



## **Genomes To Fields Phenotyping Meeting – Chicago, IL – December 10, 2014**

On December 10, 2014, the Genomes To Fields Phenotyping Initiative held an update meeting at the Hyatt Regency Hotel in downtown Chicago. The purpose of the meeting was to provide an update on the work done during its first year of research to both the collaborators and other stakeholders.

Genomes To Fields (G2F) is an umbrella initiative to support translation of maize genomic information for the benefit of growers, consumers and society. This public-private partnership is building on publicly funded corn genome sequencing projects to develop approaches to understand the functions of corn genes and specific alleles across environments. Ultimately this information will be used to enable to accurate prediction of the phenotypes of corn plants in diverse environments, and will result in improved germplasm and placement of genotypes where they will perform best. The GxE Trial is a platform experiment within G2F for the development of tools and procedures for large-scale, rapid association of phenotypic traits, environmental factors and genetic material. This initiative was initiated in 2013 with the first GxE field trial experiments launched in 2014.

A major limitation of understanding the link between genotype and phenotype is the lack of adequate phenotype and environmental data by public maize geneticists and breeders. The first step in this G2F initiative was to develop a system to collect field phenotype data, using standardized procedures, and compile the data in a maize phenotype database.

This report updates the status of this G2F initiative and the 2014 research that was conducted. Many of the presentations from this meeting are available at [www.genome2field.org](http://www.genome2field.org).

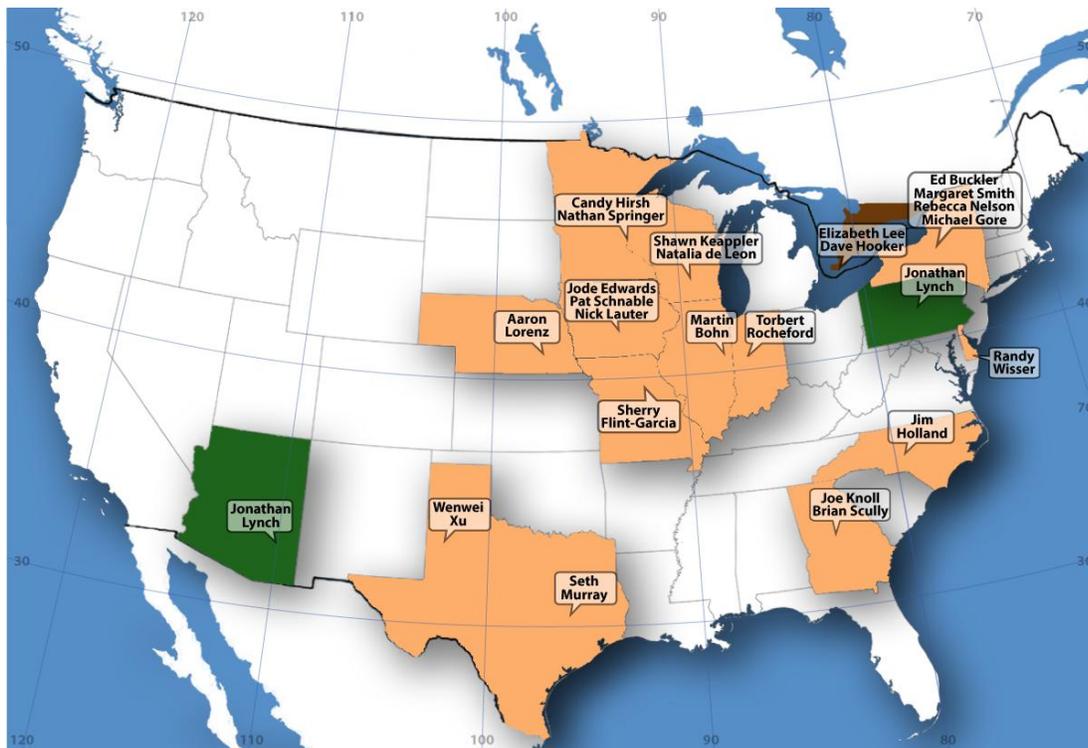
Dr. Natalia de Leon from the University of Wisconsin provided an overview of the 2014 GxE Trial. 2014 served as an exercise to allow public researchers to work together in a large scale project. This community building exercise in 2014 was very successful, with phenotype and environmental data being collected from over 13,000 plots. The participants and institutions involved in the GxE Trial are listed below.

