The role of *FLC* and *PHP* in warm winter bud dormancy activation in *Brassica napus*

IRC 2023, Sydney

Samuel Warner, John Innes Centre

John Innes Centre

Unlocking Nature's Diversity

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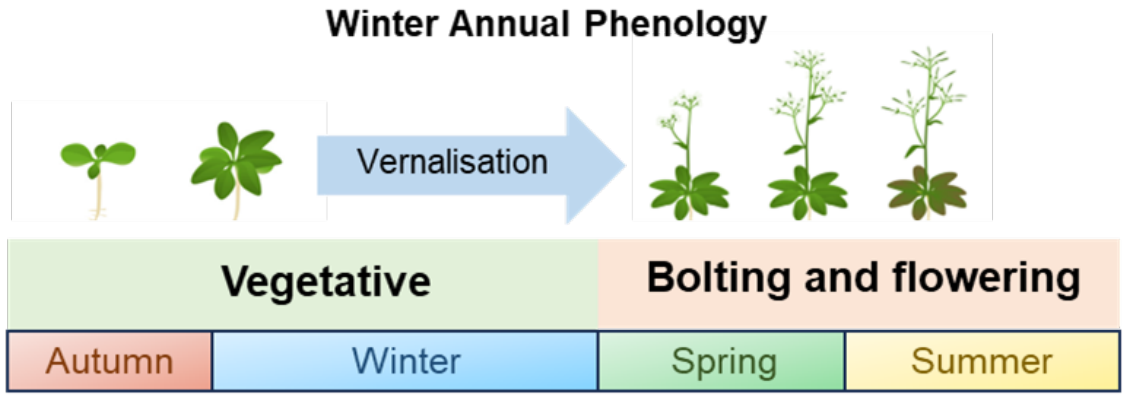
Winter annuals vernalise in winter before spring flowering



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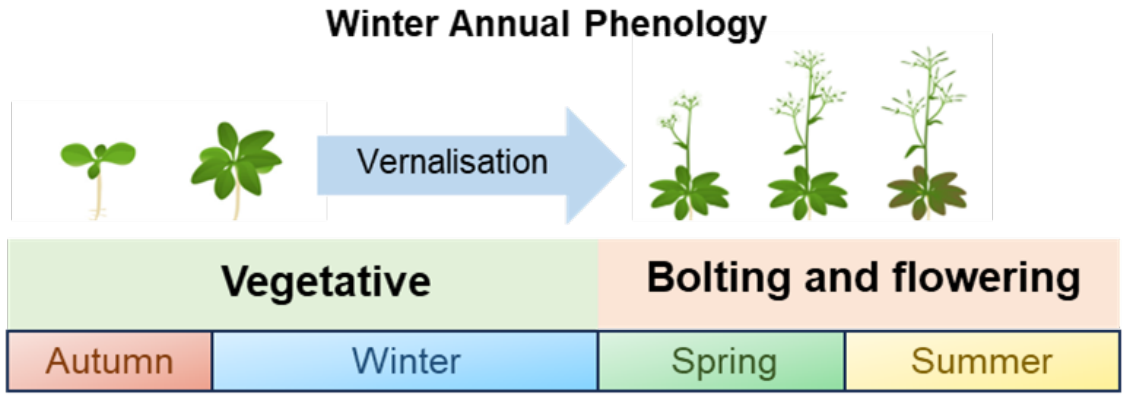
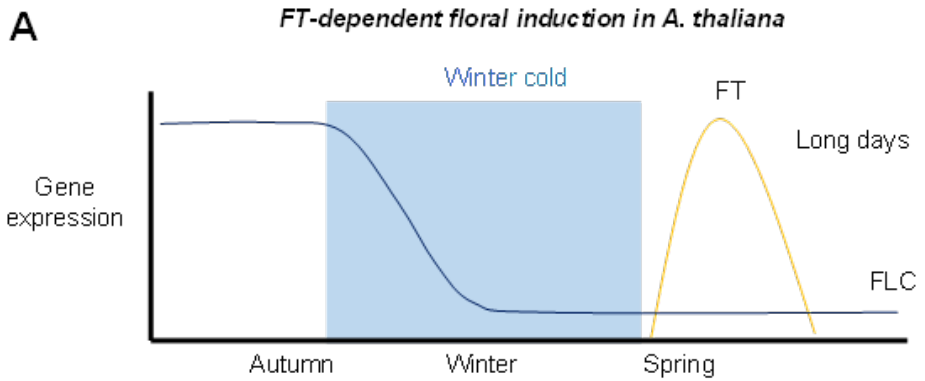
Warm long spring days then promote floral development





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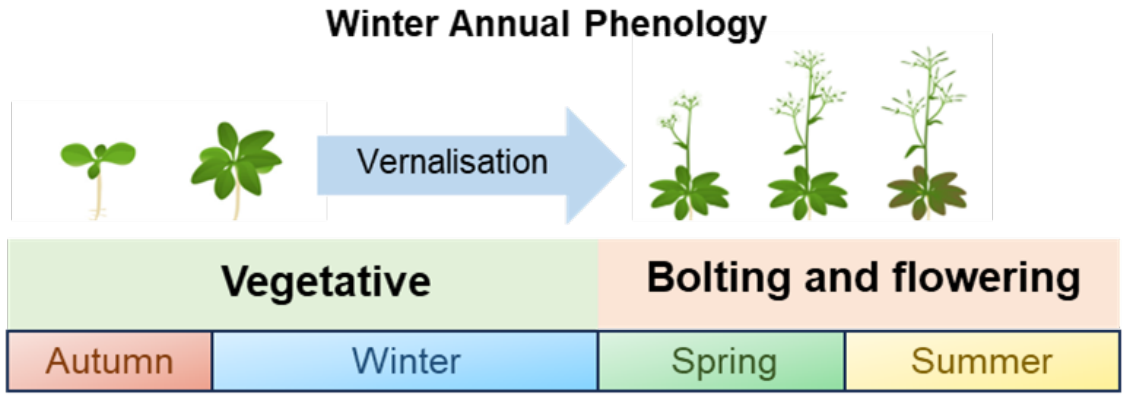
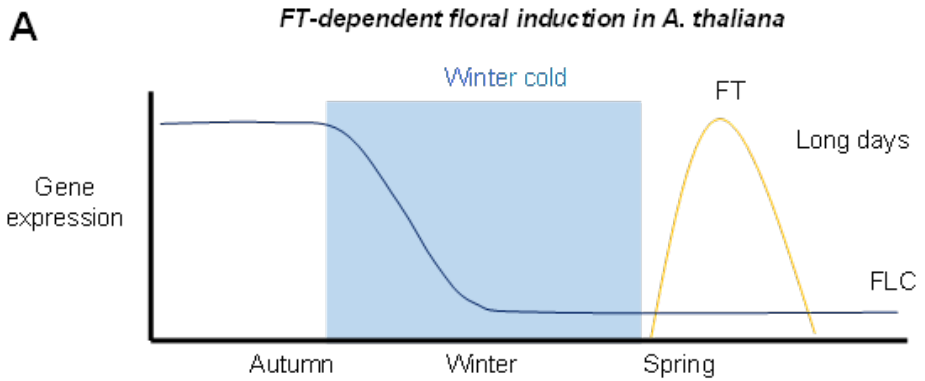
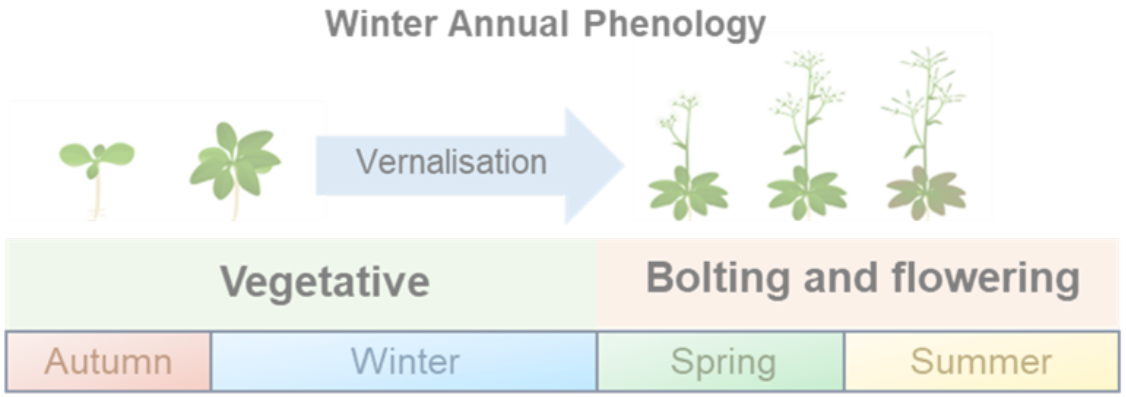
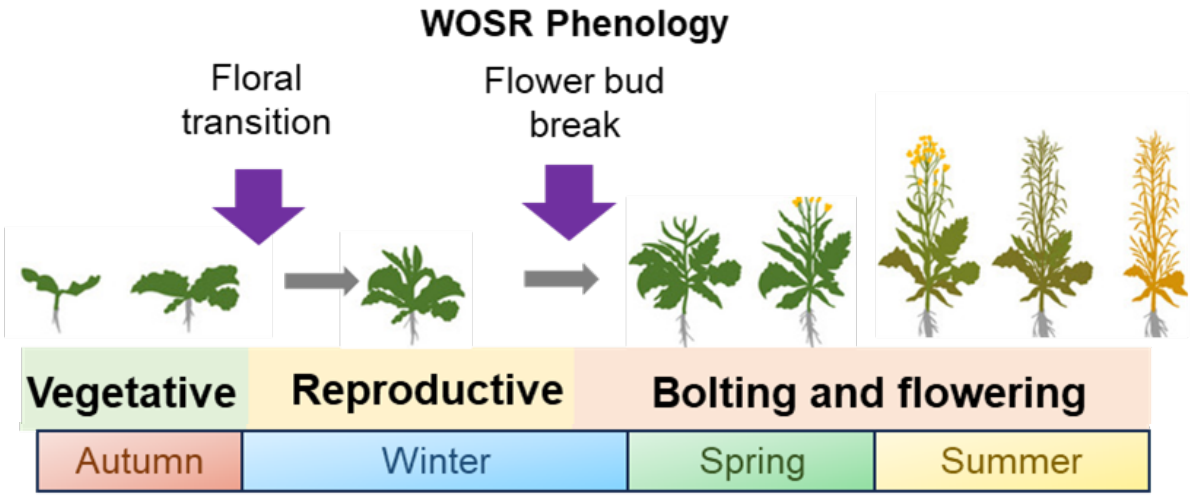


