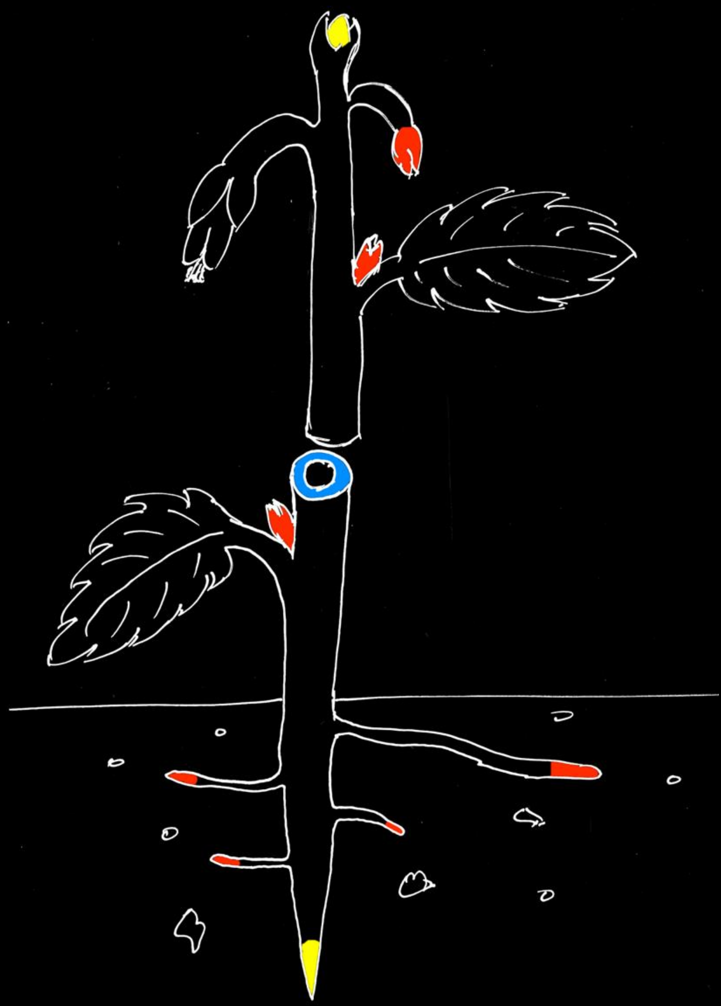
Organ boundary domains
and
de novo stem cell formation

