

# Phenes and Phenotyping

- Sunday January 10, 2016
- 8:18 – 8:36
- Town and Country – Pacific Salon 3



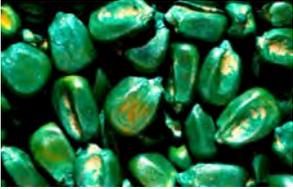
# Phenes and Phenotyping in Maize for Gene Discovery and Breeding

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# Seed to Seed: 600X biomass return



~30 kg seed/ha

~75 days



~12 Mg/ha  
vegetative biomass  
at flowering

~45 days



~12 Mg/ha  
grain









Justin Bieber Born March 1, 1994 (19)

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# The challenge of translational research

genome



phenome  
which traits?

costs & benefits?

tradeoffs?

integrated

phenotypes



agronome

productivity?

resource use?

species interactions

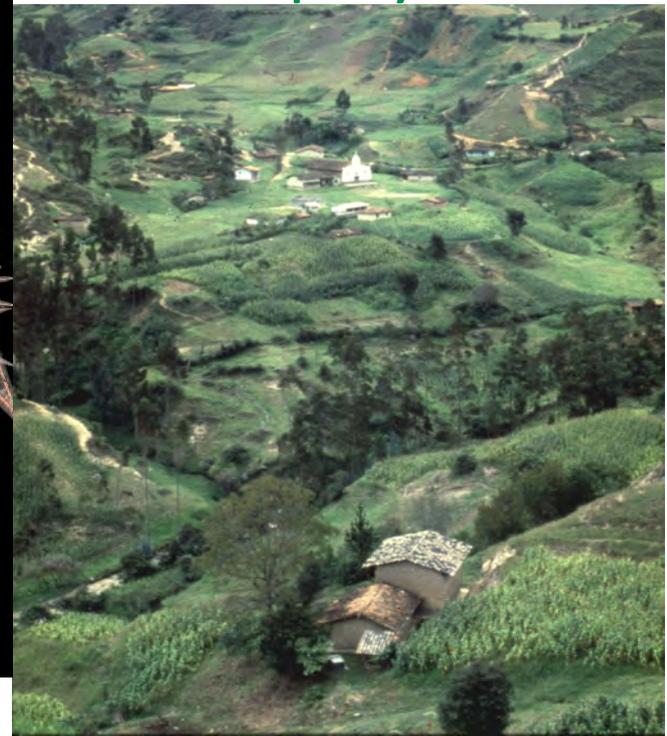
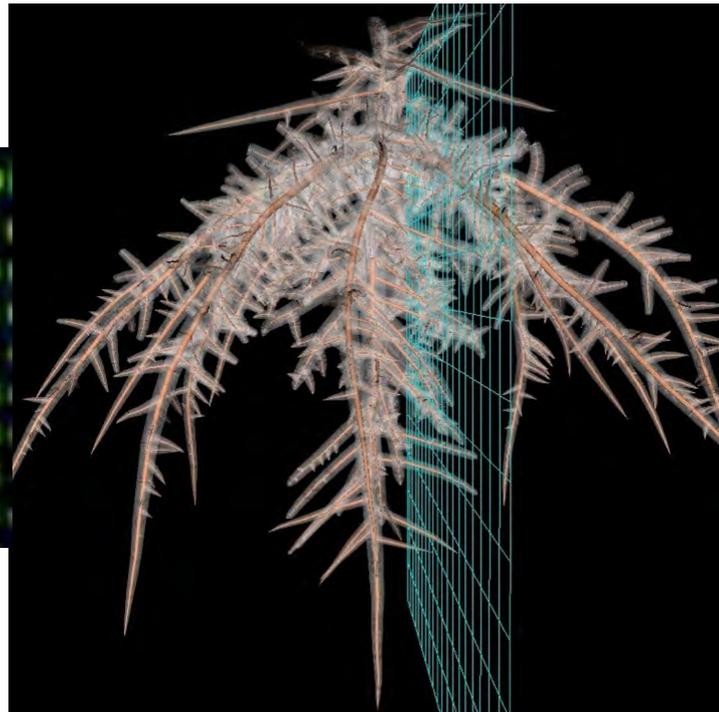
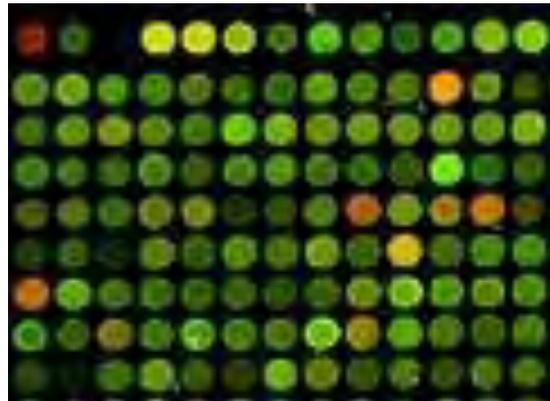
sustainability?

equity?

which genes?

regulation?

interactions?



