ON FARM EVALUATION OF NEMATODE RESISTANT COTTON VARIETIES

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Abstract

The control of nematodes in cotton production has been shown to be a cost effective practice in Louisiana. Root-knot nematodes are confined to sandier soils while reniform nematodes can live in soils with higher clay content. The location in the field and the species of nematodes present can be obtained from a routine soil sample. The advances in cotton breeding programs have produced varieties that have various levels of nematode resistance. This trial focused on four root-knot nematode resistant cotton varieties and a non-resistant variety in a field with multiple soil types and presence of southern root-knot and reniform nematode. Nematode samples for identification and population were taken along with NDVI (Normalized Difference Vegetation Index) readings, and harvest results. The root-knot resistant Phytogen 427 and 487 had lower populations of the root-knot nematode in the Bruin silt loam than the other varieties. Stoneville 5289 was susceptible and supported high levels of root-knot across all soil types. Phytogen 427 and Stoneville 4946 showed the least fluctuation in yield across the three soil types in this study.

Introduction

The Southern root-knot nematode (*Meloidogyne incognita*) and reniform nematode (*Rotylenchulus reniformis*) are major pests of cotton in Louisiana as well as throughout the Mid-south. Losses from these two nematodes were estimated to be 6% during 2015. Although rotations of cotton with corn have proven to be fairly effective in reducing extensive damage from primarily reniform, southern root-knot nematode survives fairly well on corn (Koenning and Edmisten, 2008). Resistance is present in a few cotton varieties against the southern root-knot nematode (Smith et al., 2014). None of the commercial varieties possess resistance against reniform but a number of them have exhibited some degree of tolerance (Usery et al., 2005; Weaver et al., 2007).

Cotton fields in Louisiana are often alluvial soils that may vary considerable in soil type and texture. Studies have shown that these variable soils may have a strong impact on nematicide response with lighter textured soils showing greater responses to the application of a nematicide (Burris et al, 2010; Overstreet et al., 2014). There have been no reports of the impact of nematode resistant varieties of cotton across a range of soil types within a single field. This study was conducted to evaluate the influence of root-knot resistance in cotton to a field with multiple soil types and the presence of both southern root-knot and reniform nematode.

Materials and Methods

In 2015 a trial was initiated in Tensas Parish in Northeast Louisiana to evaluate root-knot resistant varieties of cotton across a range of soil types. The field was located north of Waterproof, LA near the Mississippi River levee. The field contained three soil types: Bruin Silt Loam, Commerce Silt Loam and Commerce Silty Clay Loam. The plots were 6 rows spaced 38 inch rows wide and 1200 feet long. The cotton varieties used in this test included root-knot resistant Phytogen 427, Phytogen 487, Stoneville 1532, and Stoneville 4946 and a susceptible Stoneville 5289. Each variety was replicated 4 times for a total acreage of 2.2 acres per variety. The field had been in corn for the previous two seasons. A Normalized Difference Vegetative Index (NDVI) aerial image was taken in late season approximately 2 days prior to defoliation. Harvest data was taken with a John Deere cotton picker and yield monitor. Individual yield data for each variety was not available due to a mechanical breakdown with the scale on the weigh wagon. Due to the lack of a calibration factor yields were normalized and compared across soil types within each variety. Yield analysis was done in ArcMap GIS software. A composite nematode sample was taken before planting to determine species and population levels in the trial area. Post-harvest nematode samples were taken from plots for each variety and analyzed by species and population. Nematode samples were processed by elutriation and sugar flotation (Jenkins, 1964) and enumerated with a 40X inverted microscope.

Results

Figure 1 shows the test field that has been divided into three soil types including a Bruin silt loam, Commerce silt loam, and Commerce silty clay loam. Post-harvest nematode samples (Figure 2) reflected the amount of root-knot resistance levels in each variety. Both Phytogen (PH) varieties, 427 and 487 showed lower root-knot populations in the Bruin silt loam when compared to the Stoneville (STV) 1532 and 4946 root-knot resistant varieties. The STV 5289, non-resistant to root-knot, had similar populations in the Bruin silt loam as the other STV varieties. In the Commerce silt loam soil type the resistant varieties all had decreases in the root-knot populations except PH 427 which showed a slight increase. This is compared to the STV 5289 which had a large increase in root-knot population. The Commerce silty clay loam area showed very low levels of root-knot nematodes for all varieties except STV 5289, which still had a significant population.

None of the cotton varieties were marketed as having reniform resistance and the post-harvest nematode samples (Figure 3) reflected this across all soil types. The only exception was the PH 427 which showed a decrease in the population in the Commerce silt loam area of the trial. Whether this was just an anomaly or an indication of resistance requires further investigation.

The NDVI aerial image (Figure 4) reflected the similarities between varieties concerning maturity and plant health within soil types. The STV 1532 plots were not as mature as the other varieties across all soil types and the image confirmed this.

