INFLUENCE OF ALLUVIAL SOILS ON NEMATICIDES APPLIED TO COTTON IN LOUISIANA

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Abstract

The reniform nematode is a major pest problem of cotton production in Louisiana requiring either crop rotation or fumigants in soils when high populations are present. If site-specific application of a fumigant could be applied, the costs to producers could be substantially reduced. The objective of this research 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 as measured by apparent electrical conductivity (EC_a). The fumigant Telone II was applied in blocks to half of the test at the rate of 3 gallons/acre. Population development of the reniform nematode was monitored prior to fumigation, mid-season, and after harvest. Nematode populations and cotton yield were compared across soil zones that were identified by EC_a and nematicide treatment. The zones defined by EC_a did have an influence on the initial population of the reniform nematode in the field with lower numbers in zones 1 and 2 and highest levels in zones 3-5. The overwintering survival of the nematode was reduced in the highest EC_a zone. The fumigant significantly reduced reniform at both mid-season and after harvest populations across all zones. The response to the fumigant declined with increasing EC_a values ranging from an increase of 678.2 pounds of seed cotton over the check at the lowest EC_a zone and only 50.4 pounds of seed cotton at the highest EC_a zone. This research indicates that site-specific application of a fumigant could be utilized to help manage the reniform nematode.

Introduction

Alluvial soils are important in cotton production in Louisiana. These soils can be highly variable in texture within a field and may be comprised of sandy loams, silt loams, silty clay loams, and clays. Even with a silt loam, soil texture may vary widely both at the surface and deep within the profile as measured by apparent electrical conductivity (EC_a). Reniform nematode is often associated with finer-texture soils (Robinson et al. 1987; Starr et al., 1993) and is known to be a serious pathogen of cotton production in Louisiana (Overstreet and McGawley, 1998). Population densities within a field have historically been the most important factor in decisions about nematicide treatments. The southern root-knot and Columbia lance nematodes (Ortiz et al. 2010; Erwin et al. 2007; Khalilian et al. 2001) have been shown to be greatly influenced by soil texture and the response of nematicides in different soil zones within a field. It is likely that the response of reniform nematode in fields with variable textures will respond differently from southern root-knot or Columbia lance nematodes. This study was undertaken to evaluate 1) the influence of populations of reniform nematode and the fumigant 1,3-dichloropropene and 2) the influence of apparent electrical conductivity on the response of the fumigant in a silt loam soil.

Materials and Methods

The test field was located at the Northeast Research Station at St. Joseph, LA and heavily infested with the reniform nematode (*Rotylenchulus reniformis*). Plots were four rows wide and 45' long. Nematode samples were collected from the field prior to fumigation, mid-season, and after harvest in each of the plots. Ten soil cores were removed 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 was applied on April 30, 2013 at the rate of 3 gallons per acre by using a nematicide applicator with 30 inch Yetter Avenger coulters and injected 12 inches beneath the center of the row. The cotton variety Phytogen 499 WRF was planted on May 27, 2013. Cotton was harvested from the center two rows of each plot on October 4, 2013. The field was measured for EC_a after harvest using a Veris 3100 soil EC Mapping System and divided into six zones. Data was analyzed using a factorial design with nematicides and EC_a zones as main plots.

Results and Discussion

Populations of the reniform nematode varied greatly within the field and averaged from 7,040 to 139,200 per 500 cc of soil. Figure 1 shows the relationship of the initial population of nematode in the field and distribution within the six soil zones designated by EC_a. The field is a Commerce Silt Loam (Fine-silty, mixed, superactive, nonacid, thermic Fluvaquentic Endoaquepts). There was variability found within the field and EC_{a-sh} and EC_{a-dp} ranged from 19.1 to 42.5 and 20.5 to 50.8 mS/m, respectively. Soil texture in the upper 8 inches of soil was not as variable and ranged from 9.9 to 13% sand, 74.6 to 83.6% silt, and 5.1 to 13.9% clay. Surviving populations from the previous year which had been in cotton were lowest in zones 1, 2, and 6 and highest in zones 3, 4, and 5.