New meristems are formed during the plant's life



Embryonic meristems

Shoot apical meristem

Root apical meristem

Newly formed meristems

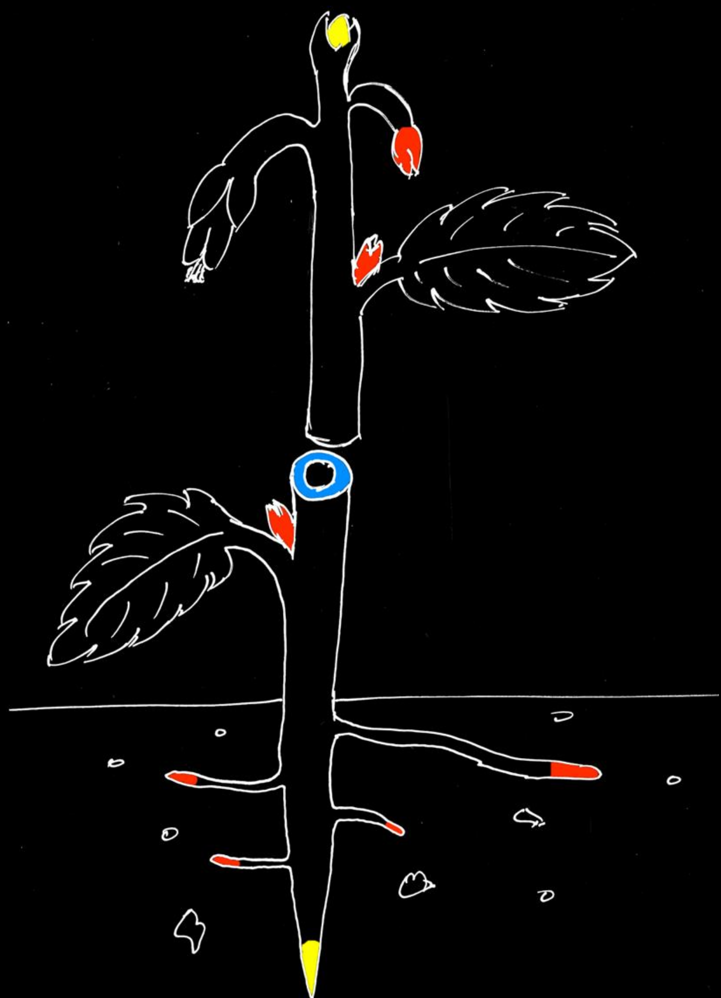
Axillary meristems

Floral meristems

Lateral root meristems

Secondary meristems

New meristems are formed during the plant's life



Embryonic meristems

Shoot apical meristem

Root apical meristem

Newly formed meristems

Axillary meristems

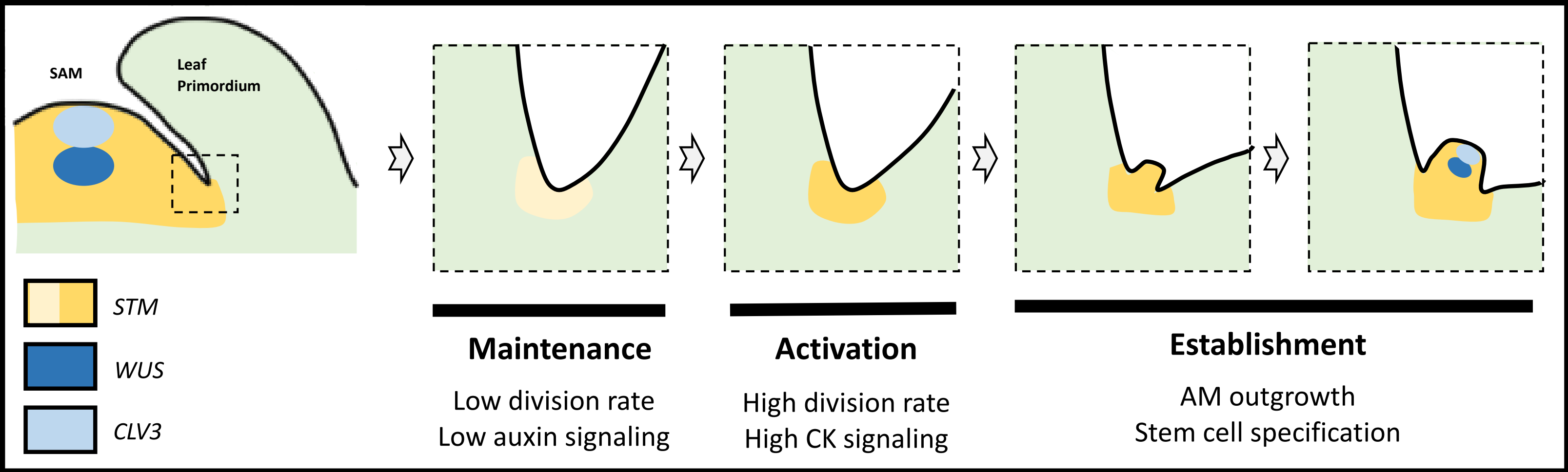
Floral meristems

Lateral root meristems

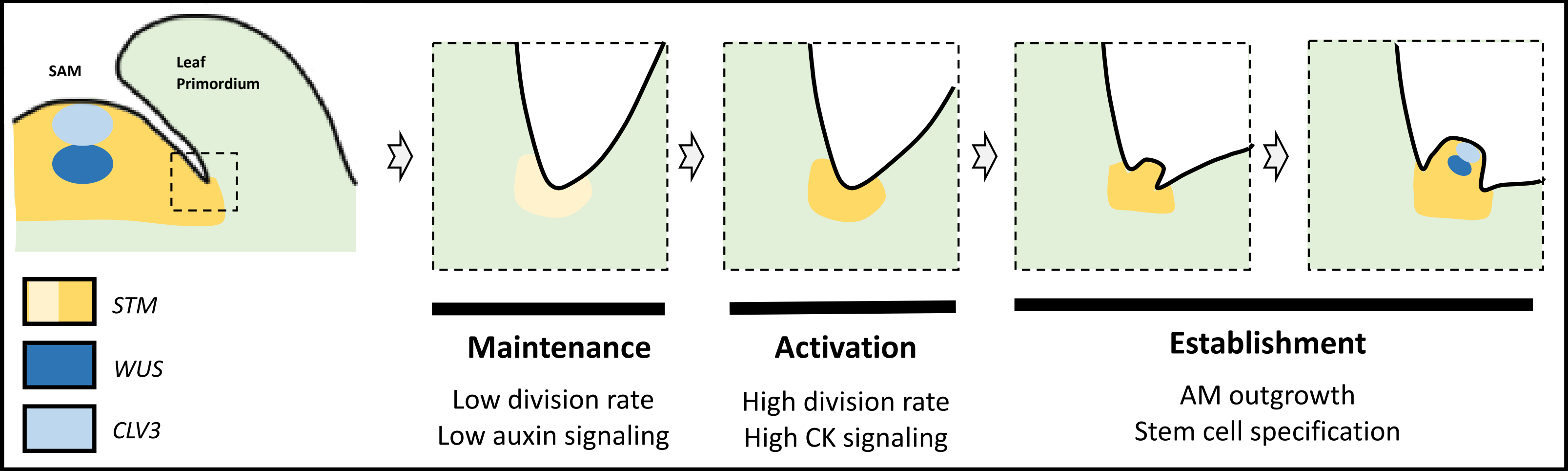
Secondary meristems

How are (axillary) meristems formed ?

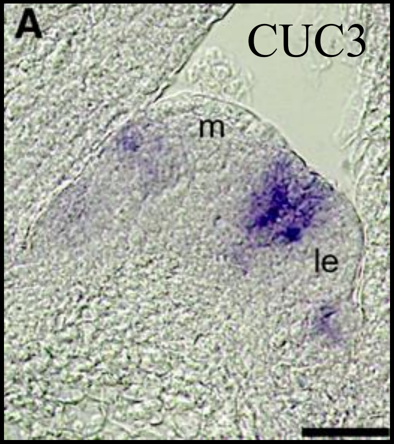
Axillary meristems derive from the organ boundary domain

