

Genomes to Fields 2014 Workshop

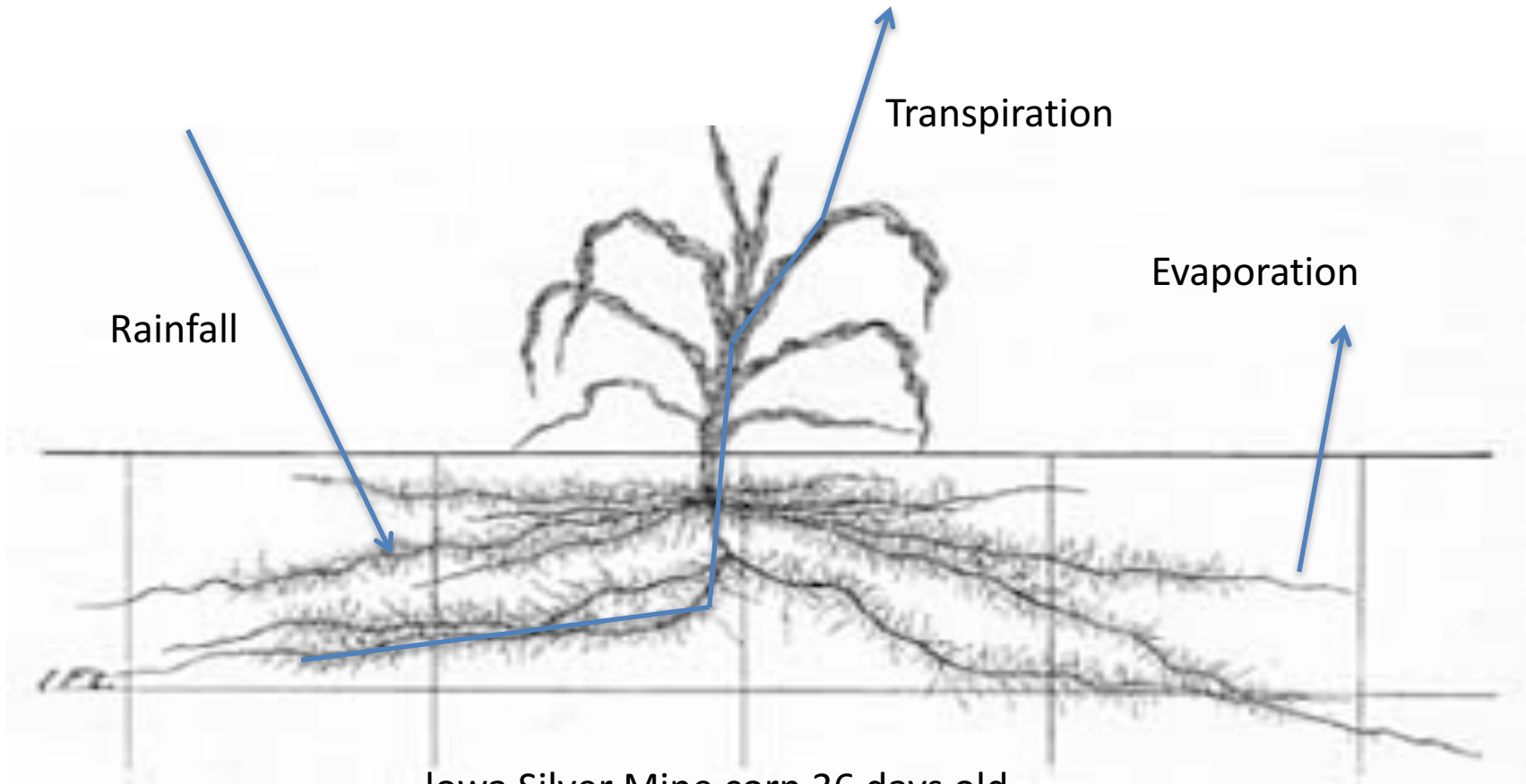
***Real time measurement of water
stress in the field***

James Schnable

Chicago, IL

December 10

Importance of water



Iowa Silver Mine corn 36 days old.



(Weaver 1926)
Root Development
of Field Crops

Why is studying water use complicated?