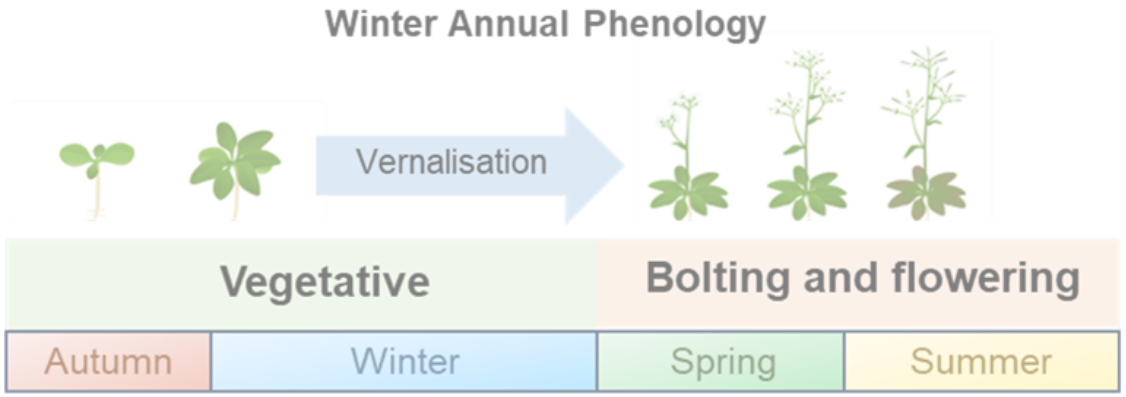


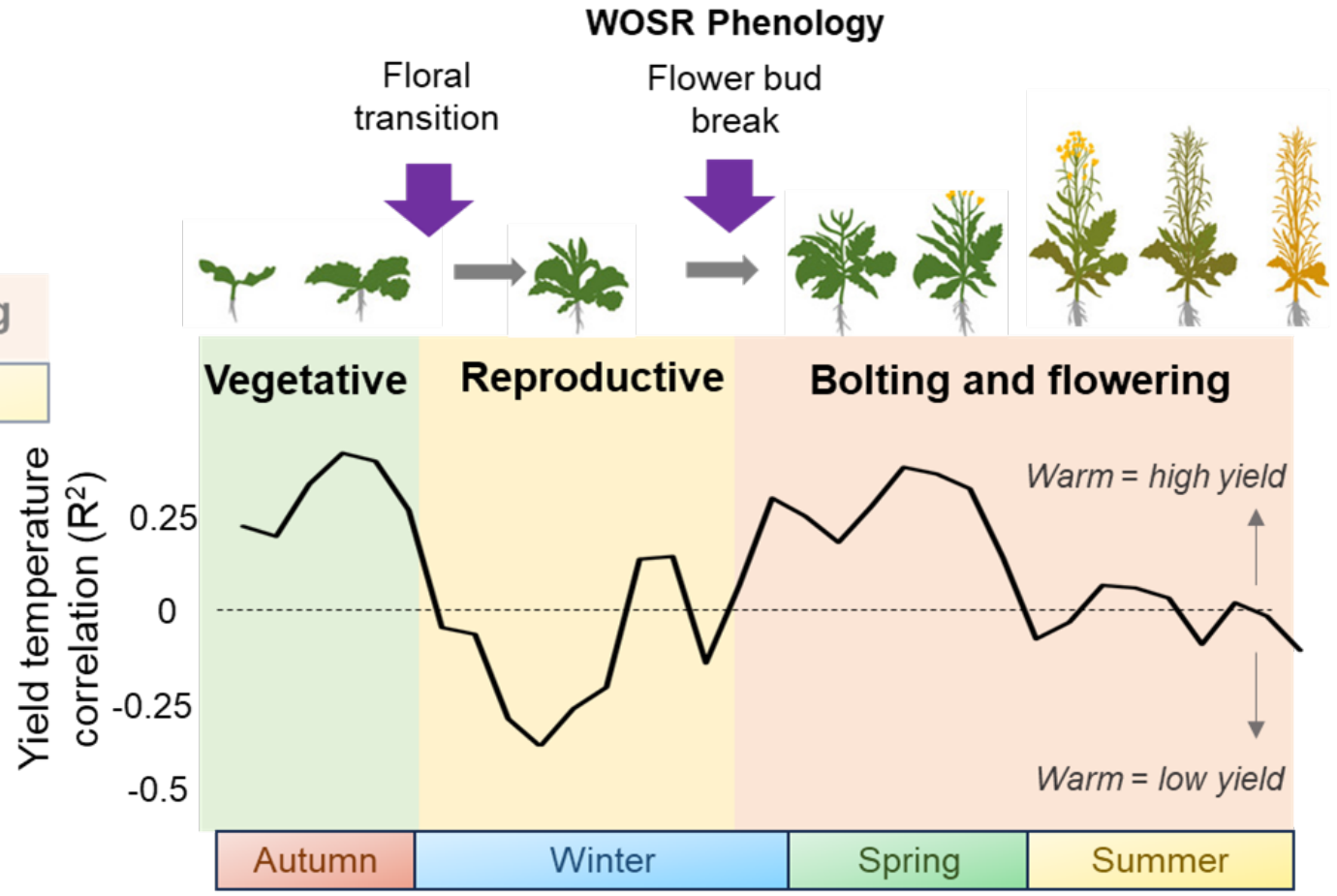
Winter Oilseed Rape Florally Transitions in Winter



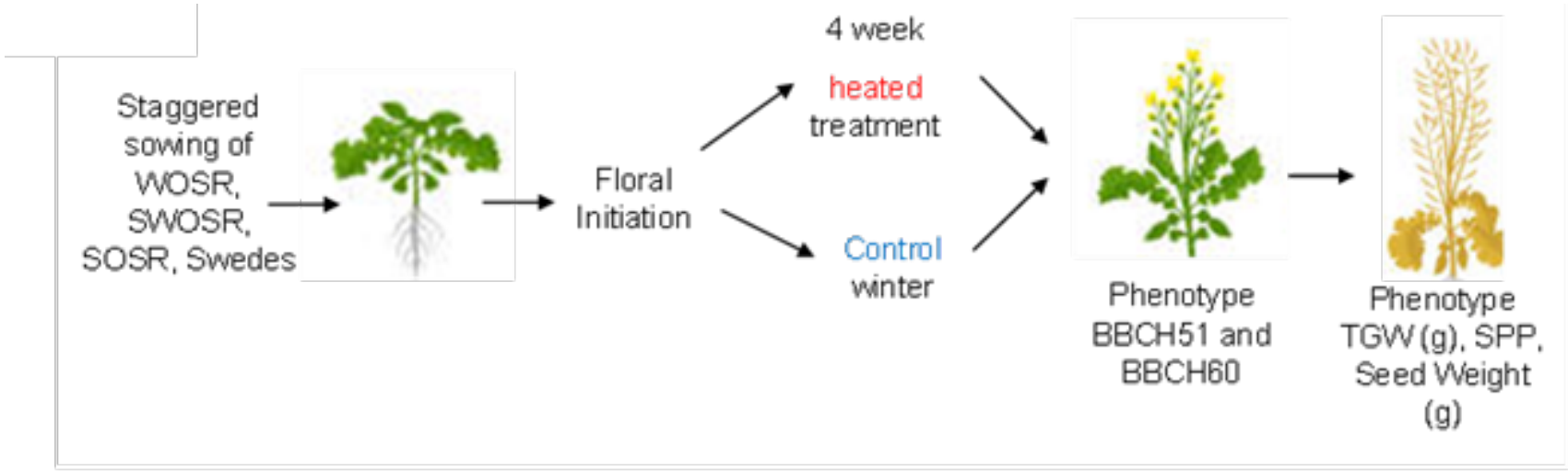


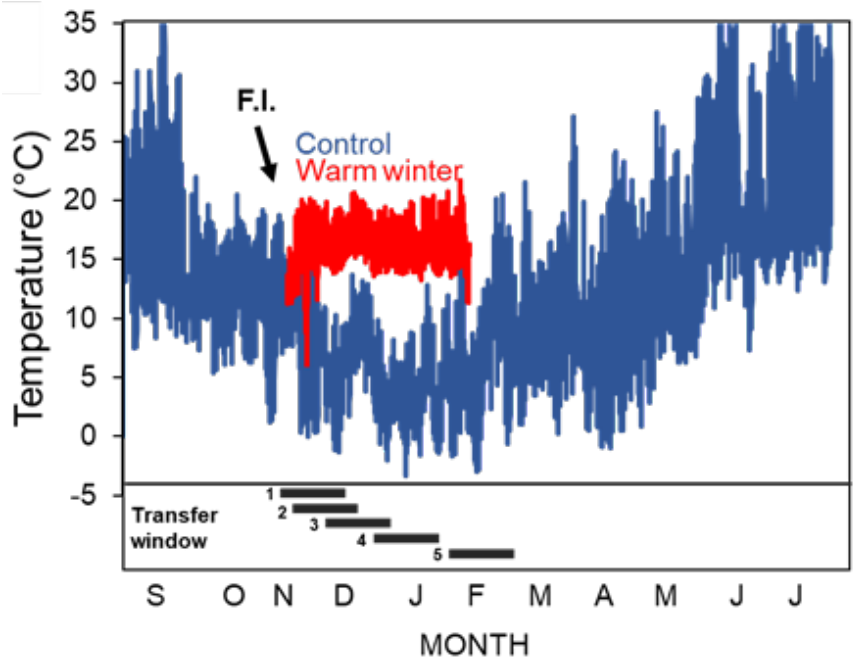
Warm temperatures after floral transition are associated low yields