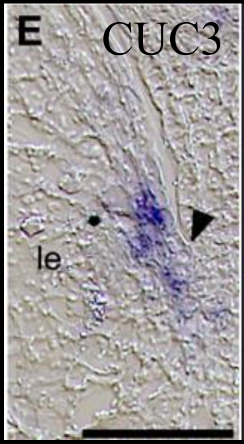


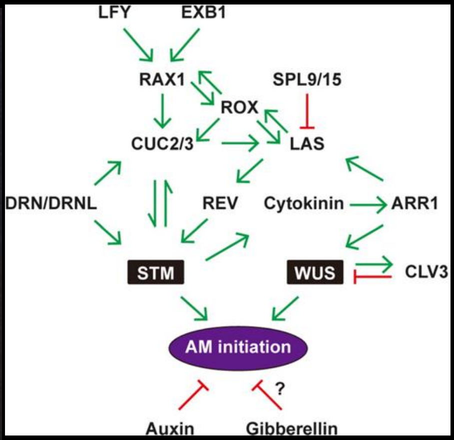
Axillary meristems derive from the organ boundary domain



The *CUP-SHAPED COTYLEDON 2* and *3* (*CUC2* and *CUC3*) boundary genes are required for AM formation

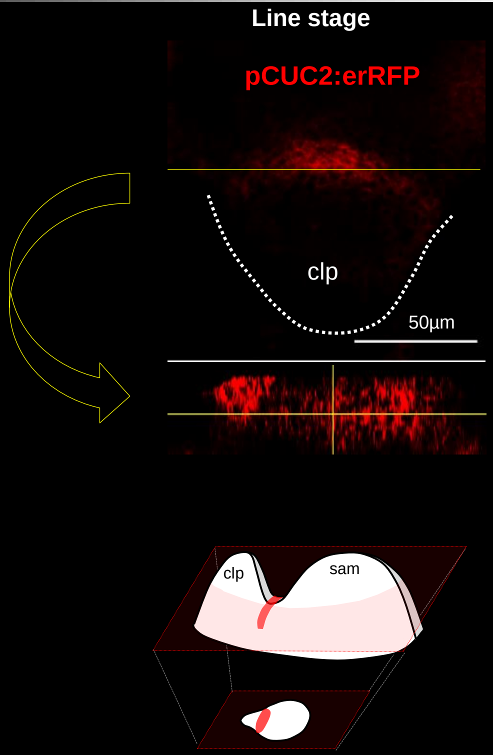






(Hibara et al., 2006; Keller et al., 2006; Raman et al., 2008; Cao and Jiao, 2020)

Boundary gene expression rearrangement goes along with AM formation



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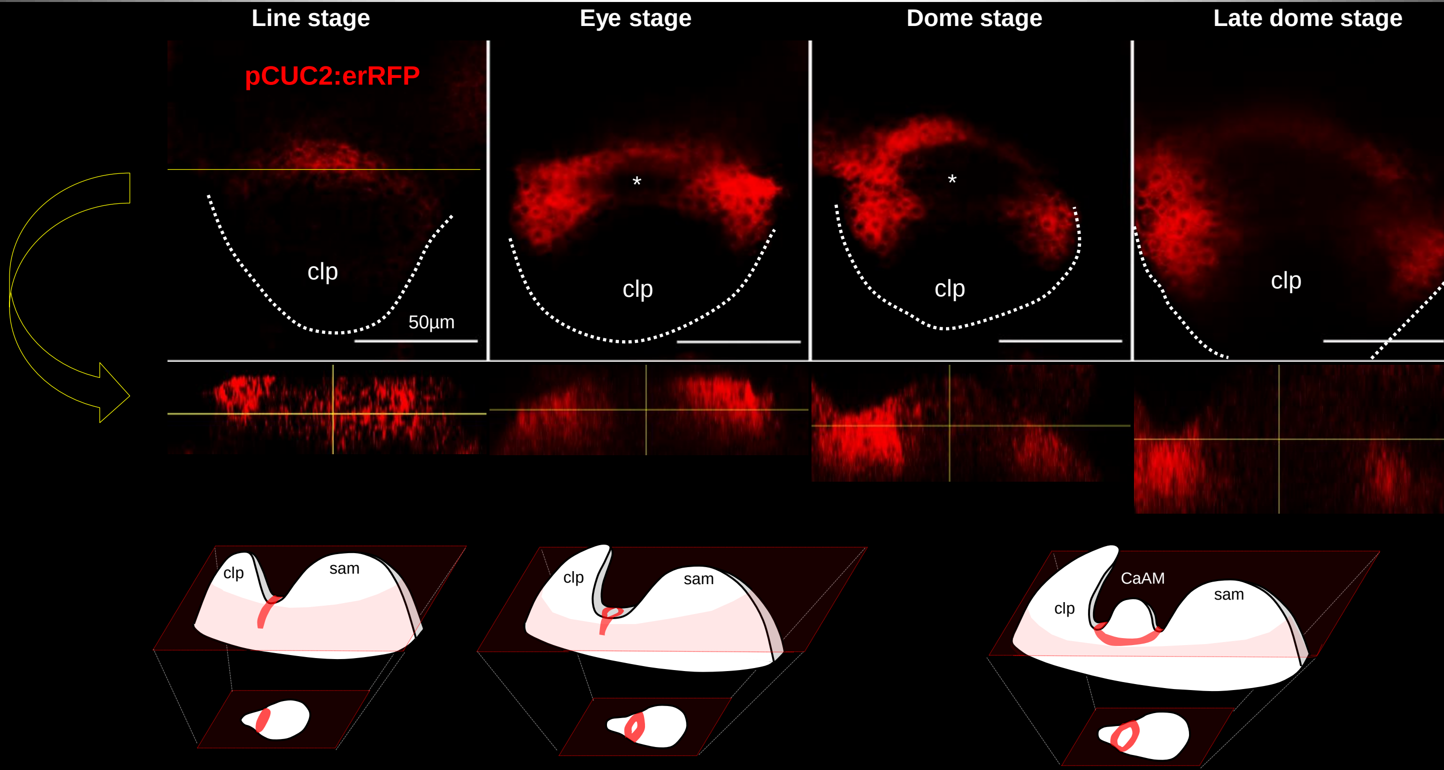
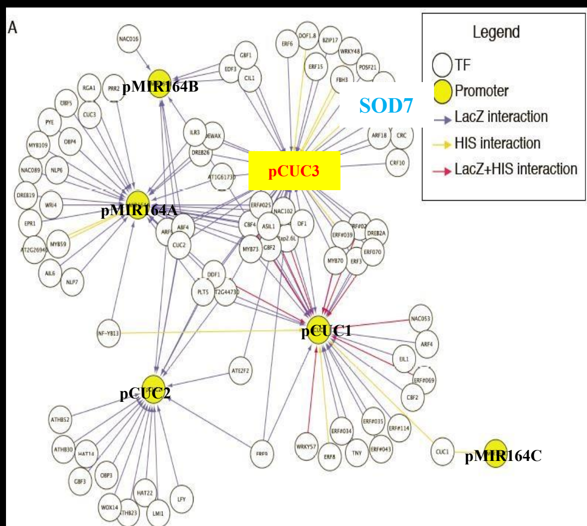


