Project 1: Identification, Characterization, and Development of FHB-resistant Germplasm
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1. What are the major goals and objectives of the research project?

The research project aims to address the issue of Fusarium Head Blight (FHB) and Deoxynivalenol (DON) contamination in barley and wheat, particularly in the Intermountain West. The major goals and objectives of the project are as follows:

Major Goals:
1. **Characterize Genetic Architecture of Resistance:**
   o Understand the genetic basis of resistance to DON accumulation in elite Aberdeen spring barley lines.
   o Guide the development of new barley lines with effective combinations of resistance alleles.
2. **Facilitate Release of New Cultivars:**
   o Develop and release new barley cultivars with FHB resistance to protect growers in the Intermountain West from this disease.

Objectives:
1. **Characterize FHB Resistance in Elite Barley Germplasm:**
   o Identify and evaluate the resistance to FHB in elite barley lines.
2. **Incorporate Genomic Selection Approach:**
   o Use genomic models to predict disease severity, fungal biomass, and DON levels in barley.
   o Improve barley through genomic selection.
3. **Characterize Spring Barley Populations for QTL:**
   o Identify and characterize quantitative trait loci (QTL) contributing to FHB resistance and lower DON levels in spring barley populations.

Expected Outcomes:
1. **Identification of Elite Germplasm with FHB Resistance:**
   o Identify barley germplasm with significant resistance to FHB.
2. **Optimized Hybridizations:**
   o Conduct approximately 50 hybridizations to combine genomic regions contributing to FHB resistance, lower fungal biomass, and reduced DON levels.
3. **Knowledge of QTL Influencing Barley Response to FHB:**
   o Understand the location, number, and effect sizes of QTL that influence barley's response to FHB infection.

Approach:
1. **Evaluation of Breeding Lines:**
   o Assess elite breeding lines for FHB resistance in various locations, including Aberdeen and Kimberly, Idaho; Langdon and Fargo, North Dakota; and St. Paul, Minnesota.

2. **Genomic Selection Training Population:**
    o   Evaluate a training population of 250 lines in Idaho and North Dakota to predict the breeding value of spring barley.
    o   Select parents for a crossing block aimed at improving FHB resistance.
    o   Advance lines by single seed descent.

3. **Bi-parental Populations:**
    o   Create bi-parental populations by crossing Aberdeen breeding lines with foliar disease resistance donor cultivars.
    o   Phenotype these populations in field nurseries and obtain DON and fungal biomass data.
    o   Use linkage mapping to identify QTL contributing to FHB response.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

    What were the major activities?

    In 2023, Four biparental mapping populations (TC18-1, TC18-2, TC18-6, and TC18-8) were planted in both Fargo and Langdon, North Dakota in two replicates (400 lines per replication. Over 3,000 plots total).

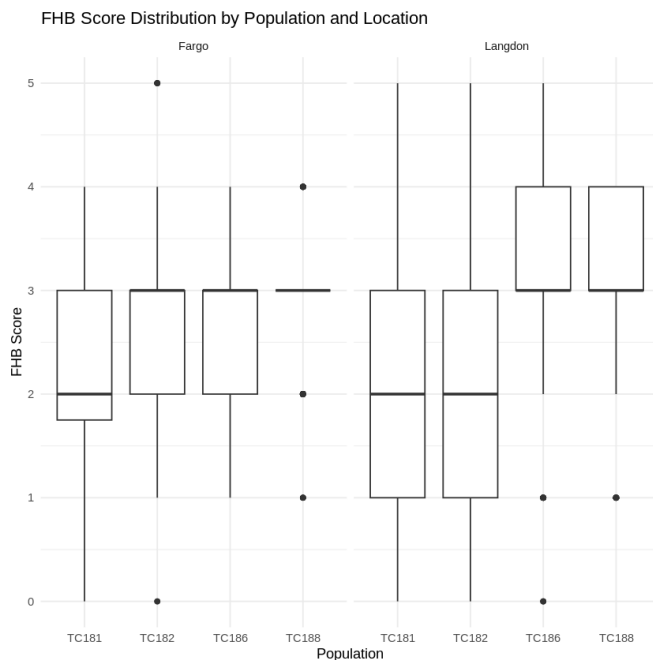   **What were the significant results?**

Figure 1: FHB Score distribution (1-5 scale)

