Project FY24-HW-007: Mapping and mobilization of FHB resistance derived from Aegilops tauschii

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What are the major goals and objectives of the research project?

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1. Field phenotypic evaluation of FHB resistance in the KSU inoculated FHB nursery to evaluate percent symptomatic spikelets, allowing calculation of FHB index and AUDPC. Harvested grain will be evaluated for FDK and DON. Two field seasons are planned.
2. Genotyping will be carried out using sequence-based methods similar to those use to evaluate *Ae. tauschii* introgressions in Nyine et al. (2021).
3. Phenotypic and genotypic data will be used to map regions associated with FHB resistance.
4. Regions associated with resistance will be targeted for KASP marker development.

2. What was accomplished under these goals or objectives?

Field phenotypic evaluation

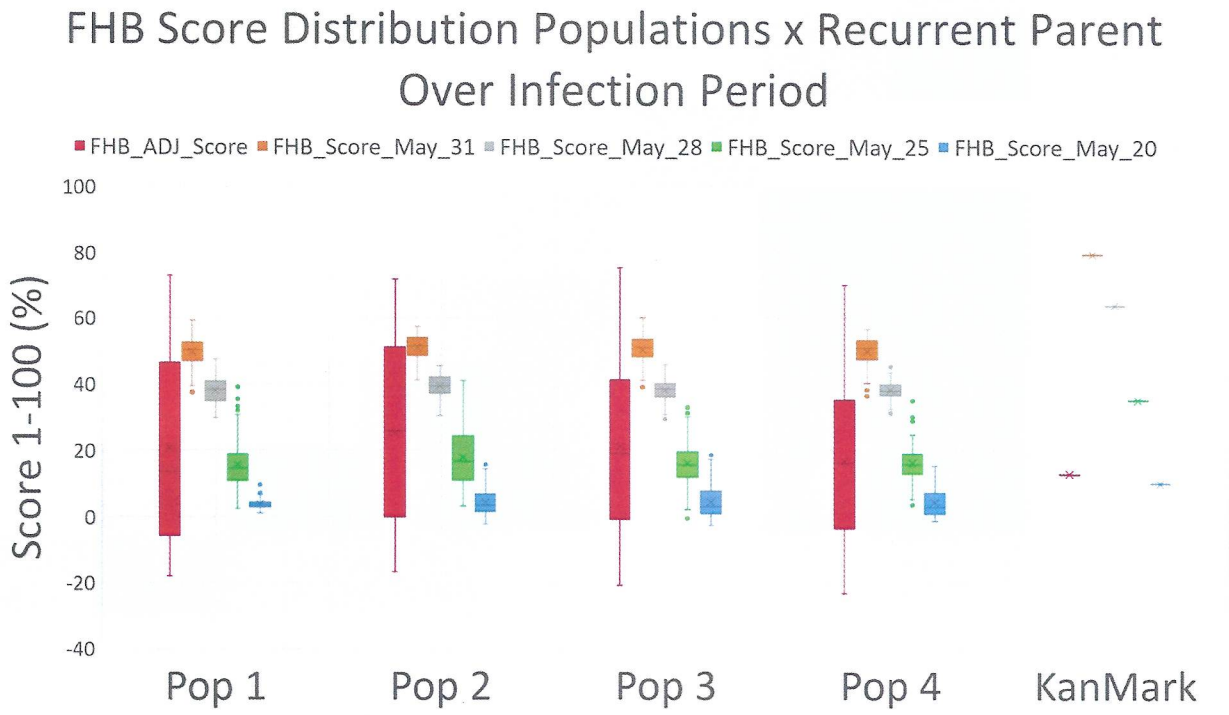
Major activities: The population of 607 lines derived from putatively resistant *Aegilops tauschii* accessions, plus recurrent parents and checks were grown and evaluated in the 2024 and 2025 inoculated FHB nursery at the Rocky Ford Research Farm in Manhattan, KS. The four populations used were TA 1599/KanMark//KanMark, TA 1691/KanMark//KanMark, TA 2477/KanMark//KanMark and TA 2478/KanMark//KanMark. Heading date and percent symptomatic spikelets (PSS) were recorded at four different dates, starting ten days after flowering. Rows were harvested and threshed and each plot was evaluated for FDK and the samples were submitted for DON analysis. All data for 2024 has been collected, including DON. PSS for 2024 was analyzed using heading date as a covariate. The 2025 PSS data has been collected and samples for FDK and DON harvested. They are currently being threshed. Once threshing is complete, FDK will be scored and DON samples will be submitted for analysis.

