NUTRIENT AND NEMATICIDE EFFECTS AGAINST RENIFORM AND ROOT-KNOT NEMATODES IN COTTON

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Abstract

Plants in cotton fields with severe nematode damage often also experience nutrient imbalances. Research summarized in this report evaluated the role of nutrients in cotton response to nematicide. Two fertility regimes were established in a cotton field infested with high populations of both reniform (*Rotylenchulus reniformis*) and southern root-knot nematodes (*Meloidogyne incognita*). The high regime received applications of P, K, B, S, Zn, dolomitic lime, and the standard rate of N at 101 kg/ha. The low regime received only the standard rate of N. Nematicide rates included an untreated control, Avicta Complete Cotton, Telone at 28 l/ha, and a combination of Avicta Complete Cotton and Telone. Fertility regimes did not impact the final populations of either nematode. However, there was a significant main effect of fertility and seed cotton with the high regime averaging 2734 kg/ha and the low regime averaging 2607 kg/ha of seed cotton. Only Telone alone or combined with Avicta Complete Cotton gave a significant reduction of root-knot populations at harvest. Both nematicides alone and combined reduced reniform populations at harvest. The nematicide or combinations were all significantly better than the untreated control for yield. There was a significant interaction between fertility and nematicides with a significantly greater yield of Avicta Complete Cotton in the high fertility regime compared to the low regime. The high fertility regime made the Avicta Complete Cotton comparable to Telone alone in the high fertility regime or the combination of nematicides in both the low and high fertility regimes.

Introduction

Nematodes such as reniform (*Rotylenchulus reniformis*) and southern root-knot (*Meloidogyne incognita*) are major pest problems of cotton in production areas of Louisiana. Either nematode alone is capable of causing severe losses. The southern root-knot nematode is usually associated with sandy or coarse-textured soils and typically in Louisiana is detected where clay content is less than 20% (Wolcott et al., 2005). The reniform nematode seems to prefer soils with finer texture containing a greater percentage of silt or clay. In the past, most fields seemed to have either root-knot or reniform alone but rarely did the two nematodes occur together. Rotations with corn are now common and may be contributing to the fact that both nematodes are now detected together much more frequently. Observations made in the past have indicated that fields exhibiting severe nematode symptoms may also be experiencing some additional nutrient deficiency. The greatest damage expressed in a field is often located where soils are the most coarse-textured or contain the greatest percentage of sand. These coarse-textured soils are also the ones most likely to be suffering nutrient issues. Nematicides still remain as one of the primary methods used to manage nematode populations in Louisiana. Since nutrients may be involved in the expression of damage by nematodes, this research was conducted to evaluate the influence of soil nutrients on nematicide response in a field coinfested with reniform and root-knot nematodes.

Materials and Methods

The study was initiated in 2010 in a field at the Northeast Research Station in St. Joseph, LA. The field was naturally infested with high concentrations of both reniform and southern root-knot nematode. Initial samples from the field also indicated that the soil was low in Ca, Mg, P, K, S, and Zn. Additionally, the pH averaged 4.9. There were two fertility regimes established for the study. A high fertility regime consisted of 100 kg/ha of N, 67 kg/ha of P and K, 9 kg/ha of S, 1.1 kg/ha of boron each year, and one application of 1.1 kg/ha of Zn. Fertilizer was applied as a sidedress application shortly after planting. The high regime also received 1860 kg/ha of lime in the fall of 2010 to raise the pH. The low fertility regime received only N at the rate of 100 kg/ha. The nematicide treatments included an untreated control (Cruiser treated seed only), Avicta Complete Cotton, Telone applied at 28 l/ha preplant using Yetter Coulters and the Premier Applicator System, and the combination of both the Avicta Complete Cotton and Telone at 28 l/ha rate. The cultivar of cotton used throughout the experiment was Phytogen 565WRF. Each of the nematicide treatments within fertility regimes were replicated 3 times in a randomized block design and the entire test repeated 6 times. Plots were 15.2 m in length and 4 rows wide and data were collected from the two center rows. Nematode samples were collected at planting and again post-harvest from all the plots. Nematode samples were processed by elutriation and sucrose centrifugation and counted using an inverted microscope. Plots were harvested October 7, 2010; September 20, 2011; and September 24, 2012 using a two-row cotton picker equipped with an electronic scale for measuring yield. Data from 2012 are presented herein. Data were analyzed using a 2 × 4 factorial analysis and mean separation using LSD.

Results and Discussion

The fertility regimes did not have any significant impact on the final populations of either root-knot or reniform nematodes (Table 1). However, there was a significant main effect of fertility with seed cotton (Figure 1). The high fertility regime did yield significantly higher than the low fertility regime.

Table 1. Main and interactive effects of two fertility regimes and four nematicide treatments.