=> *CUC2* and *CUC3* become depleted from the future AM

DPA4 and *SOD7* are required for AM development

Yeast one hybrid screen

(Siobhan Brady's lab at UC Davis)



NGAL repress *CUC* genes during leaf development

Engelhorn et al., 2012; Shao et al., 2020

DPA4 and *SOD7* are required for AM development

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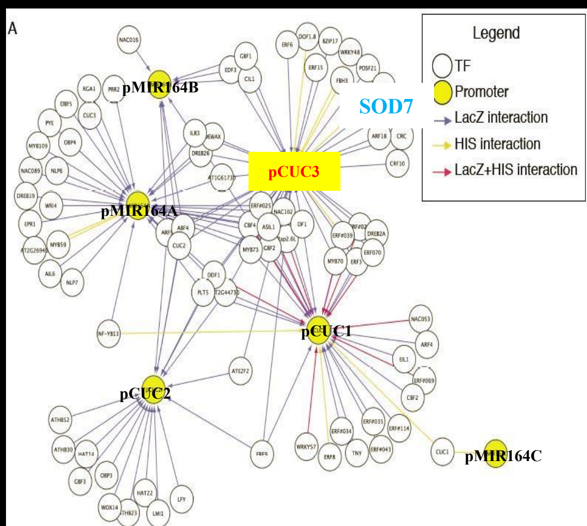
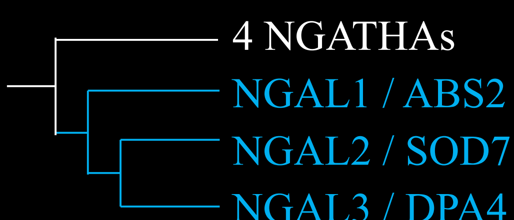
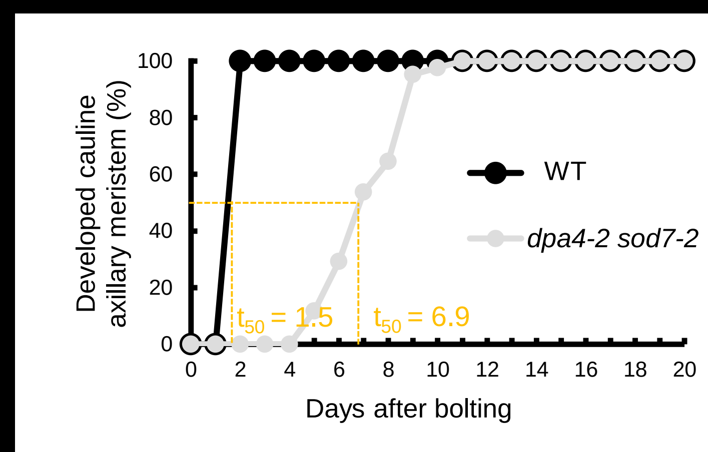




