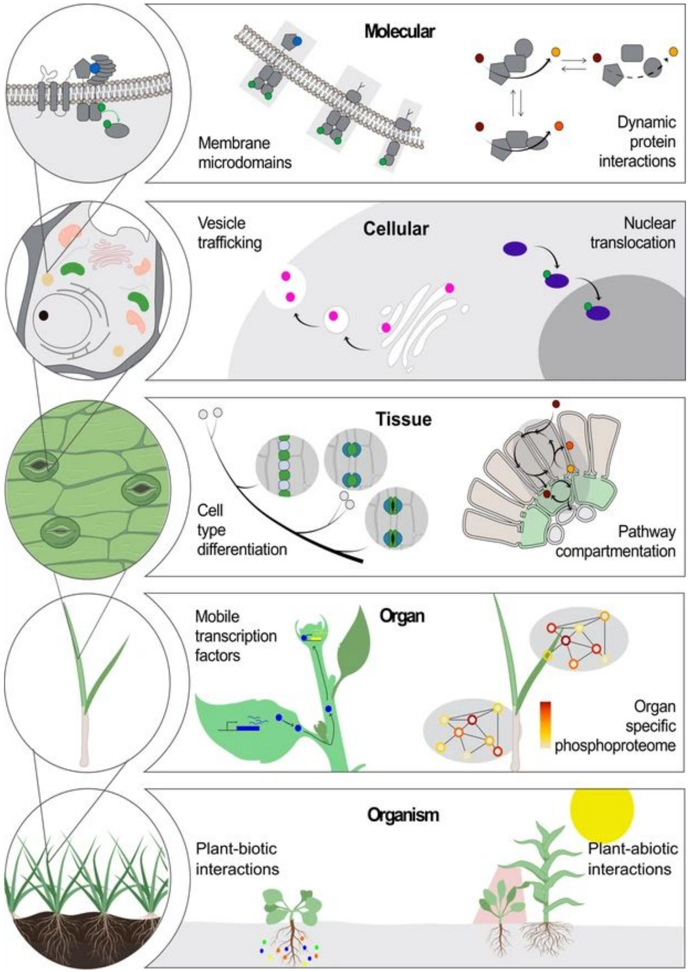
What can synthetic biology contribute to plant research and biotechnology?

Motivation for the Plant Cell Atlas: Understanding location to function

- Similar to the “structure-to-function” paradigm, we can make predictions about the functions of biomolecules based on their locations
- Single cell approaches are rapidly expanding location knowledge
- How do we test these predictions?



Plant Cell Atlas Consortium, 2021, *eLife*

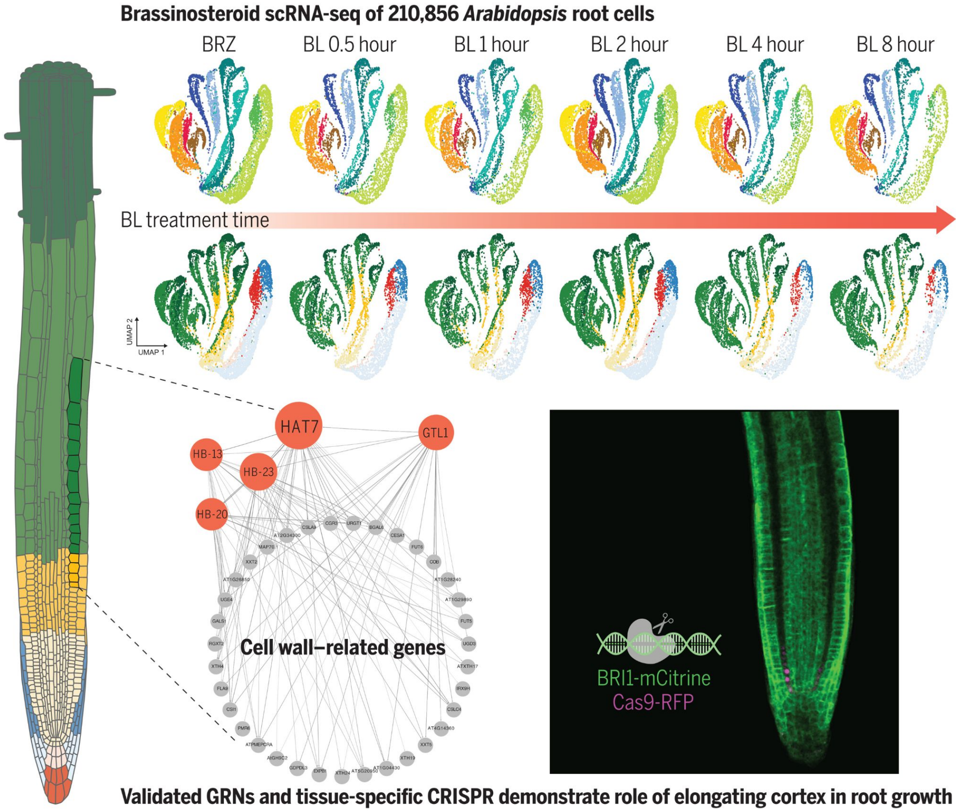
Limitations to traditional genetic approaches

