Investigating LFY K80R in Arabidopsis: Functionality and Phenotypic Effects

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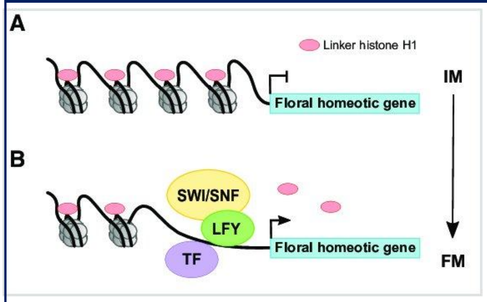
Abstract

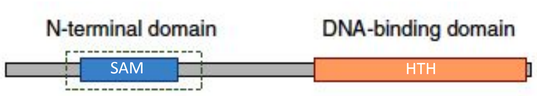
In the Arabidopsis Thaliana, LEAFY (LFY) is a master regulator promoting floral fate (meristem cells into flower) and floral organ identity. It has two functional domains: the Helix turn helix (HTH) DNA binding domain, and the SAM (Sterile Alpha Motif) domain. LFY's DNA-binding affinity relies greatly on SAM's role in facilitating higher-order oligomerization. In our prediction analysis, the K80 residue of LFY is predicted as a potential putative target for SUMOylation post-translational modification (PTM). The genetic analysis of the K80R mutation in SAM shows a dominant gain of function of LFY, causing floral organ abnormalities - no petals, increased stamen numbers, abnormal and in this case ectopic carpels. We speculate this may be due to the ectopic gain of function of LFY target *AGAMOUS* (*AG*), a C-class homeotic TF in the ABC model. Further, the overexpression LFY K80R mutant analysis also supports enhanced expression of *AG*. I will be presenting preliminary data supporting the significance of LFY SUMOylation as a post-translational modification crucial for LFY function.

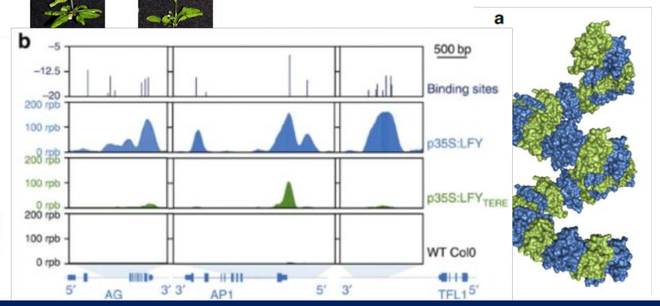
Introduction



LEAFY(LFY) is a helix turn helix pioneer transcription factor that promotes floral fate and floral organ identity.

LFY has a N terminal SAM domain and C terminal DBD.





Methods & Results

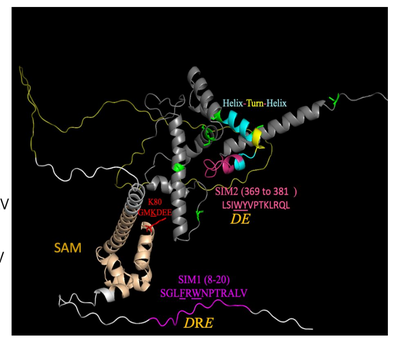
Prediction of LFY SUMO site and SUMO interacting motifs and conservation

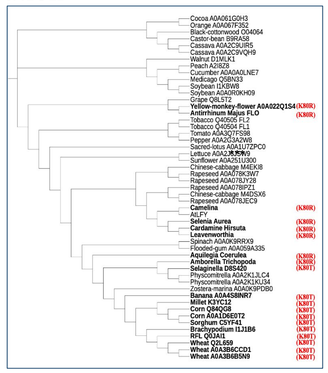
SUMO site

Position	Type	Confidence	Sequence
K80	I	99	GMKDEE

SIM sites

Position	Type	Confidence	Sequence
SIM1			
8 to 20	A	89	SGLFRWNPTRALV
SIM2			
362 to 374	R	92	VFNAHPRLSIWYV