# Potential Benefits of Phenotyping:

Identifying traits early in development  
that indicate final potential



Day 1

Day 2

Day 3

Day 4

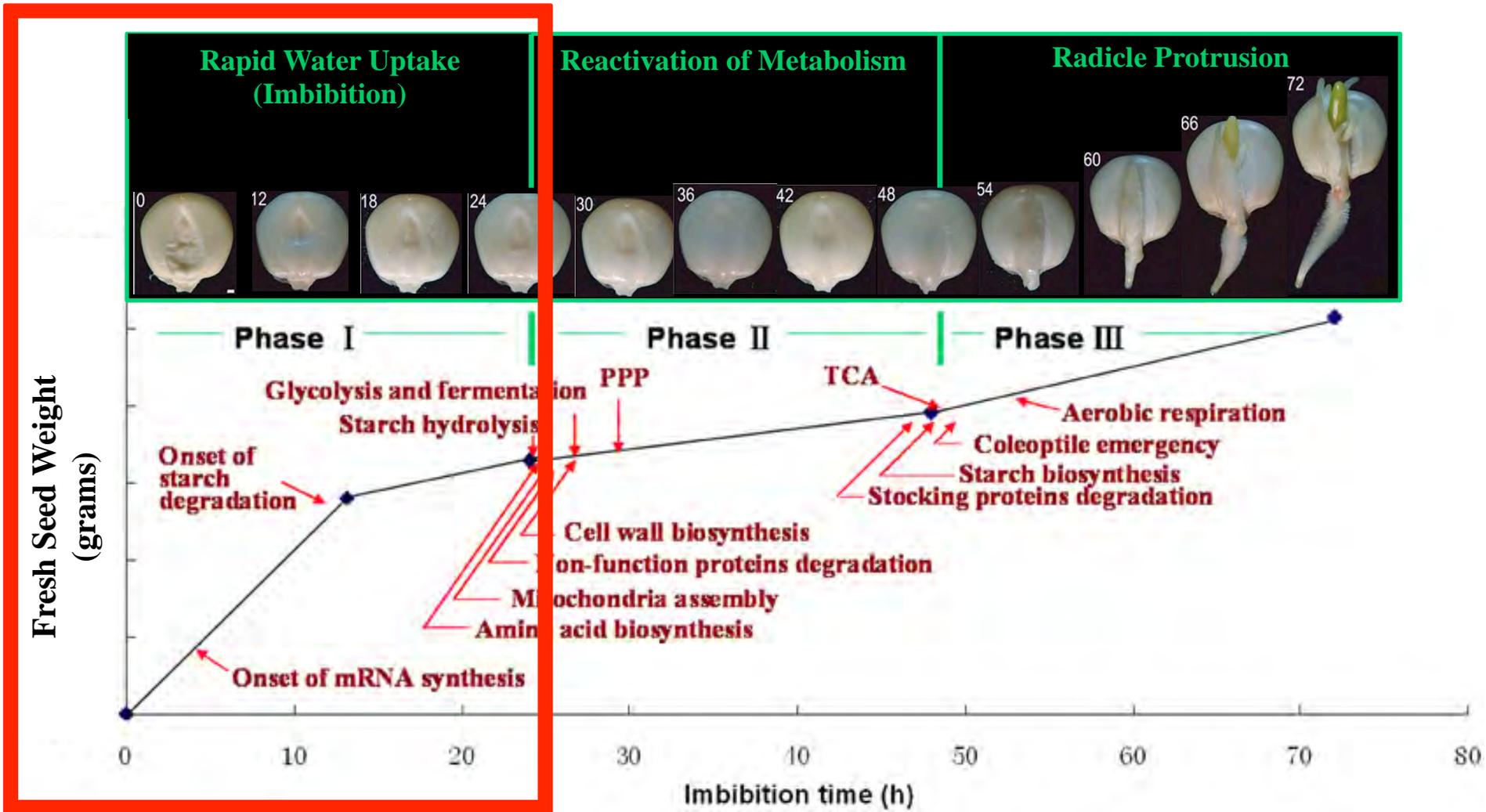
Day 5

# Maize Diversity

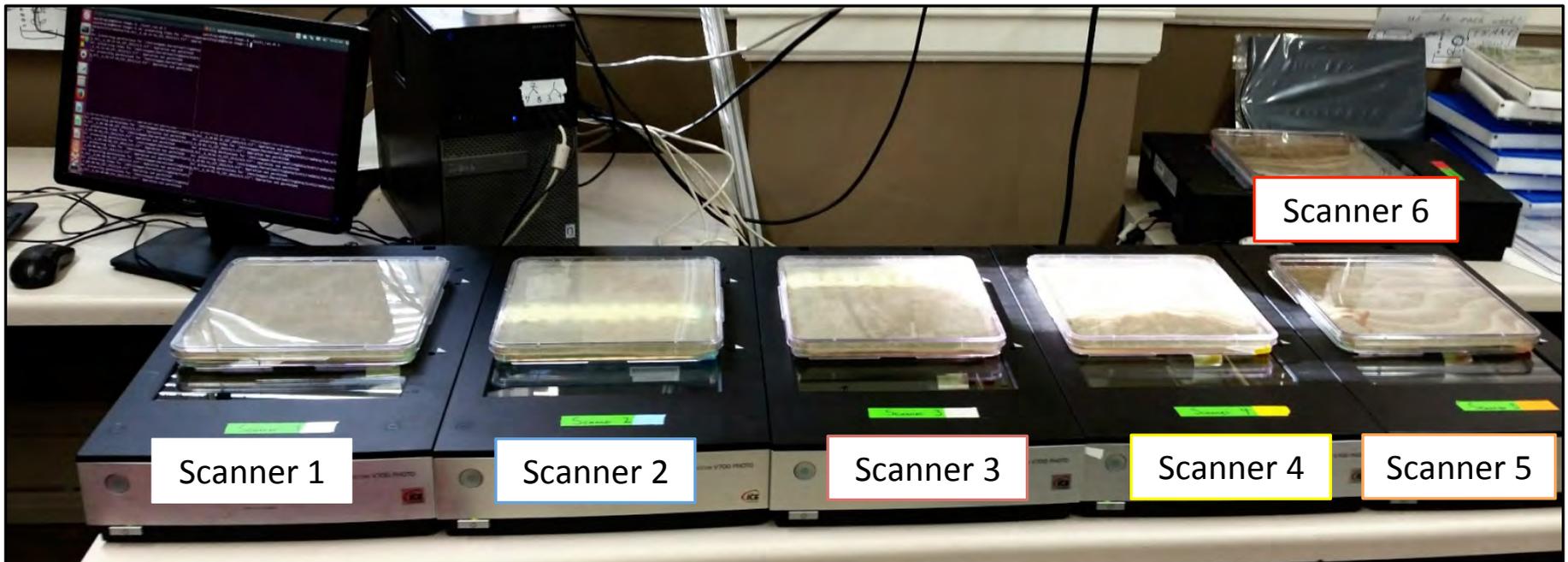
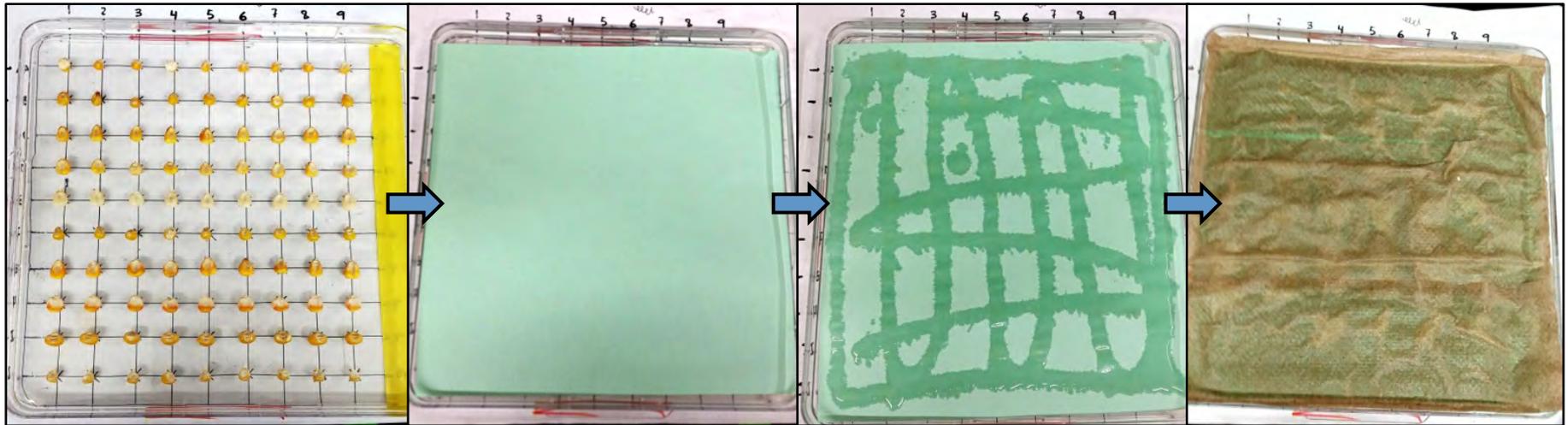