# G X E Cooperators

- ◇ Aaron Lorenz (UNL)
- ◇ Brian Scully (ARS)
- ◇ Candy Hirsch (UMN)
- ◇ Carolyn Lawrence (ISU)
- ◇ Cinta Romay (Cornell)
- ◇ Darwin Campbell (ISU)
- ◇ David Ertl (IA Corn)
- ◇ David Hooker (Guelph)
- ◇ Diego Jarquin (UNL)
- ◇ Ed Buckler (ARS)
- ◇ Greg Kruger (UNL)
- ◇ Jack Gardiner (ISU)
- ◇ Jianming Yu (ISU)
- ◇ Jim Holland (ARS)
- ◇ Jode Edwards (ARS)
- ◇ Joe Knoll (ARS)
- ◇ Jonathan Lynch (PSU)
- ◇ Judith Kolkman (Cornell)
- ◇ Liz Lee (Guelph)
- ◇ Margaret Smith (Cornell)
- ◇ Martin Bohn (UIUC)
- ◇ Mike Gore (Cornell)
- ◇ Nathan Springer (UMN)
- ◇ Nick Lauter (ARS)
- ◇ Pat Schnable (ISU)
- ◇ Patricio Grassini (UNL)
- ◇ Randy Wisser (UDeI)
- ◇ Rebecca Nelson (Cornell)
- ◇ Seth Murray (TAMU)
- ◇ Shawn Keappler (UW)
- ◇ Sherry Flint-Garcia (ARS)
- ◇ Srikant Srinivasan (ISU)
- ◇ Torbert Rocheford (Purdue)
- ◇ Wenwei Xu (TAMU)



The 2014 field trial was grown in 14 states and one province in North America.

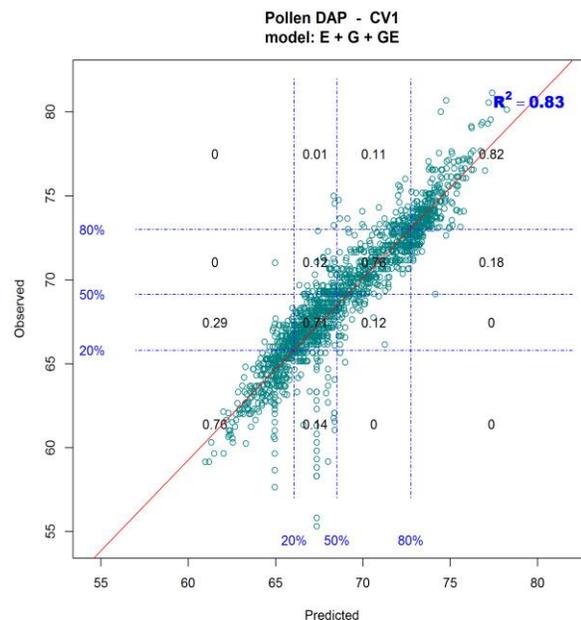
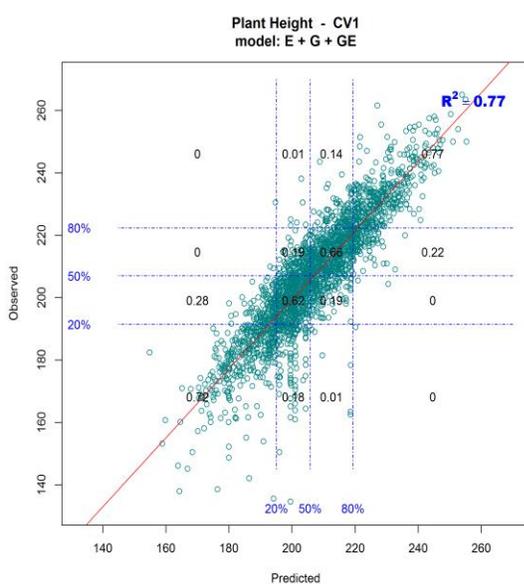


The data that were collected at each location included:

| Hybrids:         | Inbreds:                     | Environmental Data:                 |
|------------------|------------------------------|-------------------------------------|
| ✧ Stand Count    | ✧ Stand Count                | ✧ Environmental data:               |
| ✧ Plot Weight    | ✧ Stalk Lodging              | ✧ All locations (inbreds & hybrids) |
| ✧ Grain Moisture | ✧ Root Lodging               | ✧ watchdog –                        |
| ✧ Test Weight    | ✧ Anthesis                   | temperature,                        |
| ✧ Stalk Lodging  | ✧ Silking                    | precipitation, solar                |
| ✧ Root Lodging   | ✧ Ear Traits (automated)     | radiation, wind speed,              |
| ✧ Anthesis       | ✧ Additional specific traits | and related info                    |
| ✧ Silking        | in some locations            |                                     |
| ✧ Ear Height     | (shovelomics, pubescence,    |                                     |
| ✧ Plant Height   | ionomics, etc)               |                                     |

