VARIABILITY WITHIN A COMMERCE SILT LOAM SOIL ON RENIFORM NEMATODE AND NEMATICIDE TREATMENT

Charles Overstreet
E. C. McGawley
D. M. Xavier
M. Kularathna
LSU AgCenter, Dept. of Plant Pathology and Crop Physiology
Baton Rouge, LA
D. Burns
LSU AgCenter, County Agent Tensas Parish
St. Joseph, LA
B. Haygood
DOW AgroScience
Collierville, TN

Abstract

Reniform nematode is a major nematode pest of cotton in Louisiana as well as much of the mid-South. Crop rotation and fumigation are required to manage high populations of this nematode. Site-specific application of a nematicide could reduce costs to producers if high risk areas could be identified. The objective of this study was to evaluate the response of the fumigant Telone® II in a field with varying populations of the reniform nematode and changes in soil texture in a Commerce silt loam field. The field was divided into 6 soil zones based on apparent electrical conductivity (EC_a). The fumigant was applied preplant in blocks to half the field at the rate of 3.0 gallons per acre. Populations of the nematode were monitored in each of the plots preplant and after harvest. Nematode populations and cotton yield were compared to zones and nematicide treatment. Populations of reniform nematode were present in the highest levels as the soil EC_a increased, but did begin to decline at the highest EC_a values. Cotton yields were also greater as the EC_a values increased. In this study, the fumigant provided a significant and economical response in zones 1-4 but not in zones 5-6. Populations of the reniform nematode were not a good indicator of potential damage because of the variable soil texture within this field.

Introduction

Reniform nematode (*Rotylenchulus reniformis*) is one of the major pest problems of cotton production in Louisiana. Over the past ten years this nematode alone was responsible for more than an estimated 330,000 of cotton bales loss. Management practices such as crop rotation or fumigants are required in fields with high populations of the nematode. In Louisiana, a number of cotton fields are located in areas with Commerce silt loam soils. Due to the high range of textures found within the Commerce silt loam fields, the response to the nematicide application within these fields can be variable (Overstreet et al., 2014). Burns et al., 2010 reported that greater responses to the application of a fumigant in cotton were found in Bruin silt loam soil than either Commerce silt loam or Commerce silty clay loam soils. Reniform nematode is often associated with finer-textured soils (Robinson et al., 1987; Starr et. al., 1993). To guarantee profitable nematode management in these fields, it is necessary to identify areas with different textures, which can be done by measuring the apparent electrical conductivity (EC_a). The objective of this study was to evaluate the influence of apparent electrical conductivity on the response of the fumigant application in a Commerce silt loam field.

Materials and Methods

The test field was located at the Northeast Research Station at St. Joseph, LA and heavily infested with the reniform nematode. Plots were four rows wide and 45’ long. Nematode samples were collected from the center two rows of each plot to a depth of 8 inches and analyzed for vermiform stages of reniform nematode by processing a 250 cc subsample of soil from each plot through elutriation and sugar flotation. The test was established as a randomized block design. The fumigant 1,3-dichloropropene (Telone II®) was applied on April 30, 2013 and April 25, 2014 at the rate of 3 gallons per acre by using a nematicide applicator with 30 inch Yeter Avenger coulters and injected 12 inches beneath the center of the row. The cotton variety Phytogen 449 WRF was planted on May 27, 2013 and May 5, 2014. Cotton was harvested from the center two rows of each plot on October 4, 2013 and October 2, 2014. The field was measured for EC_a after harvested using a Veris 3100 soil EC Mapping Soil System and divided into six zones. Data were analyzed by a factorial design with nematicides and EC_a zones as main plots. Correlation analyses were conducted on preplant populations of the reniform nematode and yield from both the treated and untreated plots.