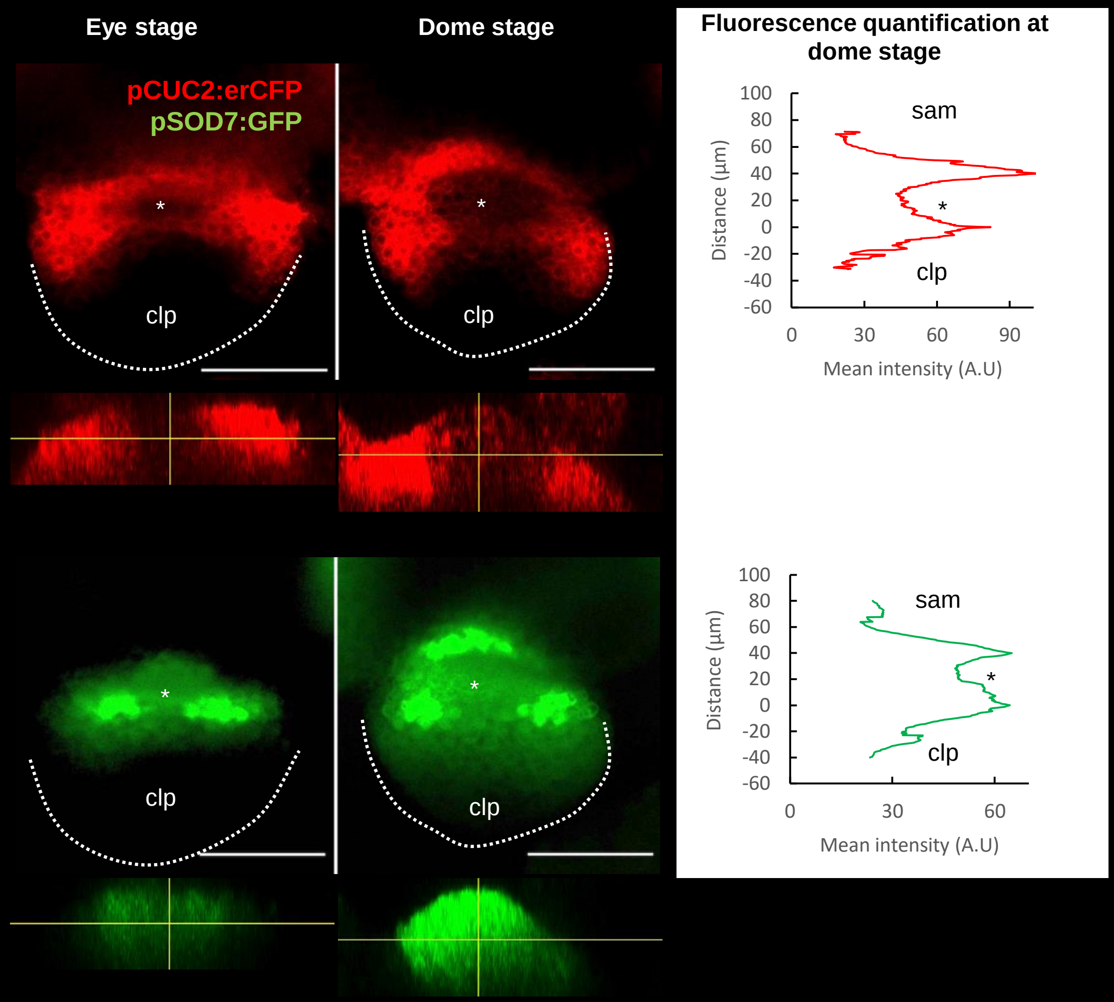
NGAL repress *CUC* genes during leaf development

