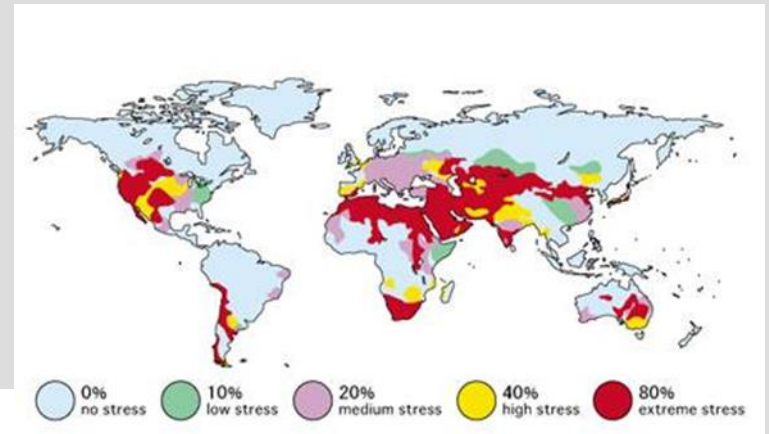




Evaluation of drought tolerance candidate genes in cotton

Randy D. Allen
Institute for Agricultural Biosciences
Oklahoma State University

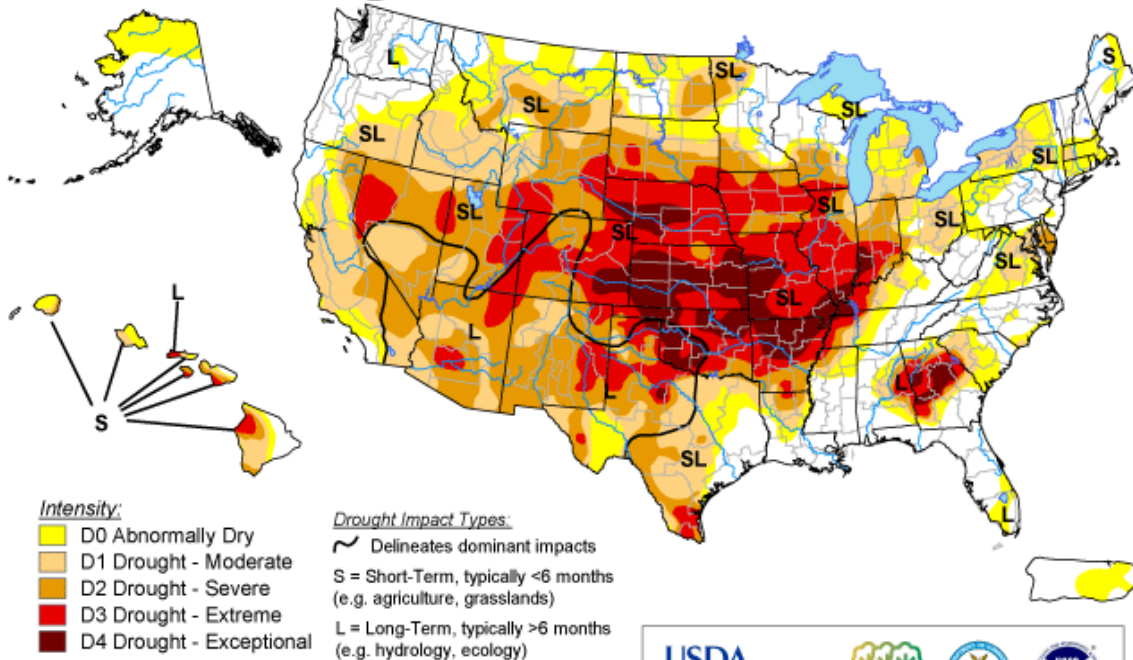
Drought:



U.S. Drought Monitor

August 21, 2012

Valid 7 a.m. EDT



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://droughtmonitor.unl.edu/>



Released Thursday, August 23, 2012

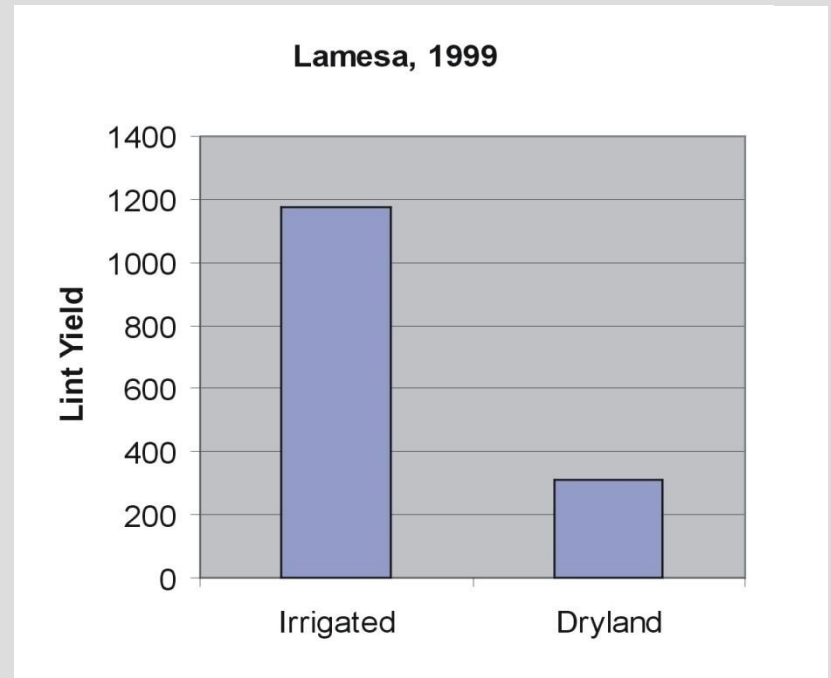
Author: Michael Brewer/Liz Love-Brotak, NOAA/NESDIS/NCDC

Abiotic stresses result in 70% to 80% average crop losses (Boyer, 1976)

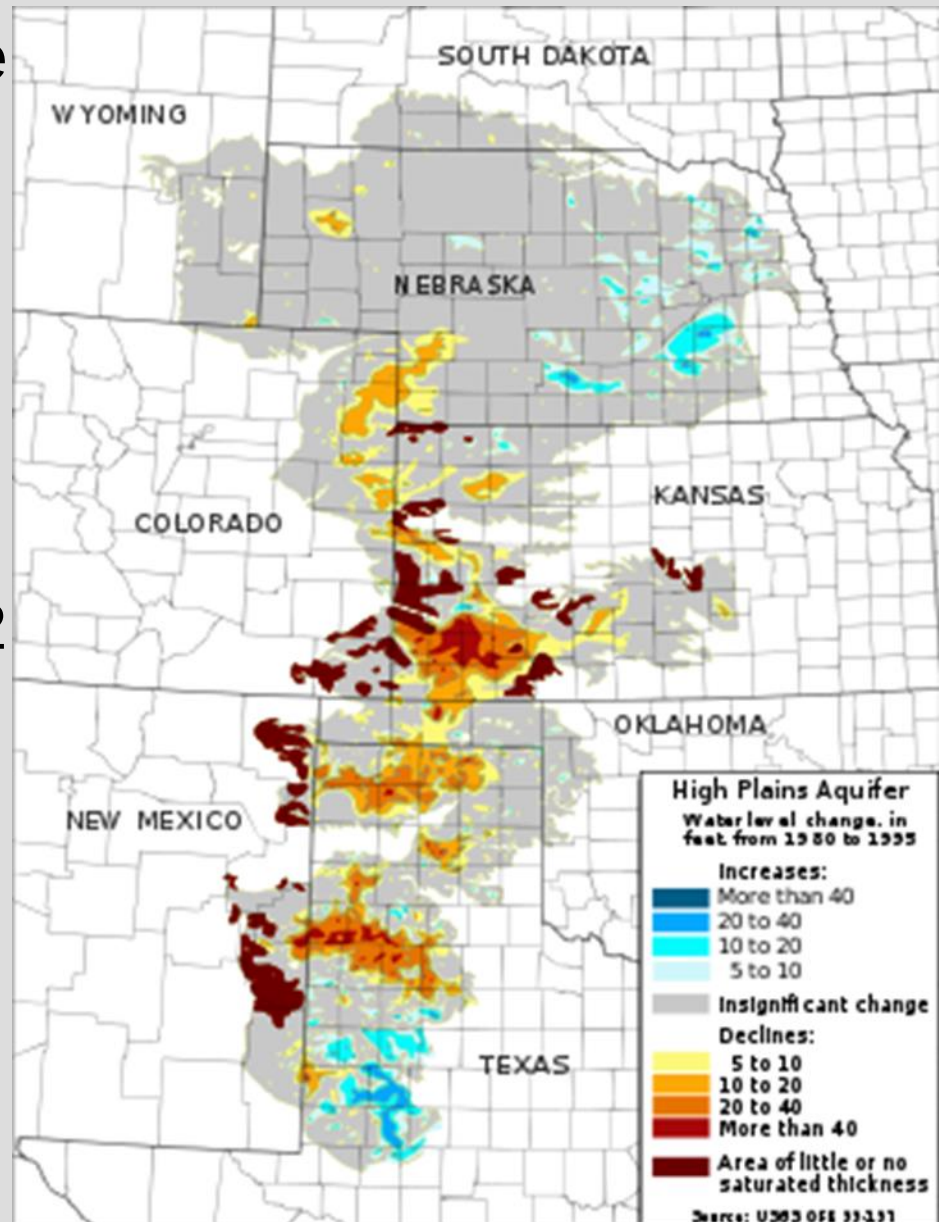
Water is the primary limiting factor in agricultural productivity, world-wide.