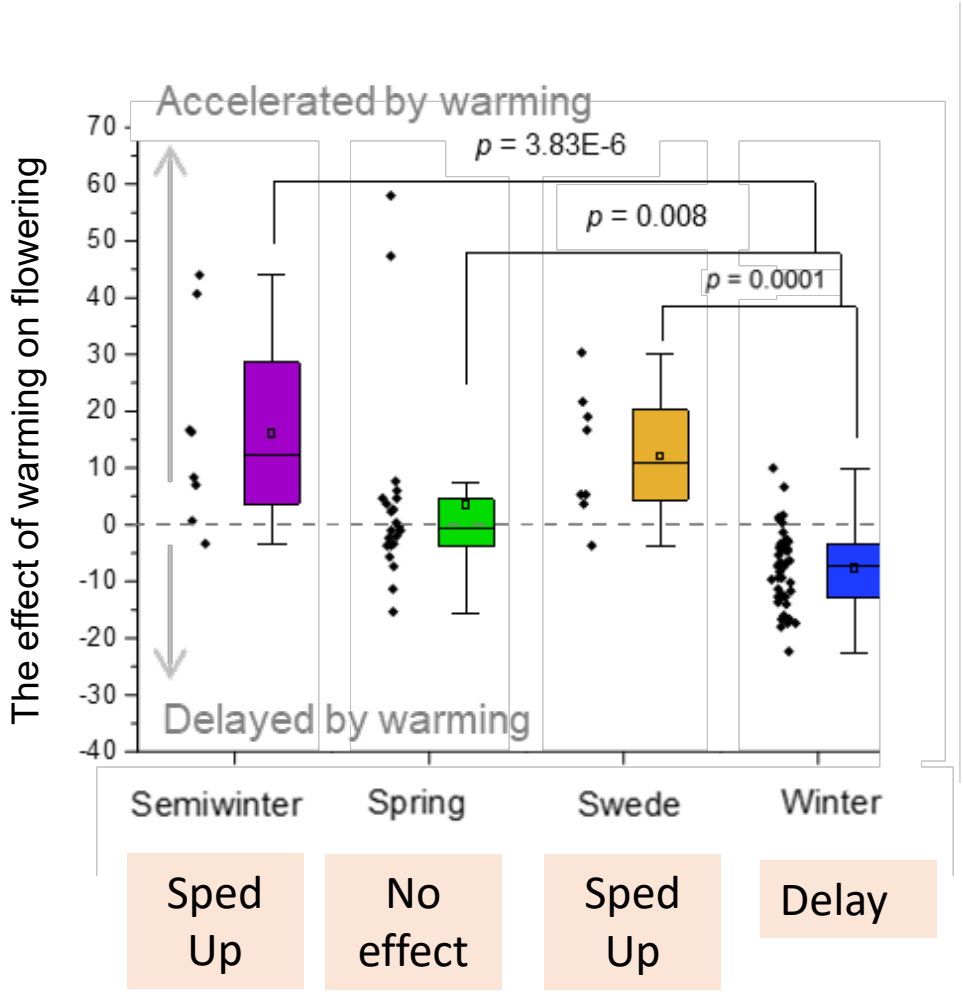
I ran a series of winter warming experiments to understand this

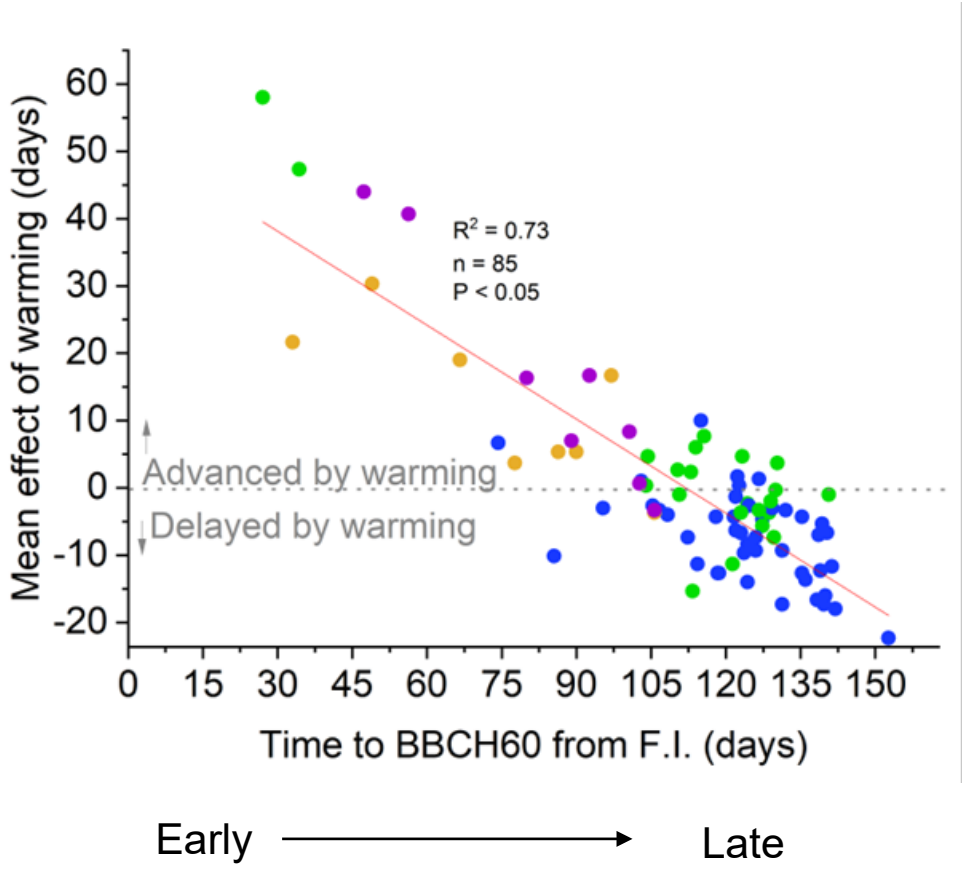




Warmed a diversity set of 96 lines following the floral initiation

Warming after floral initiation delays flowering in Winter Oilseed Rape

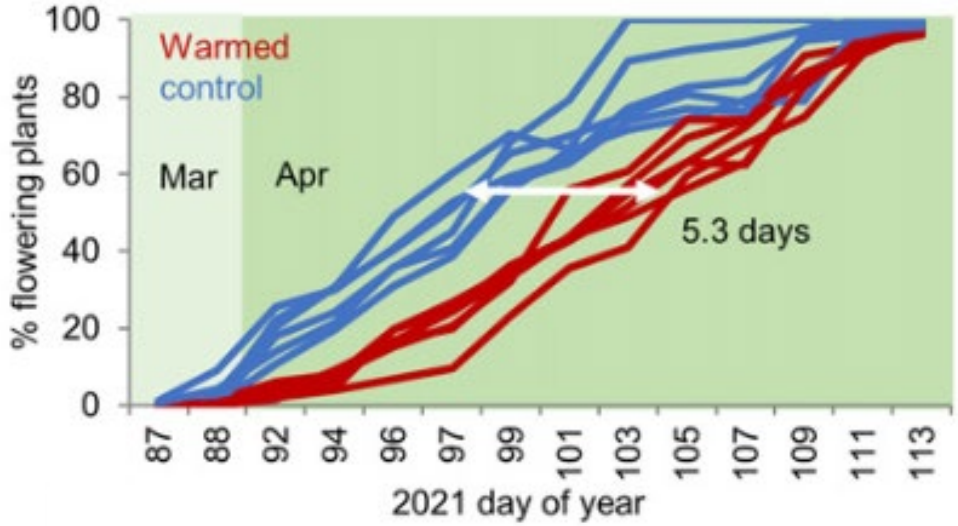




Early ⟶ Late

Later flowering lines more likely to be delayed by warming

Warming after floral initiation delays flowering in Winter Oilseed Rape

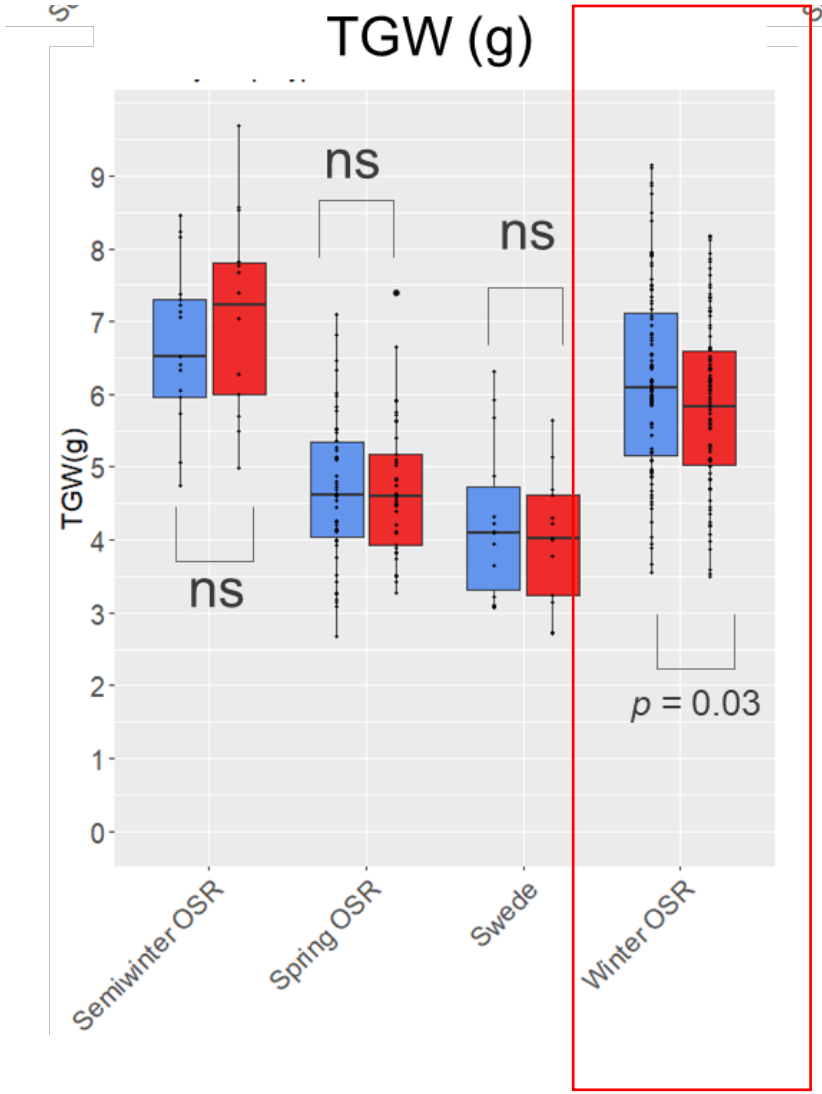


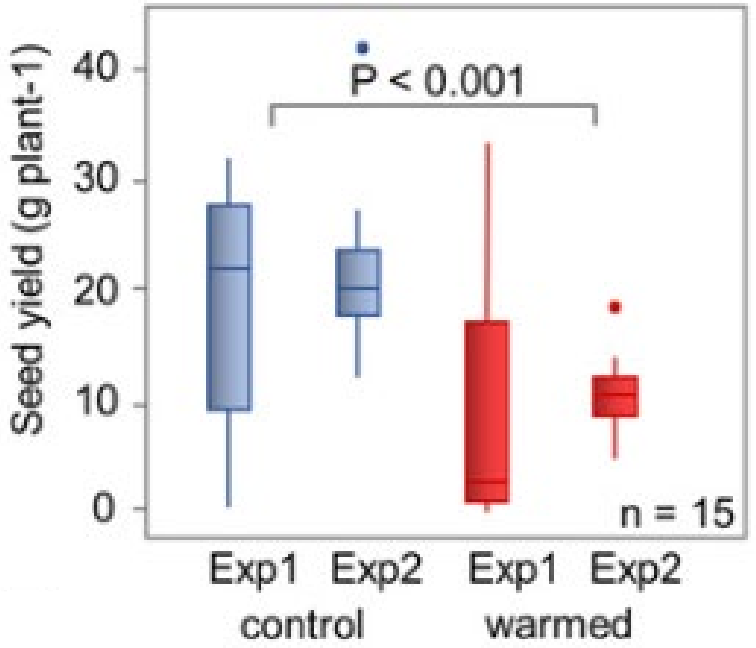
Also found in a field trial

Lu *et al.* (2022)

