



# Overview of GXE Project

CBR G X E Organizational Meeting

March 8<sup>th</sup>, 2017

[www.Genomes2Fields.org](http://www.Genomes2Fields.org)

# Genomes to Fields (G2F) Initiative:

- ✧ A publicly initiated and led research initiative to catalyze and coordinate research linking genomics and predictive phenomics to achieve advances that generate societal and environmental benefits
- ✧ Consequence of the mobilization of a community to accomplish the goals of moving crop improvement to the next level



Computer scientist

Engineers

Mathematicians

Plant Scientists

Statisticians

Crop Modelers

Soil Scientists

Biologists

Bioinformaticians

Enviromtypers

# **GENOMES TO FIELDS (G2F)**

[www.genomes2fields.org](http://www.genomes2fields.org)

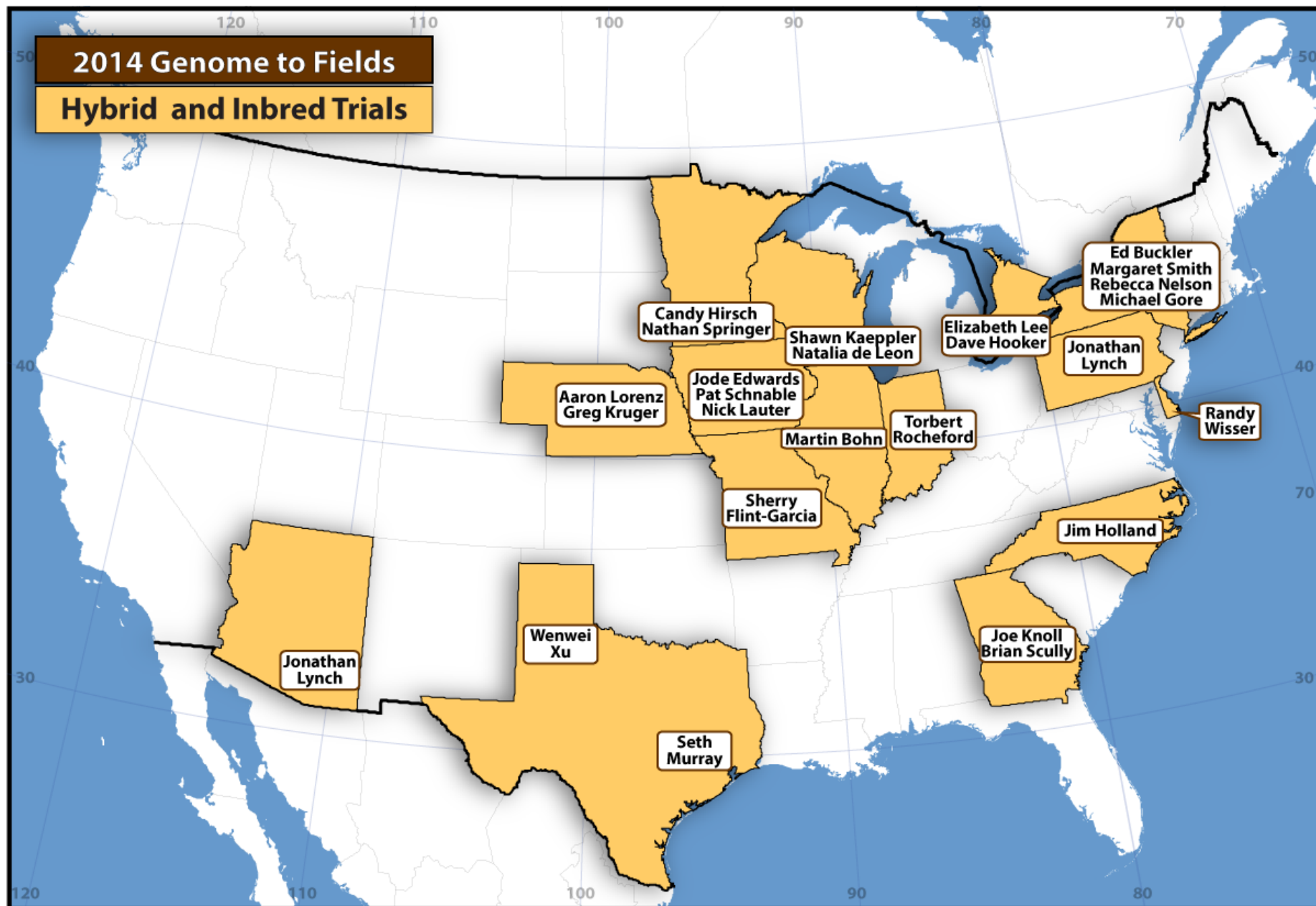
**Modeling and  
analytical  
tools**

**HT phenotyping  
tools**

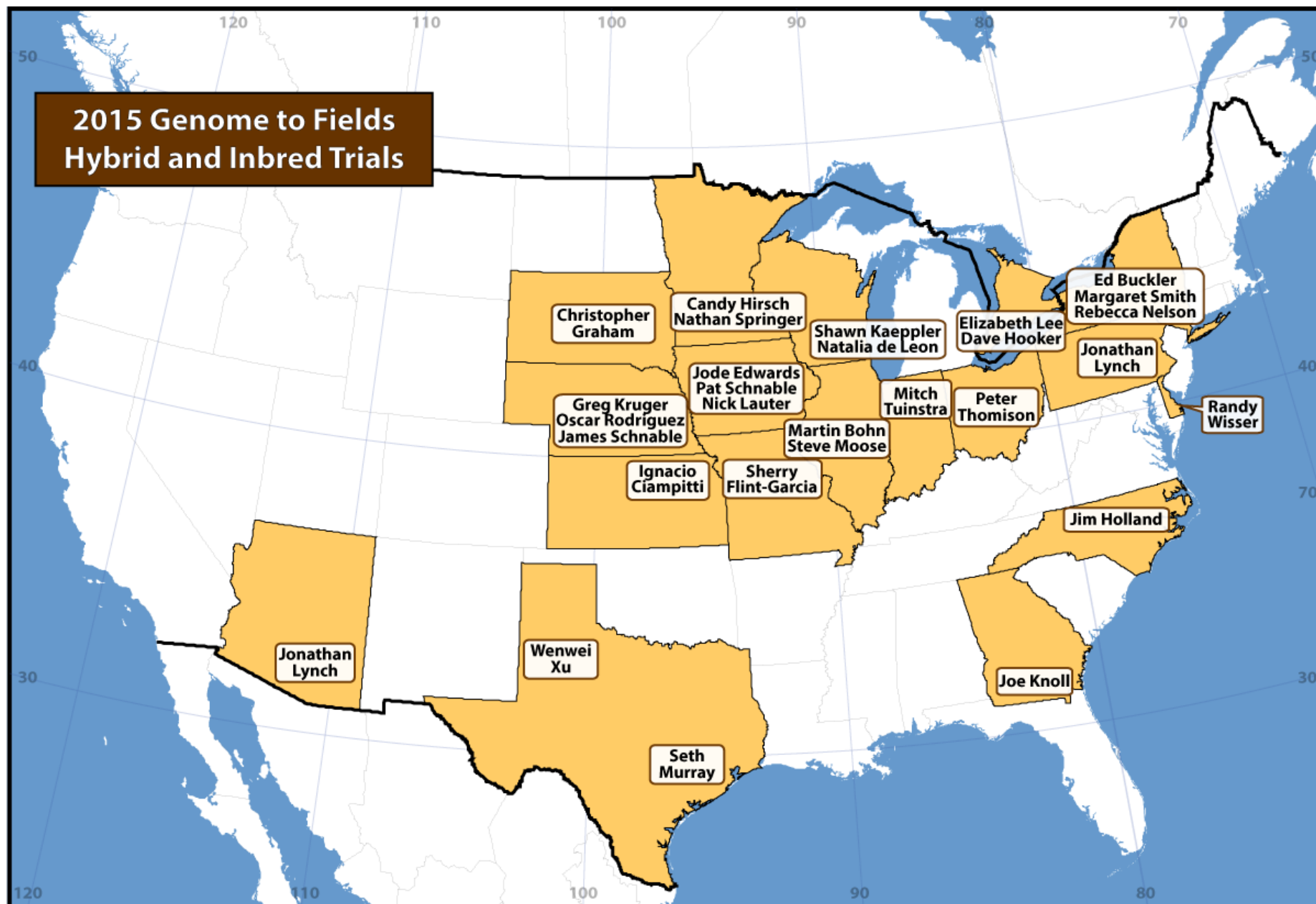
**Database  
development**

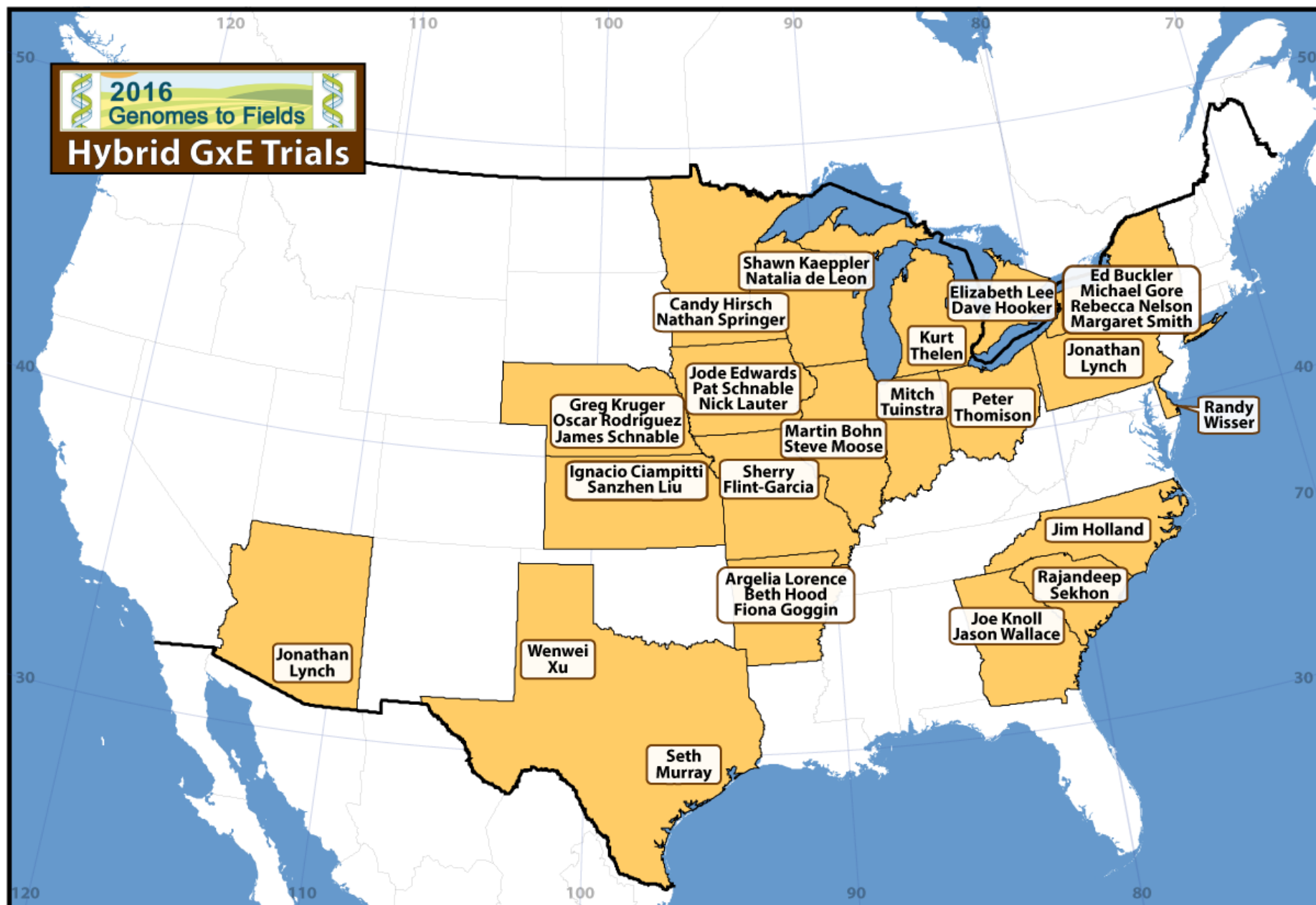
**G X E  
Project**

**Student Training**



## 2015 Genome to Fields Hybrid and Inbred Trials







# Phenotypic Data:

✧ Evaluation across all environments included:

- ❖ Days to anthesis
- ❖ Days to silk
- ❖ Ear height
- ❖ Plant height
- ❖ Plot weight
- ❖ Test weight
- ❖ Moisture
- ❖ Grain yield
- ❖ Stand count
- ❖ Root Lodging
- ❖ Stalk Lodging

✧ Additional traits measured at specific locations





# G X E Project 2014 – Hybrid Experiment:

- ✧ Set of ~250 hybrids, 2 reps per location
- ✧ Hybrids: ex-PVPs, RILs from biparental populations, breeding materials
- ✧ Set of 20 common hybrids across all locations
- ✧ Remaining hybrids overlapping sets moving south to north in the geography of NA
- ✧ Testers: LH198, LH195, LH185, CG102 & PB80



# G X E Project 2015 – Hybrid Experiment:

- ✧ Design was modified to expand diversity of materials included. Replication for 120 plots, except for northern and southernmost locations
- ✧ Each hybrid in at least 8 locations
- ✧ Hybrids: ex-PVPs, RILs from biparental populations, breeding materials
- ✧ Set of 45 hybrids across all locations + 15 regional
- ✧ Testers: PHB47, PHZ51, LH82 & LH195
- ✧ Added: Ohio, Kansas and South Dakota