Results and Discussion

There were significant main effects of the fumigation treatment for reniform populations at harvest and seed cotton (Table 1). Populations of reniform nematode were decreased at harvest by the Telone application with 71,487 reniform per 500 cm^3 of soil compared to 109,659 in the untreated. Seed cotton yields were also greater in the Telone-treated plots averaging 2766 lb/a compared to 2458 lb/a for the untreated. Zones significantly impacted reniform levels at preplant (Figure 1) and at harvest (Figure 2) as well as seed cotton (Figure 3).

Table 1. Analysis of variance for populations of reniform nematode prior to fumigation, harvest levels of reniform nematode, and seed cotton during 2013-2014.

	Reniform preplant			Reniform harvest			Seed cotton		
Source	df	F-value	*P*	df	F-value	*P*	df	F-value	*P*
Telone (T)	1	0.74	0.39	1	27.9	0.0000	1	12.8	0.0004
Zone (Z)	5	11.1	0.0000	5	3.54	0.0043	5	12.0	0.0000
T × Z	5	1.8	0.106	5	0.88	0.49	5	0.39	0.86

The overwintering populations of reniform nematode varied considerably in the Commerce silt loam soil of this field. Figure 1 presents the relationship of the initial population of this nematode and soil zones designated by EC_a. Soils in zones one and two had EC_a values of 22.5 and 21 mS/m for the shallow reading and 26.9 and 32.0 mS/m for the deep reading, respectively were found to have the lowest numbers of the nematode. Populations collected after harvest followed a similar trend (Figure 2). Seed cotton was strongly influenced by soil zone with the lowest yields occurring in the zones with lowest EC_a values and greatest yields occurring with the greatest EC_a values.

Although there were not any significant interactions with nematode populations or seed cotton, Figure 4 presents impact of fumigation at each of the six zones. There were significant increases in yield with the use of Telone in zones 1-4 but not in 5-6.

There was not a significant correlation between preplant populations of reniform nematode in either the Telone or untreated plots (Figures 5 and 6) and yield. Although the levels of reniform nematode ranged from 4,960 to 195,200 vermiform stages per 500 cm^3, the classic reaction of increasing densities of a nematode did not relate a greater reduction in yield. The correlation between preplant densities of nematode and zones was significant with R^2 values of 0.4 and $P \leq 0.001$ for the untreated plots and a R^2 value of 0.27 and $P = 0.005$ for the Telone plots.

Populations of reniform nematode followed trends that have been previously reported. Xavier et al., 2012 and 2014 reported that populations of reniform nematode were reduced as levels of clay content increased in the soil in a Commerce silt loam. Increasing values of EC_a in this field would indicate greater concentrations of clay or silt content in both the surface and subsurface. Soils which had the lowest values of EC_a were observed to be less suitable for population survival or reproduction.