- ✧ Roots are hard to measure directly
- ✧ Different root structures will be most effective under different conditions and the same line will grow different patterns of roots under different water regimes
- ✧ Wilting causes different levels of yield loss at different times in development.
- ✧ Need 16 more inches of rainfall to meet 2050 yield targets(Ort & Long 2014)



Schneekloth et al (2009)

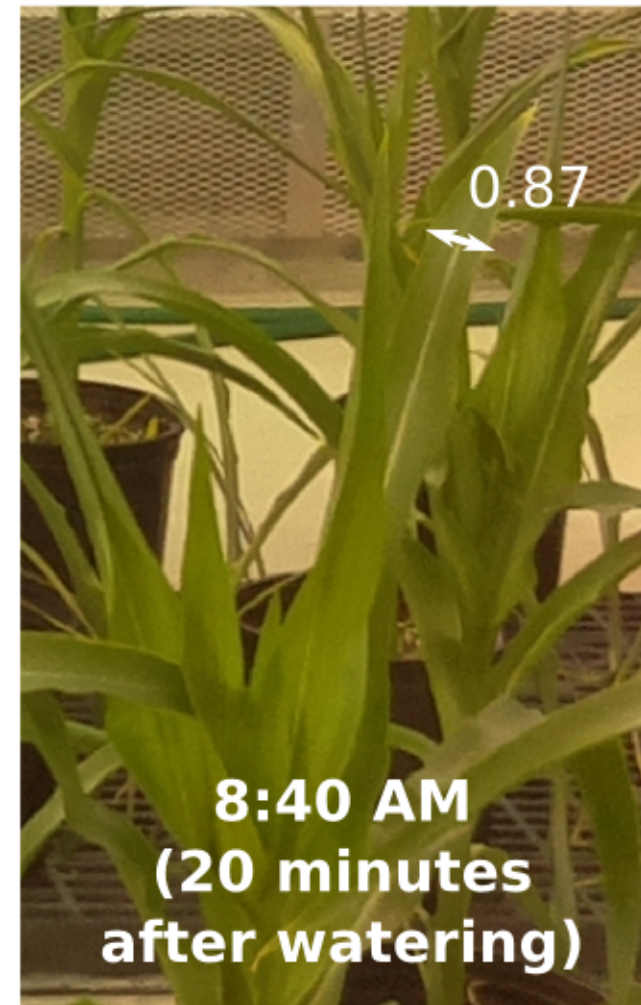
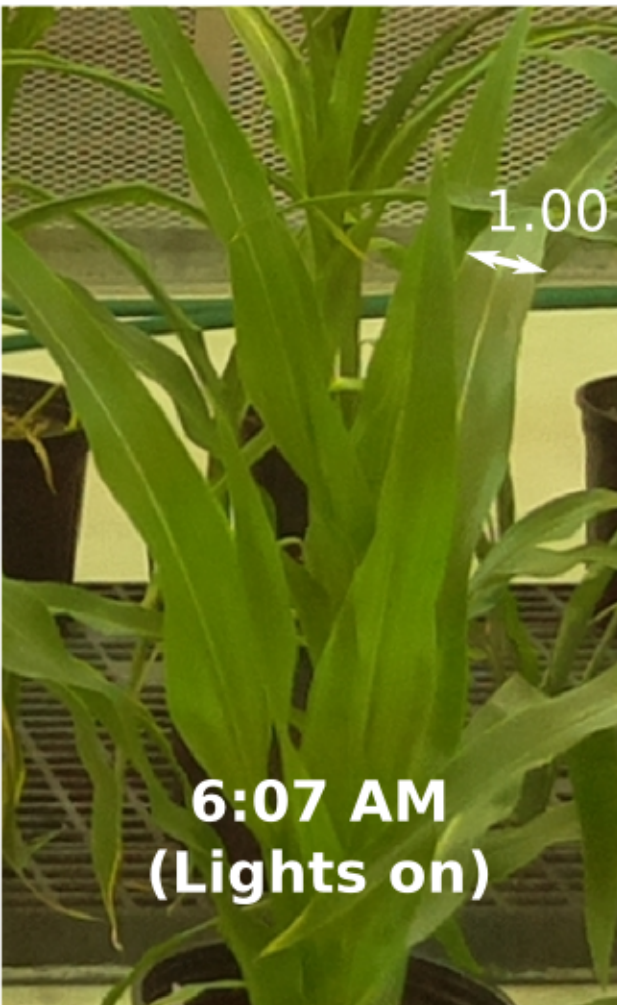
Above Ground Water Stress Phenotypes

- ✧ Leaf roll is familiar to anyone working on maize
- ✧ Loss of turgor pressure causes the adaxial (i.e. top) surface of the leaf to shrink faster than the bottom surface.