Irrigation:

- 90% of fresh water used in the U.S. is for irrigation.
- On average, an irrigated West Texas cotton crop yields 75% more than a dryland crop.
- Is irrigation of cotton in the western U.S. sustainable?



- The Ogallala Aquifer the largest single water-bearing structure in North America
- Covers 174,000 square miles of the Great Plains.
- Estimated to contain 3.2 billion acre-feet of water.
- Conservative estimates suggest it will be depleted by 2020.



DROUGHT STRESS

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graph TD; A([DROUGHT STRESS]) --> B[Physiological Responses]; A --> C[Biochemical Responses]; A --> D[Molecular Responses];
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Physiological Responses

- Recognition of root signals
- Loss of turgor and osmotic adjustment
- Reduced leaf water potential (ψ)
- Decrease in stomatal conductance to CO_2
- Reduced internal CO_2 concentration
- Decline in net photosynthesis
- Reduced growth rates

Biochemical Responses

- Transient decrease in photochemical efficiency
- Decreased efficiency of Rubisco
- Accumulation of stress metabolites like MDHA, Glutathione, Pro, Glybet, Polyamines, and α -tocopherol
- Increase in antioxidative enzymes like, SOD, CAT, APX, POD, GR and MDHAR
- Reduced ROS accumulation

Molecular Responses

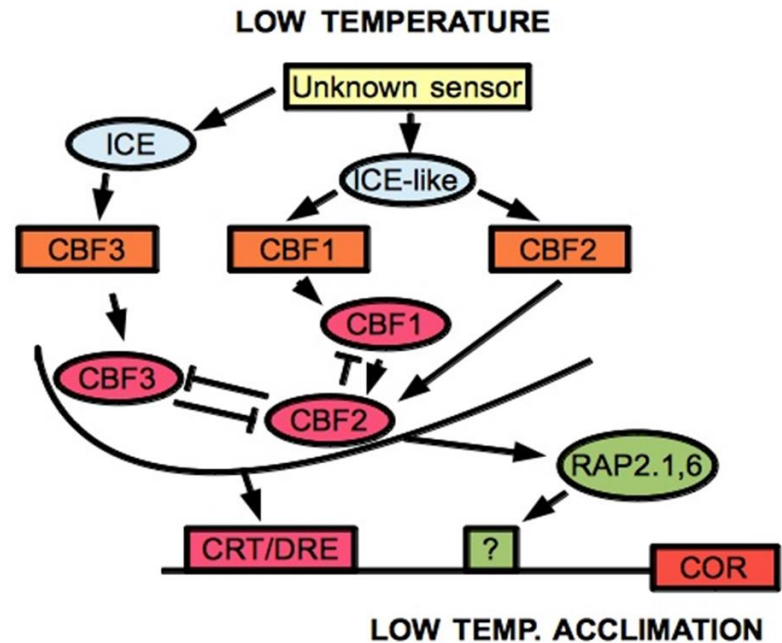
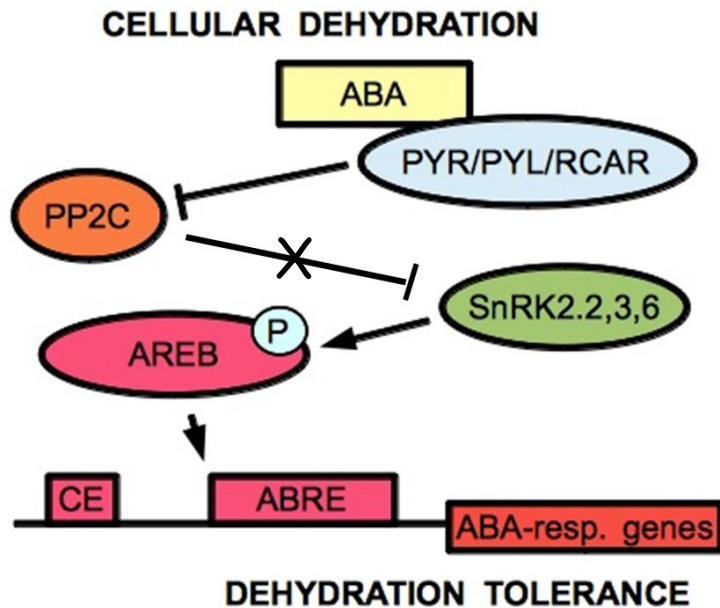
- Stress responsive gene expression
- Increased expression in ABA biosynthetic genes
- Expression of ABA responsive genes
- Synthesis of specific proteins like LEA, DSP, RAB, dehydrins
- Drought stress tolerance