Video by Edgar Spalding

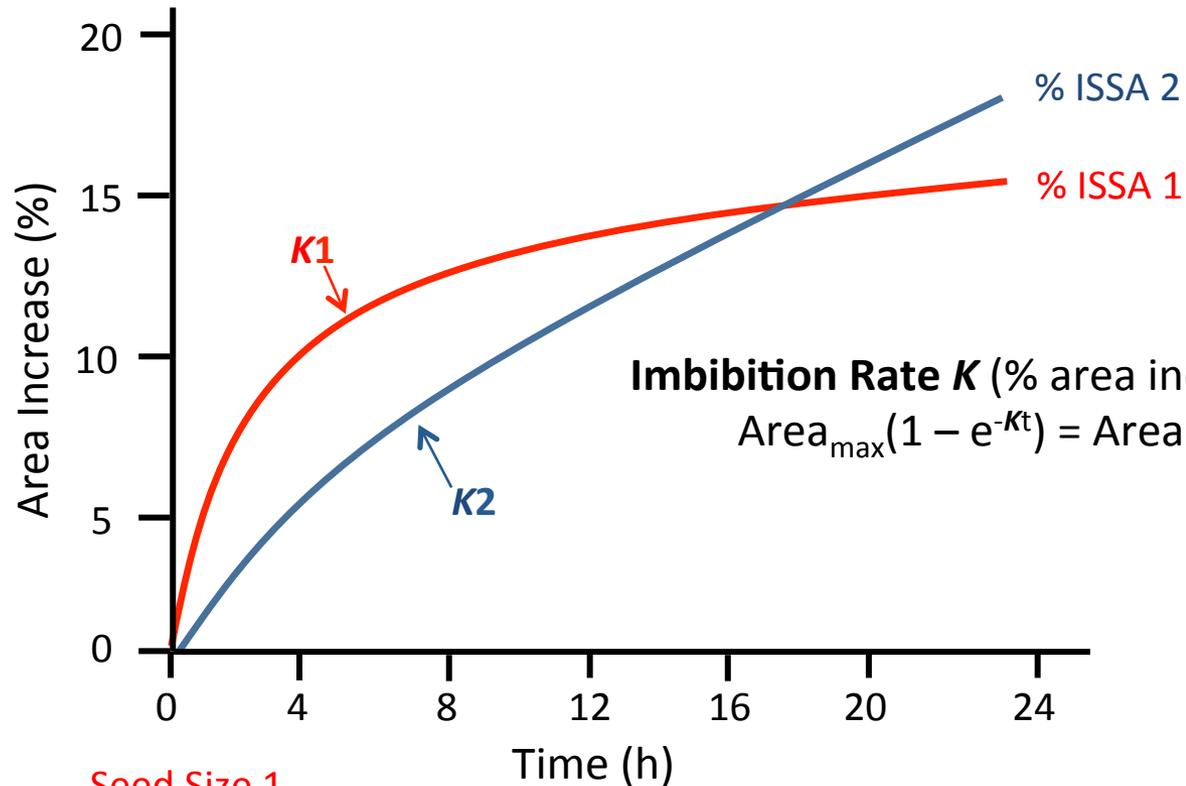
# THE TRIPHASIC MODEL OF GERMINATION



# PHENOTYPING PLATFORM

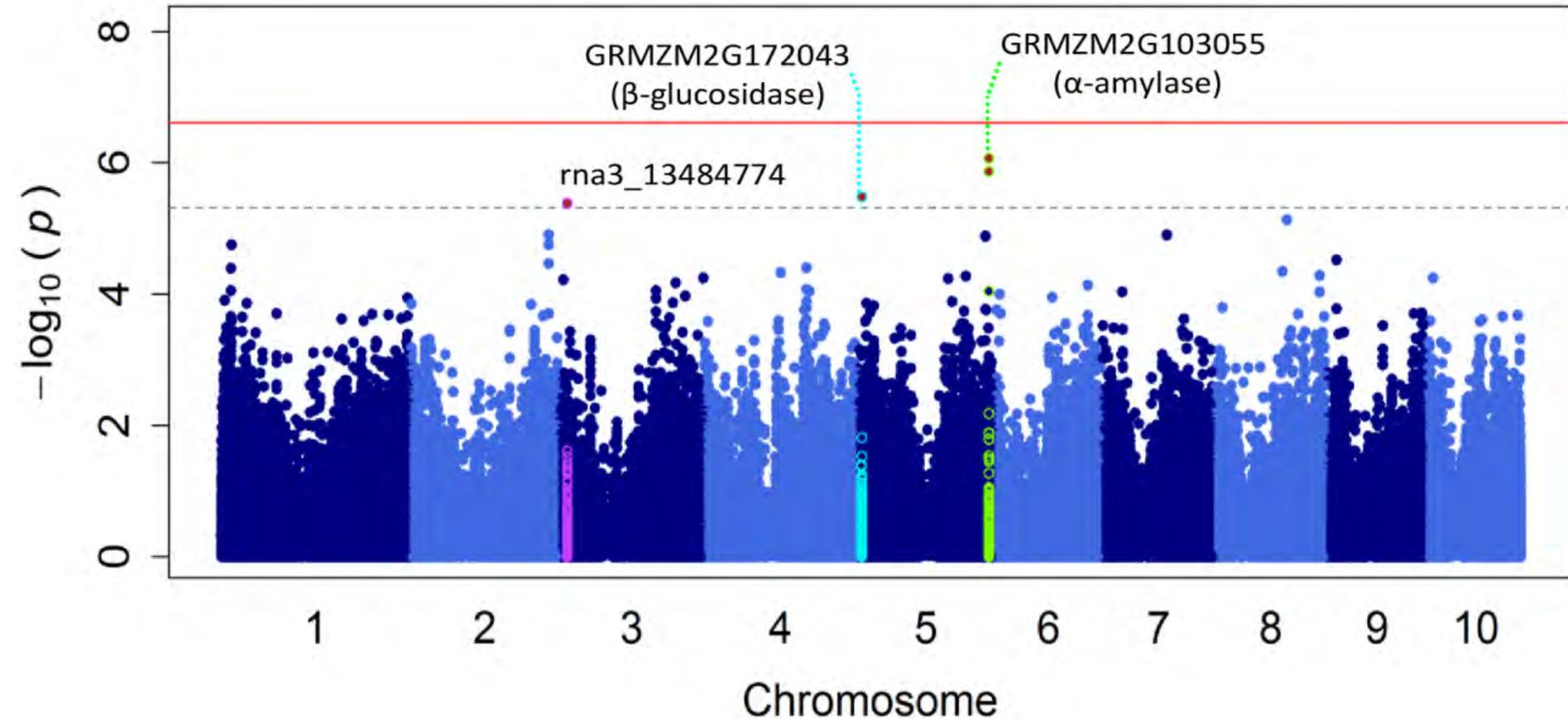


# Example Schematic of Measured Seed