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PROJECT 1 ABSTRACT

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Field phenotyping using proximal sensing can detect crop disease at high resolutions, which is difficult to achieve based on remote sensing. It is especially helpful in Fusarium head blight (FHB) detection in the field because of the visible symptoms on wheat spikes. Currently, phenotyping for resistance to FHB and the accumulation of deoxynivalenol (DON) in wheat and barley is time-consuming and costly using conventional protocols. The detection of this disease using high-throughput sensors is crucial to reducing cost and avoiding subjectivity. Color imaging can be easily utilized in high-throughput phenotyping. Hyperspectral imaging can provide insights about crop physiological responses. Therefore, proximal sensing involving both color imaging and hyperspectral imaging (HSI) is able to provide a comprehensive view of plant health status. A phenocart equipped with color cameras and hyperspectral cameras for two-row wheat/barley plots has been designed for image acquisition on both sides of a wheat or barley plot, and the images have a uniform background board as contrast to enable quick image processing for field FHB assessment.

1) The **overall goal** of this project is to develop a real time high-throughput phenotyping method on a phenocart for field FHB assessment.
   The specific **objectives** are to:
   a) hasten and streamline image processing procedures to increase phenotyping efficiency;
   b) enable real time field FHB assessments on the phenocart with on-board image computing;
   c) verify deep learning models for more robust performance with crop field trials;
   d) assess the feasibility of DON content detection in intact harvested wheat and barley seed by spectral imaging in comparison to GC-MS spectrometry.
2) The expected **outcomes** include a streamlined image collection and processing protocol, an improved phenocart design with sensors and processors that enables real time FHB assessment and the multispectral camera application based on selected spectral bands, and a more cost-effective and accurate method for determining the presence of FHB and DON.
3) **Plans**: The preliminary data analysis during 2017-2019 has paved the way for setting the protocol for image collection and processing. Collaboration among the PIs on multiple years' trials in 2020-2021 will enable close-loop validation of the FHB and DON detection models on the phenocart.

Mutual Interest: The knowledge and technology generated from this study will lead to greater efficiencies in developing wheat and barley cultivars with FHB resistance and low DON accumulation. This, in turn, will enhance food safety and supply by reducing the impact of FHB on producers, processors, and consumers.