WORKSHOP: NEMATODE MANAGEMENT-RENIFORM/ROOT-KNOT COMPETITION AND REPRODUCTION

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Abstract

Root-knot and reniform nematode are widespread cotton nematodes but are rarely found together in the same fields. There doesn't appear to be a strong interaction between populations of these two nematodes in 397 fields where both nematodes have been found in Louisiana. As the population level of one nematode increased, there was not a corresponding decrease in the other nematode. Although both root-knot and reniform nematode have extensive host ranges, there are discrepancies in host specificity that makes it possible to favor development of one over the other. Peanut stands out as the one of the only rotational crops that appears to be immune to both nematodes. Reniform nematode shows considerable variation in reproduction on crops such as cotton. Management options for this nematode may change in the future as this variability is better characterized.

Introduction

Root-knot nematode has been a recognized pest of cotton for the past 100 years. Reniform nematode has been identified as a serious pest for many producers during the past 15-20 years. Reniform is known to be spreading, root-knot has remained fairly stable. What happens when reniform nematode moves into a field where another nematode such as root-knot is already present? Reniform nematode is believed to become the dominant nematode once these two are together. Although reniform nematode can occur in the same field with a number of other plant-parasitic nematodes, the occurrence of reniform and the southern root-knot nematode together in the same field is uncommon (Overstreet and McGawley, 1996). These two nematodes are found together only 3% of the time in Louisiana. An examination of the populations of both nematodes from 397 fields where they were found together in Louisiana didn't show any strong correlation between the two nematodes (Figure 1). Thus as one nematode increased in populations, there was not a corresponding decrease in the population of the other nematode. Many fields that had a history of root-knot in the past now seem to be predominantly infested with reniform nematode.

Population development of reniform nematode has been reported to be inhibited by the presence of root-knot on sweet potato (Thomas and Clark, 1983) or unaffected when together with root-knot nematode on soybean (Stetina et al., 1997a,b). However, root-knot nematode populations were increased in the presence of reniform nematode. Cotton is a better host for reniform nematode than root-knot nematode (Koenning et al., 1996), which could explain the lack of overlap by these two nematodes on this crop.

Host Preferences

Both root-knot and reniform nematode have wide host ranges. Reniform nematode has been reported to be able to reproduce on more than 300 different plant types. Probably many more are hosts but simply have not been evaluated yet. The southern root-knot is one of the most common and destructive nematodes throughout the warmer areas of the world and has thousands of host plants. In fact root-knot is so effective as a plant-parasite, it is extremely difficult to find any type of plant that is resistant or immune to it. There are differences between host preferences of these two nematodes that can be exploited to favor one nematode over the other or neither nematode.

Table 1 shows some of the host preferences of root-knot and reniform nematodes. In addition to cotton, many crops such as sweet potato and most soybean varieties are excellent hosts for both nematodes. Rotation to some of these other crops that are susceptible to both nematodes can certainly maintain a substantial population of both types. Only a few soybean and cowpea varieties allow the buildup of the reniform nematode but not root-knot nematode. Some soybean varieties are specifically bred for resistance to the root-knot nematode, but little effort has gone into breeding for resistance to reniform nematode. Most resistance against reniform nematode is secondary associated with breeding resistance against the soybean cyst nematode. There are considerably more crops that are fairly poor hosts for reniform nematode but still good hosts for root-knot nematode. Unfortunately, corn falls into this category. Corn is widely rotated with cotton in many areas of the Mid-South and southeast. Reniform nematode can be drastically reduced with a one or two year rotation but leave behind devastating levels of root-knot nematode for the next cotton crop. Corn doesn't tend to show the typical symptoms of root-knot injury that many plants express and may give the false impression that there will not be a problem in the future. Milo has given mixed reactions to the southern root-knot nematode. In some locations, milo can be fairly resistant and support very little buildup of this nematode. However, in other locations milo acts just like any other susceptible crop building up

high levels of the nematode. The best crops for rotation with cotton would be ones that support very little reproduction by either nematode. Unfortunately, very few crops fall into this category. Peanut stands out as being the premier rotation crop since neither the southern root-knot nor reniform nematode can reproduce on it. A number of soybean varieties have been evaluated for resistance to either root-knot or reniform nematode during the past several years (Table 2-4). A number of varieties of soybean show fairly good resistance against either nematode but not both. The list is very short with only four varieties falling into this category. Picking the right variety may decrease nematode numbers to acceptable levels within one to two years. However, keep in mind that choosing the wrong variety for a specific nematode may result in a disaster for a future cotton crop.