Leaf Roll Photo

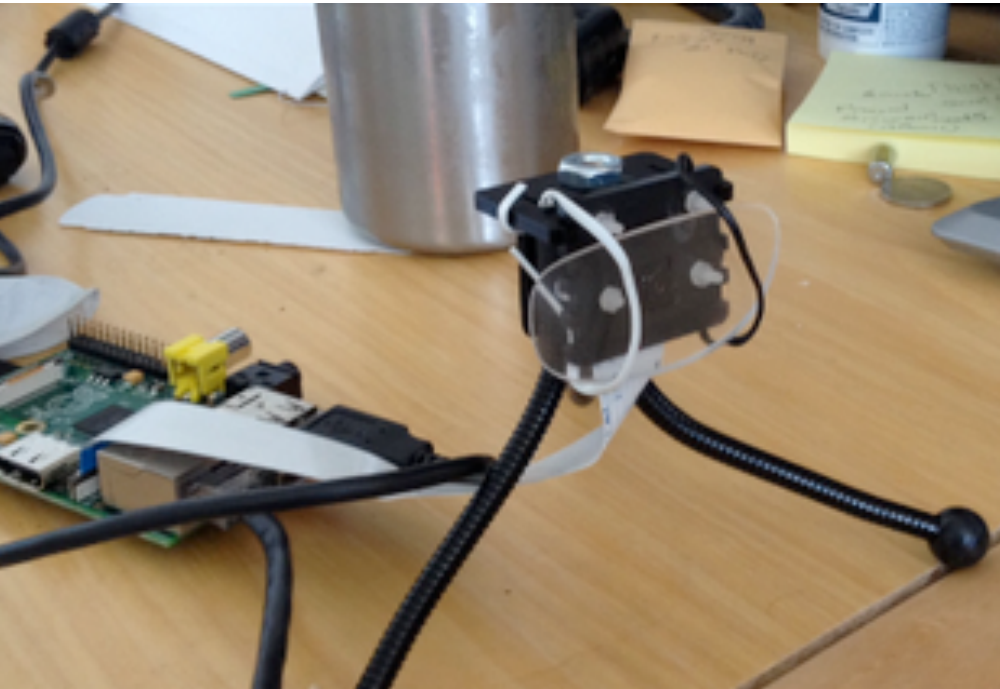


Lemnatech Phenotyper

- ✧ Costs \$2.5-5M
- ✧ Collects 3D models of plants (1/day)
 - ✧ Visible light, infrared, thermal cameras
 - ✧ Measures plant water use through change in pot weight once per day.
- ✧ Two public sector machines in the USA
 - ✧ UNL installation: 200 plant initial capacity
 - ✧ Danforth Center: 1000 plants but plants can't be more than 3 feet tall.



Raspberry Pi



Combines a low cost field deployable computer, 5 megapixel camera and wifi adapter.



Raspberry Pi



- ✧ \$200/unit in the field
 - ✧ \$100/unit anywhere an extension cord can reach
- ✧ 2D models of plants
- ✧ Can track plants to maturity.
- ✧ Data collection every 30 seconds-10 minutes