# Scale and Scope:



Naser Alkhalifah  
ISU



Emily Rothfusz  
UW

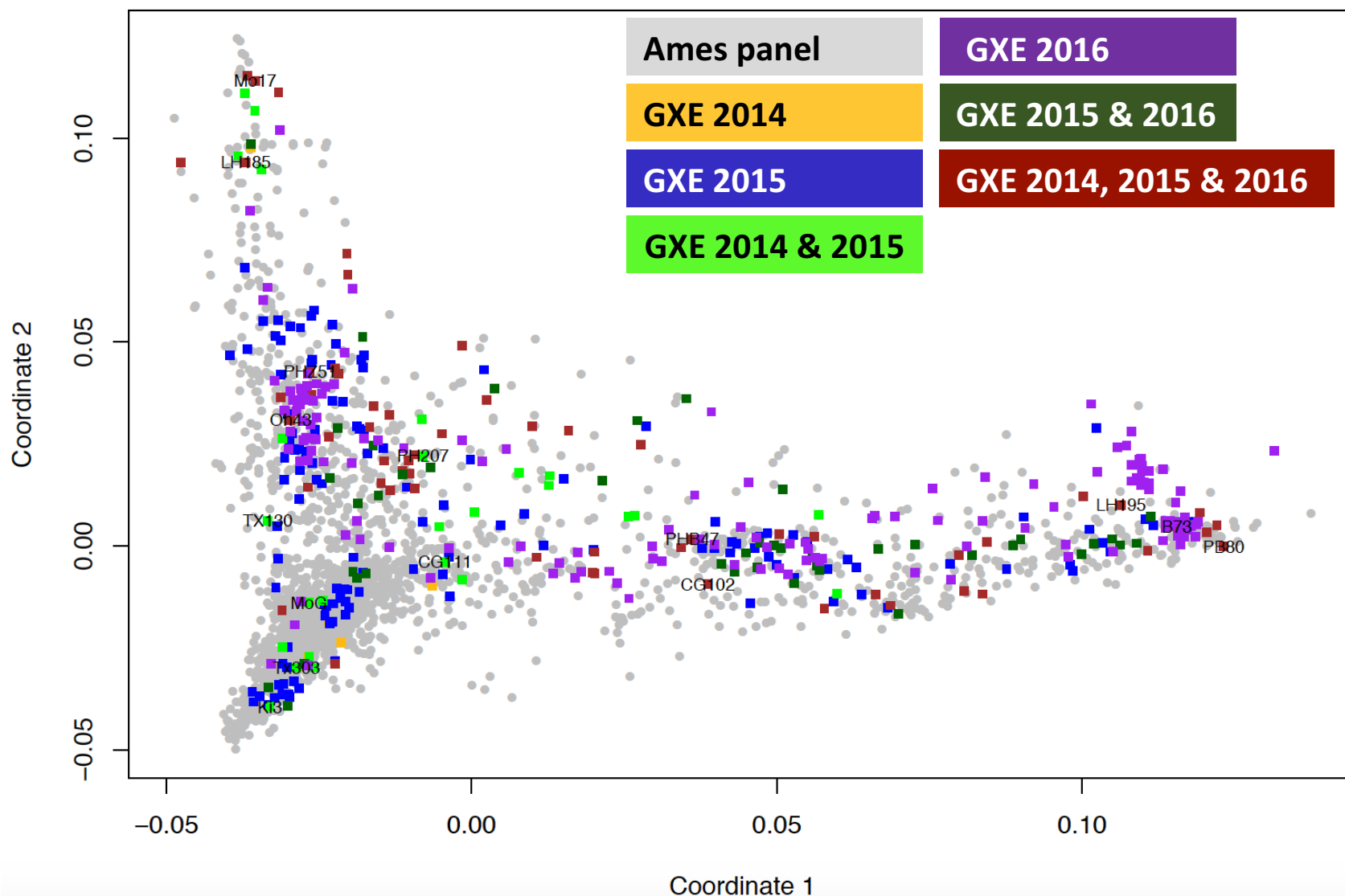
By the end of 2016: 76 unique locations and ~45,000 plots

Year	2014	2015	2016
No. of trials	23	28	36
No. of unique locations	19	24	29
No. of states/provinces	13	16	18