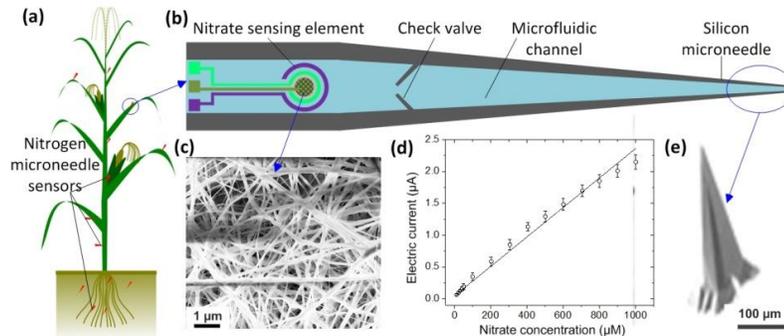
Initial data processing of the 2014 GxE Trial data involved collecting and editing data to ensure it was uniformly formatted and any missing datapoints were accounted for, and some additional data quality analyses were performed. This included weather data as well as plant phenotype data.

Dr. Aaron Lorenz and Dr. Diego Jarquin at the University of Nebraska began some initial analyses and genomic predictions. GxE was evaluated and predictions were developed using genotype, environment and GxE information. Their results highlight the importance of capturing GxE effects for predicting phenotype from genotype.



In addition to developing a field testing network for collecting and analyzing maize phenotype data, another objective of this initiative is to develop new methods for high throughput phenotyping. Four projects were funded by the Iowa Corn Promotion Board in 2014 and were summarized by the principal investigators at the Chicago meeting.

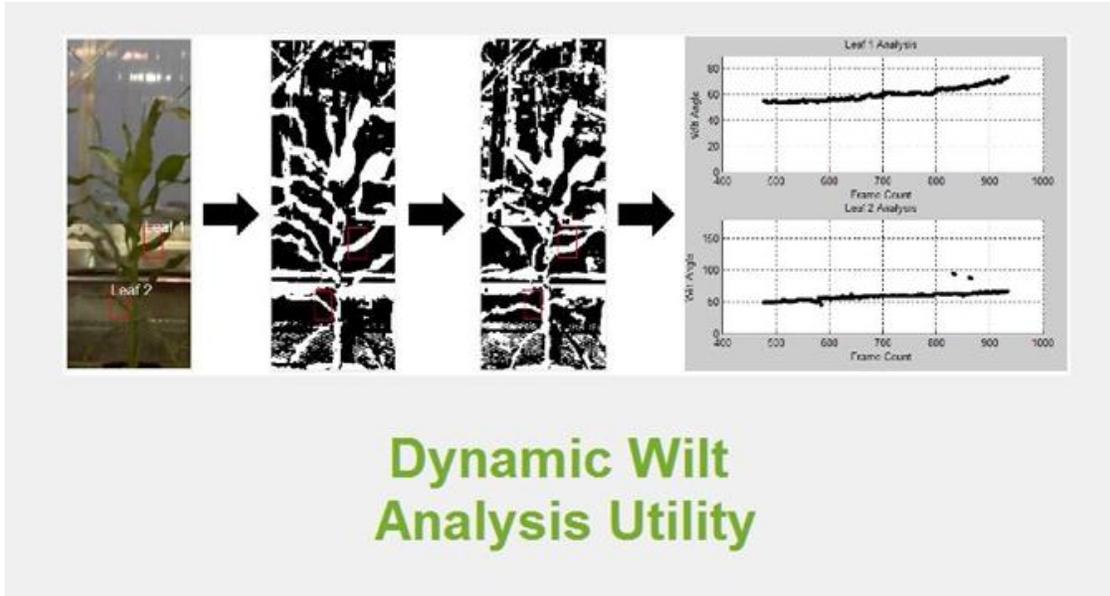
Dr. Liang Dong of Iowa State University is developing sensors to continuously monitor the nitrate levels within plants in the field. Dr. Dong is developing these sensors and expects them to be inexpensive so that many sensors could be placed in a field to monitor nitrogen status directly in the plants.