Can we find a magic pill (gene)?

- Protective factors
 - Antioxidants
 - Dehydrins
 - Osmotic regulators
- Ion regulators
 - Na^+/H^+ pumps
- Regulatory factors
 - Transcription factors
 - Protein kinases
 - Ubiquitin ligases



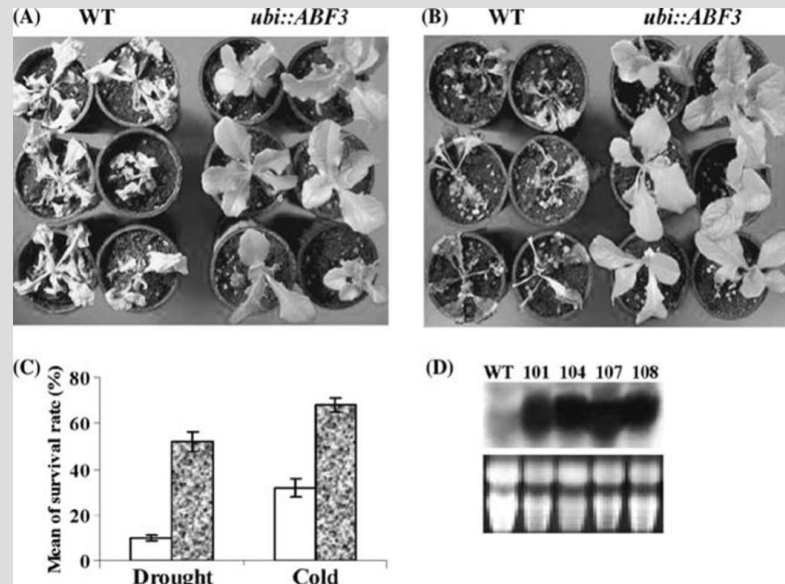
ABA-dependent and independent signaling



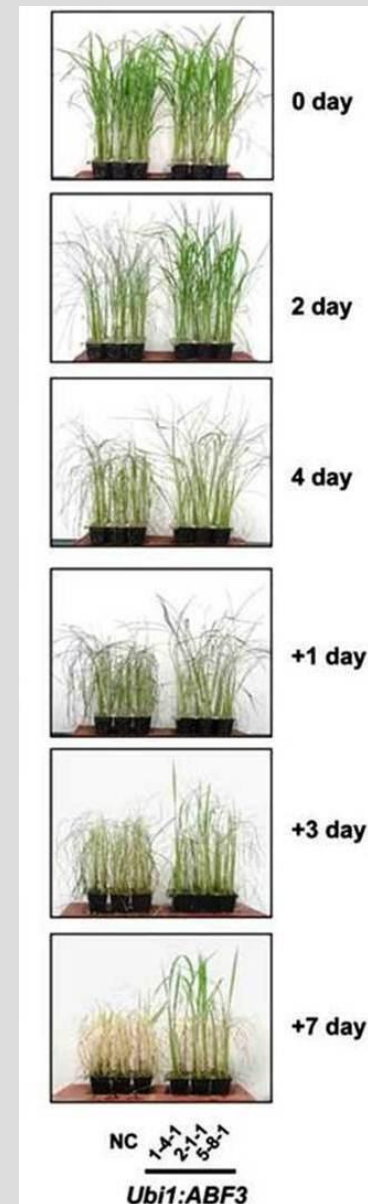
Constitutive expression of AtABF3 leads to stress tolerance:



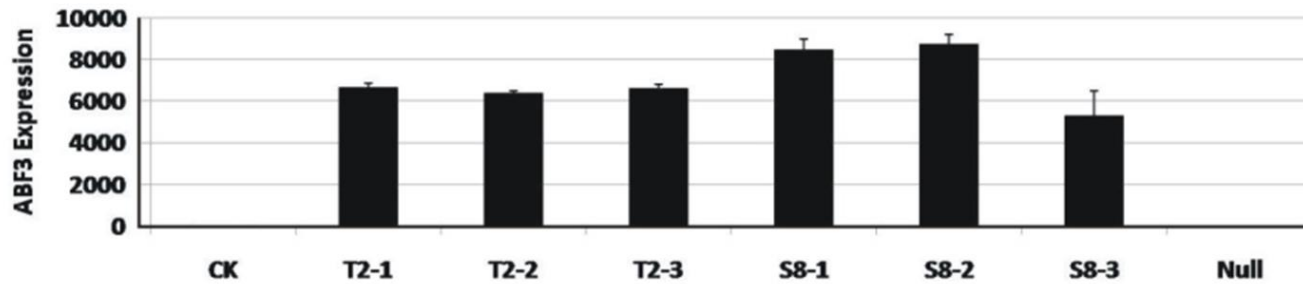
Kim et al., (2004) *Plant Biotech Journal* 2: 459–466



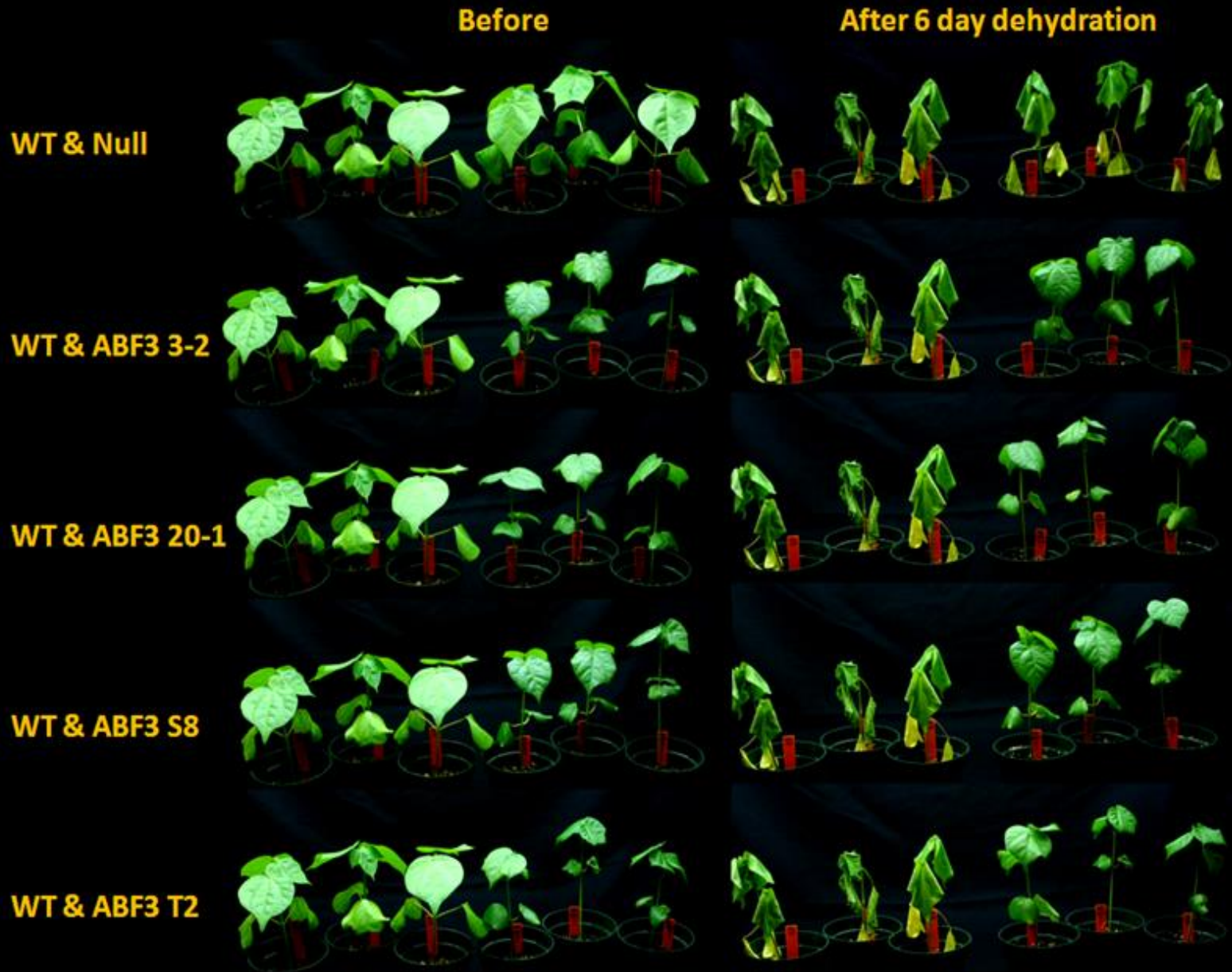
Vanjildorj et al., (2005) *PCT and O Culture* 83: 41–50