Three of the cotton varieties, STV 5289, STV 1532, and PH 487, had lower normalized yields (Figure 5) in the Bruin silt loam area of the trial. Normalized yields of all varieties increased as the amount of clay and the levels of root-knot nematodes decreased across the soil types. PH 427 and ST 4946 normalized yields were relatively stable across all soil types.

A comparison (Figure 5) of silt loam soil which had root-knot populations and the silty clay loam soils which had low or no root-knot populations indicated PH 427, PH 487, and STV 4946 all were equally stable in normalized yield across all soil types. The STV 1532, root-knot resistant, and STV 5289, non-resistant, performed equally across both soil types. This would indicate that the level of resistance in STV 1532 was not as high as the other root-knot nematode resistant varieties.

Summary

The root-knot resistant varieties evaluated in this study were effective in reducing populations of this nematode when compared with non-resistant variety Stoneville 5289. However, none of them were effective against the reniform nematode. Soil texture did have a significant impact on populations of both nematode types. Root-knot was highest in the Bruin silt loam with the exception of Stoneville 5289 occurring at the highest levels in the Commerce silt loam. Reniform levels were low in the Bruin silt loam and increased in the Commerce silt loam and Commerce silty clay loam for all varieties with the exception of low levels of Phytogen 427 in the Commerce silt loam. Phytogen 427 and Stoneville 4946 had the least impact of soil types on yield while. Stoneville 1532 and Stoneville 5289 were the most variable among the soil types. The Bruin silt loam soil had the lowest yield across all cotton varieties. The Bruin silt loam has the highest sand content, lowest yields, and has historically shown the greatest yield responses to the application of nematicides (Overstreet et al., 2014).

Figure 1. Soil types and trial location within the field in Waterproof, LA near the Mississippi River.

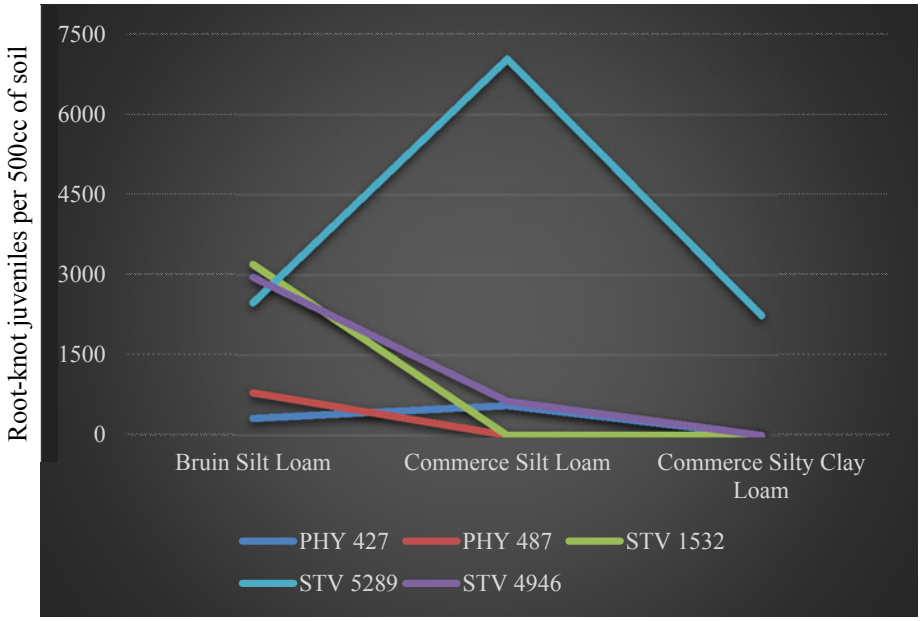

Figure 2. Post-harvest root-knot nematode populations by soil types and cotton varieties.