Source	DF	Final root-knot	Final reniform	Seed cotton
Fertility	1	0.61	0.17	<0.0001
Nematicide	3	<0.0001	0.05	<0.0001
Fertility × nematicide	3	0.94	0.32	<0.0001

Nematicides affected final populations of root-knot, reniform, and seed cotton. Root-knot populations were significantly lower in both nematicide treatments that included Telone. Avicta Complete Cotton did not reduce populations at the end of the season (Figure 2). Reniform populations were impacted by all the nematicides and significantly lower levels were present in all nematicide treatments (Figure 3).

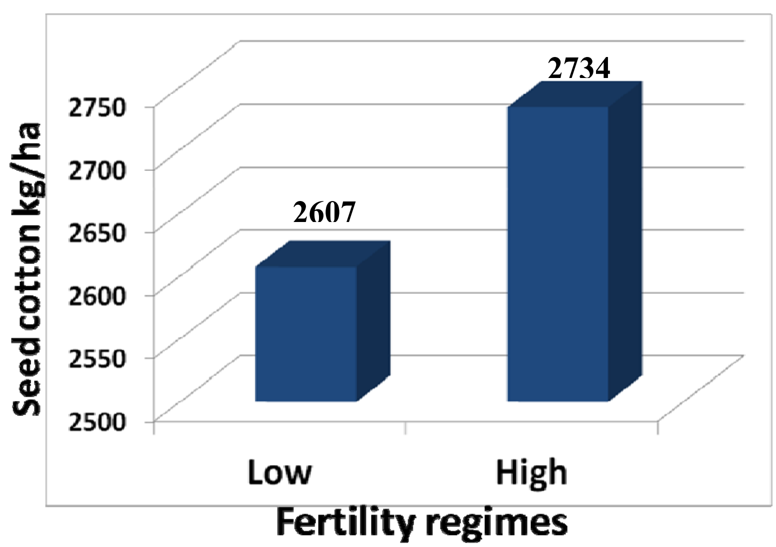

Figure 1. Main effects of fertility regimes on cotton yield in 2012.

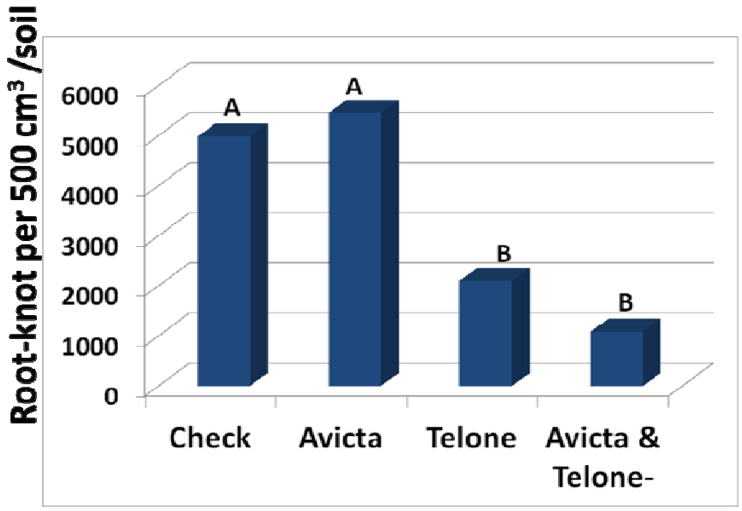

Figure 2. Main effects of nematicides on final root-knot populations in 2012. Within each column, means followed by the same letter are not significantly different based on LSD, $P < 0.05$.

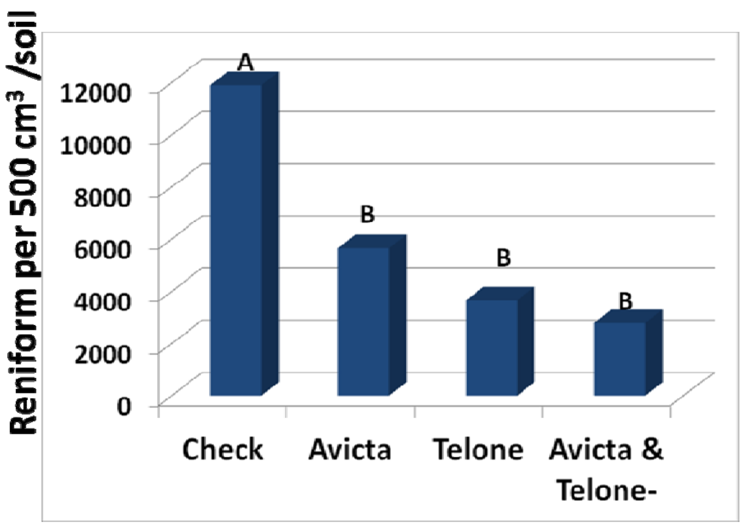

Figure 3. Main effects of nematicides on final reniform populations in 2012. Within each column, means followed by the same letter are not significantly different based on LSD, $P < 0.05$.

