Application of Spatial Statistics to Plant Disease Epidemiology

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BACKGROUND

Plant disease epidemiology deals with the study of the spread of plant pathogens/diseases and their interaction with the environment/ecology in space and time. Spatial statistics comes into the scene when one considers to investigate distribution of a disease within a given field or area of a field as affected by the environment or human intervention. Spatial patterns of plant diseases vary between high level of aggregation and high level of randomness. In an aggregated spatial pattern, knowledge of the density of a pathogen in a spatially referenced location would give some information on the pathogen density at a different unsampled location. However, in randomly distributed pattern, such information is unattainable because of lack of influence of one location over the other. Geostatistcs, in conjunction with interpolation techniques such as kriging or inverse distance weighting (IDW), has been a popular methodology in the field of spatial statistics. However, recently a novel methodology called SADIE (Spatial Analysis by Distance Indices) was introduced to quantify patterns of individual units (counts) with certain degree of precision. We are currently using both of these methodologies where appropriate to study within-field distribution of plant pathogens/ diseases.

OBJECTIVE

- Understand the underlying mechanisms of pathogen movement and disease distribution and spread as related to environmental heterogeneity.

RESULTS / BENEFITS

- We are currently in the process of quantifying spatial patterns of *Tilletia indica*, the causal agent of karnal bunt of wheat (an invasive fungal pest recently introduced to Texas) and beet necrotic yellow vein virus (BNYVV).

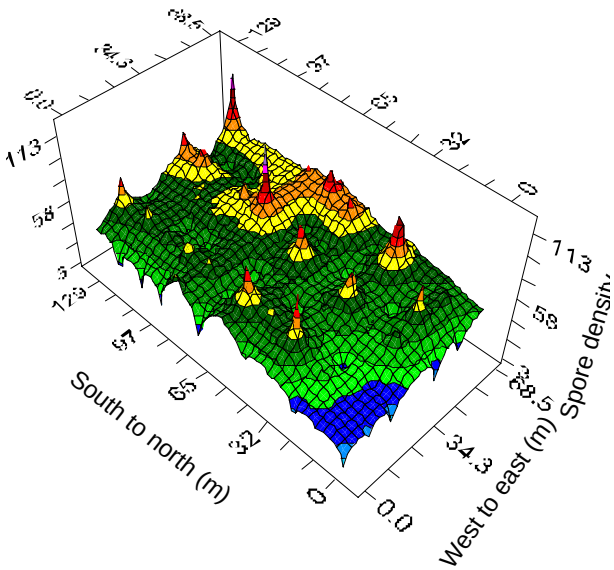

Fig. 1. Spatial pattern of karnal bunt spores in one of the infected wheat fields in Texas

- Knowledge of spatial patterns of plant disease is useful for making management decisions, especially for application of site-specific management as in precision agriculture. If a section of the field where the pathogen survives is identified and the pathogen density is quantified, there is no need to apply pesticide on the entire field.
- Field sampling strategies can be devised based on the knowledge of the spatial pattern of the pathogen under study.
- Knowledge disease distribution would provide clues to method of pathogen introduction in fields with newly discovered diseases.

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