parental Lines:
Kashmir (A wild strain from the Himalayan region)
Requires vernalization (cold exposure prior to flowering)
Columbia-gl1 (Derived from Columbia-1,a lab strain)
Does not require vernalization

Known to segregate for several growth and flowering genes such as FRI, FLC, FLM, MAF2, CRY2, and HUA2

Genetic map of the Kas-1 x Col-gl1 RIL population



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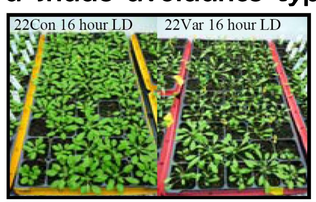
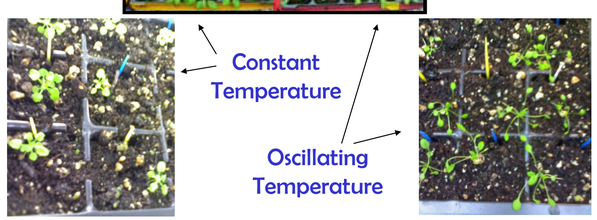
Growth under oscillating temperatures induces a 'shade-avoidance' type response.





Plants grow longer thinner, leaves, similar to when they are grown in shade.

But- Is this response the same across different strains?

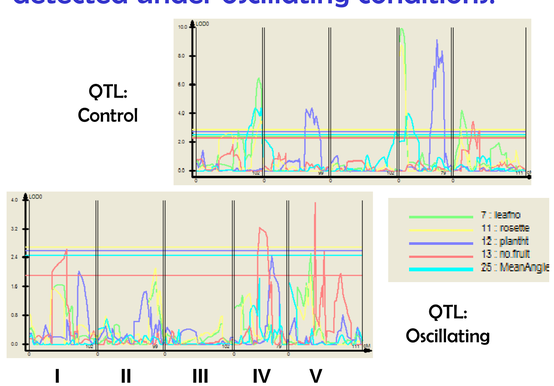
The Traits

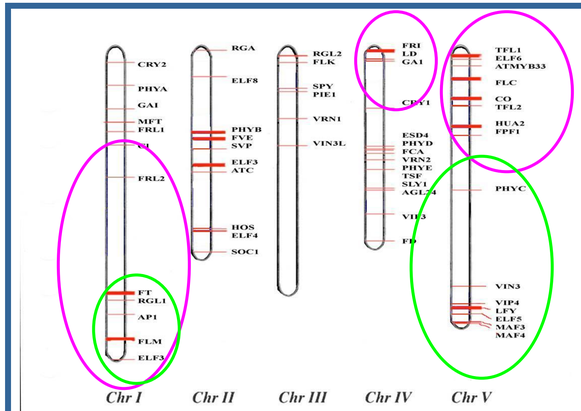
	Loci detected by ANOVA*			Loci detected by Composite Interval Mapping	
Vegetative Traits	**Strain**	**Trt**	**SxT**	**Control**	**Oscillating**
2 pair true leaves:					
Early Leaf Length	***	***		I(t) V(2)	none
Early Petiole Length	*	***		IV V(2)	IV
Early Width	*		*	I(b) V(t)	V(2)
2 → 4 Leaves (days)				V(b)	none
4 pair true leaves:					
Late Leaf Length	*	***		I	none
Late Petiole Length	**	***		I	I
Late Width				I II III	III
4 → 8 Leaves (days)		**		V (t)	II
Reproductive Traits					
Onset of Flowering					
Leaf Length	No ANOVAs: Kas-1 does not flower without vernalization! But it does under oscillating temperaures!			I IV V(t)	none
Petiole Length				I (2) IV	none
Width				V(t)	IV V(t)
2 Leaves→ F. (days)				I (2) IV V(t)	I IV
Leaf #				I IV V(t)	none
Rosette size				I IV	none
1st Dehiscent Fruit					
Flower Height				II IV	none
# Fruit				V(m)	I IV V(m)
Mean Angle (overall)				I IV	none

p = < 0.05, ** p = < 0.001, ***p = < 0.0001

Strain x Treatment interactions indicate loci controlling the response to oscillating temperature may differ between strains.

QTL Maps also show that different loci are detected under oscillating conditions!





Under lab conditions, we detect several QTL containing 'known' growth and flowering genes. However, many of these loci cannot be detected under oscillating summer temperatures!

The Genes

We measured expression levels of 6 known growth and flowering genes located in our QTL using RT-PCR. Four showed strain-specific differences in the levels of expression under oscillating summer temperatures.