

2014 GXE Team Meeting

Questions? Contact Jane Petzoldt, petzoldt@wisc.edu

Thursday, December 11

Title: GXE Team Meeting

Date and Time: December 11, 2014 from 12:00PM-5:00PM

Location: Wyndham Grand Hotel (River Room), 71 E. Upper Wacker Dr., Chicago IL 60601

Approx. 5 min walk from Hyatt, 0.2 miles

Purpose: An opportunity for the GXE group to meet face-to-face for a somewhat structured but informal discussion on the future of the GXE project and specific hypotheses we are interested in tackling. All are welcome.

Attendees:

Attended in-person:	Attended via Skype:
Sherry Flint-Garcia	Seth Murray
David Ertl	Aaron Lorenz
Diego Jarquin	Candy Hirsch
Carolyn Lawrence	James Holland
Wenwei Xu	Jack Gardiner
Jode Edwards	Nick Lauter
Martin Bohn	Lisa Coffey
Jane Petzoldt	
Srikant Srinivasan	
Natalia de Leon	
Joe Knoll	
Liz Lee	
Randy Wisser	
Cinta Romay	
Shawn Kaeppler	
Rod Williamson	
Darwin Campbell	

Agenda:

- 12:00-12:10 Attendees get food and settle in
- 12:10-12:15 Round of introductions – 5 min – group
- 12:15-12:20 Brief introduction about the project – 5 min Natalia
- 12:20-12:35 Debriefing on 2014 process and procedures – ID opportunities for improvement (15 min)
- 12:35-12:50 Plan for 2015 data management pipeline and data collection process (15 min)
- 12:50-1:10 Discuss commitments and timelines for managing public data access (20 min)
- 1:10-1:30 Formalize procedures for authorship and attribution for G2F Consortium (20 min)
- 1:30-1:40 Current plans for "baseline G X E project" testing in 2015 based on seed generated in 2014 (including germplasm and locations) – 10 min – Natalia
- 1:40-2:00 *Break*

2:00-2:20	Presentation of results of 2014 phenological data (unpolished version) - 20 min Diego/G X E analysis group – Aaron will skype in
2:20-3:00	Discussion about hypothesis driven experiments to be planned in 2015 for implementation in 2016 (40 min) <ul style="list-style-type: none"> Presenters will have specific hypotheses or questions
3:00-3:30	Discussion about finalizing "Nature Plants" publication – 30 min – group
3:30-3:50	Outline for 2014 productivity/G X E review manuscript and discussion – 20 min Jode/Liz/Shawn (via Skype)
3:50-4:00	<i>Break</i>
4:00-5:00	Continued discussion RE: hypothesis driven experiments to be planned in 2015 for implementation

I. Basic questions and considerations for new trials

- **Incorporating plant diseases:** Pioneer asked if we would consider plant diseases during the Wednesday PM GXE session. The GXE team has some pathology expertise to run inoculated trials assessing for disease resistance (Randy Wisser and Rebecca Nelson). We could consider survey-style assessments of damage, but inoculated trials is similar to the work of a testing network and we want to differentiate ourselves from that.
 - Suggested pathologists: Jan Leach (sp), Colorado State, but she works more on rice.
 - Peter Balint-Kurti (sp) at NC State
- **Defining and building the research community:** How do we organize logistically to differentiate ourselves from a testing network? A useful way to think about our work is on three tiers across locations based on research interests and abilities. Trait measurements and designs are tied to hypothesis-driven questions.
 - **1st Tier:** Broadly interesting, well-defined traits, germplasms and experimental designs applied to all locations annually to measure GXE.
 - **2nd Tier:** Pilot/feasibility studies of new traits, germplasms, or experimental designs tested at a smaller scale (smaller plots, fewer locations) with potential to scale-up to 1st tier in subsequent years. Could be initiated by a GXE subgroup that pursues a collaborative proposal. E.g., pathology study could involve leaf imaging for disease ID in maize. Technique currently under development by Tony Kaisic (sp).
 - **3rd Tier:** Deep phenotyping at a single or handful of locations (e.g. James Schnable, Edgar Spalding, shovelomics). Basic research to understand plant traits and develop new assessment tools with potential for widespread deployment. May be risky, completely novel, expensive, and most experimental.
- **What are the outputs and outcomes of the G2F initiative?**
 - Measuring and testing performance in a variety of environments beyond the ability of industry, testing networks
 - Training the next generation of graduate students
 - Ability to predict performance of existing genotypes in novel environments, and predict and select new high-performing genotypes based on model outputs
 - Enhanced understanding of underlying mechanisms that lead to phenotypic outcomes
 - Publicly available, high quality performance database
 - New protocols for collecting and managing large amounts of data, moving large quantities of germplasm
 - Data to leverage funding for individual and group proposals

- Reductionist experiments within locations (e.g. drought, density, ...) can leverage the overall data set to support individual investigator goals as well as provide mechanistic insights into cross-location trends