Lu *et al.* (2022)

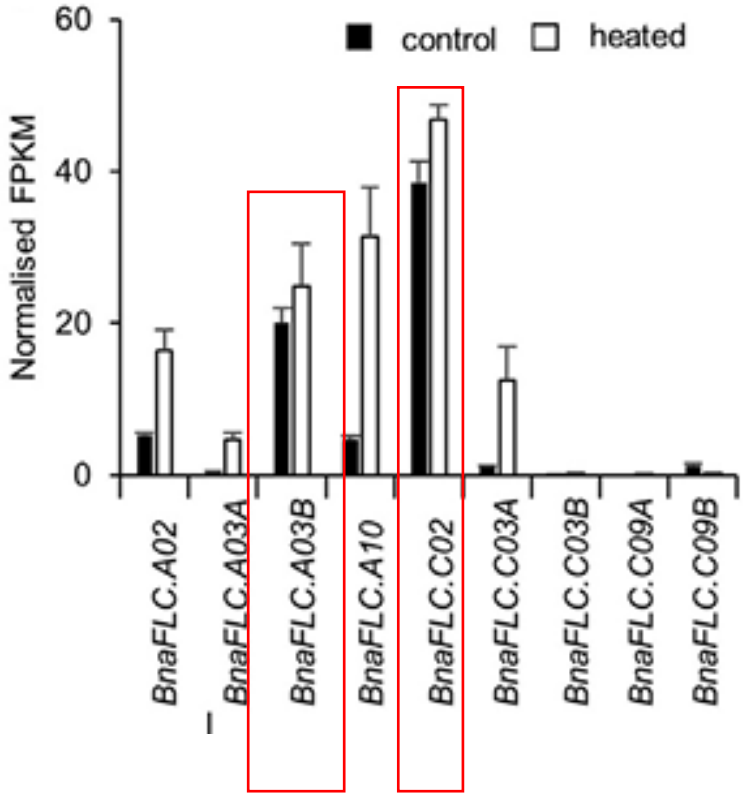
Warming after floral initiation also leads to lower yield in WOSR





Lu *et al.* (2022)

Two *B. napus FLC*s are only silenced after the floral transition



BnaFLC.A03b and *BnaFLC.C02* unaffected by pre-floral initiation temperatures

O'Neill *et al.* (2022)

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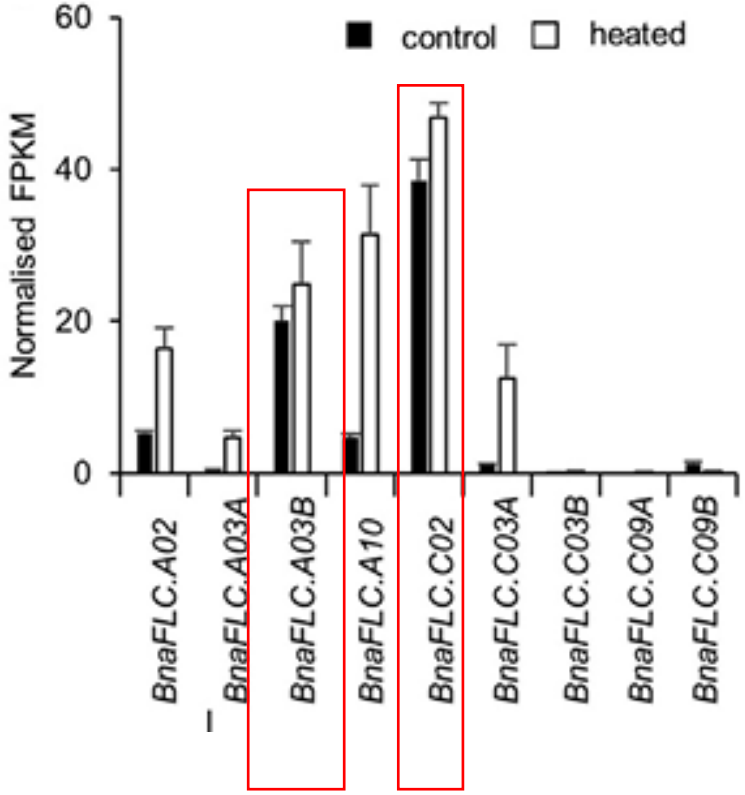

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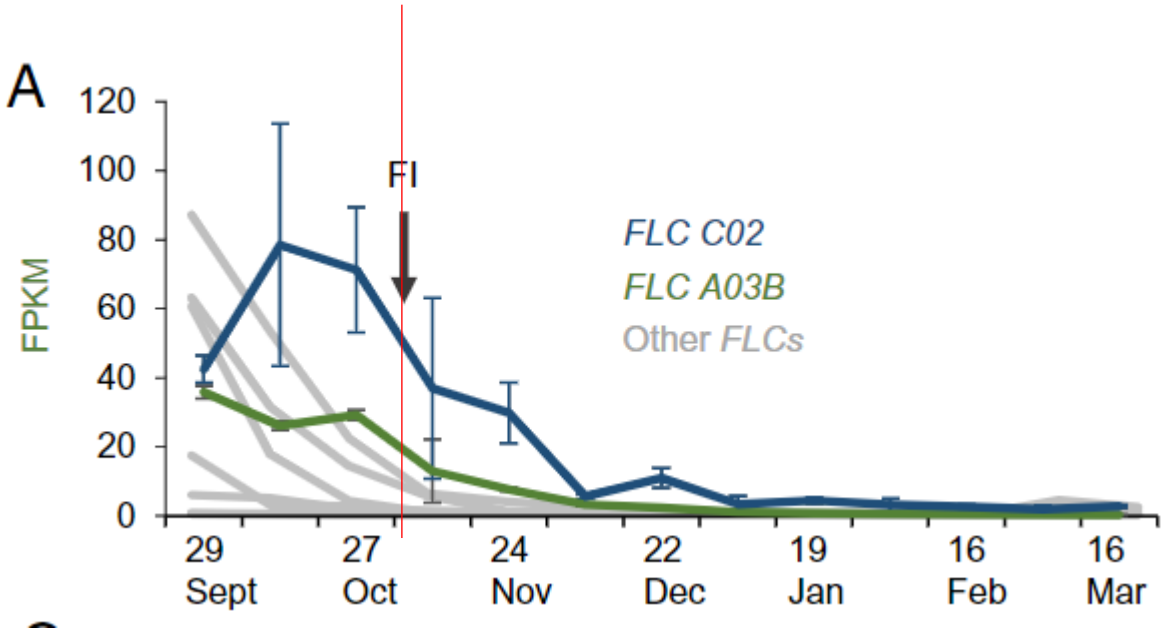

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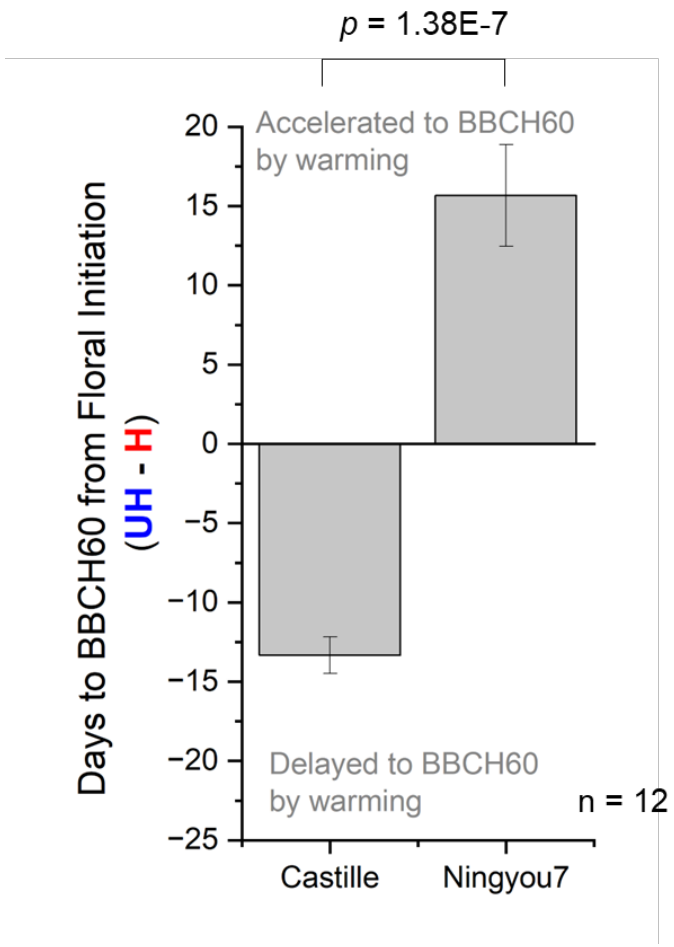
Lu *et al.* (2022)