Engelhorn et al., 2012; Shao et al., 2020

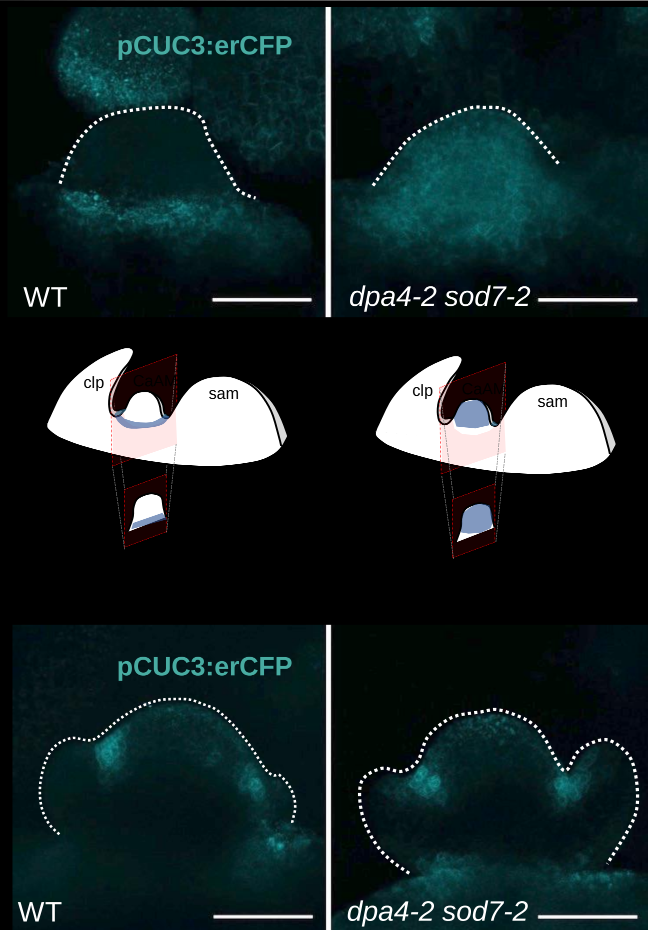
WT *dpa4-2 sod7-2*

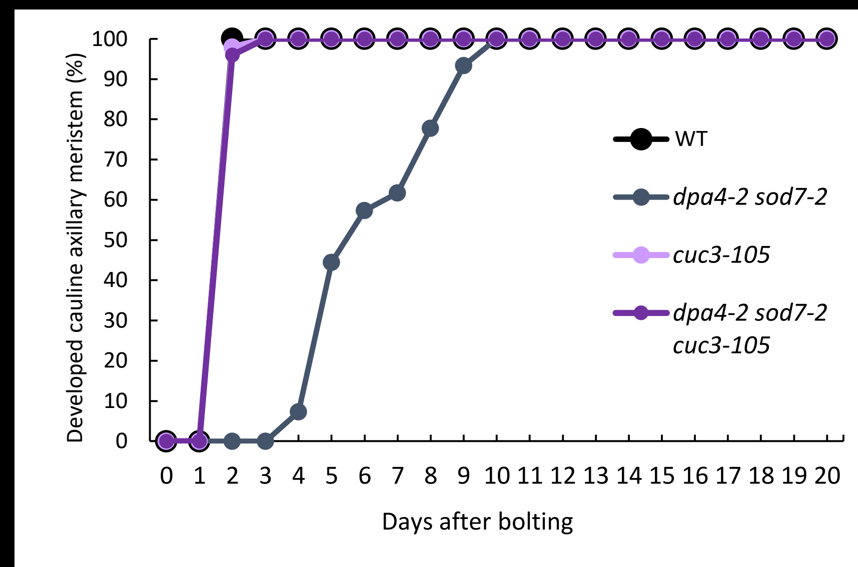


DPA4 and *SOD7* are boundary genes, but are transiently expressed in AM



CUC3 ectopic expression in AM delays their development

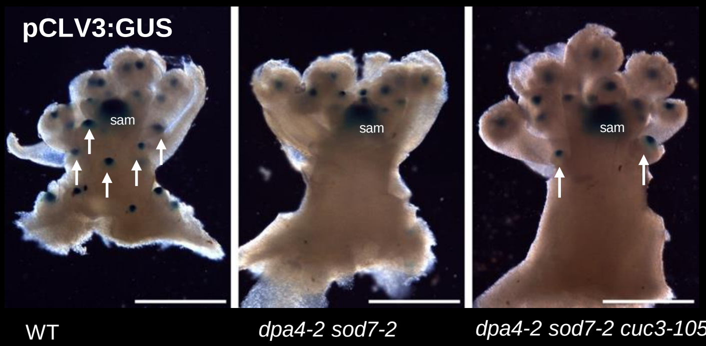


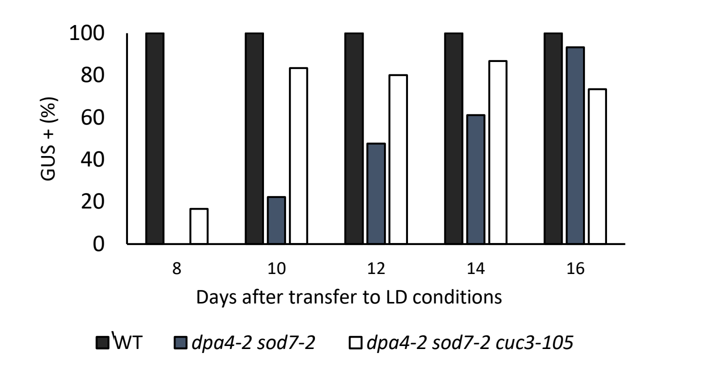


=> *CUC3* (and *CUC2*) are transiently ectopically expressed in developing *sod7 dpa4* AM

=> *cuc3* (and *cuc2*) suppress delayed *sod7 dpa4* AM development

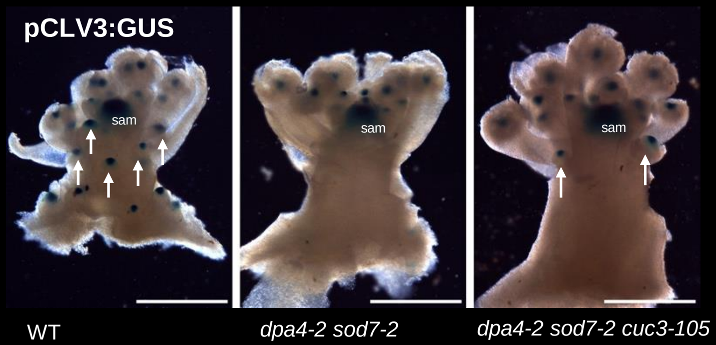
Ectopic boundary cell fate delays stem cell specification

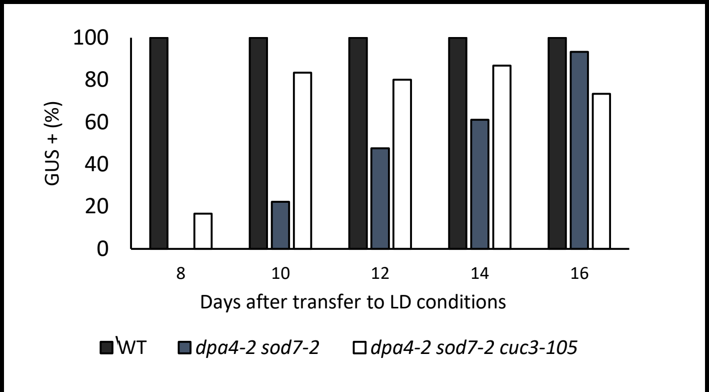


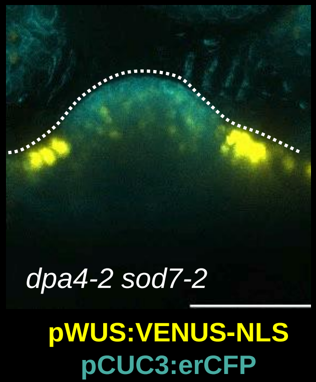


=> *CLV3* activation is delayed in *dpa4 sod7* and partially restored by inactivating *CUC3*.