II. Updates on GXE/G2F support and new collaborators

- **No firm commitments yet.** Approaching companies for funds has not yet been successful. Many companies question whether this project should be done publicly, or is better handled in the private sector. We have not yet asked them for in-kind resources. Immediate goal is to support a lobbyist in Congress to leverage additional federal support. Overall, company interest seems to be growing, but the drop in corn prices makes this a particularly difficult time for them to provide funding.
- **Two companies are excited and express general interest in correlating genotype to phenotype.** Pioneer is excited that we are evaluating ex-PVPs. They are impressed by our willingness to work collaboratively and develop uniform protocols
- **We need a way to prioritize new locations to receive support.** Which locations would expand our geographic and environmental diversity? Which locations have existing corn associations that would be willing to support GXE trials? Priority will be given to locations without own associations that enhance environmental/geographic diversity of project.
 - Last year Iowa Corn paid for seed production cost, offset costs up to \$7 per plot to collaborators in need. Less than half requested funds.
 - It could be more effective for Iowa Corn Growers to reach out to potential new collaborators, rather than individuals from the research group.

III. Discussion of specific hypotheses

- **We need more information from 2014 analysis.** An analysis of location by location means would allow collaborators to look at performance of materials they are familiar with in new locations. This would be very useful to inspire new questions that could be tested.
- **We need an inventory of seed for 2015.** We need to know how much leftover seed there is for smaller, Tier 2 and Tier 3 experiments.
- **2015 Considerations**
 - A suggestion was made to expand genotypic diversity by including more GEM lines. Reevaluate tester set.
 - GEM material needs to be brought in with specific research focus
 - We have to improve our ability to communicate our goals, importance of the project for prospective modelers

IV. Jode Edwards/ Liz Lee Presentation

See presentation slides → Edwards_slides121114.pptx

- **Propose distinguishing adaptation (appropriateness of phenology to environment) from performance (grain yield, grain moisture, lodging).** Industry is most interested in GXE for performance. We are better positioned to measure adaptation. This would involve identifying the different environmental constraints in each environment we measure. Some grain yield data won't make sense because genotypes are not grown in locations that they are adapted.
- **Can we analyze the dataset to capture the effect of adaptation?** And can/should we use this to exclude unadapted hybrids from inappropriate environments? Weeding out unadapted hybrids could allow us to identify traits correlated with better performance under particular constraints, e.g. drought, day length, season length.
- **More work is needed to develop metrics/indices to quantify environments.** E.g. soil water stress index to account for rainfall, temperature, soil texture, profile depth, shaded area. What

environmental covariates best predict environment means? What environmental covariates predict G X E? We need more information on other aspects of the environment, especially soil type/structure and biological activity.

- **Using the Volumetric Soil Water Content (VSWC) metric could reveal in-season water stress and effects on GXE.** Look at different VSWC profiles for different locations and compare that to performance of GXE patterns, and vice versa. In other words, which environmental variables co-vary with similar GXE patterns across locations? This might only be targeting environmental effects...
- **Possible collaborators and next steps:**
 - Jianming Yu: wrote review paper of covariates to predict GXE
 - Jerry Hatfield can get geo-referenced data.
 - Chris Anderson is a modeler who is very interested in the GXE project but does not have funding to pursue the project.

V. Liz Lee Presentation

See presentation slides → Lee ASTA 121114.pptx

- **Certain environments track together.** When comparing the 90 common inbred lines across MN, WI and Guelph, Minnesota and Wisconsin have similar pollination dates, but some lines seem to behave differently in Guelph than the other two sites.

New 1st Tier Proposal: Tester Experiment

From slide:

Purpose is academic and practical:

- *Practical standpoint* – get a handle on useful testers for future years
- *Academic standpoint* -
 - structure to the crosses (NC Design II)
 - working with elite, adapted material for looking at GxE
 - decent estimates of breeding values from both sides of the hybrids
- 3 environmental zones: Northern, Central, Southern
- 3 different sets of hybrids
 - Each set consists of 215 or 216 hybrids + 10 common checks and will be grown at all locations within an environmental zone.
 - Between each hybrid set, there will be some overlap of parents, and a few hybrid combinations that overlap.
- Which locations give us useful, informative, unique data within an environmental zone? – use this year's results as a guide to select these locations
- If we cannot get flowering data from a location or weather data from a location, is it worth growing a trial at that location? – NO

New 2nd Tier Proposal: Evaluating Planting Density and Bounce-Back

See final slide

- **Propose pilot measuring performance and recovery from density treatments.** This could be done at a few locations that are enthusiastic. Predict that we would observe different recovery effects depending on the location. Some locations may not have ability to bounce-back, such as in Southern locations with shorter summer days.
 - Treatments include 1/2 density, normal density, 2X density, 1x density thinned to 1/2, and 2X density thinned to 1/2.