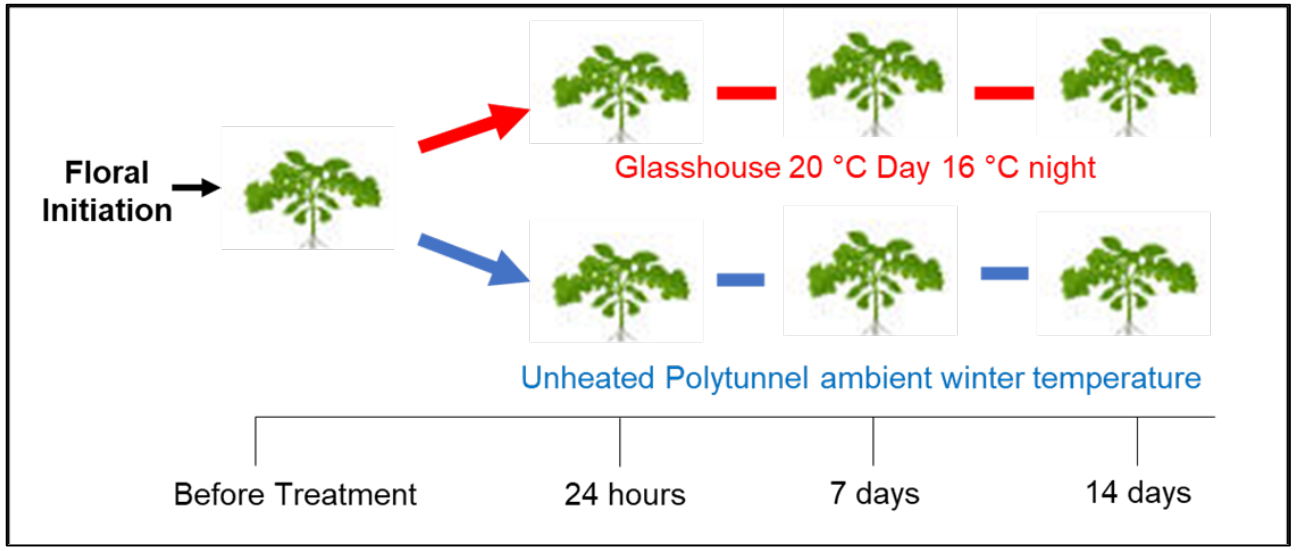
Understanding the genetic control of warm winter delay



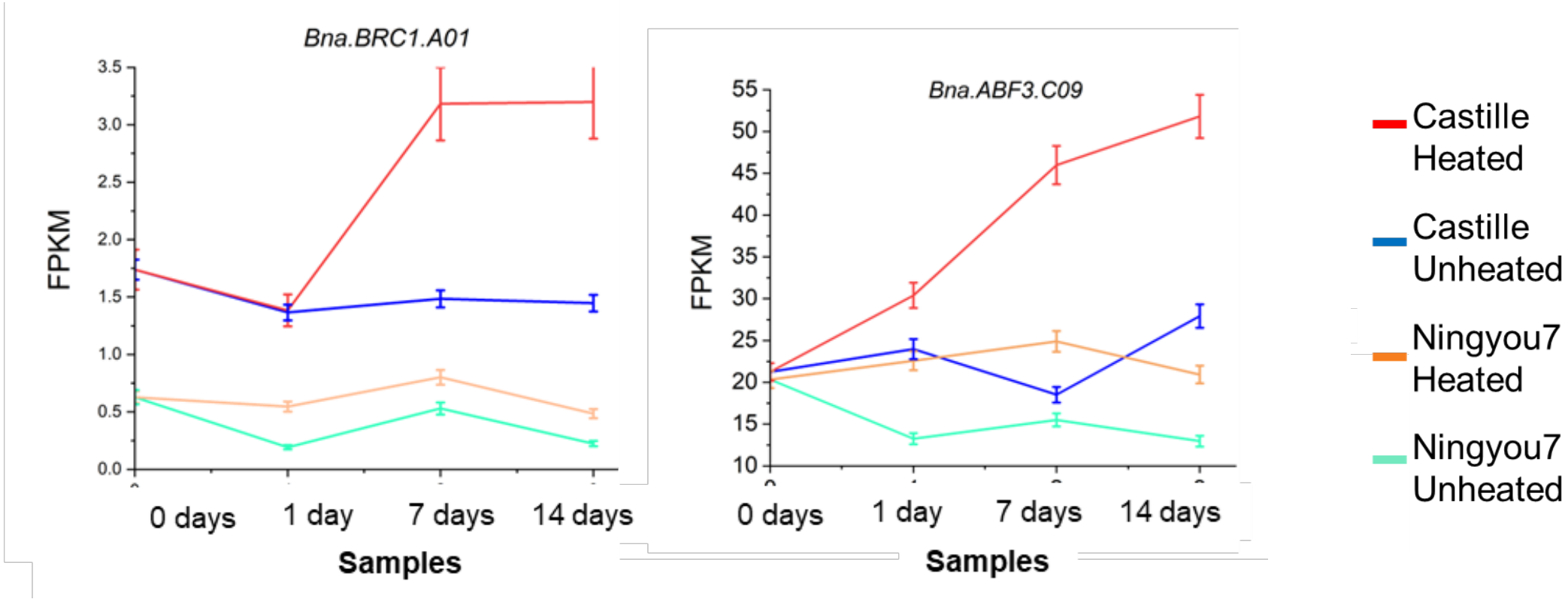
Comparative transcriptomics of a variety negatively affected by winter bud warming (Castille)

vs

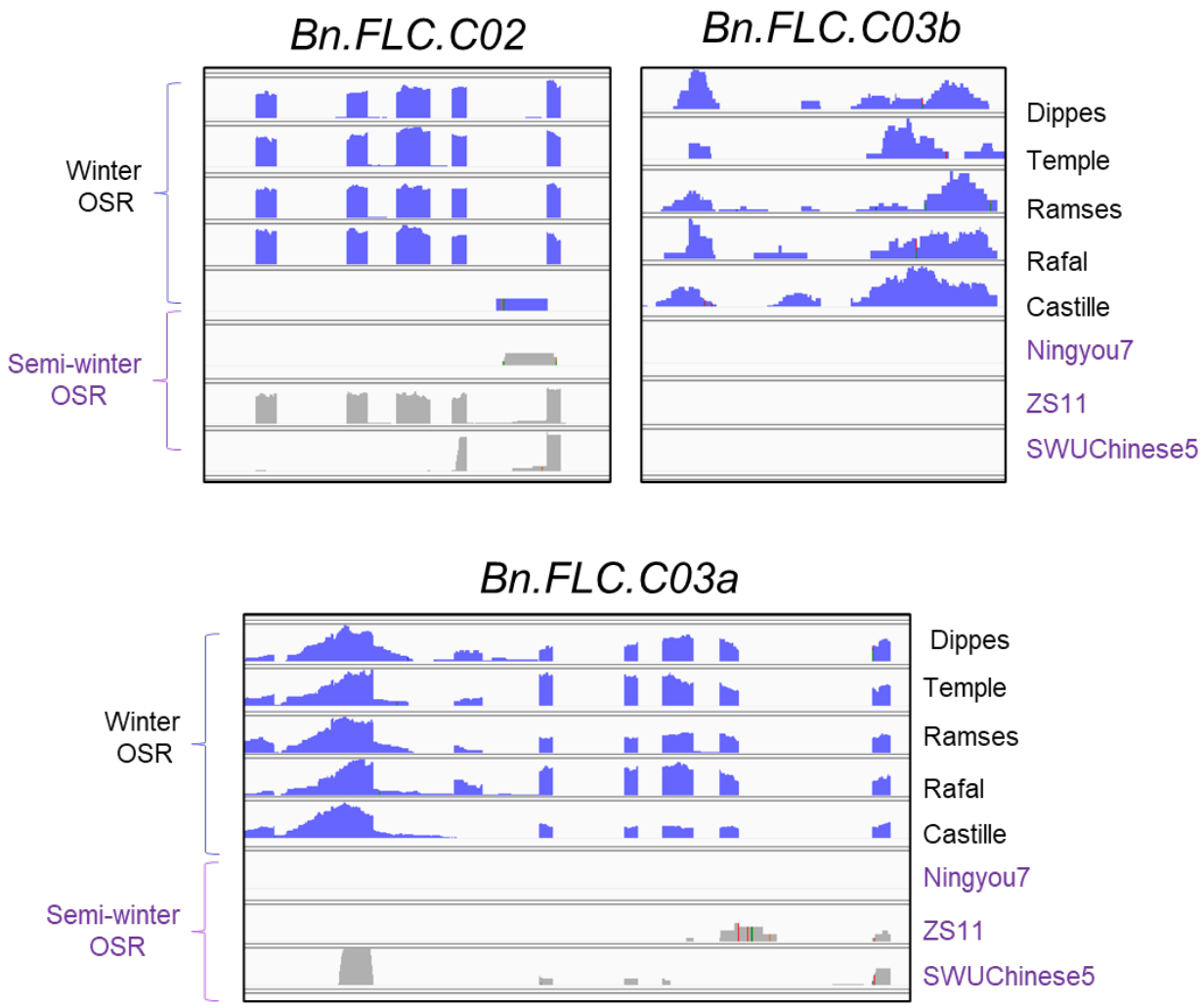
a variety unaffected by winter bud warming (Ningyou7)



