STUDY OF THE SPATIAL VARIABILITY OF SOUTHERN ROOT KNOT NEMATODE (MELOIDOGYNE INCOGNITA) AND THEIR IMPACT ON COTTON YIELD PRODUCTIVITY

by

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ABSTRACT

Site-specific management (SSM) is a promising strategy for reducing yield loses caused by the southern root-knot nematode [*Meloidogyne incognita* (Kofoid & White) Chitwood] (RKN) across the U.S cotton belt. To address this opportunity, this dissertation focused on studying and analyzing the spatial variability of RKN and its spatial relationship to edaphic, terrain, and chemical field properties. This included modifying a cotton crop growth model to simulate the RKN damage on cotton biomass observed in field experiments. The work was conducted in the Tifton-Vidalia Upland (TVU) ecoregion of the Southeastern Coastal Plain. Data were collected from eleven producers' fields and one field used for a RKN long-term research project during 2005, 2006, and 2007. The fields were located in Colquitt, Tift, and Worth Counties of Georgia, USA.

Two difference approaches were used to identify field features related with the presence or absence of RKN: (*i*) geostatistical analyses (factorial kriging) to decompose the variability of RKN and soil properties into different spatial components allowing the computation of correlation coefficients for different spatial scales; and (*ii*) canonical correlation analyses (CCA) to determine which properties explained the greatest amount

of variability in RKN population density. Areas at risk for different levels of RKN population were identified by indicator kriging and fuzzy clustering of canonical predictors derived from the CCA.

The simulation of growth and yield of cotton plants infected with RKN was conducted by modifying the Cropping System Model (CSM)-CROPGRO-Cotton. The model was modified by coupling RKN population for removal of daily assimilate and decreasing root length per unit mass as strategies to mimic RKN damage.

The most important results form this study include: (1) the identification of different spatial components for RKN population and soil properties; (2) the identification of areas a risk above a threshold value based on the combination of RKN population data and apparent soil electrical conductivity deep ($EC_{a\text{-}d}$) data; (3) the identification of edaphic and terrain properties and their ranges of variation associated with the presence of high RKN populations; (4) the definition of a set of procedures for RKN management zone delineation; (5) the quantification of the impact of RKN parasitism on different cotton biomass components; (6) an adaptation of the Cropping System Model (CSM)-CROPGRO-Cotton in DSSAT v4.0 to simulate growth and yield of the DP 458 BR cotton variety impacted by RKN population; and (7) simulation of seed cotton weight for different management zones delineated for a producer's field under risk for RKN damage.

Overall, this research contributes to the knowledge of RKN variability as function of edaphic and terrain attributes within fields of South Georgia, and development of guidelines to identify areas at risk for RKN damage based on RKN's surrogate data. It

also provides more information of the interactions within the system RKN-plant-environment.

INDEX WORDS: Cotton, crop modeling, geostatistics, growth and yield, *Meloidogyne incognita*, precision agriculture, site-specific management, southern root-knot nematode, spatial variability.