Project FY22-SW-011: Evaluation and Development of FHB-Resistant Wheat Varieties for the Midsouth

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1. **What are the major goals and objectives of the research project?**

I. Develop and release high-yielding, FHB-resistant cultivars.
II. Increase breeding efficiency through collaborative phenotyping, marker development, and introgression of new genes using marker-assisted (MAS) and genomic selection (GS).
III. Screen and report the reactions of breeding lines and currently grown commercial cultivars to FHB using misted inoculated nurseries

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

What were the major activities?

Significant progress has been made in the development, evaluation, and advancement of wheat lines resistant to Fusarium Head Blight (FHB). The following activities summarize the key accomplishments of the current breeding cycle:

1. **Crossing Program**
   Over **200 targeted crosses** were successfully made between FHB-resistant lines. These crosses aim to combine favorable resistance genes from diverse sources to develop new, elite wheat lines with improved FHB tolerance.
2. **F2 Population Advancement**
   A total of **200 F2 populations** were advanced in the field. These populations represent the early generation progeny from FHB resistance crosses and serve as a foundation for further selection and evaluation.
3. **Head Row Development**
   More than **4,000 head rows** were developed from intermediate to advanced generations. These rows include selections from early generations and ongoing evaluations for yield, agronomic performance, and FHB resistance.
4. **Seed Increase of Double Haploid (DH) Lines**
   Seed was increased for **306 DH lines** that carry genes associated with FHB resistance. These lines are valuable for rapid line development due to their fixed genetic background and are being prepared for multi-location testing and further characterization.
5. **FHB Screening and Multi-Location Testing**
   FHB screening trials were conducted at two distinct locations**,** providing essential disease pressure to differentiate among entries. Multiple nurseries were included in these trials, such as: GWAN, SunWheat, SunPre, USF, USS, and UES
6. **Mycotoxin and Kernel Damage Evaluation**
   Selected samples from the field trials were tested for Deoxynivalenol (DON) accumulation and **Fusarium-Damaged Kernels (FDK)**. These evaluations are critical for identifying lines with both field resistance and low mycotoxin levels, ensuring the development of safe and marketable wheat varieties.

What were the significant results?

FHB screening was conducted rigorously at two separate locations using mist irrigation systems to ensure uniform and sufficient disease pressure. Each entry was planted in three replications per location and evaluated using incidence (rated on a 0–9 scale) and severity (percentage of infected spikelets per spike). Each plot was assessed three times during the peak disease period, and the average scores for both incidence and severity were calculated across all replications and locations. Based on these comprehensive assessments, several lines showed high levels of tolerance to FHB, consistently exhibiting low incidence and severity. These lines are being prioritized for advancement and potential release. All FHB screening results, including those from the USS (Uniform Southern Scab), USF (Uniform Southern Fusarium), and UES (Uniform Elite Scab) nurseries, were compiled and shared with the SunGrain members to support regional selection and breeding efforts.

List of lines with high tolerance to FHB in USS, USF, and UES is as follows

USS	USS	UES
DHMD-23-316	KWS620	TX20D5143
GA17371ID-38-6-3-23E23	19VTK7-66	IL16LCSDH-06-T-2661-17
ERNIE	18VTK6-3	KWS623
BESS	TN2502	MI22R057
GA18117-58NCDH-23E37F	Pioneer Brand 26R41	SWQL-W-ABD-5
LA16038C-4-3-1	KWS571	SWQL-W-B-7
GA161198-3-1-2-23LE14F	TX21D6434	X14-1035-67-7-1
KWS578	TN2501	
LAAR15737W-2-1-4-1-3	18VTK9-68	
SC21DH240-70		
SC24W067		
TX24D9598		
VA23W-40		
GA17389ID-8-2-15-23LE39F		
KWS571		
LAVT19VDH-FHB-MAS11-10		
SC24W217		
FHB-MAS03-29-2		
DH19SRW08-020		

List key outcomes or other achievements.

I trained employees on how to increase isolates in petri-dish, make inoculum, organize seeds in the cell planter, and set up the misting system, and harvest techniques. Furthermore, I will train them how to evaluate FDK after harvesting and collecting seeds.

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

The lines submitted by different states, along with entries from the Arkansas Extension Center and the University of Arkansas Wheat Pathology Lab**,** will be evaluated through field screening, Fusarium-Damaged Kernel (FDK) assessment, and Deoxynivalenol (DON) analysis. The resulting data will be compiled and reported to the relevant research, breeding, and extension communities for further use in selection, validation, and decision-making.

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

The data from lines sent by different states and Arkansas variety testing, the Arkansas Extension Center, and the University of Arkansas Wheat Pathology lab will be tested via field, FDK, and DON. Then, the results will be reported to the communities of interest mentioned above.

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

- **Crossing and Population Development**
  I plan to make additional crosses using FHB-resistant lines as parents to develop new populations aimed at enhancing genetic diversity and improving resistance levels in future breeding material.
- **Sample Analysis and Inoculum Preparation**
  I will continue working on FDK and DON evaluations using seeds harvested from the tested lines. Additionally, I plan to increase inoculum production in preparation for next year's FHB inoculation trials to ensure consistent and reliable disease pressure.
- **Project Expansion and Collaboration**
  I intend to expand the FHB project to include new research objectives and collaborations. In particular, I will work closely with the University of Arkansas Wheat Pathology Lab to develop fresh, high-quality inoculum for use in future field screening.
- **Infrastructure Improvement (Pending Funding)**
  If funding becomes available, I plan to upgrade the misting system used in the field trials. This will improve the consistency and effectiveness of artificial FHB inoculation and screening.
- **Ongoing Field Screening and Line Development**
  I will continue field screening for FHB tolerance and focus on the development and selection of resistant lines through breeding and evaluation in both early and advanced generations.