Imbibition Phenotypes



Nathan Miller  
Spalding Lab

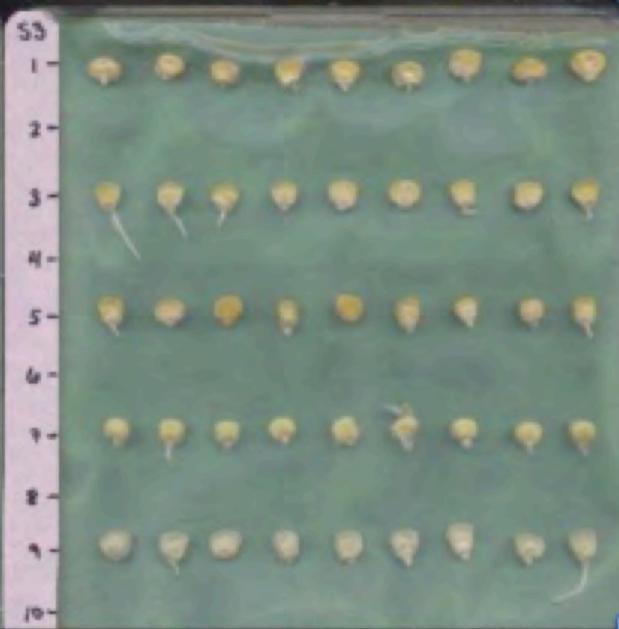
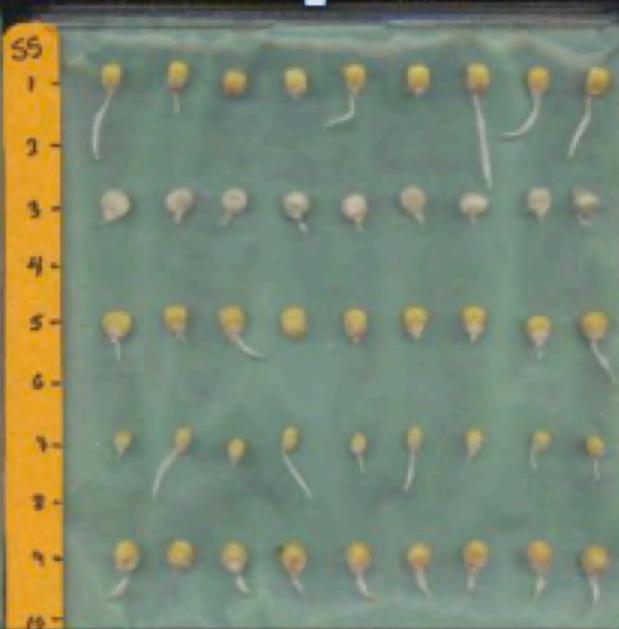
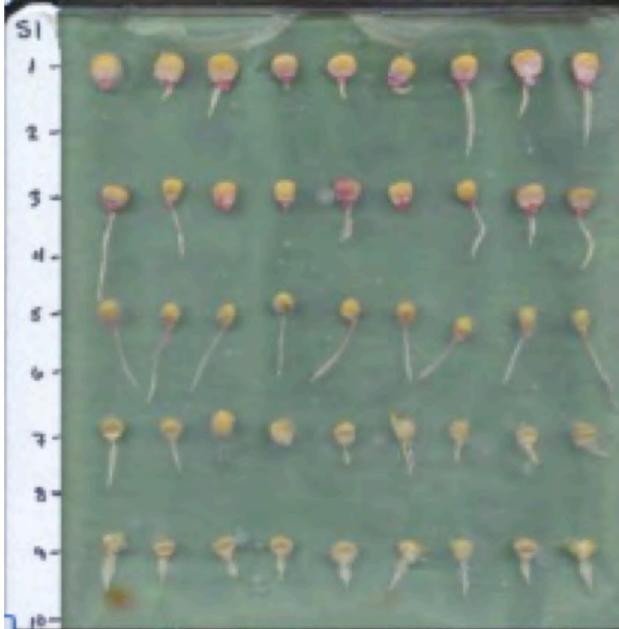
# Imbibition Rate $K$ – GWAS