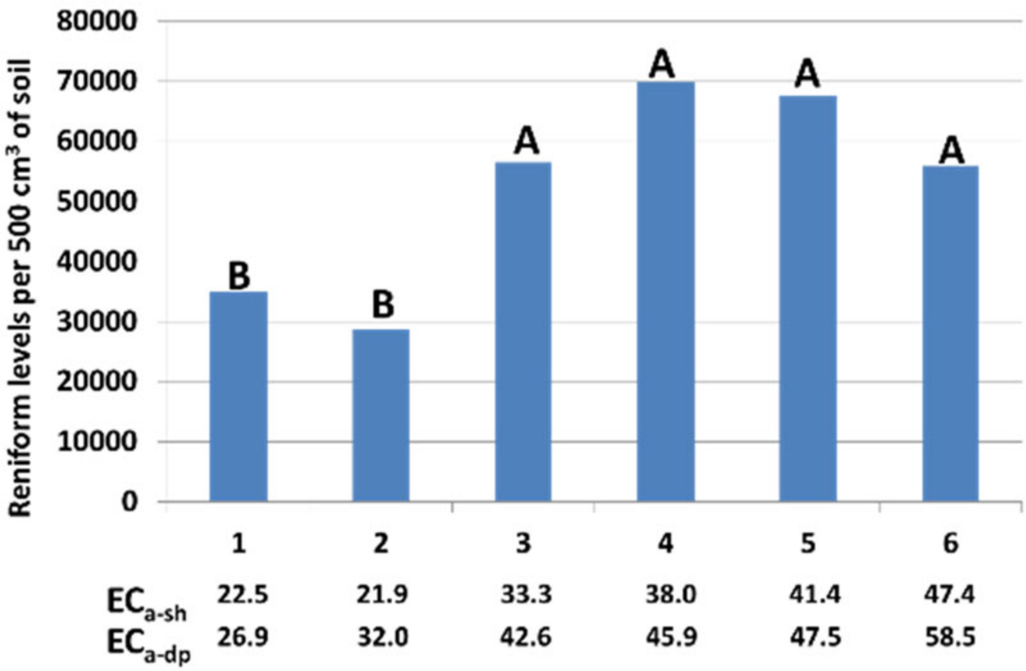

Figure 1. Overwintering populations of reniform levels by zone. Bars with common letters are not significantly different based on LSD $P \leq 0.05$.

The response to the nematicide in our study is similar to what has previously been observed to reniform or southern root-knot nematode fields (Khalilian et al., 2001; Ortiz et al., 2010; Overstreet et al, 2010; 2014). Telone was most effective and caused the greatest responses in the zones which had the lowest EC_a values. As the EC_a values increased, the impact of the fumigant began to decline. Davis et al., 2013 reported that in a study with reniform nematode on cotton, there were no differences in treatment responses within management zones. Therefore, a uniform rate of nematicide would have worked. Erwin et al., 2007 also reported that in one field in that study, a uniform rate of the fumigant was required to provide the best response. Although fields can be divided into a number of zones, it is still important to determine which of these zones will require specific nematicides and provide an economical return to the producer.

Summary

Reniform nematode occurs in a wider range of soil textures than some of the other major nematodes of cotton such as southern root-knot or Columbia lance. This study showed that the populations of reniform nematode were present in the greatest numbers as the soil EC_a increased, but did begin to decline at the highest EC_a values. Cotton yields were also greater as the EC_a values increased. In this study, the fumigant provided a significant and economical response in zones 1-4 but not in zones 5-6. Therefore, zones 5 and 6 would not require treatment and could be classified as a low risk area. Because of the variability of soil texture in this Commerce silt loam, populations of reniform nematode alone would not be a good indication of potential damage to the cotton crop.

