MAPPING "RISK" AREAS FOR COTTON ROOT-KNOT NEMATODE BASED ON SOIL AND LANDSCAPE ATTRIBUTES

Dana G. Sullivan[1], Calvin D. Perry[2], Brenda V. Ortiz[2], and George Vellidis[2]
[1]USDA-ARS, SEWRL, Tifton
[2]University of Georgia, Bio & Ag Engineering, Tifton

Introduction

Cotton root-knot nematode (RKN) (*Meloidogyne incognita*) damage is considered one of the major limiting factors in cotton production across the United States. Due to limited public awareness and a reluctance to invest in costly, yet beneficial nematicides, nematodes are among the most under-managed cotton pests in Georgia today. An extensive survey in Georgia during the late 1990s determined that nearly 36% of cotton fields were infested with root-knot nematodes. In 2002, Georgia county agents conducted a random survey of nearly 1800 fields and found that 69% of the fields were infested with root-knot nematodes.

Over the last 20 years, rapid increases in the percentage of cotton acreage across the state have contributed to increasing nematode-related yield losses. Yield losses can range from 10% to 75% depending on soil properties and weather conditions. Sandier soils, prone to drought conditions, may experience yield losses as high as 80%. During the 2002 growing season, Georgia cotton producers spent nearly $8,000,000 on nematicides, yet nematode damage still resulted in yield losses totaling over $22,000,000.

During the 2005 and 2006 growing seasons, ten farm sites with a known history of cotton root-knot nematode infestations were used to evaluate a management zone approach to mapping high-risk areas for nematode related yield-losses. Thus, our primary objectives were to: 1) establish a relationship between cotton root-knot-nematode occurrence and soil or landscape attributes, and 2) utilize this relationship to develop risk-based management zones for directed sampling and nematicide management.

Materials and Methods

In 2005 and 2006, a total of ten farm sites with a known history of nematode infestations were evaluated. Farm sites were typically a component of cotton-peanut rotation with one to two years duration of cotton, followed by a year of peanut. Sites were located in the Southern Coastal Plain of Georgia and ranged in size from 40 – 60 acres

A series of ground truth measurements were collected at each site. Ground truth assessments consisted of two types: grid samples and continuous measurements used to recreate maps of soil features.

Nematode assays, soil pH, soil texture, soil nutrients, soil water content, depth to clay layer, and plant height were collected on a 50 x 50 m grid. Nematode samples were collected twice during the growing season, and once just after harvest (0-6 inch depths). All other grid samples were collected once, prior to planting.

Continuous variables included high-density measurements of soil and landscape attributes, which have been shown to be correlated with cotton root-knot nematode densities. These data included remotely sensed airborne/satellite imagery, real time kinematic (RTK) GPS (for elevation), and Veris electrical conductivity (EC) (0-30 cm, 0-90cm). Elevation and electrical conductivity were collected in tandem at a spatial resolution of 30 ft x 30 ft prior to planting at each site. Remotely sensed data were acquired using the aircraft mounted SpectraView® Multi-Spectral Imaging System and the Quickbird Multispectral Satellite. Each system collects data in the blue, green, red and near-infrared regions of the spectrum with a 1-3 m^2 spatial resolution. Images were acquired once during bare soil conditions and have continued on a monthly basis beginning at first flower.

Results

A detailed analysis for two 2006 farm sites were conducted to determine if remotely sensed data, topography and EC could be used to delineate risk zones for RKN control. A combination of electrical conductivity measurements at two depths, remotely sensed imagery of bare soil and topography were highly correlated with the presence of root-knot nematodes. Using all variables, a high correlation between soil-landscape attributes and the occurrence of root-knot nematodes was observed, ranging from 0.42-0.64. In most cases, the high risk zones could be characterized as low-lying, sandy areas and reaffirm the fact that root-knot nematodes prefer sandy soils.

Next, spatial analyses were conducted to confirm nematode populations were spatially dependent. This was necessary to ensure the development of “high-risk” management zones were appropriate for managing nematodes. Results indicated that distributions of root knot nematode populations were strongly spatially correlated. Based on these analyses a recommended sampling interval of 80 m was proposed. More importantly, the presence of a strong spatial relationship provided the foundation for the development of “high-risk” management zones.