Ectopic boundary cell fate delays stem cell specification



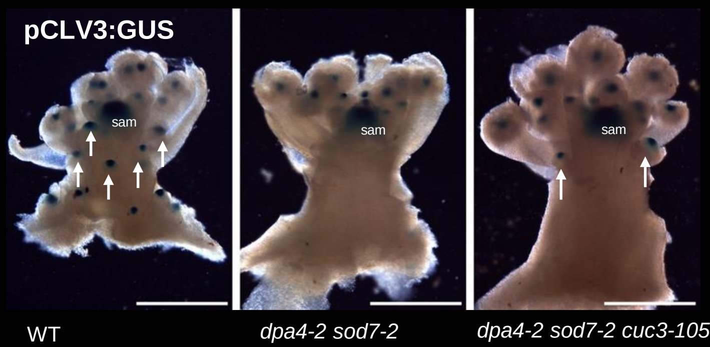


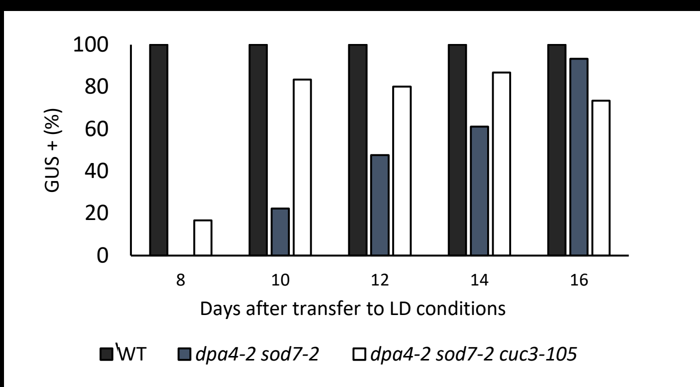


=> *WUS* is ectopically expressed in *dpa4 sod7*

=> *CLV3* activation is delayed in *dpa4 sod7* and partially restored by inactivating *CUC3*.

Ectopic boundary cell fate delays stem cell specification





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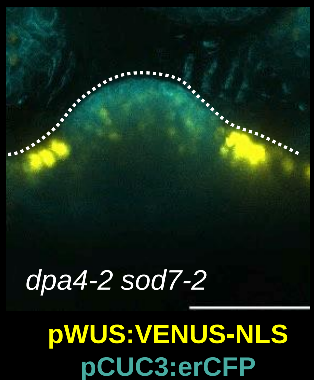

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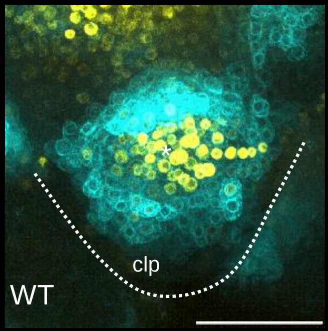
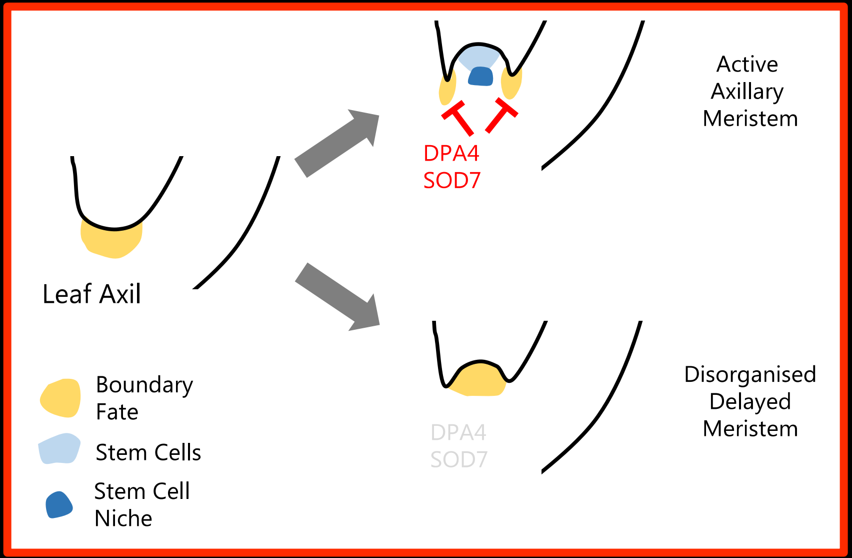


=> *WUS* and *CUC3* have complementary expression patterns in developing WT AM

A link between boundary fate and stem cells

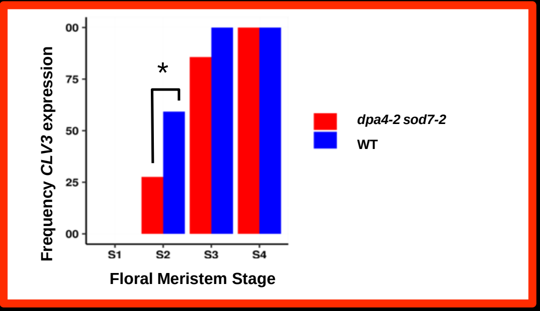
Axillary meristems



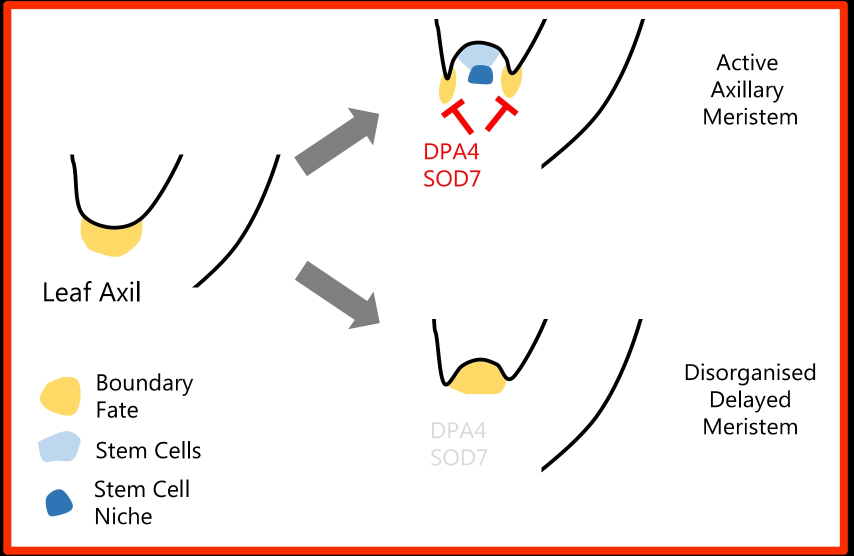
A link between boundary fate and stem cells