**FAST SWELLERS**

**MEDIUM SWELLERS**

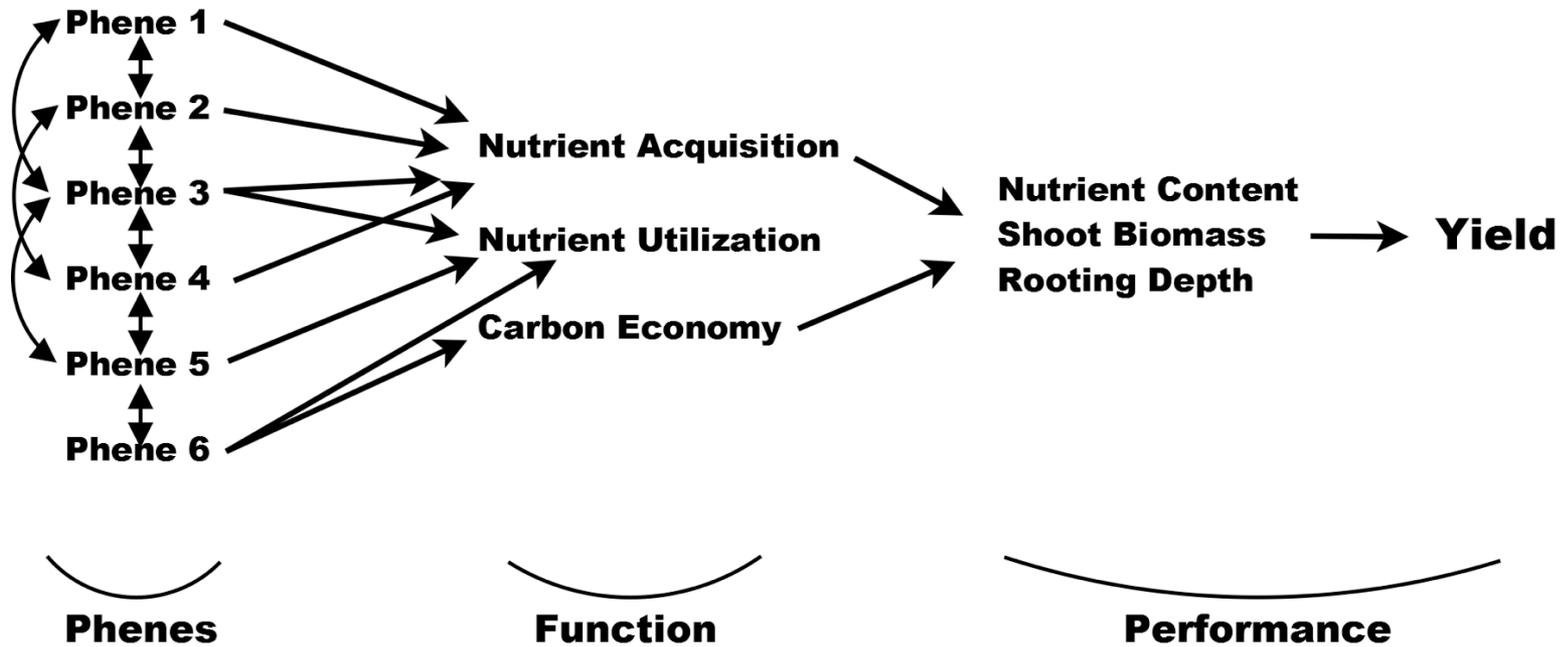
**SLOW SWELLERS**



# Potential Benefits of Phenotyping:

Identification of novel elemental phenes using unique technologies

