

# How to breed novel flowering traits in strawberry?

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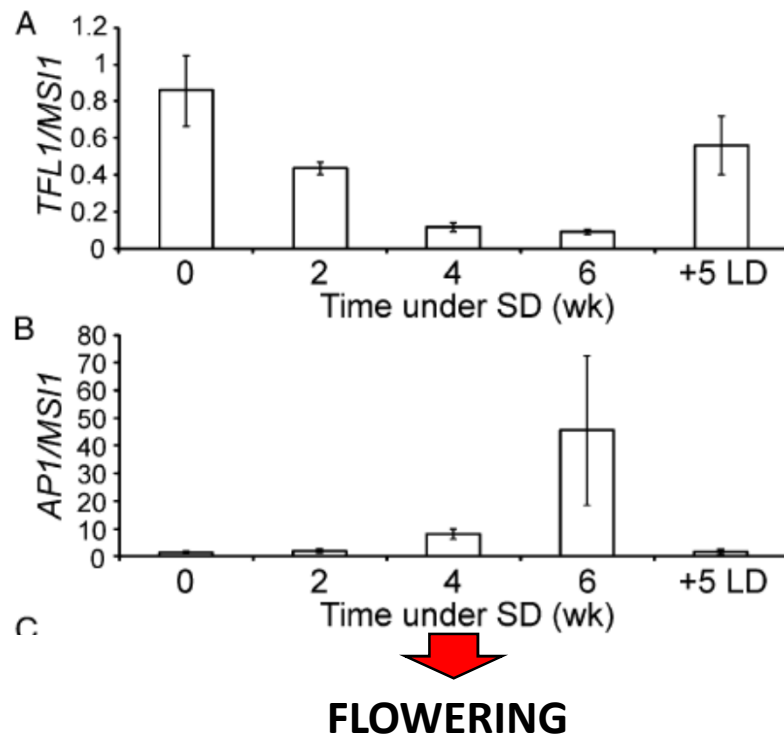
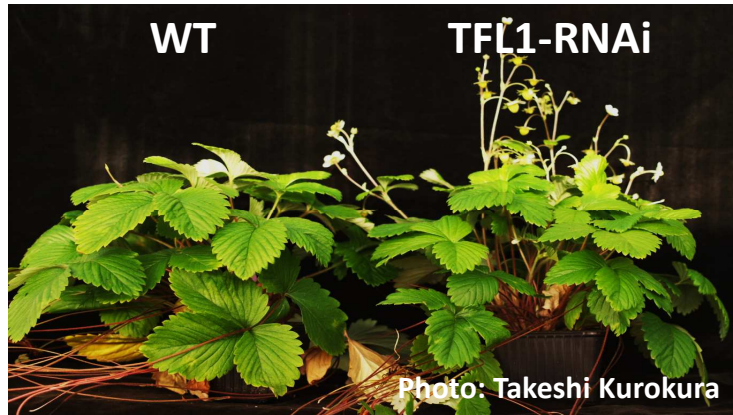
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# Breeding of flowering traits



- Flowering time is an important breeding target in many crops
  - Genetic control studied in models
- My group is studying genetic control of flowering in a Rosaceae model woodland strawberry
- Important flowering traits in strawberries:
  - Earliness
  - Duration, including perpetual flowering
- Different genes cause perpetual flowering in woodland strawberry and current octoploid cultivars
  - Woodland strawberry: TFL1 on LG6 (Koskela et al. 2012; Iwata et al. 2012)
  - Cultivated strawberry: PFRU on LG4 (Gaston et al. 2013)