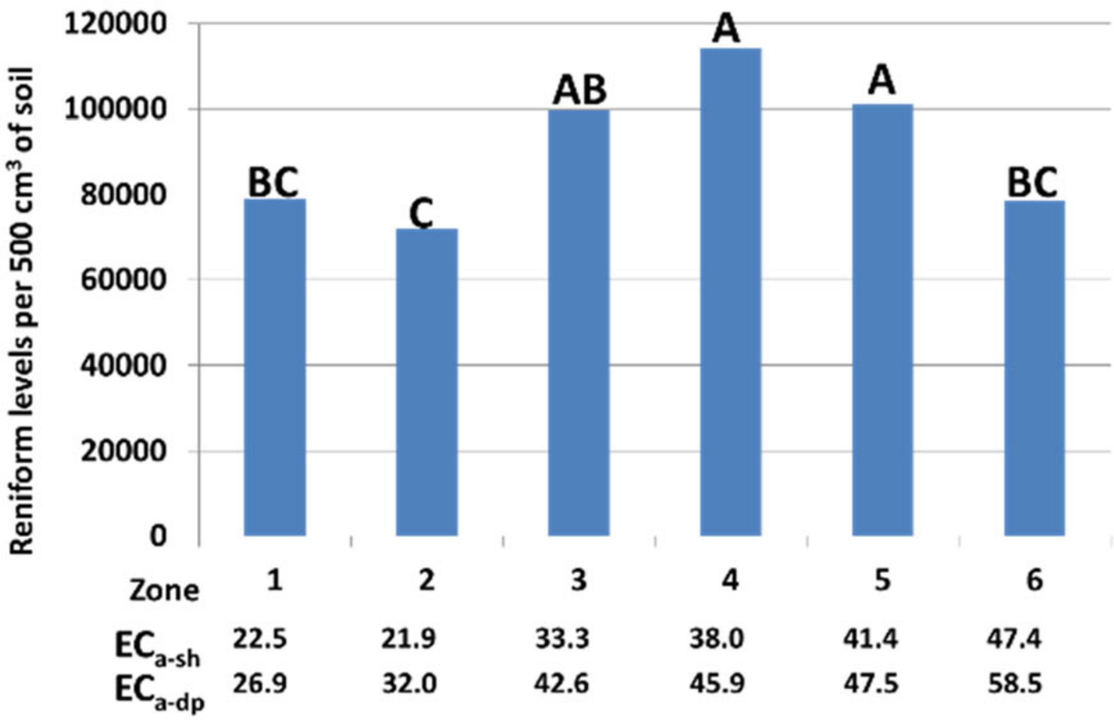

Figure 2. Harvest levels of reniform by zone. Bars with common letters are not significantly different based on LSD $P \leq 0.05$.

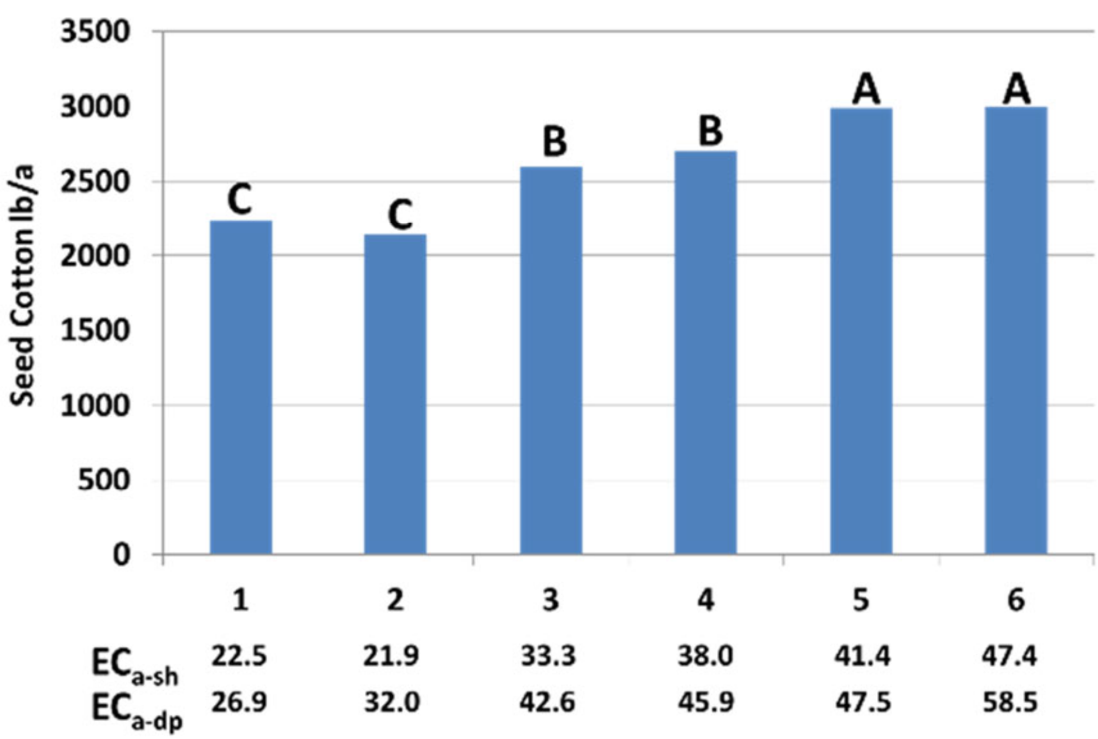

Figure 3. Overall yield response to zone in the field. Bars with common letters are not significantly different based on LSD $P \leq 0.05$.

