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?**
   a) Deployment of the daily estimates of disease risk in the US.
   b) Develop prototypes of a web-based user interface for delivering estimates of disease risk based on model ensembles.
   c) Develop climate-based risk assessment for Fusarium head blight in the US.
   d) Enhanced computing resources and storage capacity for the FHB forecasting system.

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 2023 and 2024 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 messages and emails 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 testing of tools that will enable users to select any section on the risk map to view recent weather and disease risk trends. These tools are ready to implement for the 2024 growing season.
   - Integration of graphing feature into the user interface. 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 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 development of a new web-based model interface for expert evaluation of the ensemble approach.

Develop climate-based risk assessment for Fusarium head blight in the US. We also have gathered the needed weather resources to complete the analysis. This project requires decades of hourly weather data from the continental US. We also established a database that will allow us to calculate estimates of crop growth stage and disease risk at a 20km grid throughout the spatial domain. We have completed our initial evaluations of the climate-based risk with current FHB model (figure 1). Plans are now in place to estimate the historical disease risk with the new ensembles of predictive models.

Enhanced computing resources and storage capacity for the FHB forecasting system. We requested one-time funding to support an upgrade to the server and storage capacity of the computing systems used to implement the FHB forecasting tools. This equipment has been purchased and is currently being configured with the required software. We will be migrating services and functions to the new server in Oct – Dec of 2023. The new computing resources were fully operational for the 2024 growing season.
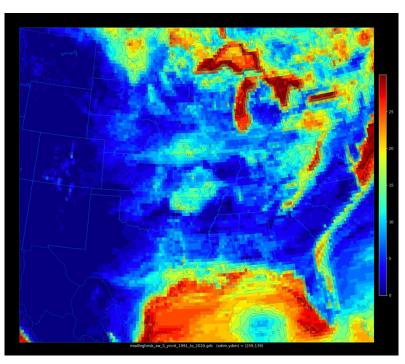

Figure 1. Preliminary estimates of FHB risk based on climate records 1991-2020. This map focuses on the areas covered by the current forecasting effort. Not: Large bodies of water included in this visualization of risk, but will be masked by additional map layers in as we move toward the final summary maps.

Completed a user survey for the FHB Prediction Center and the FHB Alert System. We worked 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?

The user survey provided valuable information about the value of the disease forecasting effort supported by the USWBSI.

- Results of the user survey indicate that 85% of the users have been using these web-based tools and information system for more than 4 years. The majority of users of these tools were farmers and agricultural advisors that work with growers to help make their management decisions.
- More than 65% of the users reported a great or moderate improvement in their awareness of disease risk.
- More than 86% of the users indicated that the information prompted them to take management action or seek advice on the correct disease management options for FHB.
- Over 90% of the users reported that the forecasting effort helped them make FHB management decisions correctly and 89% of the users indicated that they thought the information increased the profitability of their farm or operation.
- The users of the FHB information provided by the forecasting effort was worth $58 million to wheat and barley farmers annually.

List key outcomes or other achievements.

The disease forecasting models were successfully delivered in the targeted areas during the 2023 and 2024 growing seasons. This includes development of daily maps of disease risk and coordination of the commentary provided by extension plant pathologists and agronomists.

Transition to new computing resources that ensure the timeliness and reliability of the information provided to stakeholders of the USWBSI.

3. **What opportunities for training and professional development has the project provided?**
None to report

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

The forecasting system provides daily estimates of disease risk to thousands of wheat and barley producers in 35 states.

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

The proposed projects follow an annual cycle that includes intense focus on public deployment of the models covered by objective 1. The enhancements to the modeling tools, adaptation of the model ensembles and climate-based risk assessments (objectives 2 and 3) is completed in the "off-season" (Sept-Feb) when demands of public deployment of models decrease and new data are available for year-end evaluations. The user survey is conducted in Sept-Oct so that results can be shared at the FHB forum in December.