# what is a phene?



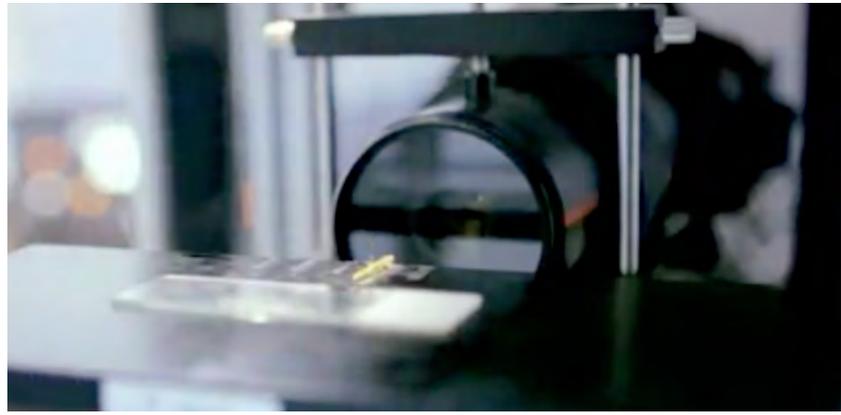
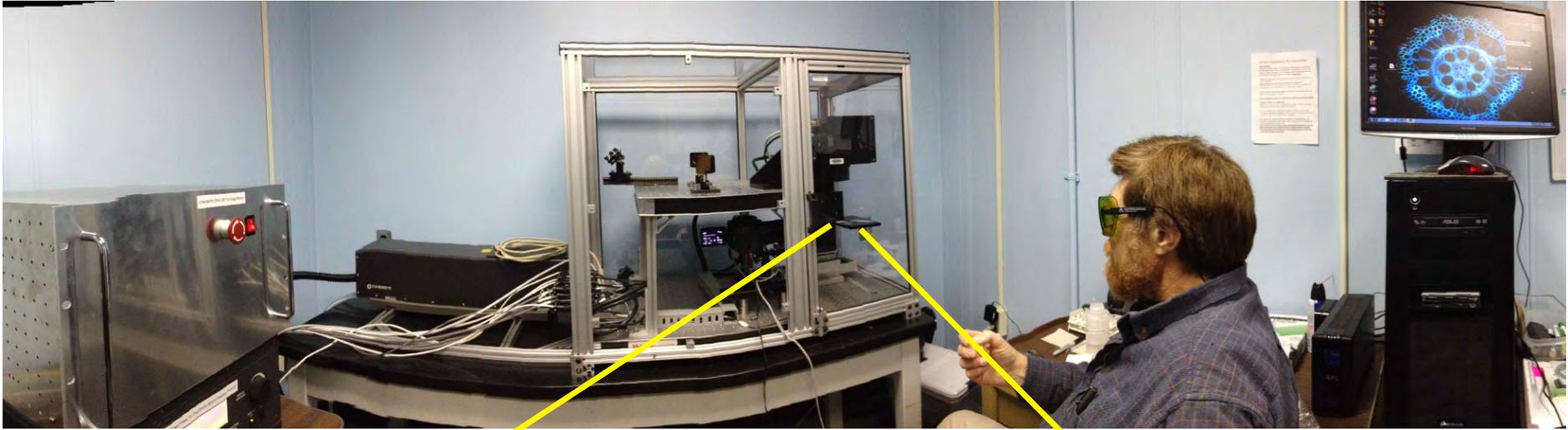
# ***Shovelomics***

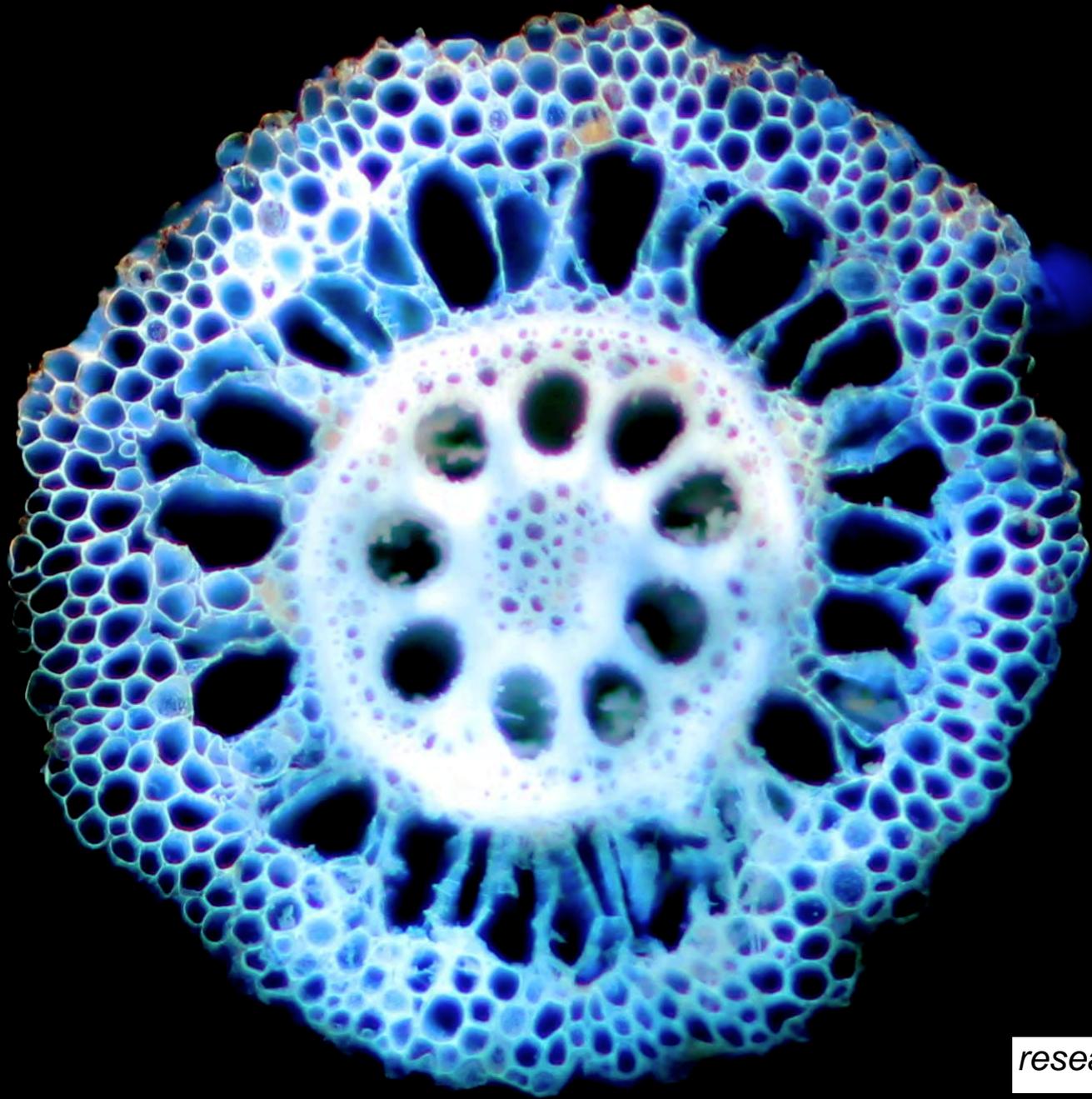
high throughput  
phenotyping of root  
architecture in the field