No. of Principal Investigators	19	25	29
No. of plots	12,678	13,650	19,300
No of unique inbreds:	380	553	310

# Genotypic Diversity – all lines genotyped using GBS:



Cinta Romay  
Cornell Univ



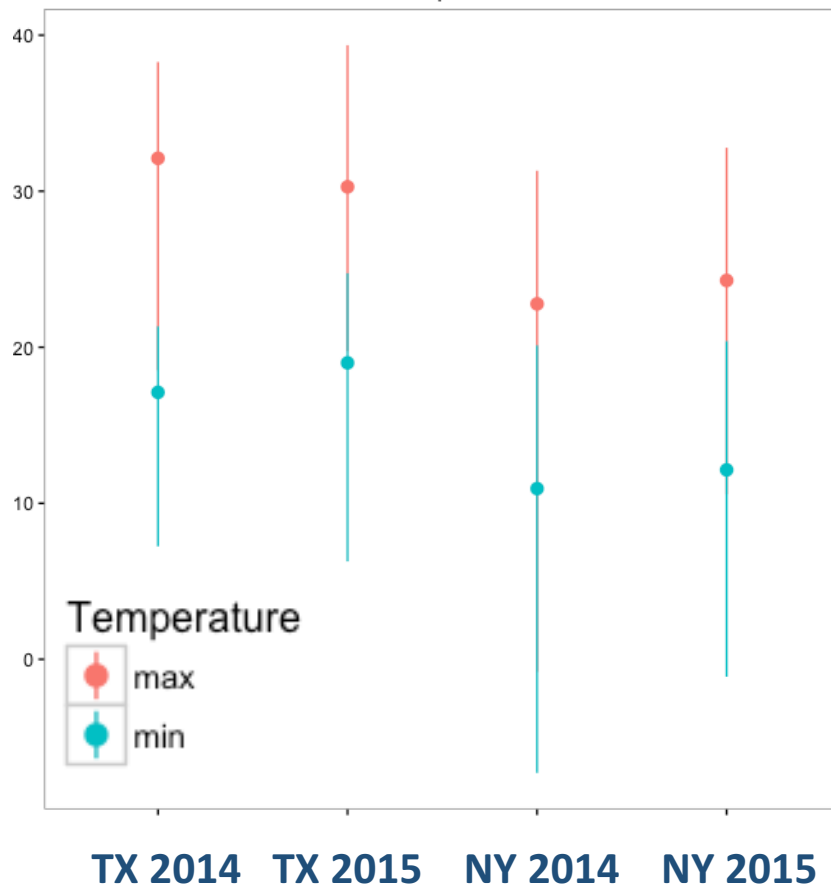
# Environmental Data:

- ✧ Spectrum watchdog at each site – temperature, precipitation, solar radiation, wind speed, and related info + soil characterization

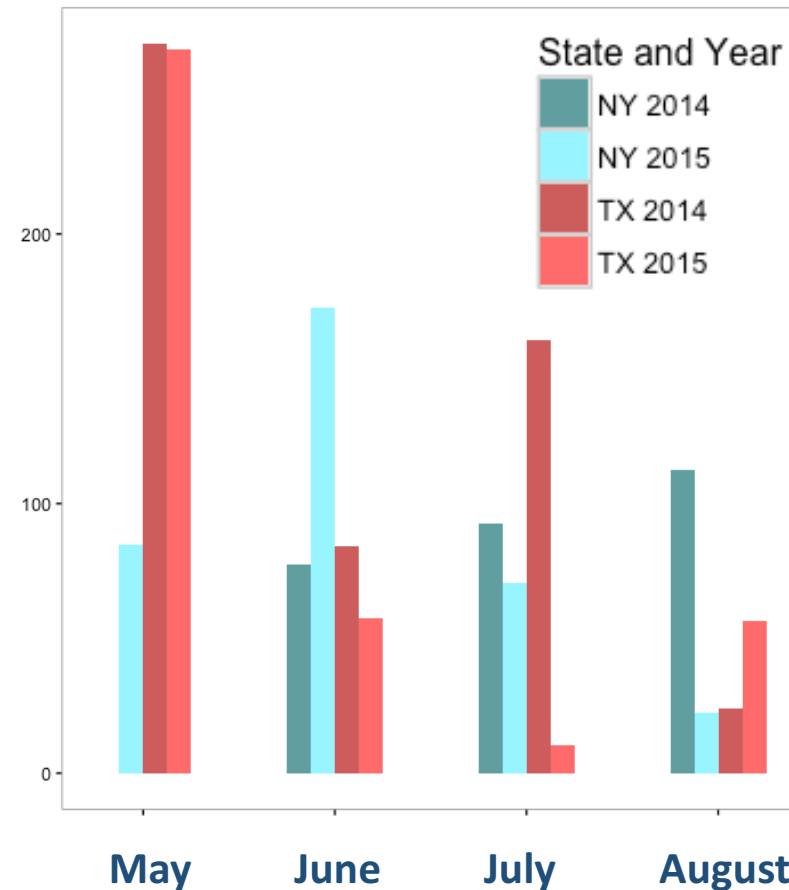


Renee Walton  
ISU

## Daily Max and Min Temperatures



## Accumulated Rainfall



## Scale and Scope:

Inbred G2F Trial Overview: 2014-2016		
Year	2014	2015
No. of trials	20	25
No. of unique locations	15	17
No. of states/provinces	12	15
No. of Principal Investigators	17	20
No. of plots	1,598	1,600



