The impact of insect aggregation and dispersal on disease outbreaks in insect-plant-virus models

Prof Linda Allen

Texas Tech University.

While feeding on host plants, viruliferous insects serve as vectors for viruses. Successful viral transmission depends on vector behavior. Two behaviors that impact viral transmission are vector aggregation and dispersal. Vector aggregation may be due to chemical or visual cues or feeding preferences. Vector dispersal can result in widespread disease outbreaks among susceptible host plants. These two behaviors are investigated in insect-plant-virus models. Deterministic and stochastic models are formulated to account for stages of infection, vector aggregation and local dispersal between adjacent crops. First, models for a single crop are studied with aggregation included implicitly through the acquisition and inoculation rates. Second, models with aggregation and dispersal of vectors are studied when one field contains a disease-sensitive crop and another a disease-resistant crop. Analytical expressions are computed for the basic reproduction number in the deterministic models and for the probability of disease extinction in the stochastic models. These two expressions provide useful measures to assess effects of aggregation and dispersal on the rate of disease spread within and between crops and the potential for an outbreak. The modeling framework is based on cassava mosaic virus that causes significant damage in cassava crops in Africa.