Project FY22-MG-005: Continued Deployment of Prediction Models for Fusarium Head Blight of Wheat & Barley

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

    - Deployment of the daily estimates of disease risk in the US.
    - Develop prototypes of a web-based user interface for delivering estimates of disease risk based on model ensembles.
    - Develop climate-based risk assessment for Fusarium head blight in the US.

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

    What were the major activities?

    Deployment of the daily estimates of disease risk in the US. The disease forecasting models were successfully delivered in the targeted areas during the 2024 and 2025 growing seasons. This includes development of daily maps of disease risk and coordination of the commentary provided by extension plant pathologists and agronomists. We also collaborated with the USWBSI NFO on the delivery of the expert commentary via the FHB Alerts, these alerts are sent to growers and other stakeholders through text message and email to stakeholders of the USWBSI.

    We continued to improve the user interface during this project year. Important changes included:

    - Upgrades to the help documentation for use of the forecasting tools
    - Improvements to the display of expert commentary by region and adjustments in the user interface to more effectively display commentary as a list with the most recent updates at the top. Users can also view all available commentary provided for a growing season at the national, or regional levels.
    - Completed launch of graphing tools that will enable users to select any section on the risk map to view recent weather and disease risk trends. These tools were fully operational for the 2025 growing season. These tools enable users to view trends in weather and disease risk for the past 14 days by selecting any point on the disease risk map.

    Develop prototypes of a web-based user interface for delivering estimates of disease risk based on model ensembles. During this project year identified candidate models that serve as members of the overall ensemble. These models, proposed by development team (funded separately), are logistic regression models based-on pre-anthesis weather observations. The deployment of a model ensemble requires additional quality control steps and evaluation of the input and outputs for each member model.

We have been testing the ensemble approach during the 2024 and 2025 growing season. This work includes developing code to calculate the summaries of hourly weather data for each of the member models, calculating disease risk for each member and then developing approaches to display the unified summary of disease risk based on the ensemble. This required the deployment of the models via a web-based model interface designed to support expert evaluation of the ensemble approach.

Develop climate-based risk assessment for Fusarium head blight in the US. Completed the initial analysis of the climate-based risk assessment for FHB. This includes processing decades of hourly weather data from throughout the continental US and establishing a database that will allows us to calculate estimates of crop growth stage and disease risk at a 2km grid throughout the spatial domain. We have completed our initial evaluations of the climate-based risk with current FHB model. We are currently working to verify the predictions based on the gridded weather data with station-based assessments of disease risk from selected weather stations in key wheat growing regions of the US.

Completed a user survey for the FHB Prediction Center and the FHB Alert System. Plans are in place to work with the USWBSI NFO to conduct a survey of the primary users of the FHB Prediction Center and the FHB Alert System. This survey was delivered electronically to the subscribers of the FHB Alerts. The survey helps us gathers information about the user demographics, usage patterns and impact of the information provided by the disease forecasting effort.

What were the significant results?
New graphing features were added to the web-based tools. These tools were improved for the 2025 growing season enabling improved grower interaction with the forecasting models.

Extension specialists provided state and regional level commentaries to help growers interpret disease forecasting models and translate these results into practical management recommendations for FHB. There were more than 30 commentary posts to date for the 2025 growing season.

List key outcomes or other achievements.
The disease forecasting models for FHB were successfully delivered 35 states during the 2024 and 2025 growing seasons. This includes development of daily maps of disease risk and coordination of the commentary provided by extension plant pathologists and agronomists.

3. **What opportunities for training and professional development has the project provided?**
Annual training on latest web-based tools at meetings of the multi-state committees coordinating the extension and research targeting small grain diseases in the US.

4. **How have the results been disseminated to communities of interest?**
   This project by its very nature is about delivering disease forecasts to small grain producers and their advisors with daily assessments of disease risk and practical management recommendations based on this information.

5. **What do you plan to do during the next reporting period to accomplish the goals and objectives?**
   As the growing season closes, we shift our work to focus on improving the user interface and data processing systems that enable the FHB forecasting tool to run smoothly in 2026. This work also includes testing new models and model ensembles for accuracy and suitability for public deployment. We also plan to implement the proposed user survey to document the influence of the forecasting on grower's management decisions and the impact of the USWBSI. We will be adding some location specific comparisons of the regional risk assessment portion of the project. This station-based assessments of the role of climate in disease risk will help support the publication of the regional risk assessment results.

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1. **What are the major goals and objectives of the research project?**
   We are addressing the risk of scab development during the critical flowering stage when the growers can ameliorate the risk with treatment. This project leverages various atmospheric data networks, including the finest scale and most accurate gridded observational data set (URMA), gridded weather model data (NBM and NDFD) and a host of regression based epidemiological models on a user-friendly graphic interface to assist growers in decision making in protecting their fields from scab. Using hourly reports of temperature and moisture from finely gridded data, each day the risk is assessed anew with the most recent observations and is available by mid-morning.

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

   What were the major activities?
   A successful daily prediction using various scab risk models have been run throughout the wheat growing season during the period of performance (May 2024-Aug 2024; Feb 2025-April 2025) from winter wheat in the southern Plains to late spring wheat in the Dakotas. Additional expert commentary is included from plant pathologists in most states to augment the utility of the interface. The tools are accessible on mobile devices due to upgraded mobile-friendly interface and risk in non-growing regions is being masked to prevent misinterpretation of the risk tool.

   In 2024, work was finalized on new graphing features that were implemented operationally during the 2024 growing season. These features provided "on-click" graphics that display past, present, and future risk values. Work continues on additional epidemiological model development for ensembling techniques to be used in future growing seasons.

   What were the significant results?
   Growers utilized the interface and modeling technique to assist crucial decisions about the risk of disease growth in their particularly locality or region. When any breaks in data stream or interface occurred, we received immediate response.

   List key outcomes or other achievements.
   Graphing feature development was finalized during the 2023 growing season that was launched at the beginning of the 2024 growing season and was successfully displayed through the entirety of the 2024 growing season and has continued during the 2025 season. Utilizing newly-developed epidemiological models, background investigation is ongoing regarding model accuracy and ensemble technique displays. Work will continue to refine the models and determine the best way to display data for expert users and separately for the general public. As of the start of the 2024 growing season, the tool has been fully migrated from older computing resources that were reaching end-of-life to new data servers and the utilization of several virtual machines for increased reliability and resiliency. The research team will continue to make improvements to the tool based on user feedback.

3. **What opportunities for training and professional development has the project provided?**
Nothing to report.

4. **How have the results been disseminated to communities of interest?**
The target audience of growers and extension personnel that advise grower consortiums receive information through the web interface. Experts provide commentary within the interface that report status of the wheat/barley crops as well as an assessment of disease risk. The interface is located at: http://www.wheatscab.psu.edu/ .

5. **What do you plan to do during the next reporting period to accomplish the goals and objectives?**
Over the next year, the project team will work on refinement and assessment of epidemiological model ensemble output. It was determined in 2024 that some of the experimental models require more analysis to determine the best suite of models to include in an ensembling technique for display on the tool. We still plan to display ensemble data in two forms – a more detailed analysis that will be available for technical users and a consensus (or summary) output that will be displayed for the general public. Work will continue on refining data display techniques so the tool remains user-friendly and understandable.

In addition to ensemble techniques, we will continue to work on improvements to the expert commentary system and to displays of data on the existing tool, including map layer displays, color schemes, and on-click graphing features. Discussions began in 2025 to investigate whether an alerting system could be developed based on specific risk thresholds. The team will continue to discuss how this could be developed and what resources would be required.