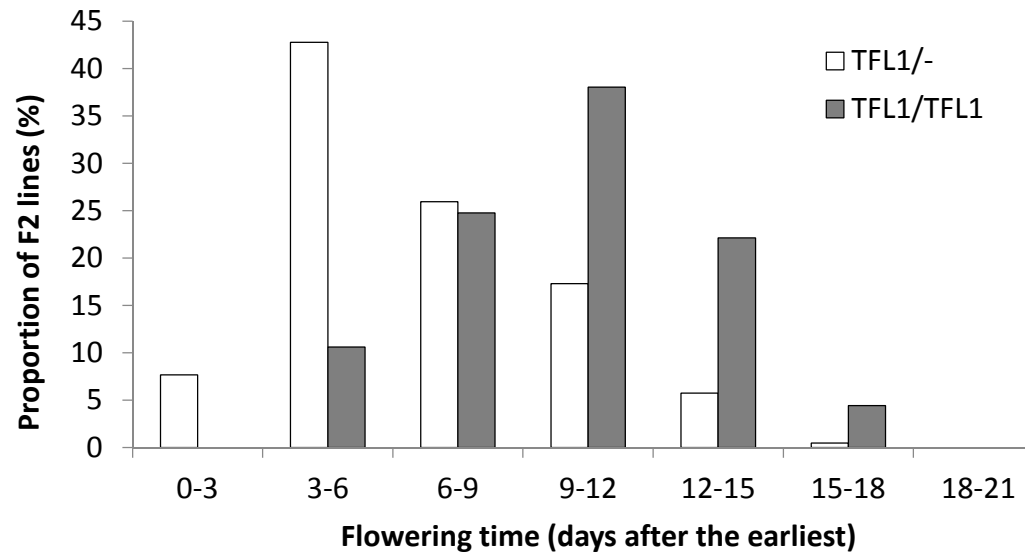
# Control of flowering in woodland strawberry



## ENVIRONMENTAL CONTROL

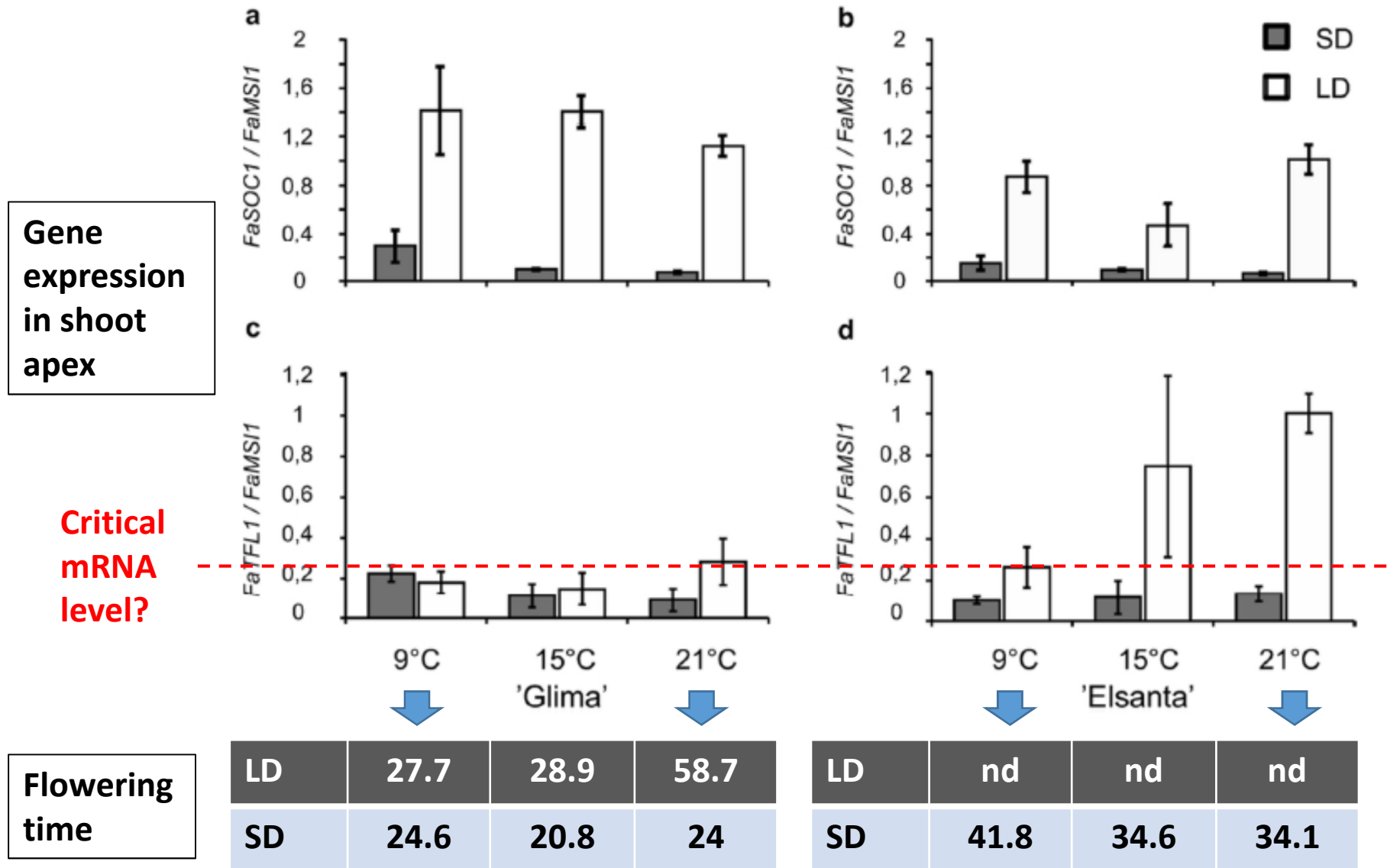
|         | LD   | SD   |
|---------|--|--|
| >20°C   | FvFT1/<br>FvSOC1 → A<br>↓ ↓<br><b>FvTFL1</b><br> | FvFT1/<br>FvSOC1 → A<br>↓ ↓<br><b>FvTFL1</b><br> |
| 13-20°C | FvFT1/ FvSOC1<br>↓<br><b>FvTFL1</b><br>          | FvFT1/ FvSOC1<br>↓<br><b>FvTFL1</b><br>          |
| <13°C   | FvFT1/ FvSOC1<br>↓<br><b>FvTFL1</b><br>          | FvFT1/ FvSOC1<br>↓<br><b>FvTFL1</b><br>          |