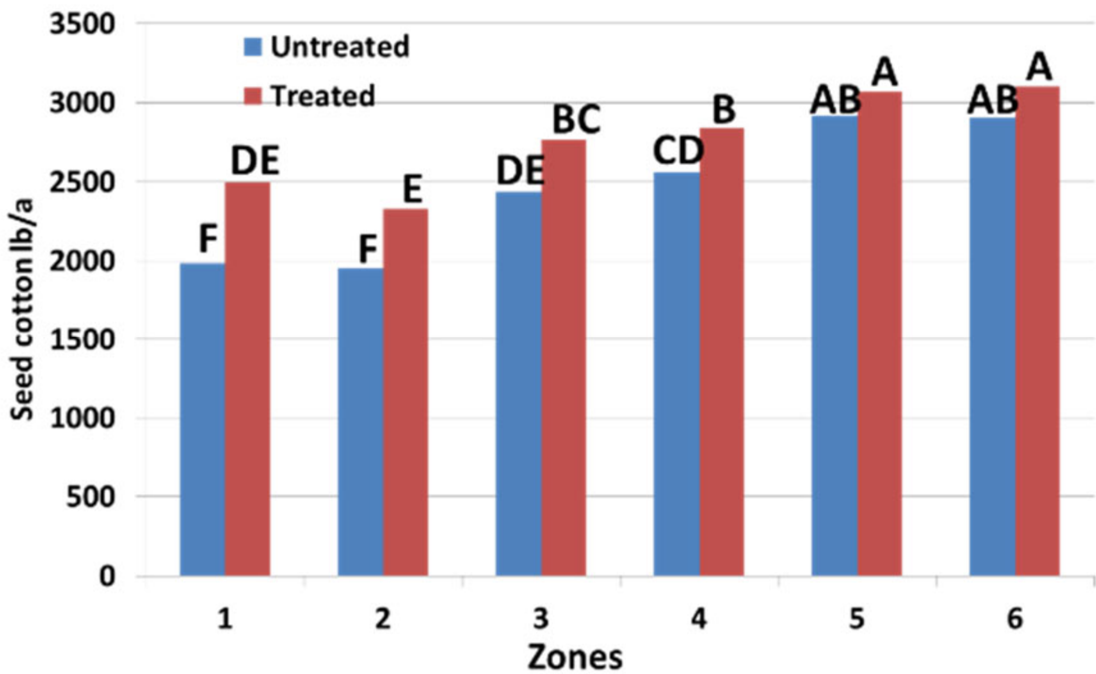

Figure 4. Average yield in treated and untreated plots by zone during 2013-2014. Bars with common letters are not significantly different based on LSD $P \leq 0.05$.

