MinnesotaCorn
RESEARCH & PROMOTION COUNCIL

PROGRESS REPORT

PROJECT TITLE: Genetics and Environmental Factors Contributing to Instability in Grain Durability
PROJECT NUMBER:
REPORTING PERIOD: 04/01/22 – 12/31/22
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1.) PROJECT ACTIVITIES COMPLETED DURING THE REPORTING PERIOD.

Identify genes controlling stability/plasticity in composition across environments: This objective proposed to use existing data on a panel of ~500 corn inbred lines grown over five environments to understand the genetic basis of stability for compositional traits to compliment previous work evaluating the genetics of mean performance across environments. We have conducted initial analyses of stability metrics on a univariate basis and are in the process of conducting the genome-wide association studies. We are also working on multivariate analysis on the extracted traits as well as the normalized spectral data to increase our power in identifying regions of the genome that are associated with overall compositional stability. We anticipate a publication describing this work to be submitted in early Summer 2023.

Conduct a state-wide multi-environment on-farm trial to determine genetic and environmental factors that contribute to variability in composition and durability in current commercial corn hybrids: A request for grower participation was sent out by Maciej Kazula, Research Director of the Minnesota Corn Research and Promotion Council, through the weekly leader update that goes to the whole membership. However, due to the timing of the request there was a limited number of growers that replied expressing interest in participating. The number was insufficient to conduct any meaningful statistical analyses and as such we did not move forward with those growers this Fall. We will be working with Maciej in the winter months to get word out to growers earlier and hopefully have better participation for the 2023 growing season.

To insure we are still able to meet the goals of this objective we conducted a replicated trial consisting of 10 commercial hybrids grown in replicate at three locations around southern Minnesota including St. Paul, Waseca, and Lamberton. These trials were successfully grown and subsequently harvested in November. Yield, moisture, and test weight information were all collected during harvest, and a subsample from each plot was retained for compositional, morphological, and durability analyses. The compositional and morphological analyses are moving forward using standard protocols we have in our group. We have been working to develop different staining protocols (Figure 1) that will allow us to maximize detection of damage following the paint

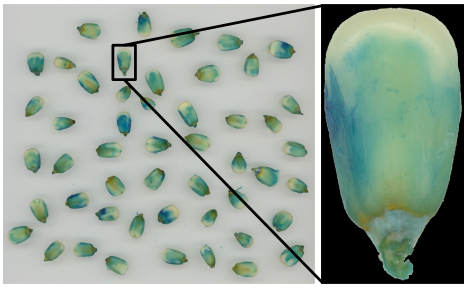

Figure 1. Example of stained kernels. The stain is used to enhance the ability to detect damage to the kernel following the paint shaker damage assay.

shaker assay to get the percent damage rating for each plot for which all other compositional and morphological traits will be related.

Assess historical changes to in-season environmental responsiveness that contribute to increased variability in composition and durability of corn grain: As proposed we developed a panel of hybrids that had high commercial acreage on our maturity zone over the past ~70 years. Two hybrids from each decade were included as experimental entries into replicated trials that were conducted in St. Paul and Waseca, MN in Summer 2022. Weekly drone flights were conducted throughout the summer and images from those flights have been stitched and are currently in the process of having plant height and canopy closure traits extracted on a per plot bases. These values will be used to fit individual growth curves for each plot (Figure 2). As with the previously described trial, these trial plots were harvested in November 2022. Grain yield, moisture, and test weight data were collected, and a subsample of grain from the plot was retained and is moving forward through a series of compositional, morphological, and durability assays. These values along with the growth rate data will be used as input into a series of univariate and multivariate regression analyses in Spring 2023 to conduct preliminary assessments of changes over time that have impacted grain yield.

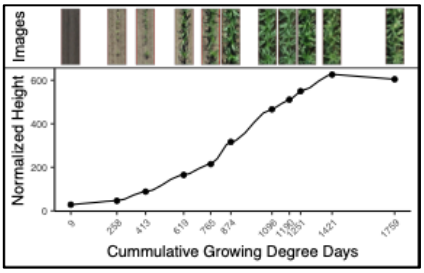

Figure 2. Extracted data from a single plot in one of the growing environments that is being used to fit a growth curve for the plot.

2.) IDENTIFY ANY SIGNIFICANT FINDINGS AND RESULTS OF THE PROJECT TO DATE.
As we are primarily in the data collection and initial analysis phase of this project we do not have significant results yet to report.

3.) CHALLENGES ENCOUNTERED.
During the Spring 2022 graduate student recruitment period we were able to identify a very talented individual to work on this project. However, the graduation date for their M.S. degree was not scheduled until the end of August. On September 1 they began their PhD program at the University of Minnesota and started work on this project on that same day. We were able to complete the proposed field experiments in the absence of dedicated project personnel. However, much of the data analysis has only just begun in the last few months.

Unfortunately, we were unable to get sufficient grower participation this year to provide a sufficient number of data points from which to make inferences. We are going to be working with Maciej Kazula, Research Director of the Minnesota Corn Research and Promotion Council, to get information out to growers earlier and more broadly in hopes that we will be able to get broader grower participation in Summer 2023. As described above we are still able to move forward with our project goals using the various replicated trails that we planted in Summer 2022 at multiple locations in the state.