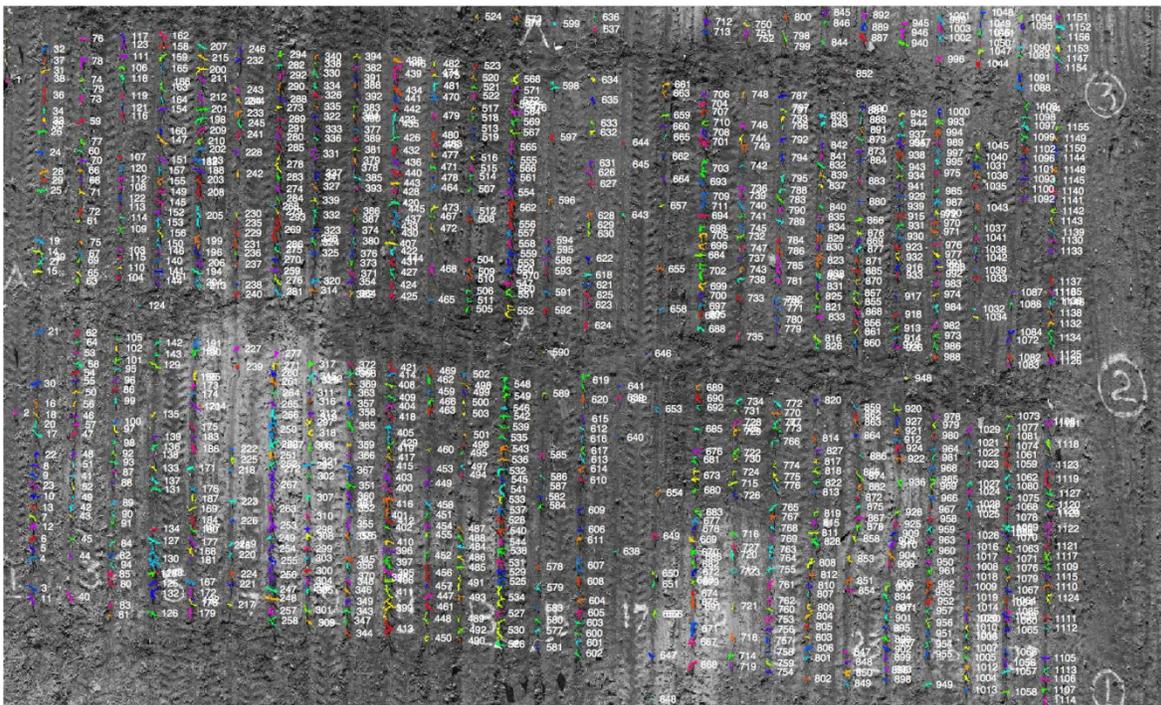
The other three phenotyping projects were various methods of imaging of plant growth as a means to phenotype plants.

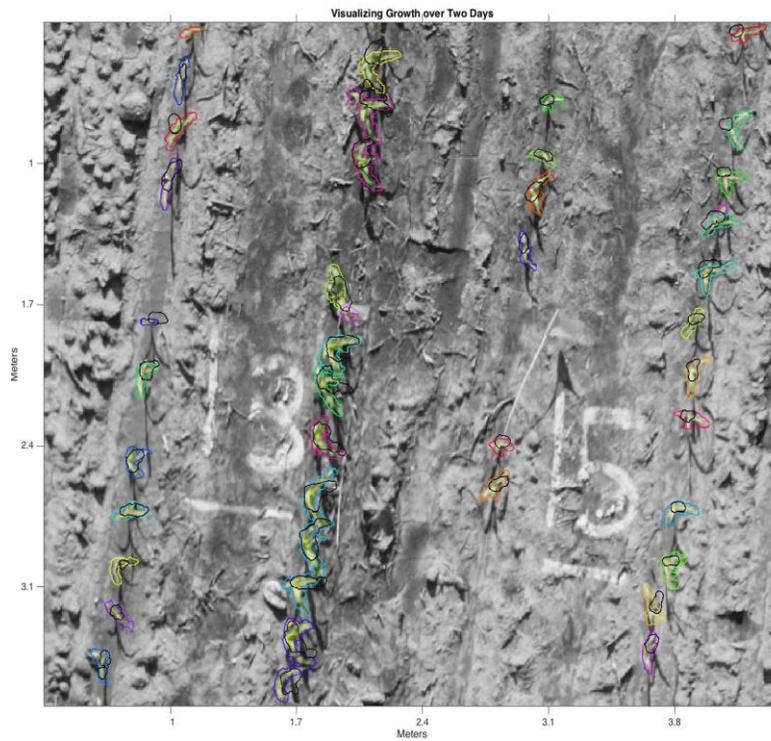
Dr. James Schnable at University of Nebraska discussed his project which involves taking videos of plants growing in the field throughout the day to measure within-day variations in phenomena such as drought stress response. His project involves small, low-cost cameras that will be placed in the field and record plant growth.