- Genetic knockouts/loss of function, constitutive overexpression - does not support the importance of location to gene function

- promoter:gene fusions - does not enable varied expression strength

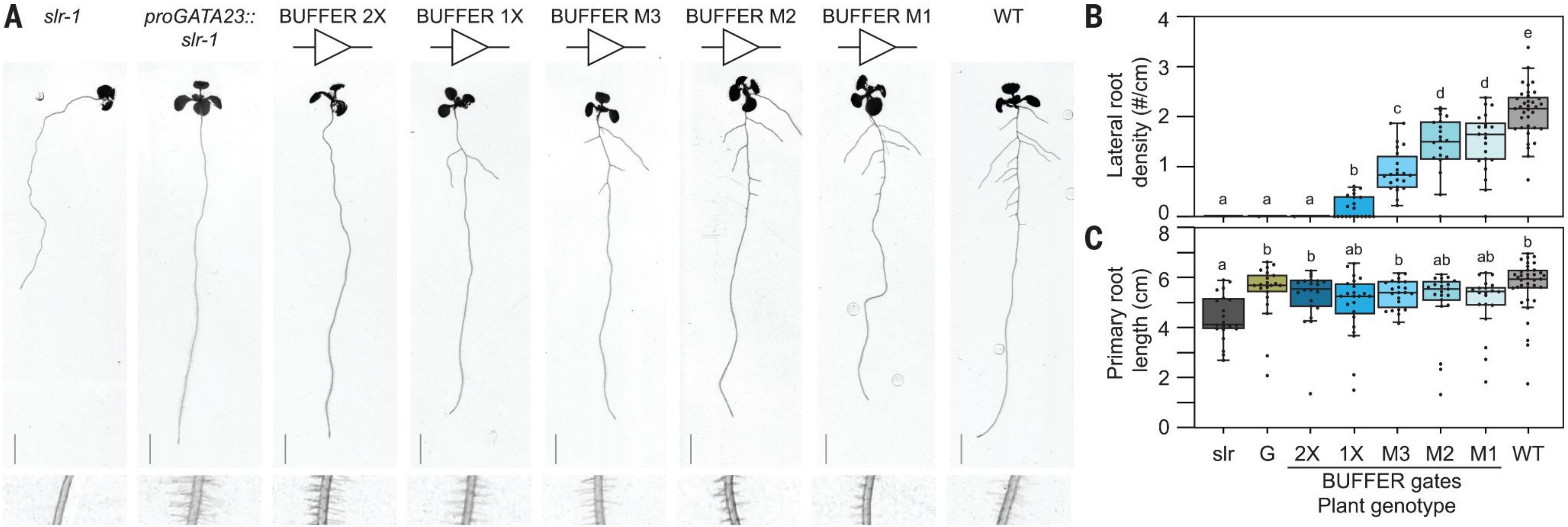
Traditional genetic manipulation can lead to unwanted pleiotropy or simply be ineffective to study genes whose activity is incredibly context specific - often the case for developmental regulators and environmental response genes

Synthetic biology tools can help test location-to-function hypotheses



Nolan et al, 2023, *Science*

Location knowledge can empower engineering plants for specific goals (yield, resilience, etc)

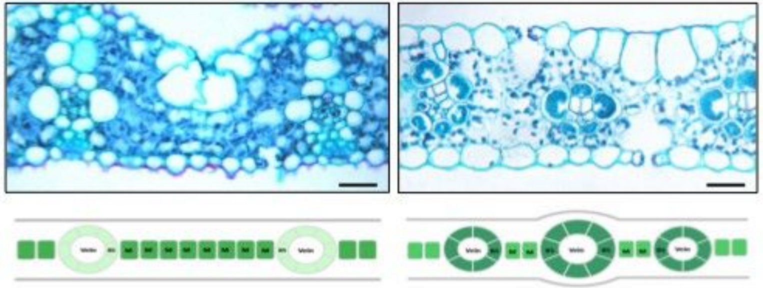


Brophy et al, 2022, *Science*

The loftiest engineering goals in plant biology will require precise spatial control

Salk Institute Harnessing Plants Initiative: Deeper roots with more suberin for carbon sequestration

ENSA Project: Engineering Nutrient Symbioses for Agriculture



C4 Rice Project

Goals for the hackathon

- Expand the expertise of plant single cell biology researchers (you!) to include new methods to perturb gene activity in specific cellular contexts

- Provide resources to demonstrate manipulation of gene activity in specific cell types

- Identify and fill technological gaps by developing new tools