Floral meristems

CLV3 activation is delayed in *dpa4 sod7* floral meristems



Axillary meristems



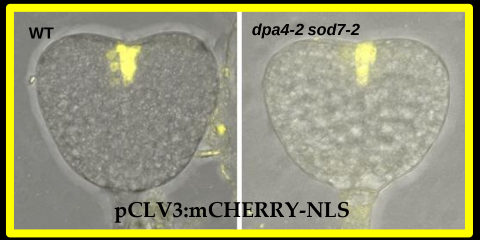
A link between boundary fate and stem cells

Shoot apical meristem

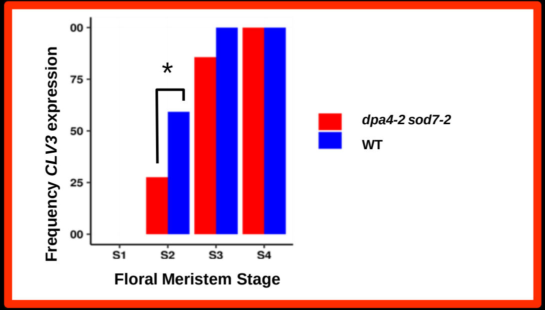
Floral meristems

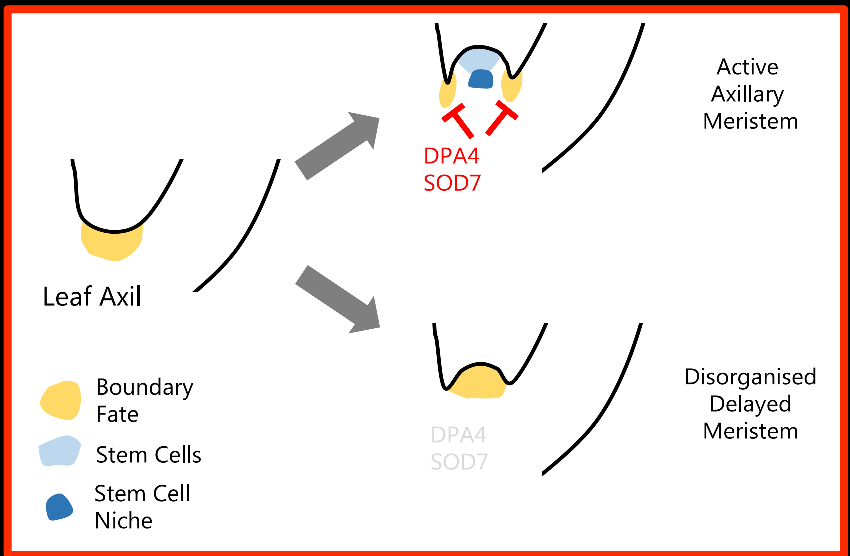
Axillary meristems

CLV3 activation is **not** delayed in *dpa4 sod7* embryos

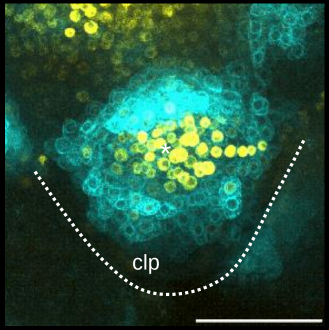


CLV3 activation is delayed in *dpa4 sod7* floral meristems





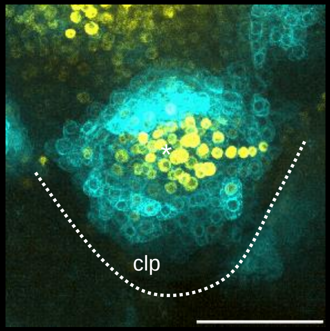
Open Questions



CUC3 and WUS complementary patterns :

- A direct genetic link ?

Open Questions



CUC3 and WUS complementary patterns :
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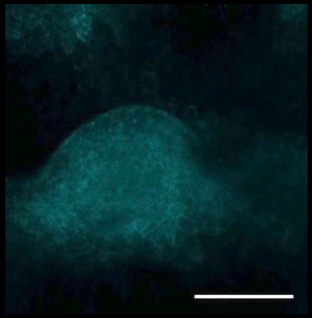
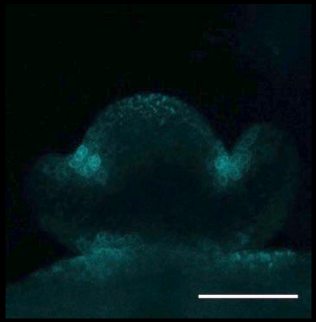


- Ectopic CUC
- Slow growth
- Perturbed cellular organisation
- Perturbed patterning



- Boundary CUC expression
- Normal growth
- Regular cellular organisation
- Stem cell activation

Other genetic factors ?

Emerging property of a « large meristematic structure » ?

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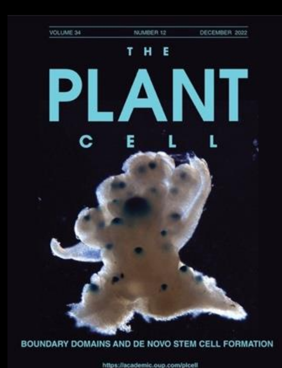

More details in
10.1093/plcell/koac269
10.3390/ijms231912007