Significant results: **Summary of Results**

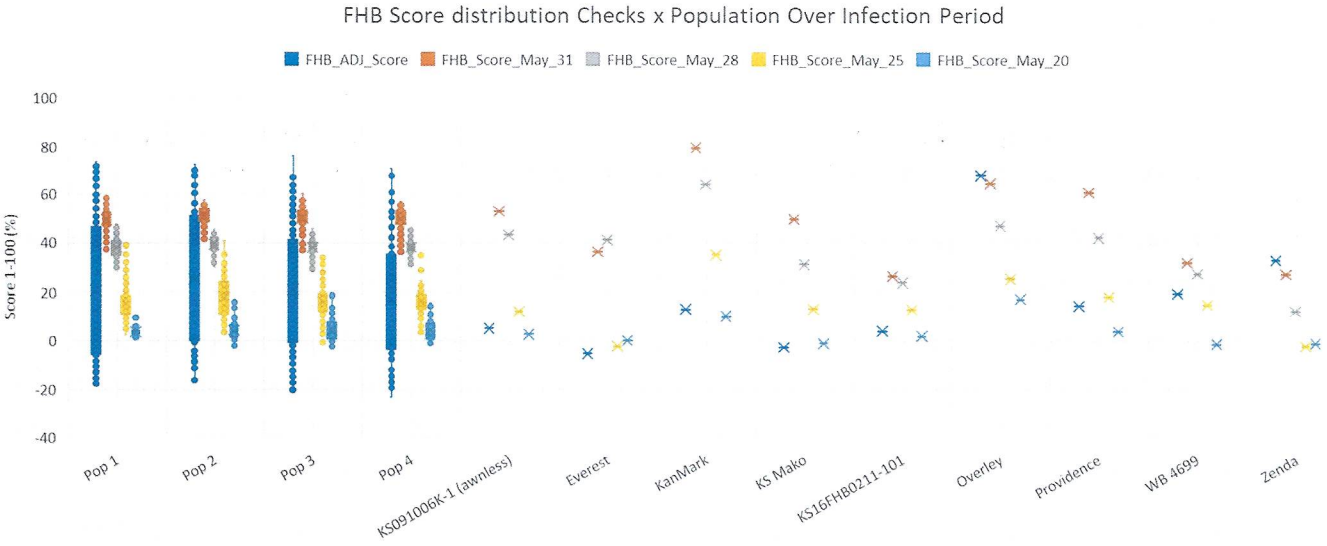
The study evaluated traits related to FHB resistance. Key results are summarized in the following table, which shows the variance components, heritability, and variance estimates for each trait:

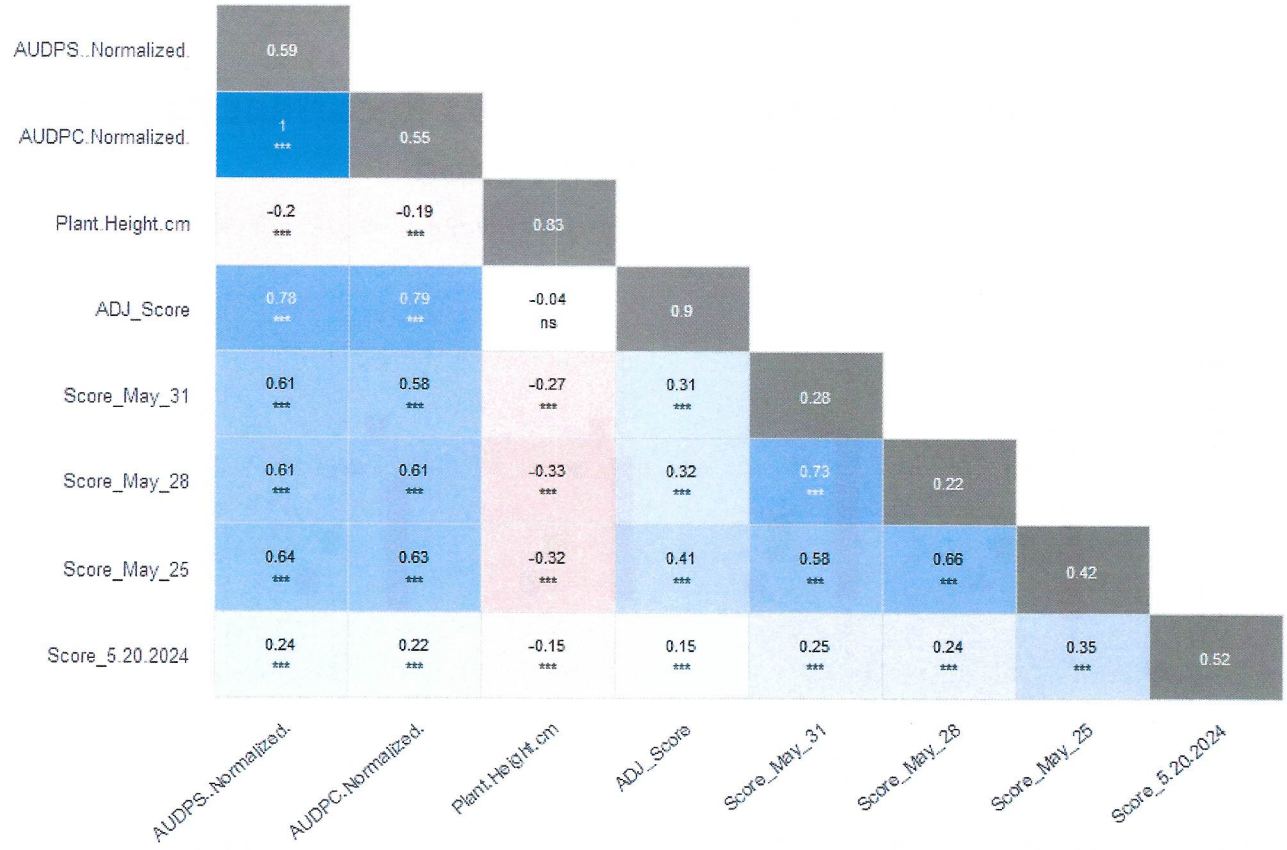
Trait	varG	varE	h^2	outliers	r^2	cv
*AUDPS Normalized	37598.62	24717.96	0.6	0	0.863	14.54
**AUDPC Normalized.	21639.3	16680.53	0.6	0	0.837	16.5
Plant.Height.cm	67.544	13.669	0.8	0	0.96	2.12
FHB_ADJ_Score	771.456	79.127	0.9	0	0.985	9.37
FHB_Score_May_31	65.089	156.246	0.3	0	0.712	14.14
FHB_Score_May_28	53.195	175.078	0.2	0	0.647	20.57
FHB_Score_May_25	108.054	140.002	0.4	0	0.75	29.02
FHB_Score_May_20	26.783	22.253	0.5	0	0.83	43.61

