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Research Category: MGMT **Duration of Award:** 1 Year

Project Title: Application of Model Ensembles and Machine Learning to the Prediction of Fusarium Head Blight

PROJECT 2 ABSTRACT
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The overall goal of this project is to create better models for predicting Fusarium head blight (FHB). For FY20-21 our objectives are to 1) enhance the FHB observation matrix with observations collected in collaboration with the MGMT IM-CP during recent growing seasons; 2) improve predictive models for FHB through "ensemble modeling" approaches that combine estimates from multiple models resulting in a more robust estimate of disease risk; 3) further apply machine learning algorithms that better address non-linear relationships between weather and FHB risk. We will also propose an educational objective for FY20-21 that 4) uses the FHB observational matrix and the predictive models to develop a suite of case studies that will help stakeholders visualize and understand weather patterns that stimulate or suppress FHB epidemics. We have already made considerable progress in modeling epidemics of FHB. This includes developing a data matrix of nearly 1,000 observations of FHB epidemics and non-epidemics, linked to hourly weather time series. Recent additions to this data set represent growing seasons with striking temperature and precipitation anomalies. Continued collaboration with the Integrated Management Coordinated Project (IM-CP) will further expand the data matrix making it more robust to changing environments. We will then examine approaches for combining models with the goal of improving predictions of FHB disease risk. For this analysis, we will use a combination of correlation, case-by-case examination of model predictions, and cluster analysis to identify individual models that are most likely to contribute unique information to the ensemble. We will then evaluate different strategies for combing model predictions including weighted mean predicted probabilities or development of a second-level (meta) models. We propose applying several machine learning algorithms offer flexible in the way they handle nonlinearities and interactions within the FHB matrix. These models will bring additional diversity to the model ensembles and further improve model predictions for FHB. We also propose an educational objective for FY20-21 that extends the utility of the modeling effort. To do this, we will use the recent FHB modeling results to develop a set of cases studies that will help the next generation of scientists rapidly gain experience with FHB epidemiology and make scientifically sound recommendations for FHB management in the future. We expect this project will result in models or ensembles of models that can be deployed via the Fusarium Head Blight Prediction Center.