# *FvTFL1* has a quantitative effect on flowering time



- Flowering time in H4 (*tfl1* mutant) x FIN56 (seasonal flowering *F. vesca*) F2 population depends on the number of functional TFL1 alleles
- **What is the functional role of TFL1 in cultivated strawberry?**

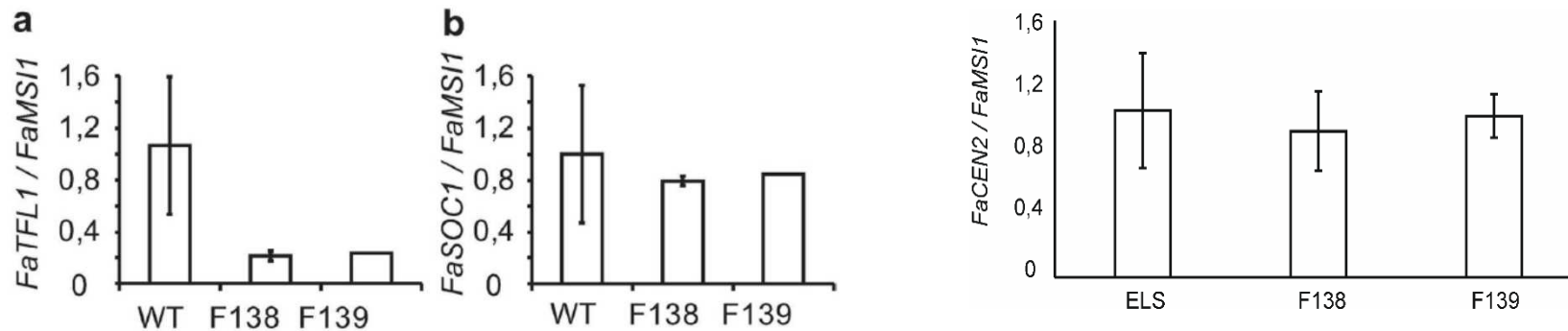
# *TFL1* expression correlates with flowering time in cultivated strawberry