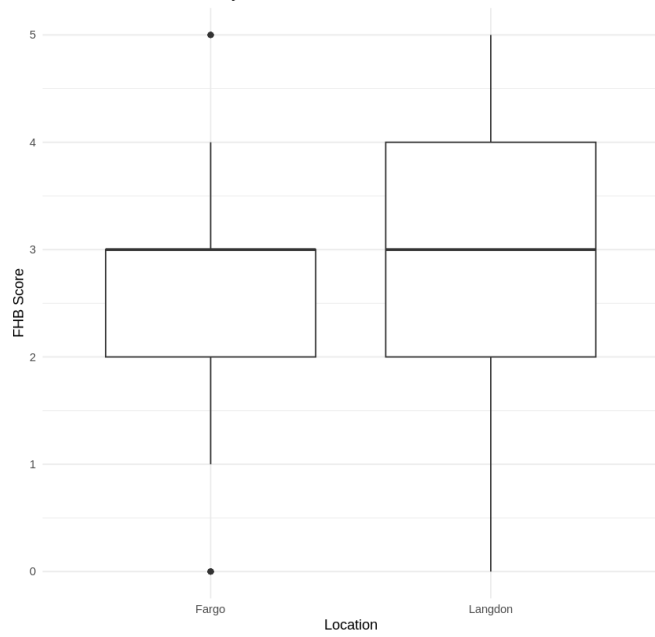FHB Score Distribution by Location

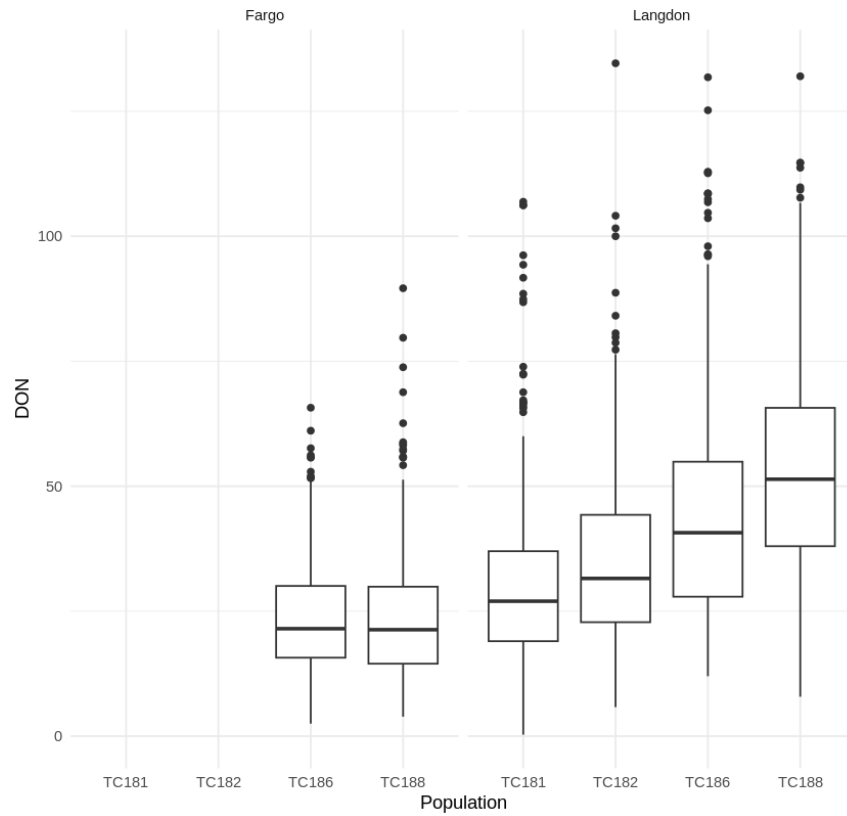Figure 2: FHB Score distribution (1-5 scale) by location

Figure 3: Don Distribution by Population (TC18-1, and TC18-2 are still being analyzed for DON)
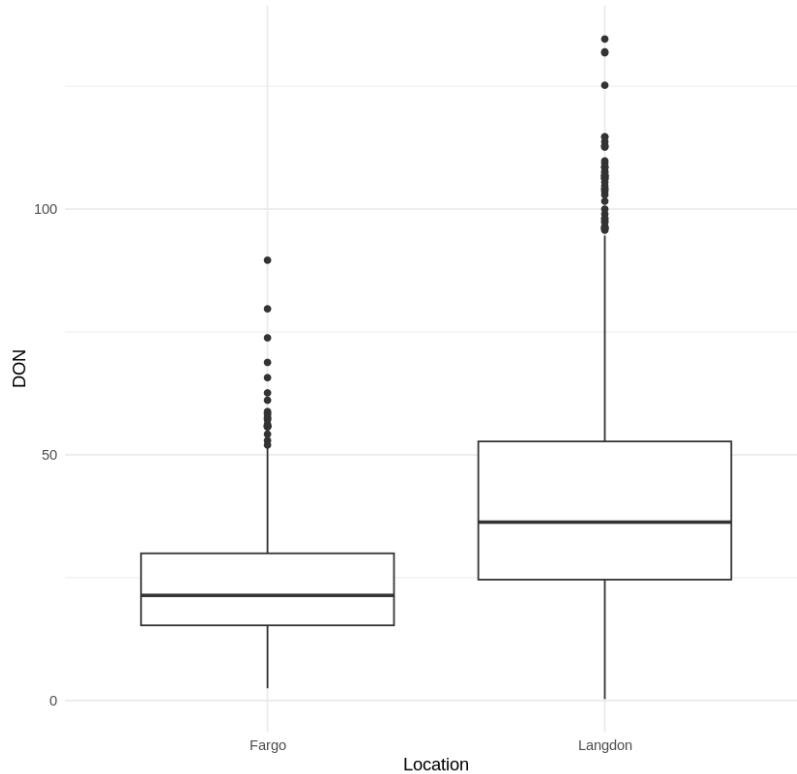
DON Distribution by Location

Figure 4: Distribution of DON by location.

List key outcomes or other achievements.

We have successfully conducted an extensive screening of four biparental barley populations across two distinct geographic locations. Achieved high-quality, reproducible data through meticulous experimental design and execution.

3. **What opportunities for training and professional development has the project provided?**

   We were able to train four graduate students who assisted in data collection and harvesting

4. **How have the results been disseminated to communities of interest?**

   We have distributed the results to the PIs in USDA-ARS Aberdeen, ID.

5. **What do you plan to do during the next reporting period to accomplish the goals and objectives?**

   We will work with PIs in the USDA-ARS Aberdeen, ID to further analyze the data and publish the results.