Project Abstract

Project Title:	A scalable, low-cost phenotyping strategy for plot and single spike FHB field rating	
USWBSI Project ID:	FY24-SP-001	
Principal Investigator:	Cory Hirsch	University of Minnesota

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Project Summary

Fusarium head blight (FHB), a devastating disease of wheat and barley, can markedly reduce yield and grain quality. Current disease mitigation strategies including cultural practices, fungicide application, and planting resistant varieties rely on accurate and efficient phenotyping of FHB severity. Most USWBSI projects that include field FHB screening utilize manual phenotyping methods, which do not provide adequate resolution for detecting small severity differences, is laborious, low throughput, and have rater bias and inter-rater variation. Increasing the throughput of FHB field assessment is necessary for continued improvement of varieties, efficacy of management practices, understanding disease development, and monitoring of FHB.

Previously, we deployed a sophisticated phenotyping rover developed by Mineral Earth Sciences, a project of X which is a division of Alphabet Inc, the parent company of Google, for high temporal and fidelity FHB detection in wheat and barley. The initial project using the rover and image-based disease assessment correlated well with human ratings. In this proposal, our aim is to enhance and improve on our initial assessment models and transition away from using a cost prohibitive rover to easier to use, maintain, and scale cell phones. The specific objectives of this proposal are:

1. Transition FHB imaging and detection from rover based to cell phone captured imagery.
2. Improve image analysis pipeline to increase throughput of cell phone image acquisition.
3. Validate cell phone imagery in a reliable diverse panel of germplasm to demonstrate the broad use of the phenotyping methods and disease assessment models across disease severities and spike morphologies.

The project will use collaborations with the University of Minnesota wheat breeders, pathologists, and disease management researchers to directly output FHB disease ratings for thousands of plots using non-invasive imaging techniques. Previously developed machine learning models will be tested on newly collected cell phone-based imagery. These same plots will be phenotyped in the field as well for comparison purposes. If model performance needs to be improved, we will manually annotate the necessary images for FHB severity, which will be used to provide new criteria for the model to learn from. This will update and improve the model to be successful while allowing easier to capture images to be used. We will work to validate these models across years, locations, and a variety of germplasm to show the generalization and reliability of the models for the USWBSI community to use a low cost, low input, highly usable FHB phenotyping platform.