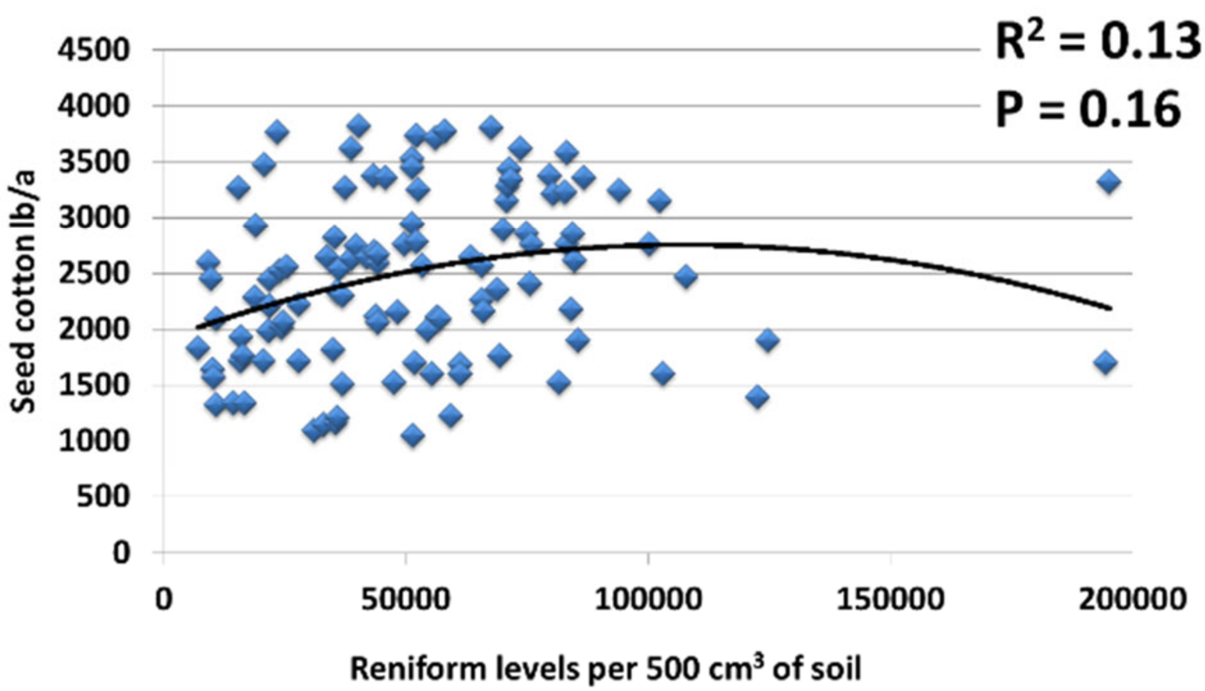

Figure 5. Population levels of reniform nematode at planting and yield in the untreated plots.