Presence of warm induced delay associated with ABA and dormancy associated genes

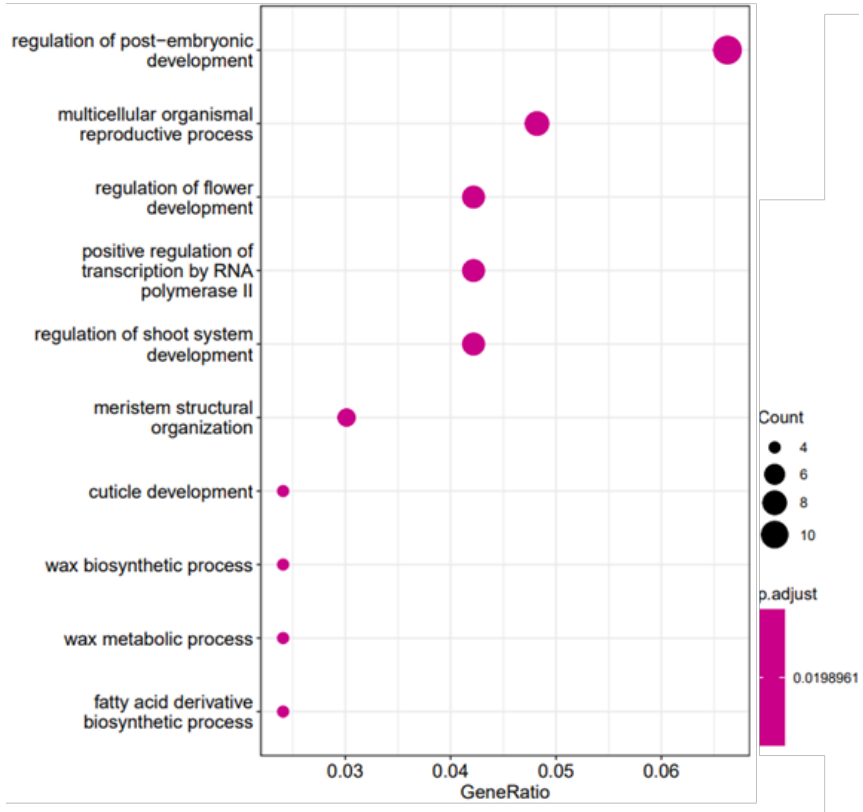


Presence of warm induced delay associated with *FLC* retention

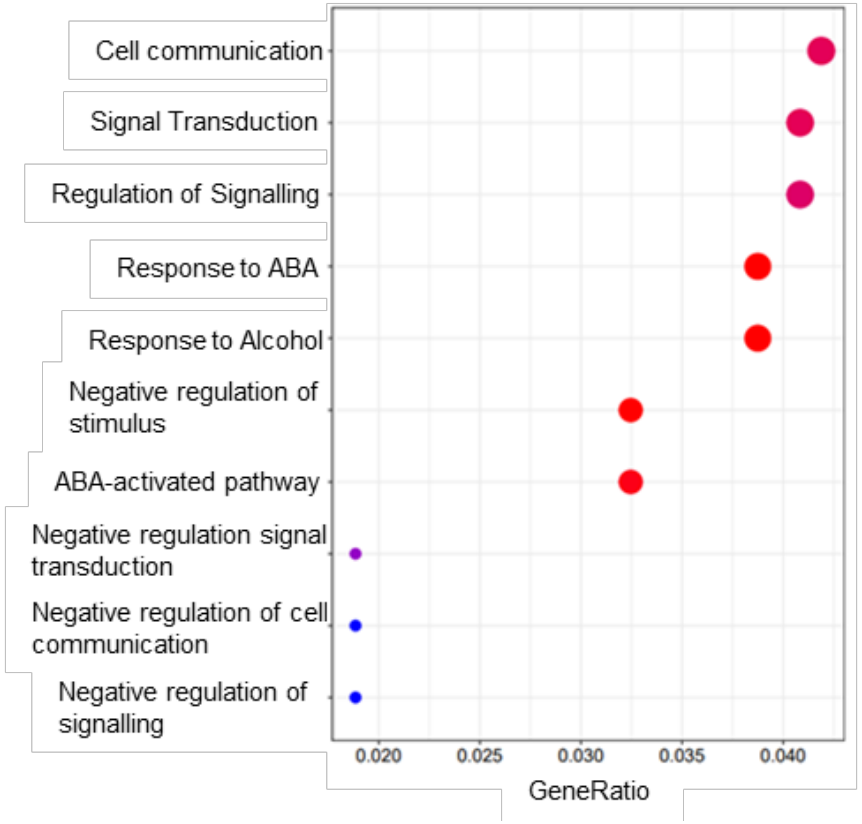


Higher *FLC* activity associated with presence of bud dormancy

Putative *FLC* targets in a variety **without** bud dormancy



Putative *FLC* targets in a variety **with** bud dormancy



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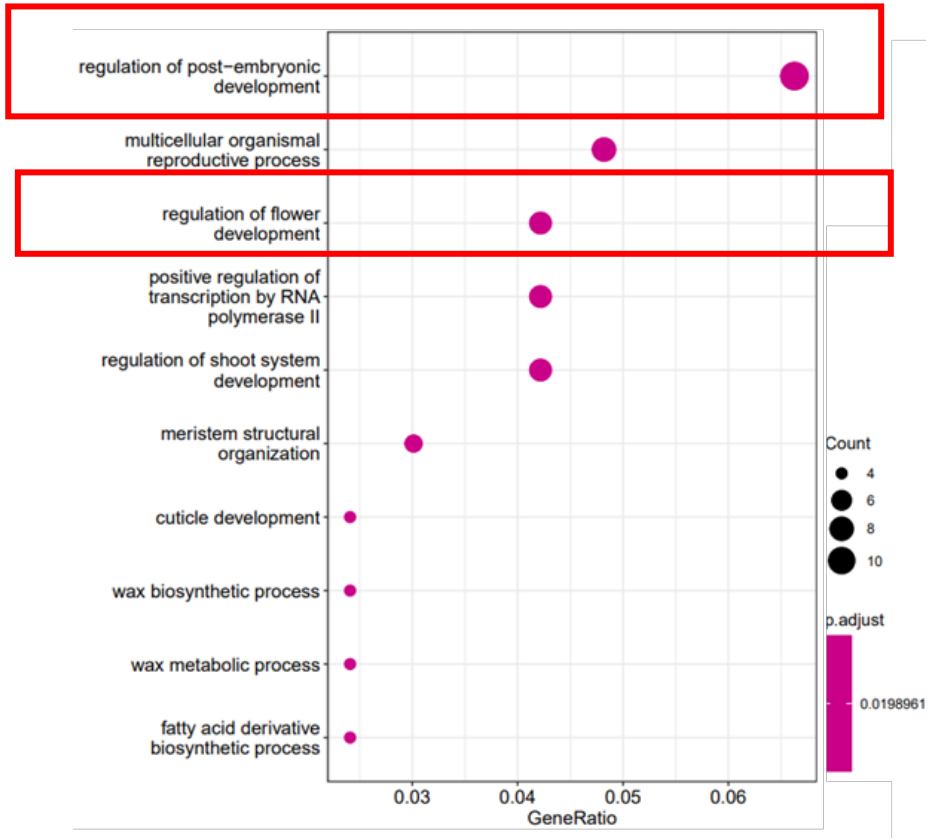

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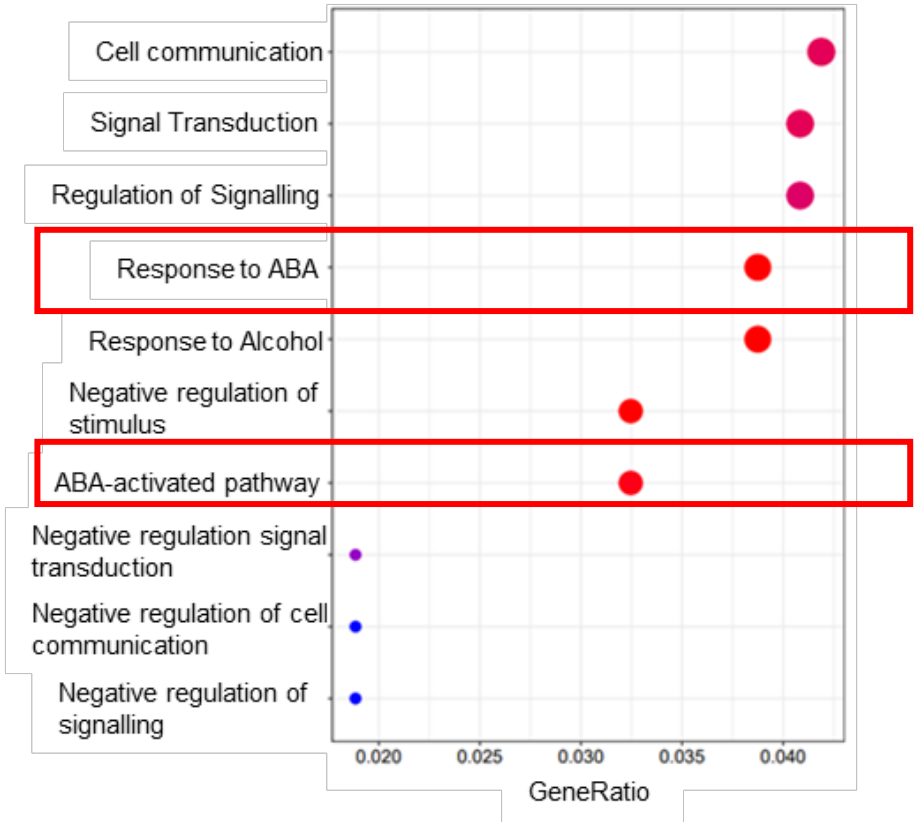

PLANT HOMOLOGOUS TO PARAFIBROMIN (PHP) associated with effect of post floral initiation warming on floral delay