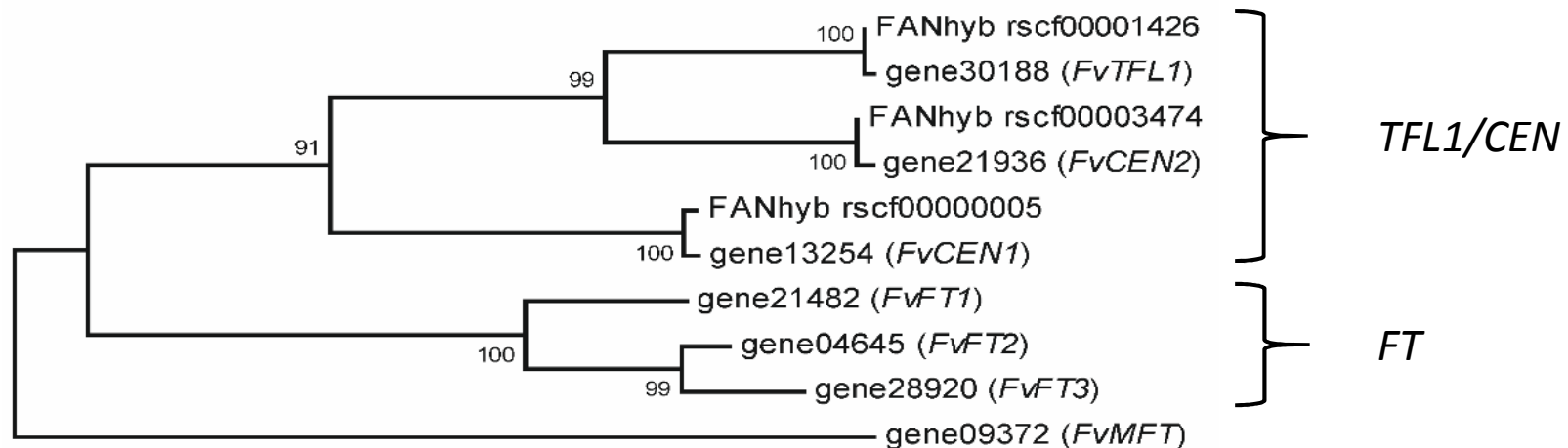
# Function of TFL1 in cultivated strawberry

## **TFL1-RNAi in cv. Elsanta**

- *TFL1* was down-regulated
- *CEN2* not affected



## **Phylogeny of *FT/TFL1* genes in strawberry**



# Phenotypes of *TFL1*-RNAi lines

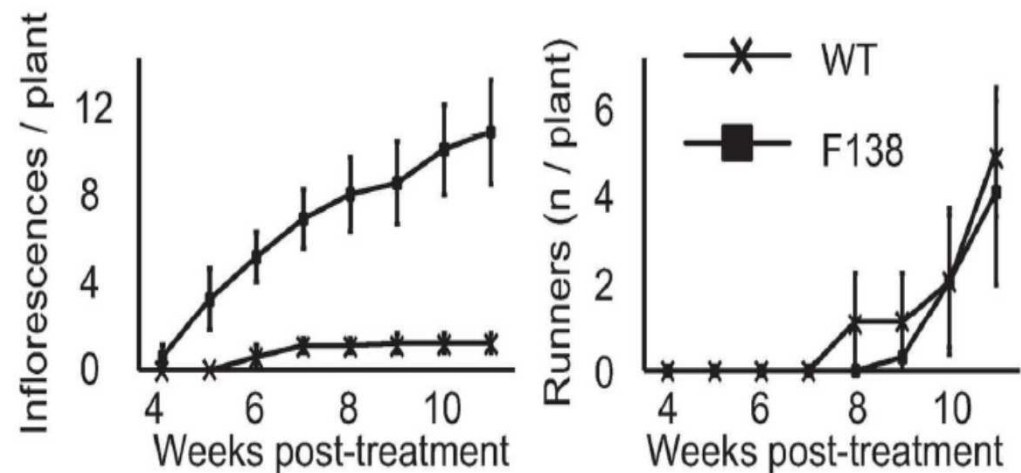
## *TFL1*-RNAi in cv. Elsanta

- Occasional flowering *in vitro*
- Early flowering in long days



## Other phenotypes

- Artificial growth cycle experiment
- Earlier / perpetual flowering
- No effect on early runner production