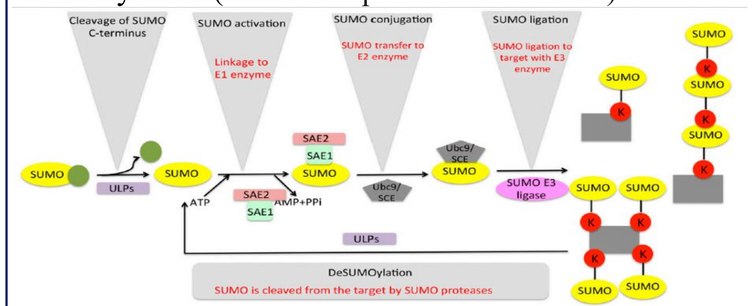


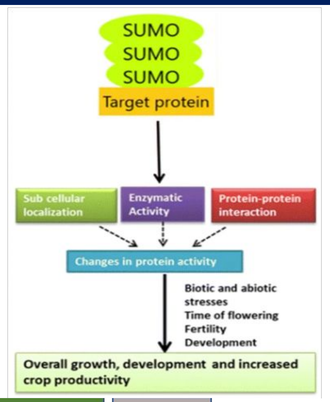


GPS-SUMO (http://sumosp.biocuckoo.org/online.php),

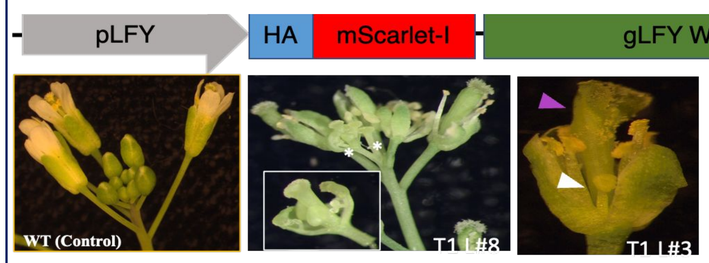
Methods & Results

SUMOylation (Small Ubiquitin-like Modifier)

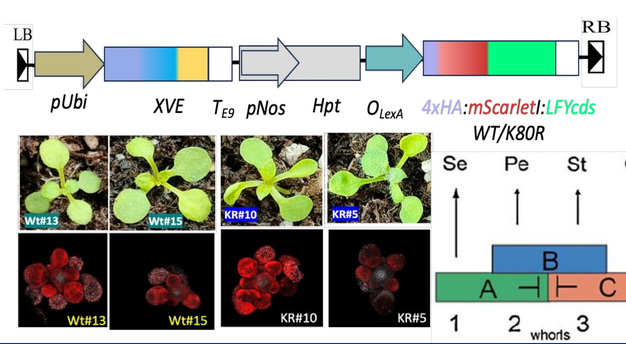




Preliminary phenotypic analysis of LFY^{K80R} mutant



65% (32 lines out of 48) of plants
Dominant phenotype
- No petal formation
- Increased number of stamens
- Carpel defects
- Some terminal flowers



Summary:
LFY K80R has increased activity in
-Flower patterning, perhaps due to ectopic expression of AGAMOUS in whorl2
-In meristem determinacy

Future Directions

- Is LFY K80 SUMOylated?
- Which SUMO protein (SUM1, 2, 3 and 5) and SUMO protease is responsible for LFY SUMOylation and DeSUMOylation?
- Does LFY K80 SUMOylation alter biochemical property of LFY like oligomerization, transcriptional activation, and interaction with cofactors like SWI/SNF complexes?

References

Wagner Science 1999; Yamaguchi A. Dev Cell 2009, Winter Dev Cell 2011, Pastore Development 2011, Yamaguchi N. Science 2014, Jin R. Nat Com 2021, Srivastava and Sadanandom; 2020, Ghimire et al., 2020.

Acknowledgments

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