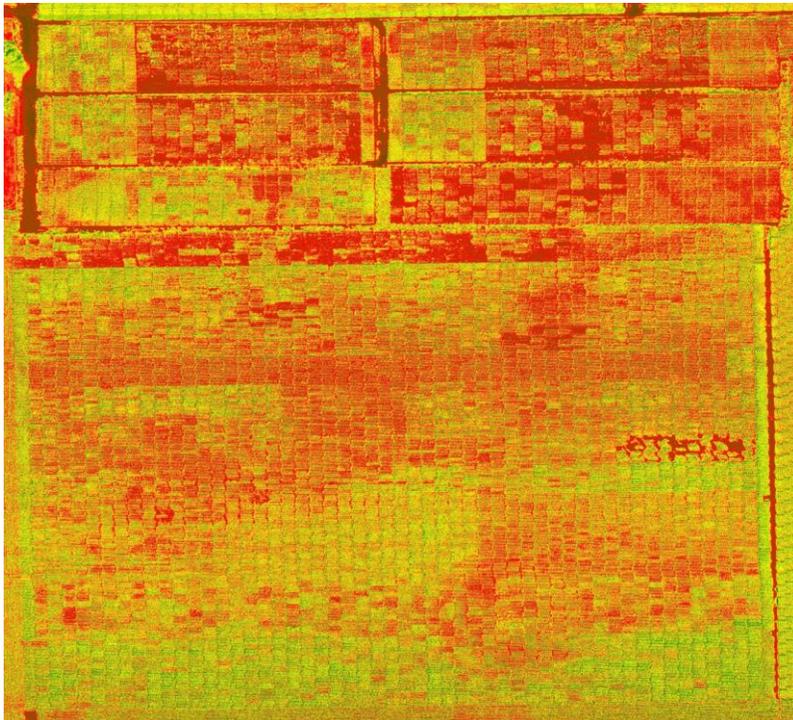


Dr Edgar Spalding of the University of Wisconsin is developing aerial based imagery to enable plant measurements to be collected and analyzed rapidly and with automation. His team's initial work involved identifying and measuring leaf area on individual plants in the field.





Dr. Jode Edwards, ARS-USDA at Ames, Iowa, conducted some aerial imagery of the GxE plots measuring NDVI using an airplane. Three flights were made post-flowering of the four locations in Iowa. Next year, it is anticipated that senescence, leaf structure, chlorophyll, biomass and leaf area data will be collected from airplanes.



While all four of these projects are in the early stage of development, it is already possible to see how these tools could be used to collect high-throughput phenotype data from fields many times during the growing season.

Dr. de Leon wrapped up the technical session by reviewing plans for publication of the results from this first year of the GxE Trial. Initially a perspectives paper will be written using the phenological data from the 2014 Trial to support specific hypotheses to be addressed in the manuscript. The goal is to understand plant development (phenology) in the context of variable/extreme climates and to be able to predict genotypes and management practices that can buffer daily and annual climate change to mitigate risk.

A second manuscript will be prepared with full analysis of all the phenotype data collected in 2014. This will likely be submitted to Crop Science Journal in mid 2015.

Participating in the event was a farmer and Board member of the Iowa Corn Promotion Board, Deb Keller, from Clarion Iowa. Deb spoke to the gathering about the importance to farmers of continued development of improved genetics for their operations. She discussed the challenges of farming and the attributes that are important in modern hybrids for her operation. She applauded and encouraged the G2F consortium of scientists to continue this work on farmers' behalf.

Rodney Williamson of the Iowa Corn Growers Association spoke about the importance of synergy amongst the public and industry scientists and various organizations and institutions in driving this phenotyping initiative. He also spoke about the need to obtain dedicated funding to ensure the long term success of this new initiative, and the plans to raise that funding.

Plans are underway and seed is already produced for a 2015 GxE Trial. It is anticipated that additional locations will be added to this experiment.

Additional information can be obtained by contacting Dr. David Ertl, [dertl@iowacorn.org](mailto:dertl@iowacorn.org) (515) 225-9242.