2 min/genotype

25,000 plots/yr  
bean, maize, sorghum,  
cowpea, groundnut, barley







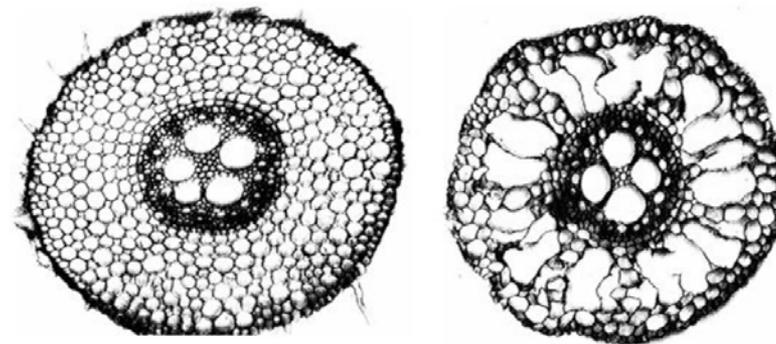
*research of Ben Hall*

# High RCA improves yield under **drought**



Under water stress in field studies in the USA and greenhouse mesocosms, high RCA lines had

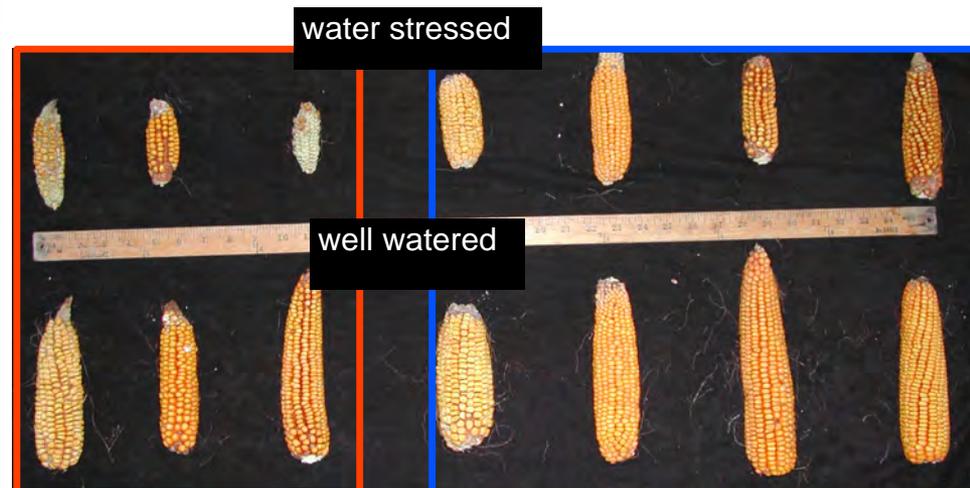
- 55% less specific root respiration
- 340% more roots 40-50 cm deep
- 10% greater leaf RWC
- 43% better growth
- **800% more yield**



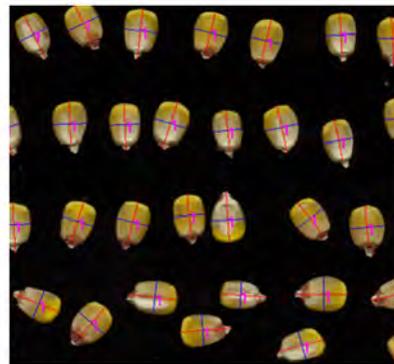
Seminal root sections of RILs of Oh43xW64A differing in RCA

**RILs with less RCA**

**RILs with more RCA**



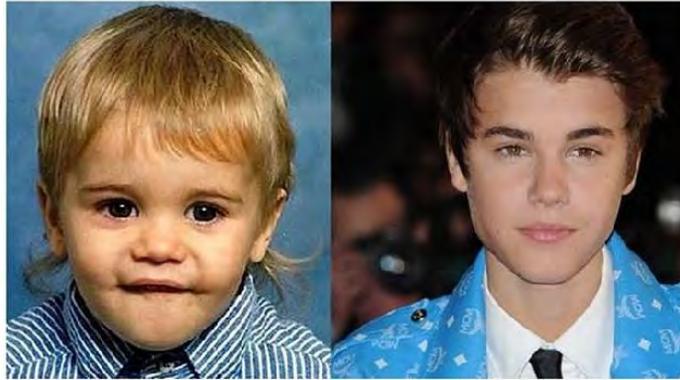
# Advances in computation, imaging, detection, and robotics and nanotechnology make many measurements possible



Major and minor axes measured for each kernel (above).  
Fourier transform of the ear (left) measured the average kernel length in the axial direction.  
Together, these two measurement modes determine the three principal dimensions of the average kernel on an ear.