# G X E Project 2016 (repeat 2017 – seed on its way!):

## ✧ Combination of five primary experiments:

- a. Expired Plant Variety Protection (Ex-PVP) Factorial for Prediction – Liz, Jode, Martin
- b. Backcross-Derived Line Group – Candy, Nathan, Sherry
- c. Stiff Stalk G X E – Shawn, Natalia
- d. GEM materials – Seth
- e. Set of Common Hybrid – 50 across all locations, subsets of regionals

## ✧ Design:

- ✧ Two replications per location, blocked by exp.
- ✧ Added: Arkansas, South Carolina, Michigan
- ✧ 2017: Colorado, Mississippi, cooperator in Arizona



# 2018-19 Experiment Plan:

- ✧ Use same genetics across all locations:
  - ✧ PHW65 X PHN11 (ex-PVP x ex-PVP) – “Good” allele source
  - ✧ PHW65 X Mo44 (ex-PVP x Old) - “Bad” allele source
  - ✧ PHW65 X MoG (ex-PVP x Unselected) – “Ugly” allele source
- ✧ Tester:
  - ✧ LH195 (B37 X B73) Midwest to South
  - ✧ Early SS (TBD) for North
- ✧ Selected Subset of Yellow Stripe hybrids (30 plots/location)
  - ✧ Accumulate G X Y data and link previous work to new locations
- ✧ Continue a small component of the ex-PVP Design II hybrids or TX714 vs B73 and NILAS testing (~70 plots at a subset of locations)
- ✧ Addition of inside canopy mini-weather station
- ✧ Incorporation of phenotyping technologies





# Manuscript Submission Update:

- ✧ Title: “The effect of artificial selection on phenotypic plasticity in maize”
  - ❖ 2014 data
  - ❖ Joe Gage submitted to Nature Communications – working on response to reviewers
- ✧ Topic: “G X E interaction as a driver for enhance whole genome prediction”
  - ❖ 2014 & 15 data
  - ❖ Diego Jarquin – draft to be submitted
- ✧ Topic: “Expression of Productivity and Phenological Traits Across a Diverse Set of Environments”
  - ❖ 2014 & 15 (maybe also 2016?) data
  - ❖ Liz Lee
- ✧ Topic: “Evaluation of G X E in inbred backgrounds, the utility of indicator traits”
  - ❖ 2014 & 15 data
  - ❖ Celeste Falcon



# Data Releases:



Darwin Campbell  
ISU

Field Season	Release to Collaborators (ARK)	Release to Public (DOI)
2014		<a href="http://dx.doi.org/10.7946/P2201Q">http://dx.doi.org/10.7946/P2201Q</a>
2015	February 2017	<a href="https://doi.org/10.7946/P24S31">https://doi.org/10.7946/P24S31</a>
2016	March 2017	March 2018
N	March of N+1	March of N+2