Our data indicate that nematode prone areas may be identified based on EC, landscape position and surface reflectance patterns. This combination of variables reduced the overall variability in RKN distributions by as much as 30% and most accurately identified “high-risk” RKN zones. Electrical conductivity, in particular, was highly correlated with the presence of root knot-nematodes, and contributed greatly to the resulting “risk” map Figure 1.

Conclusion

Cotton root-knot nematode distributions are highly correlated with soil and landscape attributes. Based on this observation, a novel method of developing “high-risk” management zones for site-specific sampling and nematicide treatment has been developed. Our research indicates that field areas at the greatest risk of nematode related yield losses may be identified using a combination of electrical conductivity, topographical data and remotely sensed imagery.

Acknowledgements

Funding for this project was provided by the Georgia Cotton Commission/Cotton Inc. The authors would like to thank Dr. Robert Nichols with Cotton Inc. for his support and direction of this project.

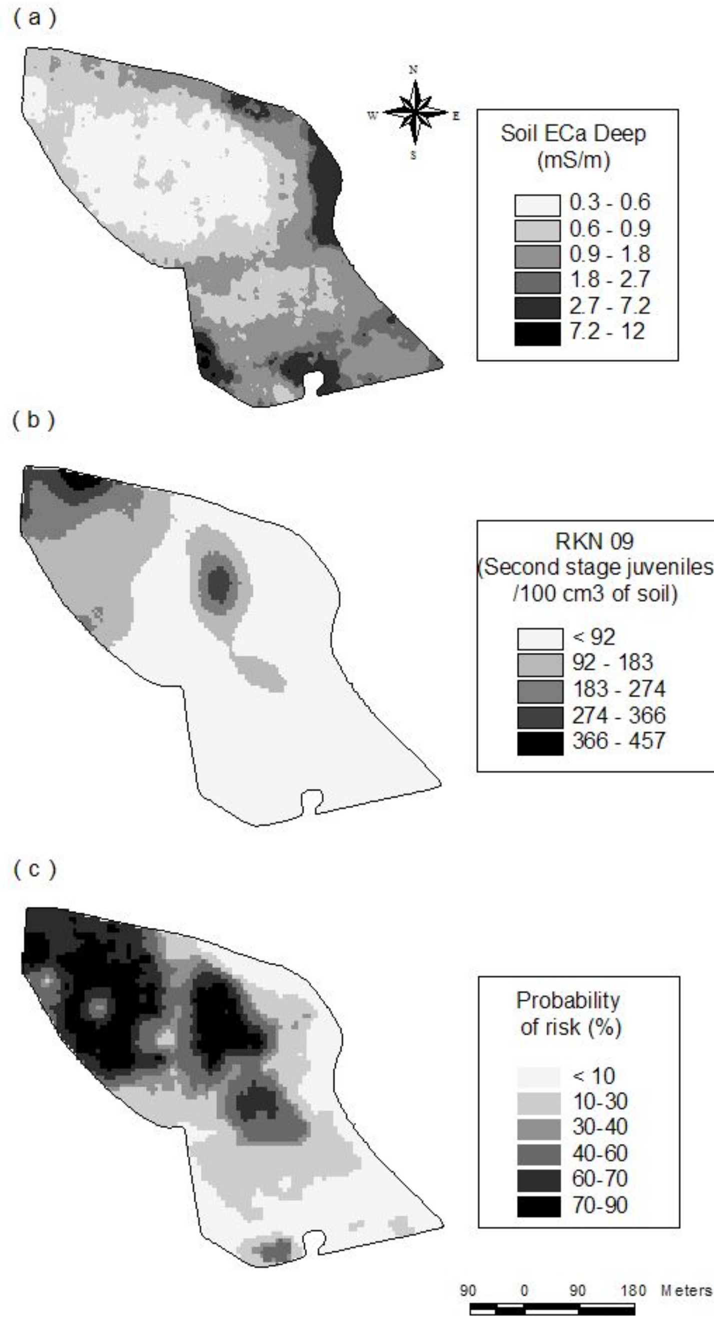

Figure 4. Analysis results from one field in study. A - Electrical conductivity (0-90 cm). B – RKN count. C – Probability of risk for RKN.