4.) FINANCIAL INFORMATION
Due to challenges in identifying staffing for this project (please see above) there was limited spending in Year 1. As such, we request to carry forward unspent Year 1 funds into project Year 2. Per the award contract there is no reversion of funds, and it is unclear what, if any process, needs to be completed to request this carry forward of funds. If there is a formal process that NCGA would like completed with regards to the carry forward, please let me know.

5.) EDUCATION AND OUTREACH ACTIVITES.

Our project hosted 3 undergrad interns from Macalester College in St. Paul and 2 high school students through the Eureka! Program at the YWCA of Minneapolis in the Summer of 2022. For all 5 of our interns, the first time they entered into one of our fields this summer was their first experience stepping into a corn field. They were given the opportunity to participate in experiments associated with this project as well as many of our other ongoing projects to get exposure to a range of research areas related to agriculture and crop improvement. A poster that was prepared by the Macalester College Interns at the end of the summer describing their internship experience (Figure 3).

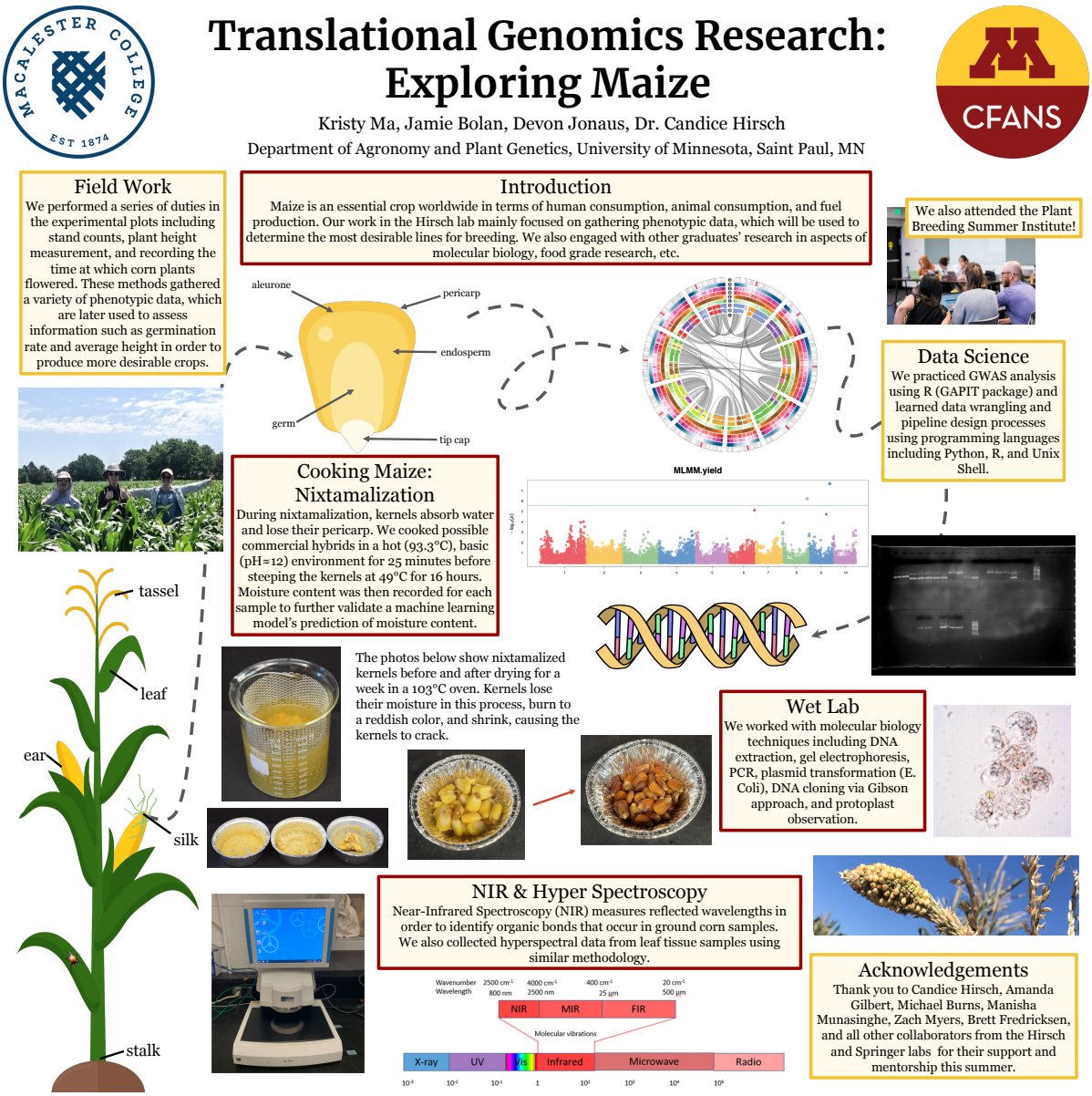

Figure 3. Poster prepared by 2022 Macalester Summer Interns describing the many experiences they had during their internship period.

As detailed above, we did not have grower participation in Summer 2022 and as such did not prepare and disseminate individual reports to participating growers following the Summer 2022 field season as was initially proposed.