# G X E Cooperators

*Principal Investigators who grew GxE trials in 2014-2016*

- |                              |                              |                              |
|------------------------------|------------------------------|------------------------------|
| ✧ Martin Bohn (UIUC)         | ✧ Joe Knoll (ARS - UGA)      | ✧ Oscar Rodriguez (UNL)      |
| ✧ Ed Buckler (ARS - Cornell) | ✧ Judith Kolkman (Cornell)   | ✧ Cinta Romay (Cornell)      |
| ✧ Ignacio Ciampitti (KSU)    | ✧ Greg Kruger (UNL)          | ✧ James Schnable (UNL)       |
| ✧ Jode Edwards (ARS - ISU)   | ✧ Nick Lauter (ARS - ISU)    | ✧ Pat Schnable (ISU)         |
| ✧ Sherry Flint-Garcia (ARS)  | ✧ Liz Lee (Guelph)           | ✧ Brian Scully (ARS)         |
| ✧ Christopher Graham (SDSU)  | ✧ Natalia de Leon (UW)       | ✧ Rajandeep Sekhon (Clemson) |
| ✧ Mike Gore (Cornell)        | ✧ Sanzhen Liu (KSU)          | ✧ Margaret Smith (Cornell)   |
| ✧ Candy Hirsch (UMN)         | ✧ Argelia Lorence (AR-State) | ✧ Nathan Springer (UMN)      |
| ✧ Jim Holland (ARS - NCSU)   | ✧ Aaron Lorenz (UMN)         | ✧ Kurt Thelen (MSU)          |
| ✧ Elizabeth Hood (AR-State)  | ✧ Jonathan Lynch (PSU)       | ✧ Peter Thomison (OSU)       |
| ✧ David Hooker (Guelph)      | ✧ Steve Moose (UIUC)         | ✧ Mitch Tuinstra (Purdue)    |
| ✧ Fiona Goggin (Univ AR)     | ✧ Seth Murray (TAMU)         | ✧ Jason Wallace (UGA)        |
| ✧ Shawn Kaeppler (UW)        | ✧ Rebecca Nelson (Cornell)   | ✧ Randy Wisser (UDel)        |
|                              | ✧ Torbert Rocheford (Purdue) | ✧ Wenwei Xu (TAMU)           |



# Genomes To Fields Collaborators

† G2F Executive Committee members \*GxE Coordinating Groups ~G2F co-lead

✧ Naser Alkhalifah (ISU)	✧ Diego Jarquin (UNL)*	✧ James Schnable (UNL)
✧ Martin Bohn (UIUC)*	✧ Shawn Kaeppler (UW)†	✧ Pat Schnable (ISU)†~
✧ Ed Buckler (ARS)†	✧ Joe Knoll (ARS)	✧ Brian Scully (ARS)
✧ Darwin Campbell (ISU)*	✧ Judith Kolkman (Cornell)	✧ Rajandeep Sekhon (Clemson)
✧ Ignacio Ciampitti (KSU)	✧ Greg Kruger (UNL)	✧ Kevin Silverstein (UMN)
✧ James Clohessy (Cornell)	✧ Nick Lauter (ARS)	✧ Margaret Smith (Cornell)
✧ Liang Dong (ISU)	✧ Carolyn Lawrence-Dill (ISU)*	✧ Edgar Spalding (UW)
✧ Jode Edwards (ARS)*	✧ Liz Lee (Guelph)*	✧ Nathan Springer (UMN)†
✧ David Ertl (IA Corn)*†	✧ Zhizhai Liu (TAMU)	✧ Srikant Srinivasan (ISU)*
✧ Sherry Flint-Garcia (ARS)*	✧ Natalia de Leon (UW)*†~	✧ Yiwei Sun (ISU)*
✧ Joseph Gage (UW)	✧ Alex Lipka (UIUC)	✧ Kurt Thelen (MSU)
✧ Jack Gardiner (ISU)*	✧ Argelia Lorence (AR-State)	✧ Peter Thomison (OSU)
✧ Fiona Goggin (Univ AR)	✧ Aaron Lorenz (UMN)*	✧ Kelly Thorp (ARS)
✧ Byron Good (Guelph)	✧ Jonathan Lynch (PSU)†	✧ Mitch Tuinstra (Purdue)
✧ Mike Gore (Cornell)	✧ Nathan Miller (UW)	✧ Jason Wallace (UGA)
✧ Christopher Graham (SDSU)	✧ Steve Moose (UIUC)	✧ Renee Walton (ISU)
✧ Patricio Grassini (UNL)	✧ Seth Murray (TAMU)*	✧ Rod Williamson (IA Corn)
✧ Jerry Hatfield (ARS)	✧ Rebecca Nelson (Cornell)	✧ Randy Wisser (UDeI)*
✧ Candy Hirsch (UMN)	✧ Torbert Rocheford (Purdue)	✧ Wenwei Xu (TAMU)
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✧ David Hooker (Guelph)	✧ Emily Rothfusz (UW)*	



# Genomes To Fields Sponsors



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