

**Project FY22-SW-001:** Enhancement of Fusarium Head Blight Resistance in the Southeastern U.S. Germplasm

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

- 1) Increase the number of varieties with improved FHB resistance and other important traits to reduce DON in the US grain supply
- 2) increase efficiency of Coordinated Project breeding programs by enhancing cooperation and coordination of research, and
- 3) evaluate and implement modern breeding technologies to further enhance short term and long-term improvement of FHB resistance.

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

**1) Increase the number of varieties with improved FHB resistance and other important traits to reduce DON in the US grain supply.**

**What were the major activities?**

Approximately 330 advanced lines were evaluated at Kinston, NC. Of those, 75% were expected to have at least one major QTL for FHB resistance. Entered advanced lines into three uniform nurseries (GAWN, Uniform Southern, and Uniform Southern Scab).

**What were the significant results?**

NC14757LDH-44 (Fhb1BJ, Fhb 4AN, Fhb 6AN) and NC15305-43 (Fhb1, Fhb1BJ, Fhb 4AN) were among the top 10 lines for yield in the 2023 GAWN for the NC-SC region. Four NCSU lines were among the best performing in the Uniform Southern Scab nursery for FDK and DON: NC14711-12 (FDK, DON), NC19-19921 (FDK), NC19-19942 (FDK), NCVT.D-33 (DON).

**List key outcomes or other achievements.**

More data has been generated to nominate NC18-16900 for release but pending final approval. Breeder seed for pre-release lines NC13217-211 and NC1530-747 were produced

**2) Increase the efficiency of Coordinated Project breeding programs by enhancing cooperation and coordination of research.**

**What were the major activities?**

We coordinated the annual Southern Uniform Scab Nursery for collaborators from eight breeding programs, seven public and one private. There were 51 experimental entries and six checks. We collated and summarized data and published a report on the USWBSI website. We participated in coordinated breeding activities with the seven-university SUNGRAINS cooperative breeding program. Jeanette Lyerly, a Research Associate on my project, ran the Genomic Selection activities in the CP.

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The annual Uniform Nursery report was published online at [https://scabusa.org/pdfs\\_dbupload/suwwsn23\\_report.pdf](https://scabusa.org/pdfs_dbupload/suwwsn23_report.pdf). This report contained a diverse set of information for breeding programs that included multi-state disease resistance evaluation, updates on the effectiveness of the training population used for genomic selection, QTL content of entries and advice on the optimum cross combinations to make in developing future breeding populations. The quantification of scab resistance of entries in the SUNGRAINS nurseries influenced the advancement decisions of seven university breeding programs. Genomic predictions for scab resistance in addition to yield, test weight, powdery mildew, leaf and stripe rust resistances for over 4,000 advanced lines were distributed to breeders in March of each year prior to field selection.

### **List key outcomes or other achievements.**

The Southern Uniform Scab Nursery provides public and private sector breeders with multi-environment evaluations of FHB resistance in advanced generation breeding materials compared with the resistant check varieties. The report contains a large set of information to assist in breeding for scab resistance. Correlations between predicted and observed measures for scab resistance consistently ranged over 0.50. Our seven years of applied experience with genomic predictions for scab resistance and yield strongly suggest that the initial selection for both these key traits can be made based on genomic predictions rather than field evaluations without detrimental impact on a program.

### **3) Evaluate and implement modern breeding technologies to further enhance short term and long-term improvement of FHB resistance.**

#### **What were the major activities?**

The improvement of genomic predictions for Fusarium Damaged Kernels (FDK) and DON was investigated from Uniform Scab Nursery historic data tracing back to 2012. Emphasis was placed on check line performance in each environment. GWAS studies were conducted to identify SNP incorporated in the GS pipeline through training population and database updates associated with FHB resistance traits and evaluate SNP to determine if they improve prediction outcomes for FHB resistance.

#### **What were the significant results?**

The best environments to use for a training population were those with clear separation of susceptible and resistant check means. There was a benefit to removing very low heritability environments. Using clustering as a method to better quantify and automate environment selection for a training population gave better response for DON and FDK but does not outperform training population selection based on check means for RAT or SEV.

GWAS identified SNP in the Fhb1 region on chromosome 3BS that were not identified in previous analysis with available SNP data. The continued inclusion of new breeding material in the GS pipeline, along with updates to the SNP database for southern and

eastern germplasm, have improved characterization of this region with regards to genomic prediction efforts.

**List key outcomes or other achievements.**

The data from the Southern Uniform Winter Wheat Nursery may be used for genomic prediction. Creating training populations based on check performance improves forward genomic predictive accuracies. Filtering out locations with low genomic, per-plot, and narrow-sense heritability and with poor differentiation between the resistant and susceptible check means improves predictive accuracies.

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

Two undergraduate students worked in scab nurseries and on post-harvest processing of materials harvested from the scab nurseries. They worked with the project leader and technical staff on these activities.

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

The Southern Scab Uniform Nursery report was published online at [https://scabusa.org/pdfs\\_dbupload/suwwsn23\\_report.pdf](https://scabusa.org/pdfs_dbupload/suwwsn23_report.pdf). Presentations made at NC producers' meetings and field days in August 2023 and January 2024.

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

PI Bandillo took over the NCSU small grains breeding program on May 16, 2024. New materials are expected to be evaluated. Genomic prediction for new breeding populations and early generation materials will be generated and accounted for making selection.