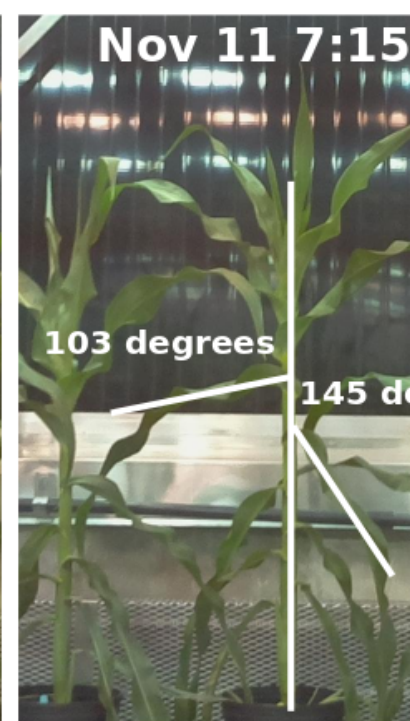
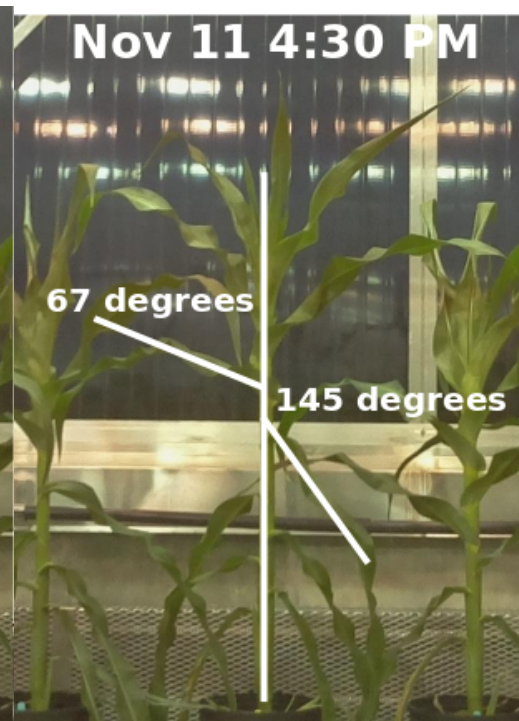
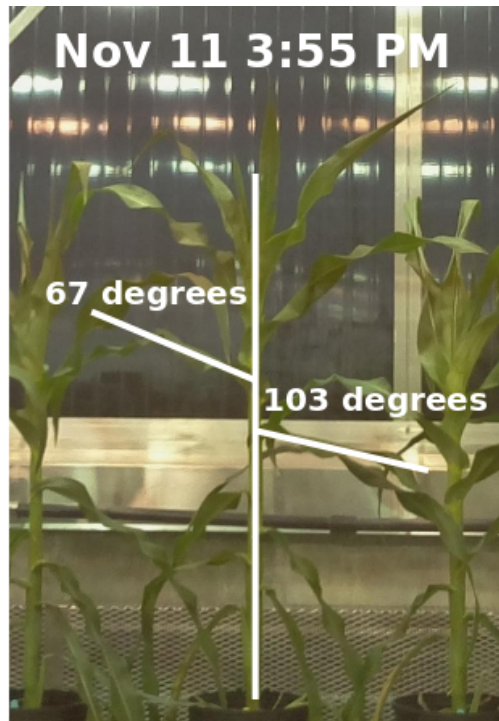
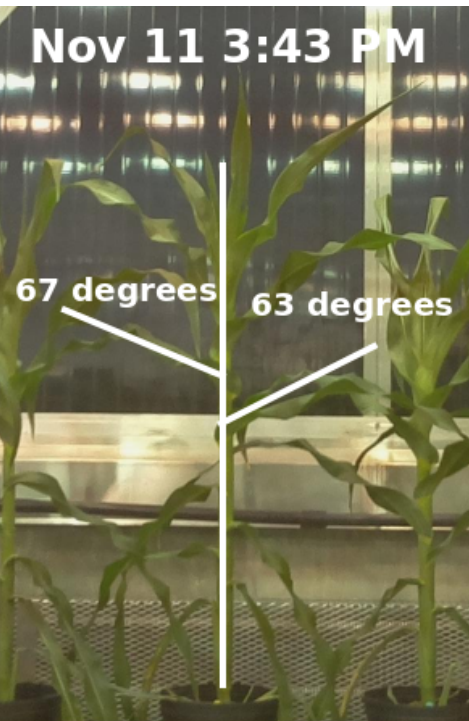


