Project FY24-NW-001: Breeding Soft Red Winter Wheat for Improved Yield and Fusarium Head Blight Resistance

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

   Breeding program is a continuous process that needs generation of new genetic variants, advancement of breeding germplasm, and test and selection superior lines for the target environments, followed by seed increase for potential target environment. For Indiana in particular, superior variants are those that are high yielding and show moderate resistance to Fusarium head blight disease. The detailed and mainly recurring objectives are producing new breeding crosses every year, generation advancement of breeding populations, and line testing locally and regionally.

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

   What were the major activities?

   Objective 1. The crossing block of spring 2025 consisted of ~80 parents drawn from recent P/NUWWSN trials which contained at least one FHB resistance QTL (e.g., Fhb1) up to multiple QTL such as Fhb1, 1B of James Town, 1A of Neuse, 4A of Neuse, and 6A of Neuse based on the molecular marker data provided by Small Grains Genotyping Laboratory. From these lines, we performed > 100 crosses. A total of 189 F1 pedigrees (with crosses made in previous season) was planted for seed increase in F1 plants were grown spring 2025 greenhouse season.

   Objective 2. Generation advancement. We have planted **145** families of F2s. The planting was performed in head row fashion with a few rows per family. After selection based on visual characteristics and plant population, we hand harvested the rows in bags for bulk planting of F3 generation in fall 2025. have planted **104** F3 pedigrees and **68** F4 pedigrees were planted in bulk each in standard size plot. Seeds will be drawn from the plots that were harvested from F3 plots to make the F4s of next generation. Single heads were drawn by hand from F4 plots to make the next generation of head rows.

   Objective 3. We have planted **451** stage-1 single-replicated lines for yield and agronomic trait testing in Purdue farm. These were selected from head row nurseries of 2023-24. In addition, **30** stage-2 lines, **25** stage-3 lines and **9** elite lines were tested each in 4 replicates with proper local checks. Reciprocally, we grew the same number of lines for each of the named breeding programs. Besides these local trials, 1) we participated in group activity as a part of NIFA project by sharing ~**35** lines for sparse testing to KY, OH, MI, NY (partial set), and IL for yield testing; 2) we grow a commercial testing trial for a wheat seed company; and 3) we participated in conducting the Uniform Eastern Nursery.

   Objective 4. The P/NUWWSN scab nursery and nearly 30 advanced Purdue lines were planted in replicated rows. Unfortunately lack of additional field workers due to the budget decrease did not allow us to perform the disease inoculation and phenotyping.

What were the significant results?

Breeding trials were successfully harvested. Variations in grain yield and FHB traits were observed during the season and harvest time. At this point (July 21) we are preparing data for selection.

List key outcomes or other achievements.

The key outcome after we finalize data and share them with collaborators will be selection of higher and more stable yielding lines across multi-location. The ultimate outcome will be selection of candidates for variety release.

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

Undergraduate and graduate students, postdocs, and visiting scholars of the program who are involved in molecular biology research were able to participate in harvest, bagging, and sickling.

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

Dr. Mohammadi is communicating with seedmen and organic farmers to promote the advanced lines that showed yield equal to the existing checks from private entities. If possible and funding for traveling to USWBSI forum of 2025 becomes available, the data will be communicated with various stakeholders. The expertise and experience learned from FHB activities are being used for various grant writing activities to enable active research in the lab in the area of FHB research while other sources are limited.

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

Continue the core of breeding program in the current funding situation. Not only the breeding program at Purdue aim to develop and release varieties, but also it is an integral part of our graduate program in plant breeding and genetics. Together, wheat, sorghum, corn, and soybean field research provide hands-on education opportunity formally (e.g., AGRY 550) and informally (e.g., graduate students and undergrads funded or not funded by the initiative).