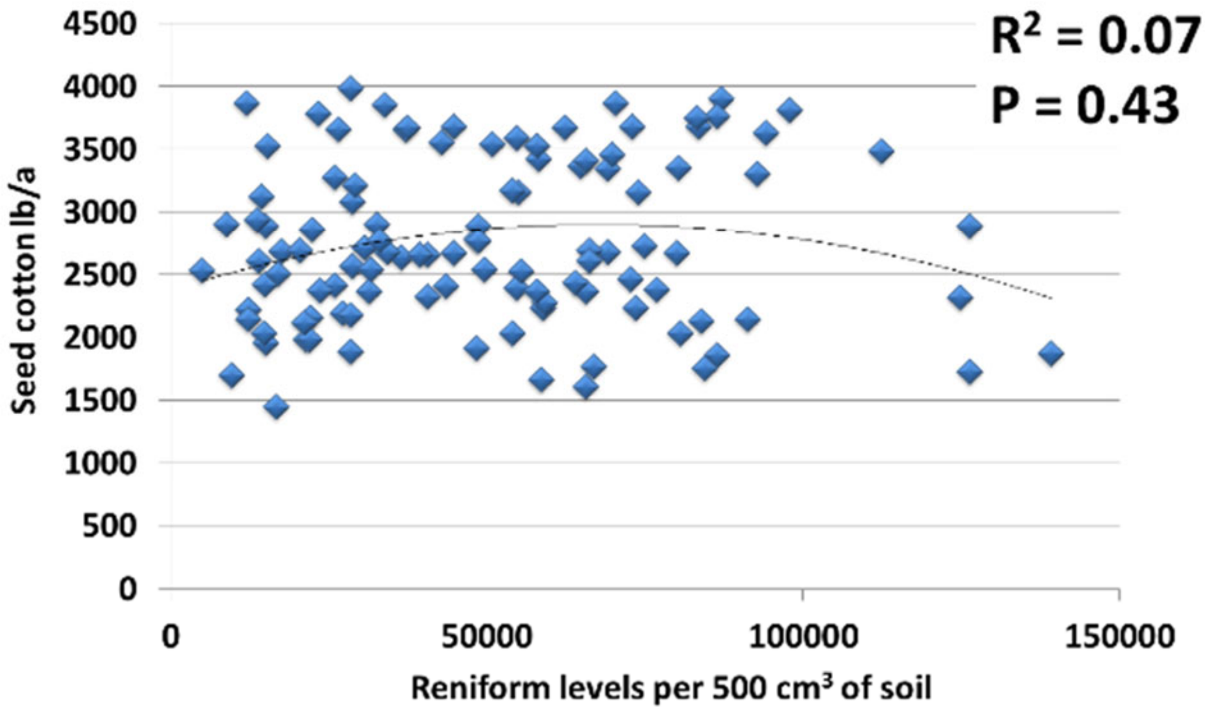

Figure 6. Population levels of reniform nematode at planting and yield in the treated plots.

References

Burns, D., Burris, E., and Overstreet, C. 2010. Using verification strips to delineate treatment zones. Proceedings of the 2010 Beltwide Cotton Conference, 4-7 January, 2010, New Orleans, LA. 35-41.

Davis, R. F, Aryal, S. K., Perry, C. D., Sullivan, D. G., Timper, P., Ortiz, B. V., Stevenson, K. L., Vellidis, G., and Hawkins, G. 2013. Utilizing management zones for *Rotylenchulus reniformis* in cotton: effects on nematode levels, crop damage, and *Pasteuria* sp. Crop Protection 50: 53-60.

Erwin, T. R., Overstreet, C., and Wolcott, M. C. 2007. Nematode management of cotton in Morehouse Parish, Louisiana. Proceedings of the 2007 Beltwide Cotton Conferences, 9-12 January, 2007, New Orleans, LA. 1368-1376.

Khalilian, A., Mueller, J. D., Han, Y. J., and Wolak, F. J. 2001. Predicting cotton nematodes distribution utilizing soil electrical conductivity. Proceedings of the 2001 Beltwide Cotton Conferences, 9-13 January, 2001, Anaheim, CA. 146-149.

Ortiz, B. V., Perry, C., Goovaerts, P., Vellidis, G., and Sullivan, D. 2010. Geostatistical modeling of the spatial variability and risk areas of southern root-knot nematodes in relation to soil properties. Geoderma 156:243-252.

Overstreet, C., G. Burris, and D. Burns. 2010. Site-specific management strategies for dealing with multiple nematode pests. Proceeding of the Beltwide Cotton Conference; 4-7 January, 2010; New Orleans, LA. National Cotton Council, Cordova, TN. Pp. 305-311.

Overstreet, C., E. C. McGawley, A. Khalilian, T. L. Kirkpatrick, W. S. Monfort, W. Henderson, and J. D. Mueller. 2014. Site specific nematode management- development and success in cotton production in the U.S. Journal of Nematology 46:309-320.

Robinson, A. F., Heald, C. M., Flanagan, S. L., Thames, W. H., and Amador, J. 1987. Geographical distributions of *Rotylenchulus reniformis, Meloidogyne incognita,* and *Tylenchulus semipenetrans* in the Lower Rio Grande Valley as related to soil texture and land use. Annals of Applied Nematology 1:20-25.

Starr, J. L., Heald, C. M., Robinson, A. F., Smith, R. G., and Krausz, J. P. 1993. *Meloidogyne incognita* and *Rotylenchulus reniformis* and associated soil textures from some cotton production areas of Texas. Journal of Nematology 25:895-899.

Xavier, D. M., C. Overstreet, M. T. Kularathna, D. Burns, and R. L. Frazier. 2012. Reniform nematode (*Rotylenchulus reniformis*) development across the variable soil texture in a Commerce silt loam field. Proceeding of the Beltwide Cotton Conference; 3-6 January, 2012; Orlando, FL. National Cotton Council, Cordova, TN. 242-246.

Xavier, D. M., C. Overstreet, E. C. McGawley, M. T. Kularathna, and C. M. Martin. 2014. The influence of soil texture on reproduction and pathogenicity of *Rotylenchulus reniformis* on cotton. Nematropica 44:7-14.