Leaf Drop

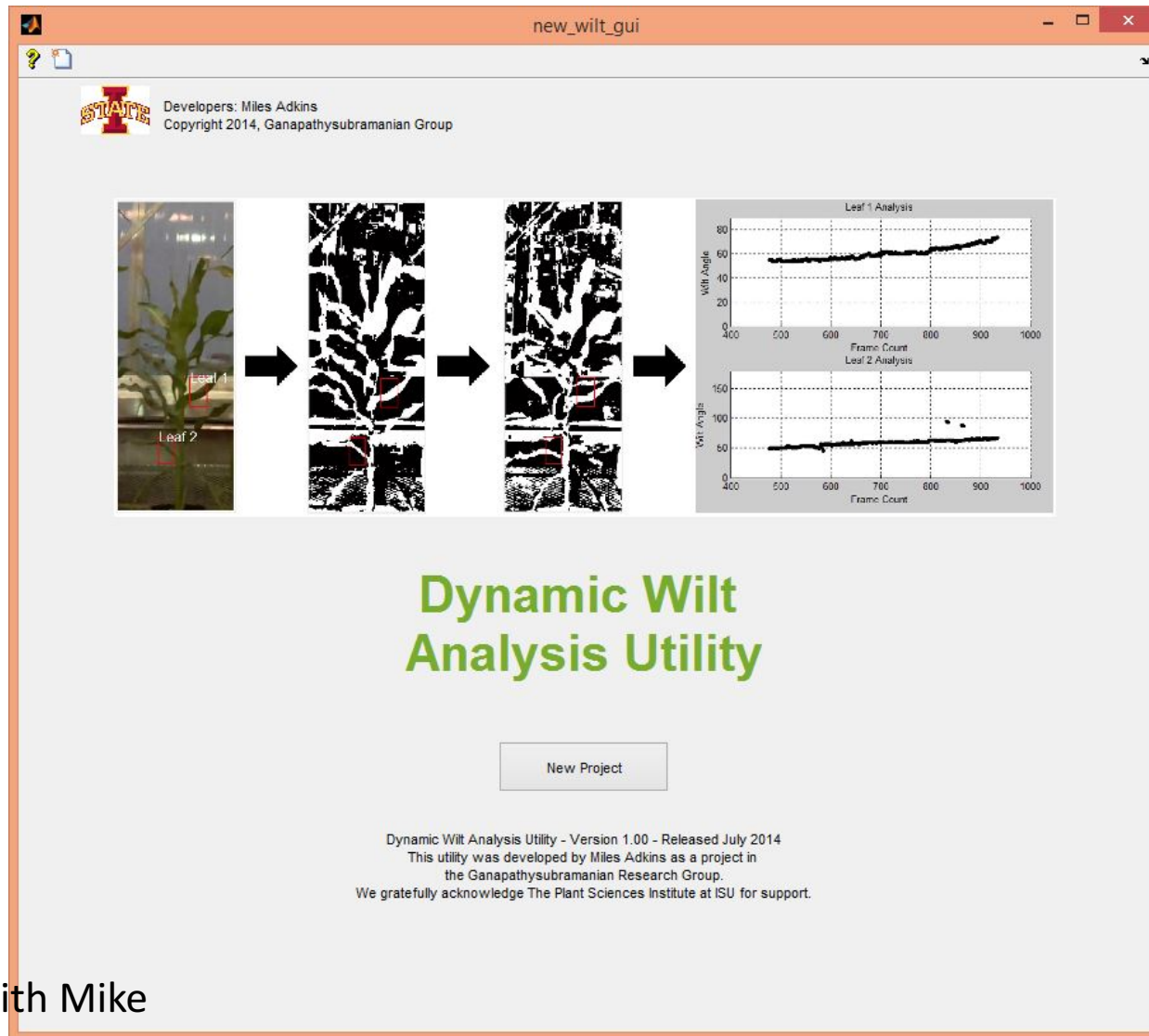
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Leaf Drop Diagram



Quantitative image processing



Collaboration with Mike
Adkins and Baskar
Ganapathysubramaniam at
Iowa State



Water Stress Resistance vs Water Use

- ✧ First study of leaf drop compared mutant and non-mutant plants in a segregation population. Less water use efficient plants have faster leaf drop.
- ✧ When looking across diverse inbred/hybrids will we be studying differences in rates of water use or tolerance for water stress.
 - ✧ Collecting preliminary data now

