SPATIAL ECONOMETRIC MODELING FOR SITE-SPECIFIC NEMATODE MANAGEMENT

Zheng Liu
Terry Kirkpatrick
Division of Agriculture University of Arkansas
Little Rock, AR
Terry Griffin
Cresco Ag, LLC.
Memphis, TN
Scott Monfort
Clemson University
Clemson, SC

Abstract

Management of nematodes infested cotton field soils has eluded farmers and researchers for decades. Effective nematode management has relied heavily upon nematicide application. Recent advances in precision agriculture technologies and spatial statistics allow the feasibility of site-specific nematode management which relies upon applying nematicides at a single or different rates across fields only in locations where economically justified based on several key criteria. The estimation of profitability of site-specific management and the development of application recommendation strategies are based on the clear establishment and estimation of yield potential (penalty) function. Due to the existence of spatial dependency in the crop yield monitor data, spatial econometric techniques with modeling correlation among neighboring observations should be considered to obtain more reliable estimates for yield response function.

This paper reviewed and applied spatial econometric modeling to determine the potential of site-specific nematicide application. The spatial autoregressive error model, spatial autoregressive lag model, spatial Durbin model, and the spatial panel model with fixed and random effect extension were used to estimate cotton lint yield as a function of nematode population, soil texture, nematicide application and other environmental factors. The on-farm experiments precision agriculture data collected in southeastern Arkansas from 2001-2003 (with nematicide application) and 2004 and 2011(without nematicide application) were used for spatial cross-sectional (for single year data) and spatial panel (for five year combined data) econometric analyses. Specific, spatial econometric theory applied to panel data with fixed effect and random effect extension provides the framework to control for both spatial and temporal heterogeneity and dependencies and deliver more reliable information.

The empirical results from both cross-sectional data and panel data analysis support the following findings: 1) spatial econometric models are the proper alternative to non-spatial classical models (OLS) for site-specific nematode management case studies; 2) post-treatment nematode population at bloom and percent sand fraction are significant factors in explaining cotton yield variability; 3) yield penalty resulting from a given nematode infestation vary with differing soil texture; 4) yield response for nematicide application differs by soil texture. The results provide evidence to support the potential of site-specific nematicide application and can be used to develop efficient site-specific nematode management strategies.