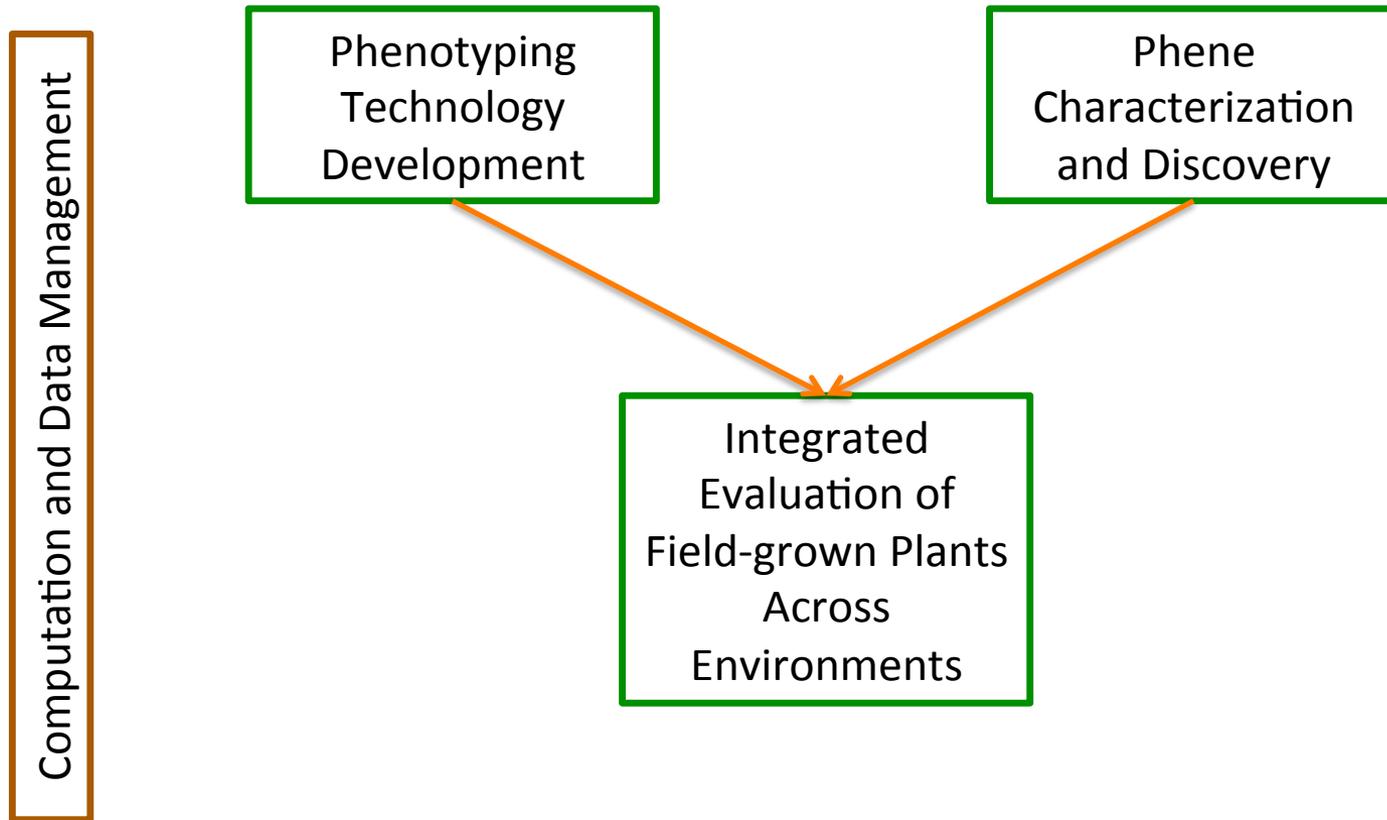


The challenge is to determine which measurements are valuable



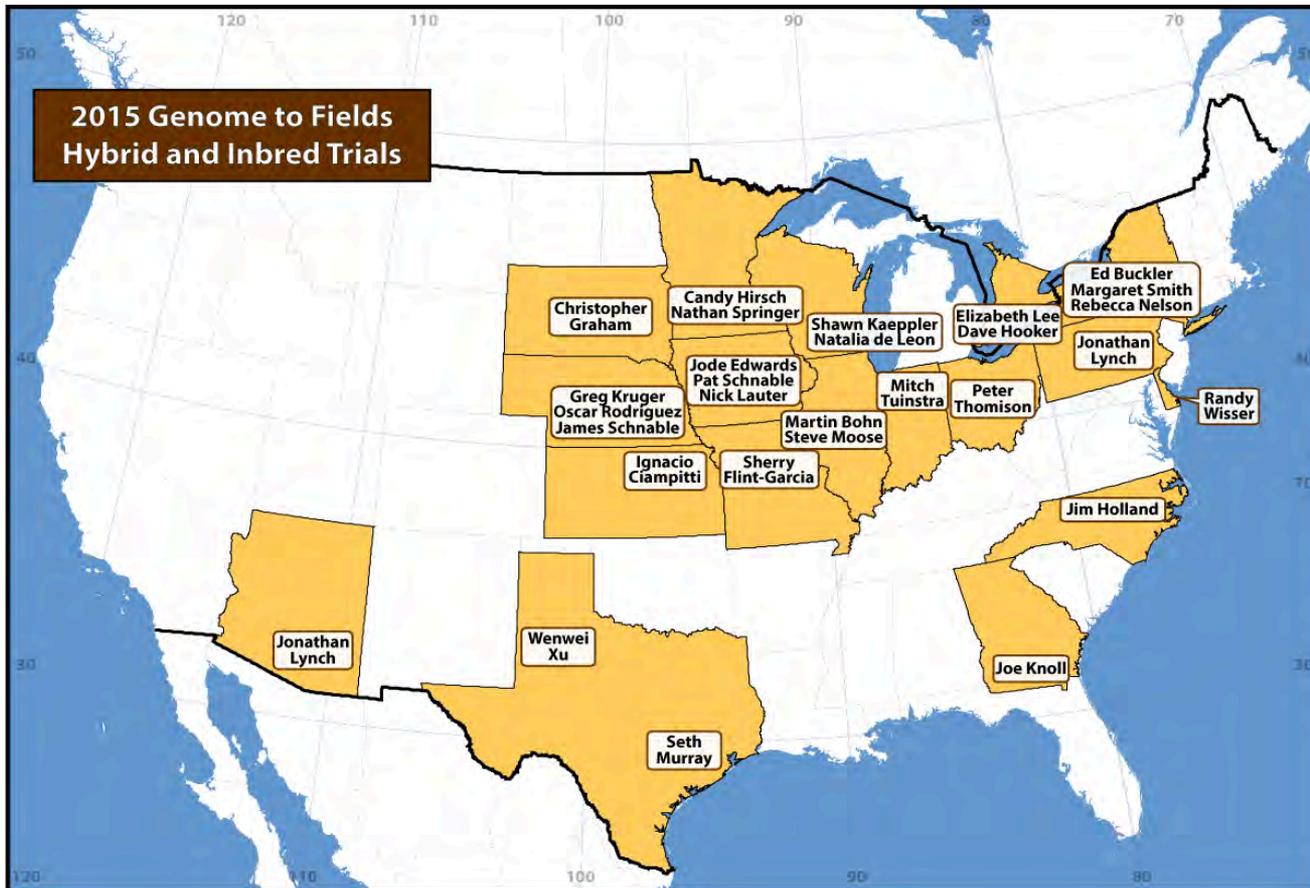
Justin Bieber Born March 1, 1994 (19)

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# Genomes to Fields



# Acknowledgements



Questions?