VI. Shawn Kaeppler Presentation

See Slides → Kaeppler ASTA 121114.pptx

- Proposes visualizing performance curves under temperature or other environmental variables.
- **We need a process for deciding what things we will pursue as a group for 2015 and beyond.** The decision-making process could look like the following:
 - 1st Tier measurements for 2015 season are held constant from 2014
 - Key decision points:
 - Jan. 30: Concept documents received describing potential experiments for 2016 and seed needed to be produced
 - Post-Jan 30 conference call: Consider how to integrate ideas from researchers
 - Maize Genetics Conference / Corn Breeding Research Committee Meeting: final decision on seed to produce in 2015 for 2016/2017 experiments
 - Jan. 30: Identify and get commitments from existing and new collaborators with consideration of expansion to new strategic new locations.

VII. Discussion of data management, publications and authorship procedures

- **Considerations of data management, terms of use and timeline.** Natalia's email was a first attempt at a transparent understanding of the boundaries. This is necessary because we do not have a formal grant tying us together and holding each other accountable.
- **Everyone that contributes data, intellect, and/or time will be a co-author on the two papers.** The data management agreement will be updated to reflect this.
- **The data will be made public (individuals outside of the set of cooperators) at a specified date.** Our proposed timeline would be after the second paper is submitted by July 1, 2014. Key considerations include what type of data, ie. Curated vs. raw and annotated data. Other considerations include how to structure database so that key information is not lost, including metadata, methods and annotations.
- **Collaborators will have access and can use data once the full dataset is compiled.** Collaborators may begin working on additional manuscripts, with the understanding that they will not submit additional manuscripts before the first two papers are submitted. For example, a third paper describing our environmental data could be useful. This policy will consistently give collaborators a 1 year head-start on data analysis relative to the public. Collaborators can also use data for presentations, applying for grants, or other approved uses prior to public release. As a courtesy, we ask that collaborators who share information related to GXE inform the group (venue TBD?). Collaborators should include two slides (templates will be made available with updated Data Use Agreement):
 - **Disclaimer Slide:** specifies that analysis in the presentation belongs to the individual and has not been reviewed by nor does it reflect the opinions of the G2F Consortium. We can't verify the quality of analysis, and don't want different interpretations attributed to the Consortium.
 - **Collaborator Acknowledgement Slide:** Lists all collaborators and supporters of the GXE project and their affiliations.
 - **Other group resources for presentations:** Slide template, maps, list of collaborators, color scheme

VIII. Nature Plants Article Discussion

- **Data management and documentation:** How do we annotate data in the pipeline? It is essential that we document steps taken to reach the curated state so that our analysis is repeatable. Curated data is what we want to release, not analyzed data. In other words, annotated raw data.
- **Article contents:** Same 4 figures, accompanied by big picture discussion of GXE and G2F.

- Figure 1 – Genotypic variability of the set included compared to relevant subset of the Ames panel. PCA, or network diagram?
- Cinta will make versions of all and we will decide when we look at them. Network diagram is beautiful but does not distinguish well.
Figure 2 – characterization of environmental variation in the context of environmental variation available from weather stations across the US
- Figure 3 – G X E patterns among common hybrids
- Figure 4 – Diego's prediction work
- **Data inventory:** Still missing GA and TX genotypes. Jode will re-run analysis sometime next week. In next analysis, consider excluding MN if crazytop is shown to have affected trial. due to crazytop.
- **Dividing the work:** Diego is focusing on phenology and developing predictive models. Jode is looking at all phenotypes and environmental characteristics. More comprehensive, less predictive. Jode will lead a subgroup writing committee. Subgroup volunteers must be accountable to mutually agreed upon timelines.

IX. Action items

- Collaborators will send around entry list for ISOs.
- Survey GXE and G2F participants – what is the best way to engage you and maximize overlap of your work? – Jane will coordinate
- Sherry will adjust CBR meeting schedule in March to accommodate GXE meeting. Meeting purpose is to finalize 2015 field plans, discuss both papers, and discuss 2016 plans.
 - Meet before CBR meeting on Tuesday afternoon and Wednesday morning (preferred)
 - OR Morning or afternoon of Thursday for G2F meetings
- Liz will begin working on methods section of paper.
- Aaron and Natalia will contact editor of Nature Plants regarding the suitability of our work for submission.
- Rod and David will continue reaching out to state corn associations and will contact prospective collaborators when formal letter is finalized. Kansas has expressed interest.
- Jode will develop spreadsheet of location means for collaborator review.
- Jane/Natalia/Exec. Committee will update Data Usage Policy with authorship policy, template disclaimer and collaborator slides.
- Jane/Natalia/Executive Committee will update a formal letter for prospective collaborators for approval by executive committee.
- Collaborators will notify Jane of presentations, reports, grants submitted based on 2014 GXE data.