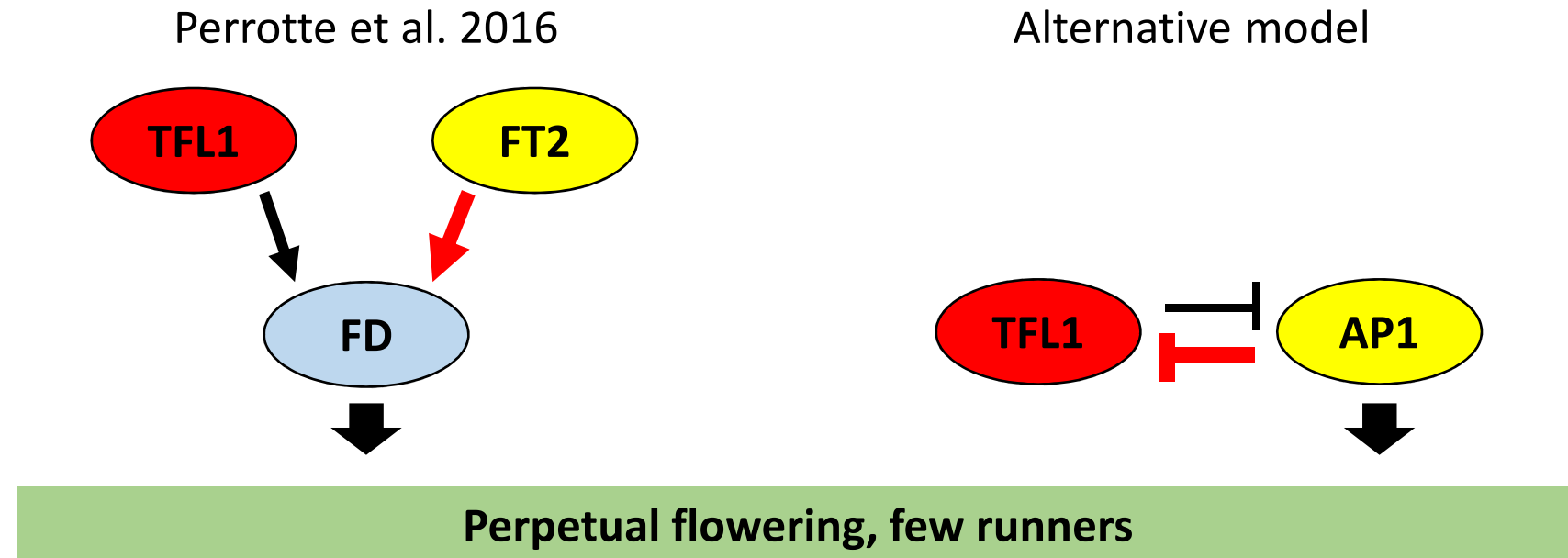


# Conclusions

- TFL1 is a major floral repressor also in cultivated strawberry
- Silencing of *TFL1* is an alternative way to produce perpetual flowering
  - Targeted mutagenesis
  - Weak/null alleles??
- Selection of *TFL1* alleles may allow fine-tuning of flowering time
  - New research on *TFL1* allelic variation needed



# What is the relationship between *TFL1* and *PFRU*?



## **FT2 is expressed in flowers and fruits**

- Altered spatial expression?
- Altered protein transport?

## **Both genes expressed in the meristem**

- Altered *AP1* activity?

# Acknowledgements



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