*AUDPS (Area Under Disease Progress Stairs) – Normalized; **AUDPC (Area Under Disease Progress Curve) - Normalized



Pop 1= TA 1599/Kan Mark//KanMark; Pop 2= TA 1691/KanMark//KanMark; Pop 3 = TA 2477/KanMark//KanMark; Pop 4 = TA 2478/KanMark//KanMark





Key outcome: These results indicate that *Aegilops tauschii* exhibit promising FHB resistance, which is critical for developing wheat varieties with improved disease resistance in future breeding programs.

DNA was isolated from all lines in the Akhunov lab and samples submitted for low pass sequencing in order to generated genotyping information.

The student on the project is analyzing the DON data and gaining knowledge of the genotyping pipelines to be able to manage the sequencing data when it is returned.

Overall, the project is on target. We have discussed how to better handled samples for 2025 to ensure that DON samples are submitted more quickly than 2024 so the student can drop that data into the analysis in anticipation of completing their Master's degree in December, 2025, which is also the target data for submission of a journal article describing the work.

Analysis of phenotypic data showed an near normal distribution for PSS data. This confirmed the presence of genes for FHB response in the targeted Ae. tauschii accessions.

Genotyping will be carried out using sequence-based methods similar to those use to evaluate *Ae. tauschii* introgressions in Nyine et al. (2021).

Major activities: Samples were submitted for low pass sequencing and data was returned. Graduate student is modifying a previously-used pipeline to make genotype calls. The task is in progress and should be completed by September 1, 2025.

Significant results: The data analysis is in progress. The populations will eventually be made available to the community and will include the genotypic data, which will have relevance for future FHB work. The populations may also have value for traits beyond FHB and the presence of high quality genotypic data will facilitate their use for other future objectives.

Key outcomes: The work is still in progress

The other two major objectives were use of phenotypic and genotypic data will be used to map regions associated with FHB resistance and development of KASP markers for regions associated with resistance. These objectives are still to be carried out since we have not completed analysis of field phenotypic data and are just now preparing samples to be sent for DON analysis of the 2025 crop. The progress on collection of phenotypic and genotypic data means we are well-positioned to accomplish these objectives over the next few months.

Overall, the project has accomplished the tasks as required to successfully complete the project as described in the proposal. Funding delays have required some financial balancing acts on the part of the PIs but the work has been carried out as proposed. The ultimate objective is identification of lines containing specific QTL derived from Ae. tauschii that may be used by breeders, along with markers to facilitate rapid and efficient introgression. We are confident we will deliver those tools to the wheat breeding community.

3. **What opportunities for training and professional development has the project provided?**
   The project has provided for graduate training for one M.S. student. They have progressed well, both in the classroom and in execution of the research project. We decided to delay presentation of the research to the 2025 USWBSI Forum in order to provide a more complete presentation of the work.

4. **How have the results been disseminated to communities of interest?**
   So far they have primarily been disseminated through the HWW-CP discussion at the McFadden Symposium in Lincoln, NE in the spring of 2025. The graduate student will present results at the 2025 USWBSI Forum. The results will also be disseminated through the students thesis and in the form of at least one journal article describing the work and a planned germplasm release containing the lines that best combine novel QTL for Ae. tauschii and good agronomic characteristics. The two publications will ultimately provide both germplasm and appropriate breeding tools.

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

The activities that will occur in the next reporting period include analysis of the second year of field phenotypic data include PSS, heading date, FDK and DON. The genotypic data will be used to map the various traits and regions associated with resistance will be targeted for KASP

development. Much of the remaining work is analysis of data so is no longer subject to the vagaries of weather. The student would like to defend their thesis this fall, but may have to push it off until early spring. They will also present a poster at the USWBSI Forum in December.