

Assessing the Risk of Cucurbit Downy Mildew Outbreaks in the Eastern United States

Dr. Peter Ojiambo

North Carolina State University

Outbreaks of cucurbit downy mildew in the eastern US are spatially correlated with time to disease in fields closer together being more similar than in fields farther apart. A Bayesian time-to-event model with spatially correlated random effects following a spatial conditional autoregressive model was fitted to assess the risk of disease outbreak in the eastern United. The model showed clustering of outbreaks at the state level and indicated that states in the mid-Atlantic region have high spatial frailties and a high risk of disease outbreak. Once disease occurs in a field, that field can serve as a source of inoculum for neighboring disease-free fields. Thus, time to disease outbreak and epidemic duration affect each other and understanding this association can aid in managing epidemics. Consequently, we develop a joint Bayesian hierarchical model with spatial correlated random effects. Here, a parametric Weibull distribution to the censored time to disease outbreak data, and a zero-truncated Poisson distribution to disease duration data. In a simulation study, several competing models are considered for the process model. Results show that a generalized multivariate conditionally autoregressive model that includes a correlation and spatial structure is the most preferred model. Using disease records in the 2009, the joint model indicates that states in the mid-Atlantic region tend to have a high risk of disease outbreak. Thus, disease surveillance efforts should concentrate within this region and immediate application of fungicides in the region should substantially reduce the velocity of the epidemic wave front in the eastern US.