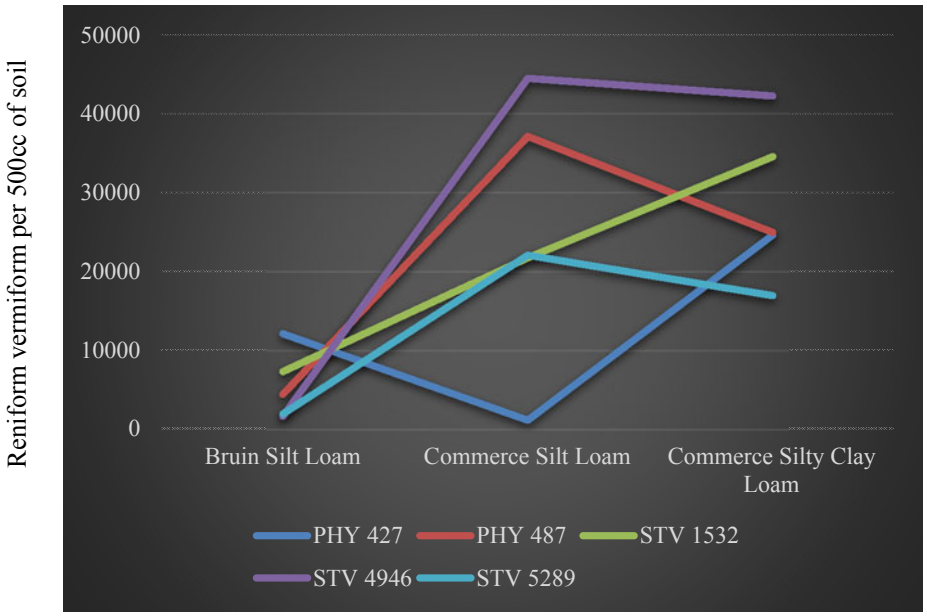

Figure 3. Post-harvest reniform nematode populations by soil types and cotton varieties.

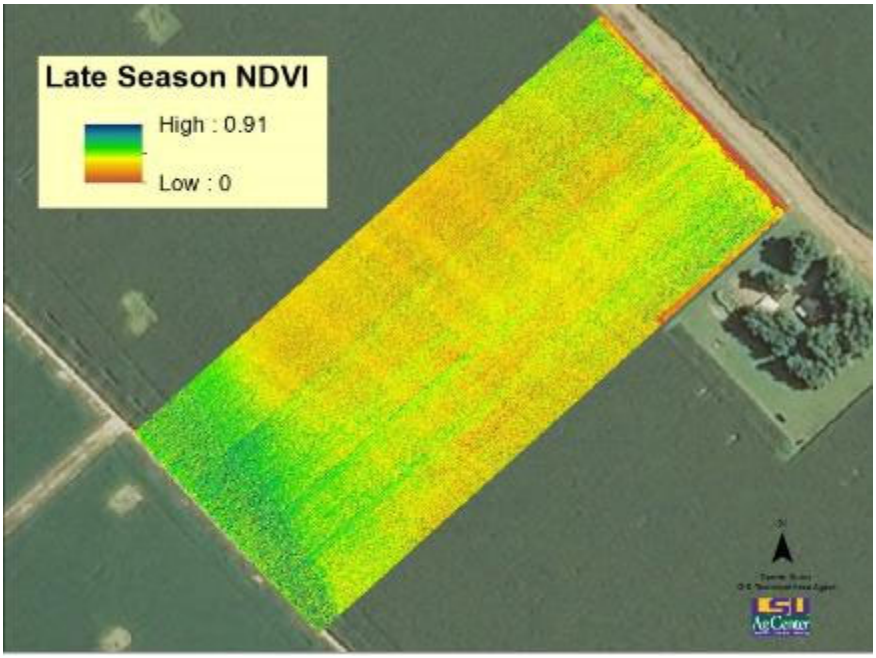

Figure 4. NDVI aerial image taken on September 9, 2016.

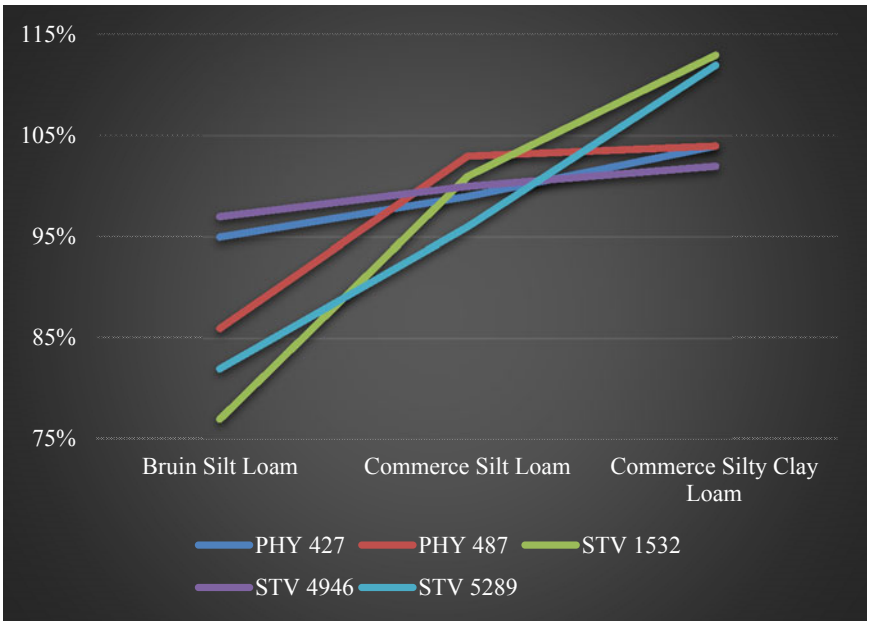

Figure 5. Normalized cotton yields across soil types.

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