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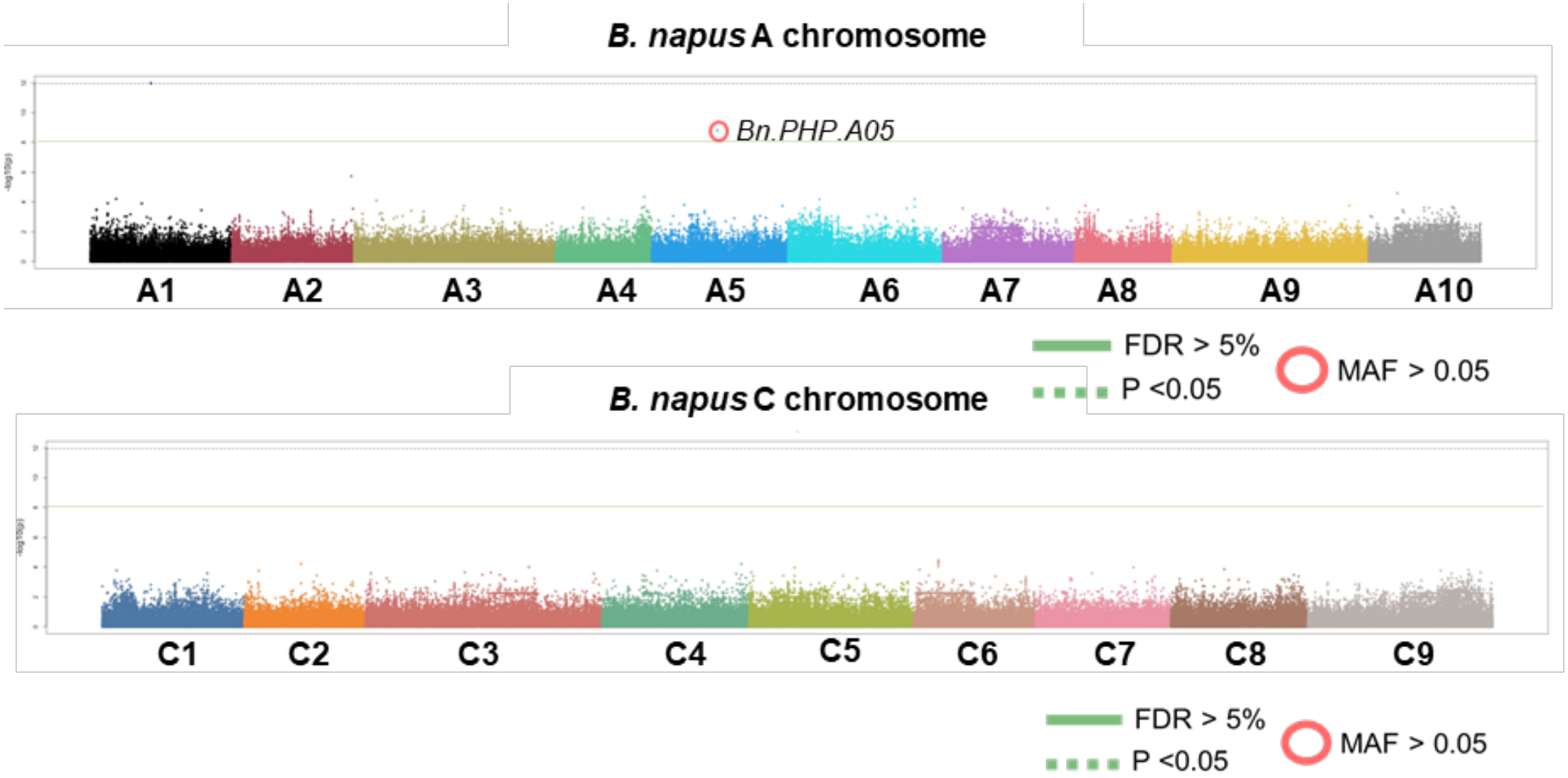
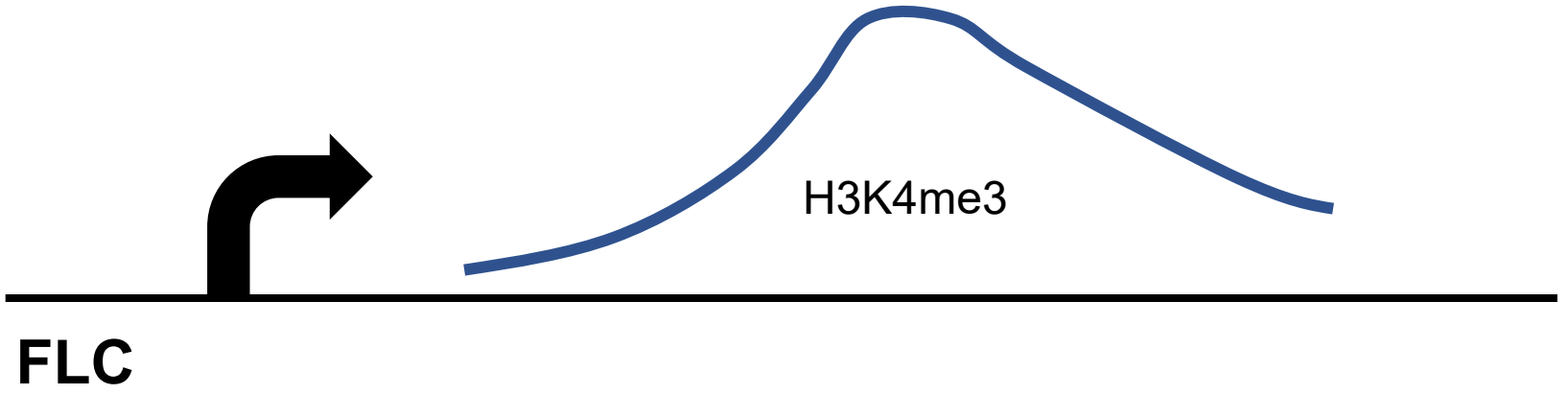
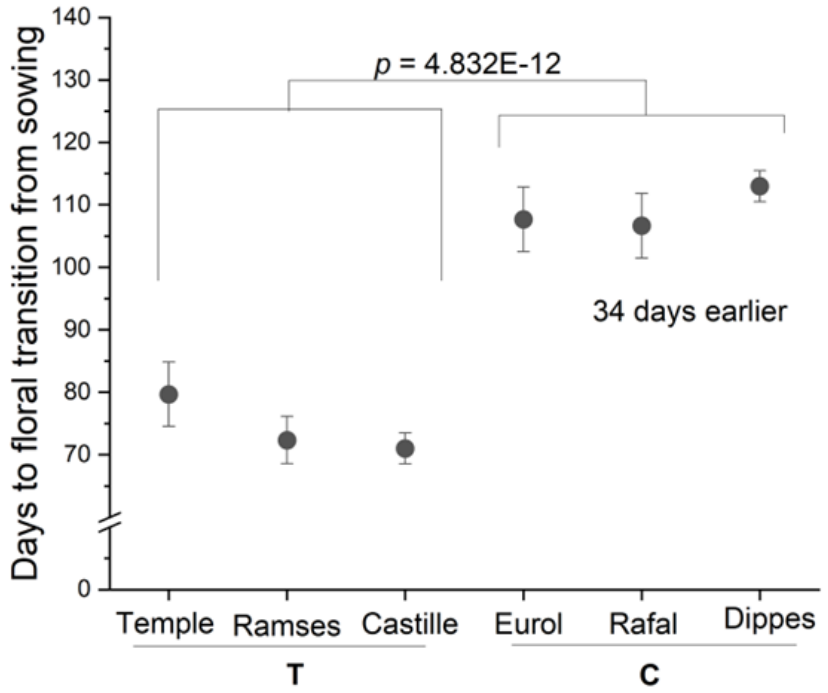