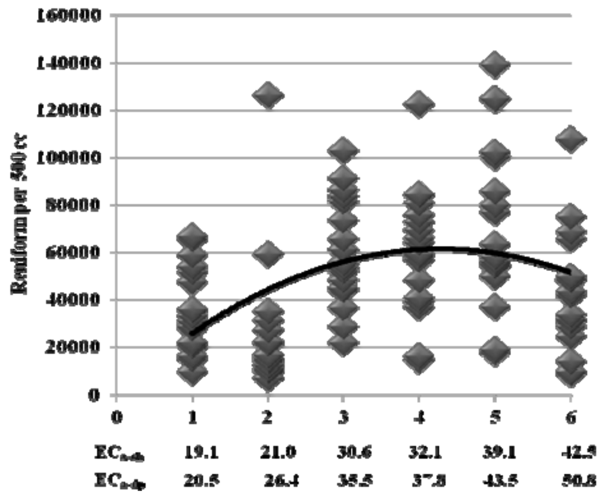

Figure 1. Initial population of reniform nematode and relative densities within EC_a zones (R^2=0.31, P = 0.001).

Table 1 shows the influence of the nematicide and EC_a zones on population development of reniform nematode and cotton yield at the end of the growing season. There were highly significant (P>0.000) effects of zones on population development of the nematode at all three sampling intervals and on cotton yield. The nematicide was highly significant (P>0.000) on nematode levels at mid-season and harvest. There was a significant interaction of zones × nematicide only with seed cotton. The response of the nematicide decreased as EC_a levels increased. The greatest response with yield to the fumigant was in the zone with the lowest EC_a values (678.2 pounds of seed cotton) and least response in the zone with highest EC_a values (50.4 pounds of seed cotton).

The patterns observed for the reniform nematode were similar to those reported for either southern root-knot or Columbia lance nematodes. Highest populations of the reniform nematode were found initially in the middle zones in this research. However, by the end of the growing season, populations were extremely high in all soil zones. Xavier et al. (2012) reported that population levels of the reniform nematode declined at higher levels of clay content in a Commerce silt loam soil. The percentage of clay in this field was low enough that it did not limit population development. However, the zones did influence the survival from the previous year which had been in cotton. The response in yield from the nematicide did decrease as the values of each EC_a increased in each zone. This is similar to what others have reported with southern root-knot and Columbia lance nematodes. Although it is difficult to compare EC_a values from different locations, the zones where responses to the nematicide occurred in this research appear to be higher than reported for the other two nematodes.

Although populations of nematodes are often used as the criteria for determining the need for a nematicide, the influence of soil should also be considered. Soils that are known to be deep sands are more likely to be prone to nematode injury compared to soils with sand overlaying clay (Wolcott et al. 2008). The application of EC_a does provide a better tool of defining differences deep within a soil compared to information only obtained from a shallow soil sampling. Management zones can be better defined to incorporate the soil textures that are present within the soil profile and reflect the areas of a field which will better respond to the application of a nematicide.

Table 1. Effect of soil EC_a zone and nematicide on population densities of reniform nematode and yield of Phytogen

499WRF cotton.

Zones	$EC_{a\text{-}sh}$ (mS/m)	ECa-dp (mS/m)	Nematicide	Reniform per 500 cc of soil (1000s) At plant	Mid-season	Harvest	Seed cotton
1	19.1	2.5	-	33.2 def	59.0 a	60.4 ef	1372.3 h
			+	37.9 bcdef	17.1 d	37.1 f	2050.5 cdef
2	21.0	26.4	-	19.3 f	32.8 bcd	93.2 cd	1573.0 gh
			+	31.6 ef	16.7 d	60.0 ef	2024.7 def
3	30.6	35.5	-	59.3 abc	66.8 a	124.7 bc	1837.6 fg
			+	62.1 ab	31.2 cd	74.9 de	2303.8 abcde
4	32.1	37.8	-	64.0 a	54.2 ab	159.3 ab	1992.5 ef
			+	57.1 abcd	30.1 cd	87.8 de	2221.6 bcde
5	39.1	43.5	-	71.4 a	61.2 a	133.1 ab	2336.1 abc
			+	72.99 a	17.8 d	79.6 de	2418.4 ab
6	42.5	50.8	-	50.2 abcde	44.5 abc	166.7 a	2493.8 ab
			+	36.6 cdef	12.7 d	75.9 de	2544.2 a
Zones				***	**	***	***
Nematicide				NS	***	***	***
Zones × nematicide				NS	NS	NS	*

Data are means of 9 replicates. Within each column, values followed by the same letter are not significantly different ($P > 0.05$) according to a Least Significance Difference test. *, **, and *** indicates significance at 0.05, 0.01, and 0.001 levels.

Summary

The implications of this research are that nematicides for the reniform nematode may be applied for site-specific application similar to that of other nematodes. The reniform nematode is able to survive, reproduce, and cause damage over a range of soil textures including medium and fine textured soils unlike either southern root-knot or Columbia lance nematode which prefers coarse or moderately coarse textured soils. Therefore, it is likely that management zones will have to be developed incorporating the specific soil preferences and damage potential of the reniform nematode.

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