Nematicides also had a significant main effect on cotton yield (Figure 4). The single treatments of either Avicta Complete Cotton or Telone were significantly greater than the control. The combination of both nematicides was significantly better than either nematicide alone. Nematicides followed the trend previously reported by others where seed treatments are less effective than fumigants (Kemerait et al., 2007). Fumigants are generally considered to be much more effective at managing higher populations of plant-parasitic nematodes. However, the interaction between fertility and nematicide showed an interesting pattern (Figure 5). The additional nutrients that were applied to the untreated control improved cotton yield numerically but not significantly. Avicta Complete Cotton in the low fertility regime was no different than the low fertility regime of the control. However, the high fertility regime significantly improved the response of Avicta Complete Cotton and resulted in yields comparable to those with Telone alone in the high fertility regime or the combination of nematicides in both fertility regimes. These differences in response to the application of supplemental nutrients have implications on the use of nematicides. Since fumigants are relatively costly, application to very specific areas within a field has been of interest for site-specific management of nematodes for several years (Burns et al., 2010; Overstreet et al., 2009). The application of fertilizers may be able to modify management zones and reduce the areas within a field that require treatment with a fumigant. Burris et al., 2010 reported that cotton yields were significantly greater in plots fumigated with Telone and Avicta Complete Cotton that had low N fertility compared to high levels of N fertility in the untreated control.

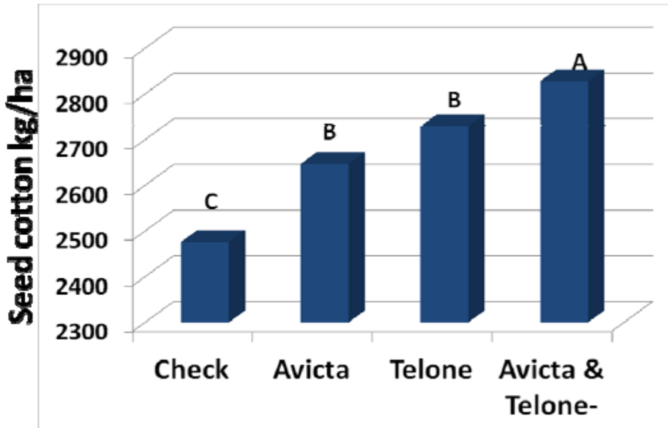

Figure 4. Main effects of nematicide on cotton yield in 2012. Within each column, means followed by the same letter are not significantly different based on LSD, $P < 0.05$.

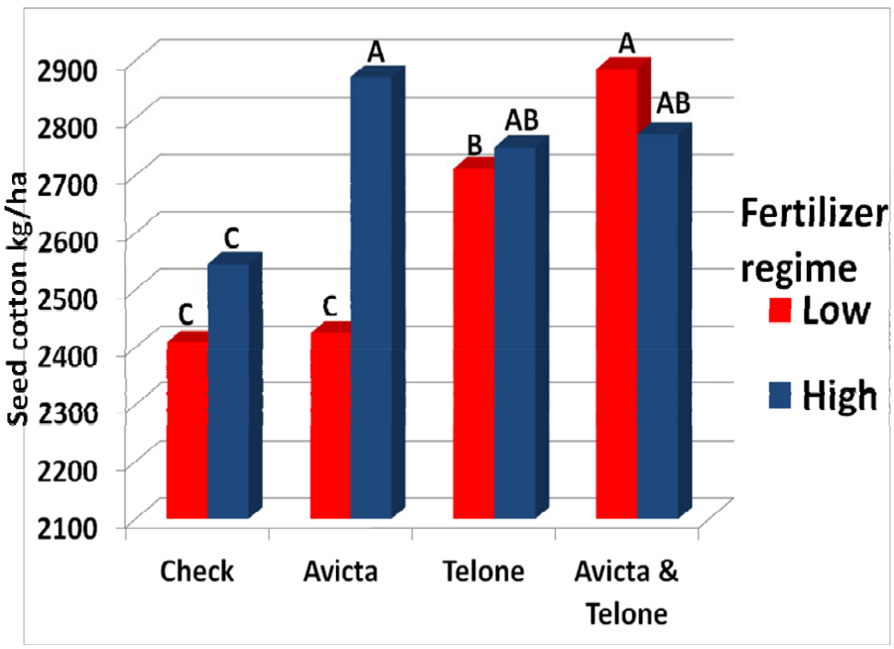

Figure 5. Interactive effects of nematicides and fertility on cotton yield in 2012. Within each column, means followed by the same letter are not significantly different based on LSD, $P < 0.05$.

Summary

This study reports on both the effectiveness of both seed treatment nematicides as well as the utility of a fumigant for increasing yields in cotton. Fertility has an important function in the development of a cotton crop. Nutrients and nutrient availability may be impacted both by soil type and nematode incidence within a cotton production program. The benefits of enhanced nutrients were more apparent with the seed treatment nematicide than with the fumigant. These results indicate that nutrients may have value in altering areas within a field that would require treatment with a soil fumigant. Fumigants have generally been required in only the areas within a field where soil texture was coarse-textured (sandy) at the surface as well as through the upper soil profile. Management zones used for site-specific nematology could be altered to reflect enhanced fertility within areas that would only need the application of a seed treatment nematicide (Overstreet et al., 2010).

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