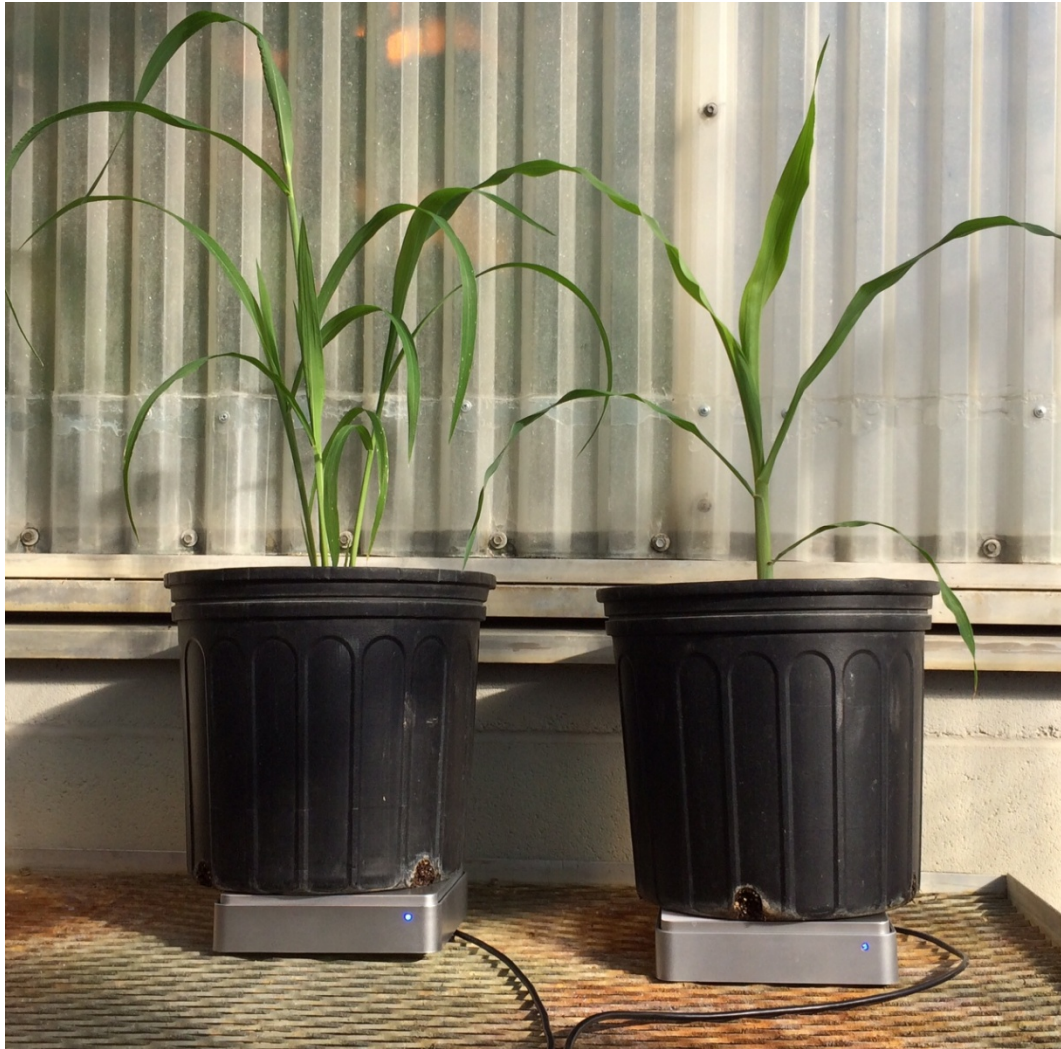


Correlated Water Stress With Water Use In the Greenhouse

Control Pot



Correlated Water Stress With Water Use In the Greenhouse



Raspberry Pi

Next summer, my lab will collect phenotypes of 1000 maize plants under field conditions.

Cost will be ~1% of buying a Lemnatec Phenotyper



Thank You



Anthony Studer
(Danforth Center)



Baskar
Ganapathysubramanian
(ISU)