Is there any advantage to favoring one nematode over another in a field where cotton will be grown in the future? Management options such as nematicides or variety selection may be influenced by both the type and population level of nematode present. At the present time very few cotton varieties have any level of resistance against the root-knot nematode (Paymaster 1560 or 1560BG or Stoneville 887). Currently, no cotton varieties have reniform resistance. This may change as breeding programs release varieties with resistance for each nematode. There is some evidence that some cotton varieties are more tolerant than others, and certainly some appear to support fewer reniform than others (Table 5). Ideally, resistance or immunity against both nematodes may be in the future, especially as biotechnology continues to expand against additional pests such as plant nematodes. Nematicide types, rates, and application methodology continue to evolve over time. It may be cheaper or easier to treat for one type of nematode than the other. Certainly, low population levels of either type of nematode are easier to manage than high populations.

Reniform Variability

Variability in how reniform nematode attacks various plants has been reported since the early 1960s. There have been at least 20 crops for which there are contradictory reports of host suitability and susceptibility. Because a population of reniform nematode was found that could not reproduce on cotton or castor (normally susceptible crops), two races were described in India. Studies conducted by the LSU AgCenter during the past several years have indicated considerable variability in reproduction and pathogenicity to crops such as cotton, soybean, or vegetables (Dominguez et al., 2000; McGawley and Overstreet, 1995).

What are the implications of genetic variability of reniform nematode to our cotton industry? The first consideration would be in management options including rotations, nematicides, and resistant or tolerant cotton varieties. Crop rotations with resistant crops such as corn, milo, or peanut have been considered excellent management tools because they can greatly reduce nematode populations within one to two years. A least two populations of reniform nematode have been found that could reproduce slightly on peanut (considered immune). Occasional nematode samples in Louisiana are processed after corn (one or two years in this crop) that still exhibit high levels of reniform nematode indicating that the corn didn't do a very good job of reducing populations. If these variable populations continue to develop and spread, current rotational strategies may have to change. Nematicides have been one of the primary methods used to manage reniform nematode in cotton. There has been considerable variation in the response to various nematicides reported across the Mid-South and southeast. Although thought by nematologists to be related to soil type or environmental conditions, these differences may be related to how aggressively reniform populations attack cotton or how well nematicides can protect them against these populations. Eventually, resistant cotton varieties will be developed against the reniform nematode. The fastest way to find out just how variable a nematode can be is to start planting a resistant variety against that nematode. Problems with races have quickly emerged with other nematodes such as the soybean cyst nematode in soybean. The variability already observed by this nematode would strongly suggest that it will show the same capability to break resistance as cotton varieties are developed against this nematode in the future. Characterization of the diversity of reniform nematode continues to remain a challenge for nematologists and producers who are battling this pest.

Literature Cited

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Table 1. The reaction of various crops against root-knot or reniform nematode.

Crop	Root-knot nematode	Reniform nematode
Corn	S	R
Cotton	S	S
Cowpeas	S-R	S
Melons	S	S
Milo	S (R)	R
Peanut	I	I
Peppers	S	R
Soybean	S-R	S-R
Sugarcane	S-R	R
Sunflower	S	R
Sweet potatoes	S-R	S
Tobacco	S	S
Tomatoes	S	S

S = susceptible; R = resistant; and I = immune.

Table 2. Soybean varieties that have been reported as resistant against the southern root-knot nematode in the Mid-South or Southeast during the late 1990's and 2000-2001.

Group 4	
Avery	
Delsoy 4210	
Manokin	
Northrup King S46-44	
Southern States FFR-RT47630N	
Group 5	
Accomac	Northrup King S59-95
AgriPro APX-9519RR	Novartis S51-T1
Agripro HY 574	Novartis S57-A4
Delsoy 5710	Novartis S59-V6
Delsoy 5710	Pioneer 95B34
DynaGrow 3576	Pioneer 95B71
Hartwig	Pioneer 95B97
Northrup King NK S59-95	Pioneer 95B96
Northrup King S57-11	Ranger
Group 6	
Asgrow 6711	Musen
Boggs	Northrup King S65-50
Bryan	Novartis 9671
Deltapine 3640	Pioneer 96B51
Deltapine 3682	Southern States RT6999
Dillon	Terra TS6299RR
Eagle ES11	
Group 7	
AgriPro AP727	Hartz H7550RR
Benning	Haskel
Buckshot 72	HSC 741
Carver	Northrup King S75-55
Deltapine 3733	Novartis S73-Z5
Deltapine 417	Pioneer 97B61
FFR 731	Pioneer 97B62
Hagood	Santee
Hartz H7141	Southern States FFR-731N
Hartz H7440	Southern States RT7499
Group 8	
Cook	Motte
HY 798G	Northrup King S83-30
Kuell	Perrin
Maxcy	Prichard

Table 3. Soybean varieties that have been reported resistant against reniform nematode in the Mid-South or Southeast during the late 1990s and 2000-2001.