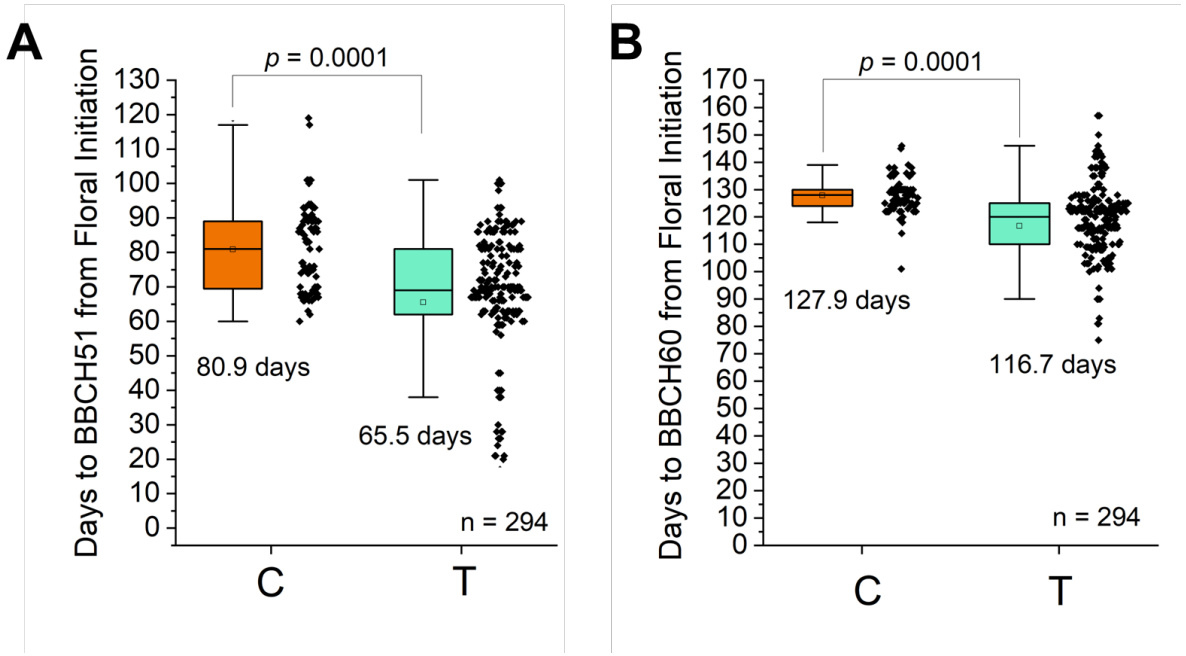
PHP upregulates *FLC*



PHP.A05 associated with floral timing before and after floral transition

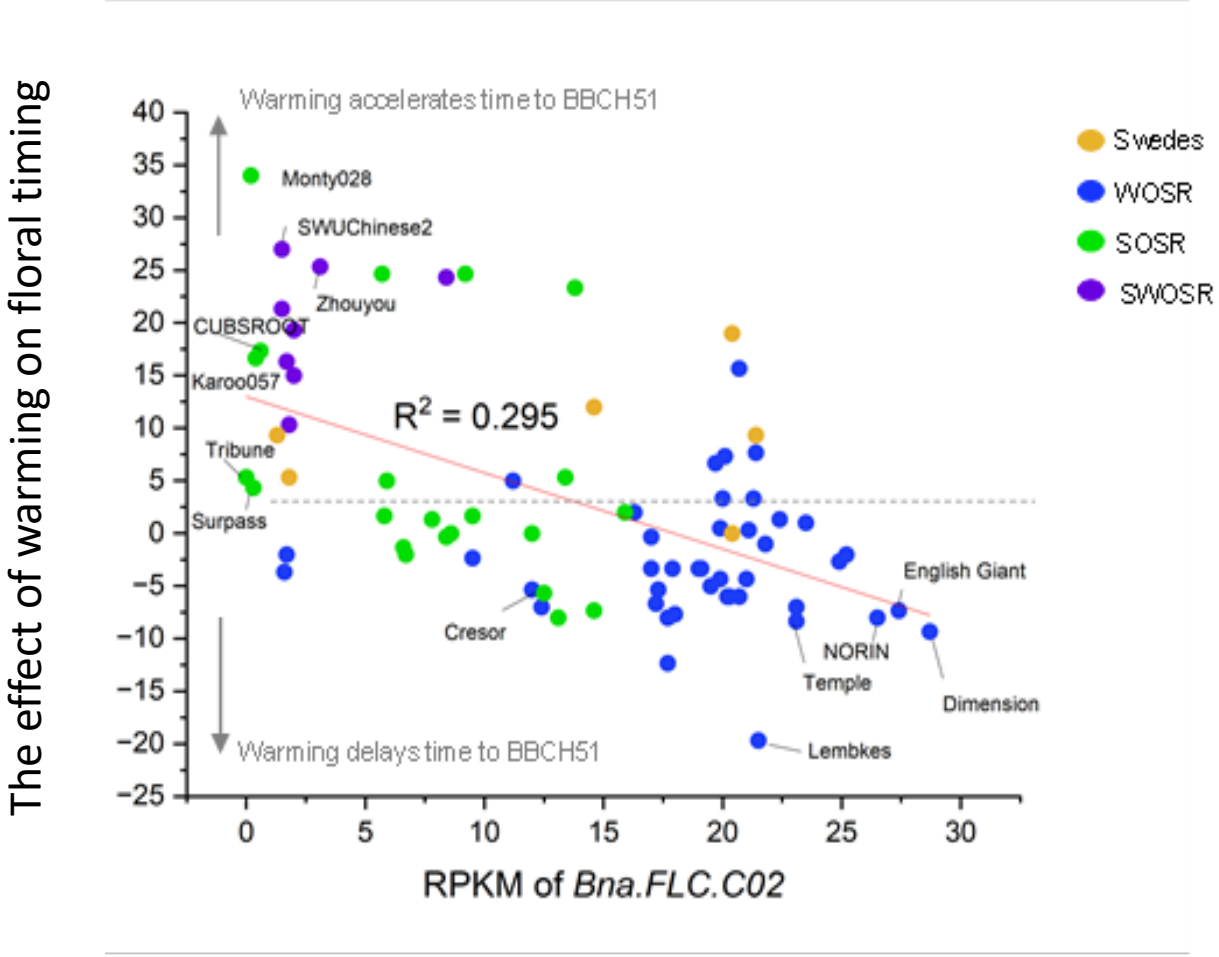


Floral development before floral transition



Floral development after floral transition

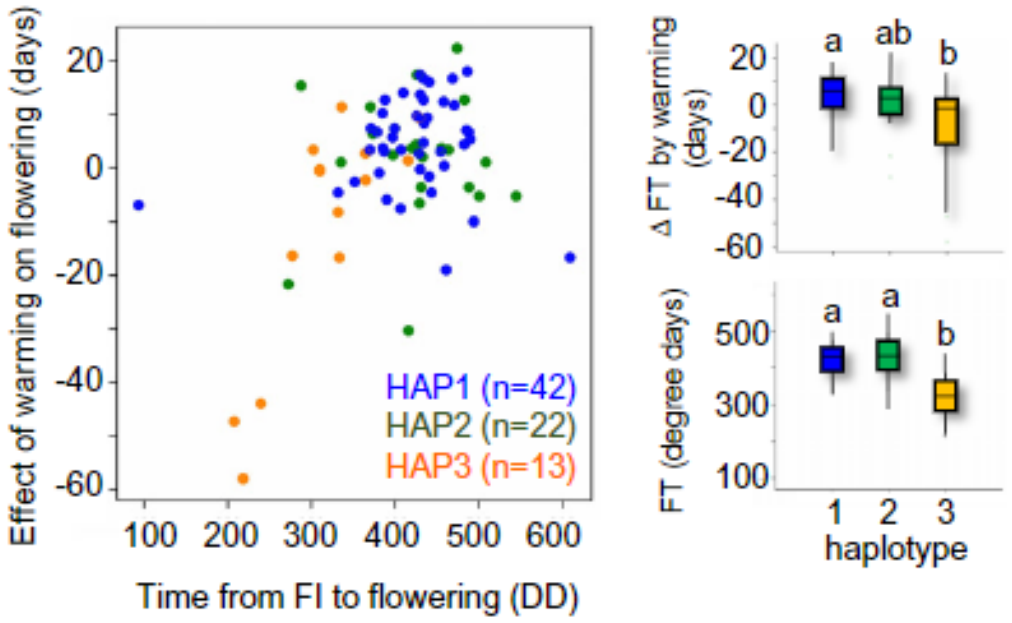
FLC.C02 associated with presence of bud dormancy



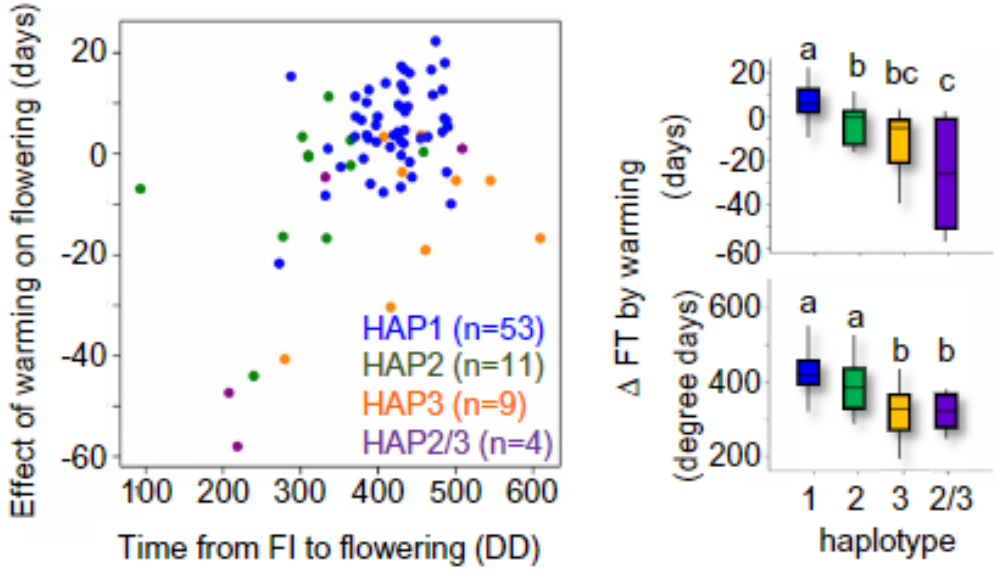
Higher expression of *FLC.C02* associated with bud dormancy

FLC.C02 associated with presence of bud dormancy

C02 haplotypes

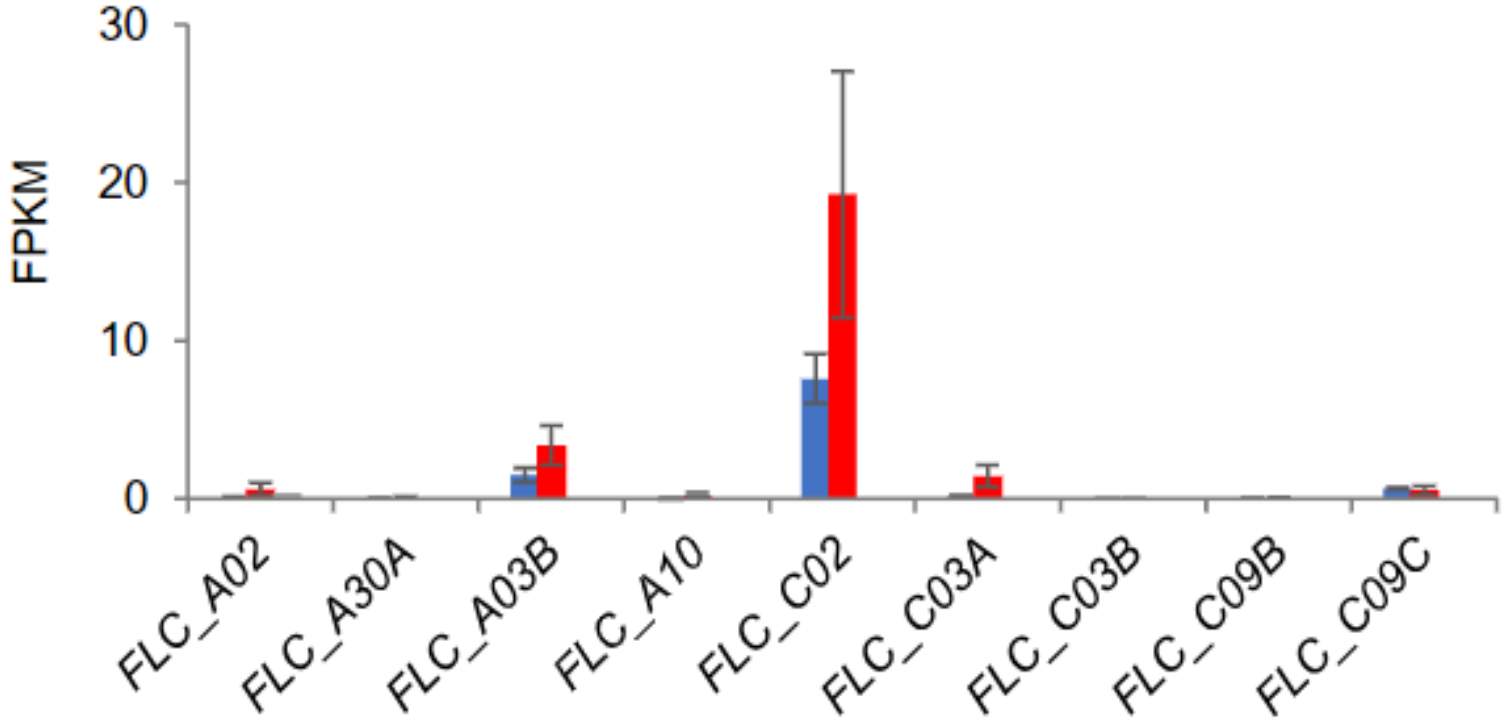


A03B haplotypes



Lu *et al.* (2022)

Warming causes upregulation of *FLC.A03b* and *FLC.C02*



Lu *et al.* (2022)

Conclusions

- Contrary to expectation, Winter *Brassica napus* undergoes the floral transition in late autumn
- Warm winters after the floral transition associated with yield decline
- In winter *Brassica napus* warm winters are associated with delayed reproductive development and low yield
- Dormancy associated genes upregulated in varieties with warmth induced floral delay
- This suggests that cold is necessary for floral development in *Brassica napus* and warming induces bud dormancy
- This bud dormancy phase is likely controlled by *FLC,* particularly *FLC* genes active after floral transition
- *PHP* likely a universal up-regulator of all *FLC* genes

Acknowledgements

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