Phenotype of 35S::*ABF3* Cotton:



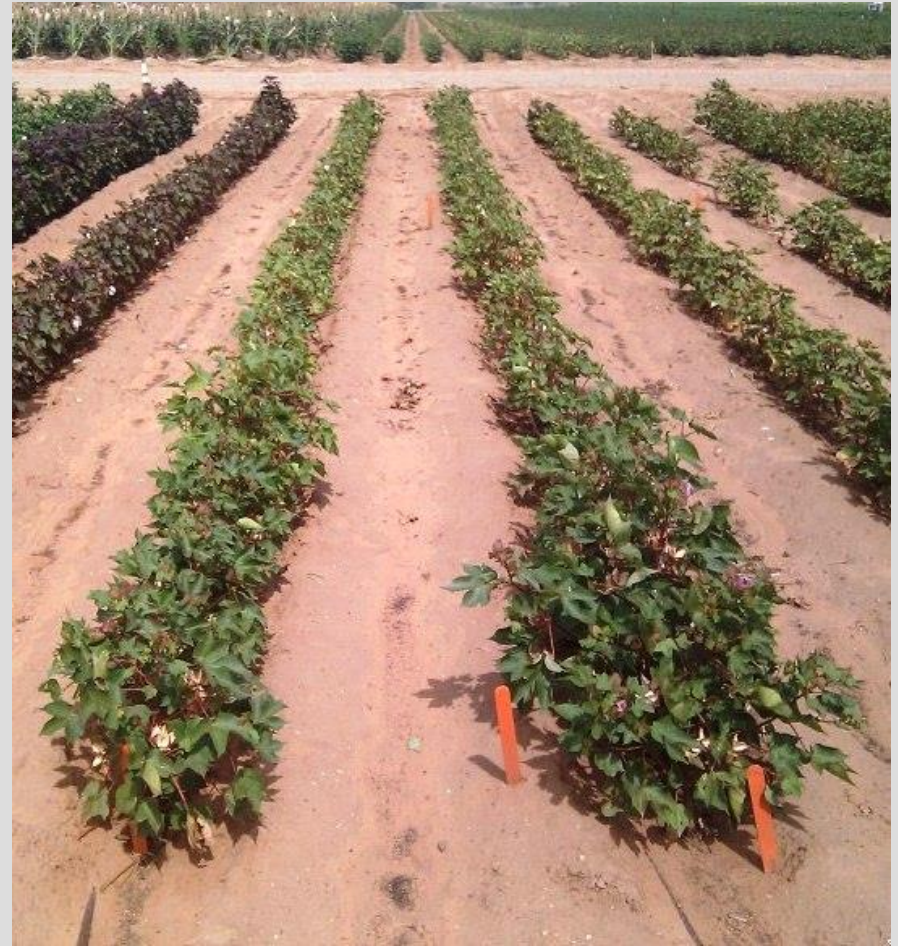
Delayed wilting in 35S::*ABF3* Cotton:



Field evaluation of *AtABF3* cotton:



p35S::AtABF3



Coker 312

Constitutive expression of AtABF3 in cotton :

- ABF3 influences plant responses to water deficit:
 - Reduced transpiration
 - Delayed wilting
 - Delayed development (greenhouse)
- Effects of ABF expression on field performance:
 - Various event-specific responses
 - Some lines show enhanced yield under water stress.
- Can ABF3 performance be improved?
 - Stress responsive promoters
 - Native cotton homologs

Acknowledgements:



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