Group 4	
Delta Grow 4850RR	
Deltapine DP 4969RR	
Hartz H4998RR	
Terral TV4770	
Group 5	
Agri Pro AP588RR	Hartz H5181RR
Asgrow A5843	Hatwig
Asgrow AG5602RR	HBK 5990
Delsoy 5710	HBK R5404
Deltapine 5354	Hornbeck HBK 5770
Deltapine 5806RR	NK S53-Q7
Deltapine DP 5644RR	Riverside Robin 5
Deltapine DP 5644RR	Southern States RT5999N
Deltapine DP 5806RR	Terral TV5797
Hartz A5000RR	USG 7539
Group 6	
Asgrow 6711	
Boggs	
Dyna Grow 3682	
Padre	
Group 7	
Deltapine DP 7375RR	
Stonewall	

Table 4. Soybean varieties that are resistant to both root-knot and reniform nematode

Group 5
Delsoy 5710
Hartwig
Group 6
Asgrow 6711
Boggs

Table 5. Populations of reniform nematode at harvest and yield for varieties in a cotton field in Morehouse Parish during 2000.

	Reniform nematode (500 cm^3 soil)	
Variety	**Harvest**	**Seed cotton**
Paymaster 1218B/RR	96,400	2187
Paymaster 1560B/RR	71,520	1843
Deltapine 409B/RR	95,680	1836
Deltapine 458B/RR	60,000	1682
Deltapine 422B/RR	62,960	2018
Deltapine 451B/RR	89,120	1993
Suregrow 501B/RR	81,570	2193
Suregrow 125B/RR	50,570	2056
Stoneville 4892B/RR	63,680	2047
LSD 5%	NS	398

Average of 4 replications. All varieties were treated with Telone 3 gal and Temik 15%G at 3.5 lb.

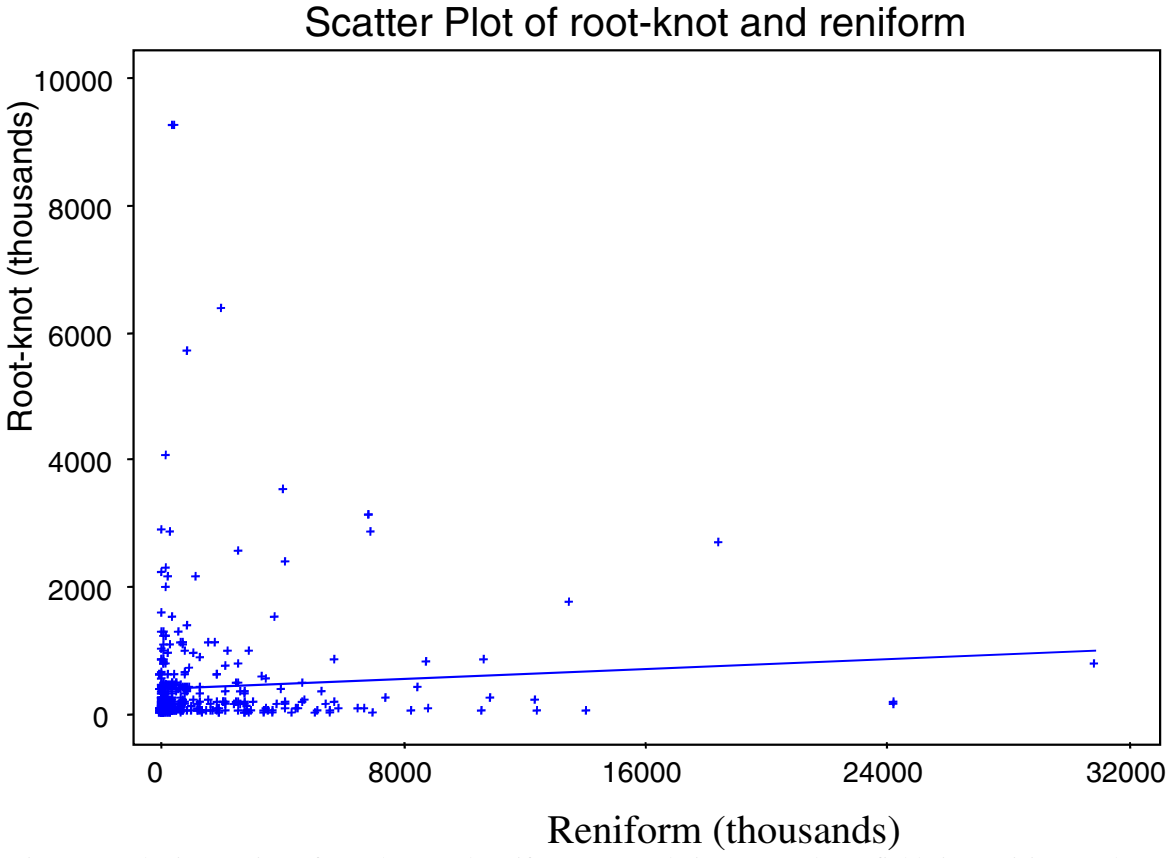

Figure 1. The interaction of root-knot and reniform nematode in 397 producer fields in Louisiana. The R value was 0.004, indicating very little interaction between the two species.