

A Survey of South Carolina Cotton Fields for Plant-Parasitic Nematodes

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ABSTRACT

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Approximately 5% of the cotton hectareage in each of 16 counties in South Carolina was sampled in a postharvest survey of 1,219 cotton fields during 1989–1992. Eleven species of plant-parasitic nematodes were recovered from soil samples. *Hoplolaimus columbus*, *Meloidogyne* spp., and *Rotylenchulus reniformis* were recovered from 61, 25, and 12%, respectively, of samples. *H. columbus* and *Meloidogyne* spp. were found in all 16 counties, but *R. reniformis* was found in only 11. Populations of *H. columbus* were in excess of damage thresholds in 37% of fields, of *Meloidogyne* spp. in 7% of fields, and of *R. reniformis* in 3% of fields. *Belonolaimus longicaudatus* was recovered from fewer than 1% of sampled fields. Concomitant populations of *H. columbus*, *Meloidogyne* spp., and *R. reniformis* were detected infrequently.

Additional keywords: Columbia lance nematode, reniform nematode, root-knot nematode

Plant-parasitic nematodes cause an estimated annual average yield loss of 2%, worth \$116.4 million, to cotton (*Gossypium hirsutum* L.) in the United States, although estimates of losses vary across regions and states (1). One reason for uncertainty of loss estimates is a general lack of knowledge of the relative distribution and infestation levels of the various genera and species of plant-parasitic nematodes known to damage cotton.

In South Carolina, *Hoplolaimus columbus* Sher (9), *Meloidogyne incognita* (Kofoid & White) Chitwood races 3 and 4 (11), *Rotylenchulus reniformis* Linford & Oliveira (4), and *Belonolaimus longicaudatus* Rau (5) have been associated with poor growth and yields of cotton. Other genera, including *Pratylenchus*, *Tylenchorhynchus*, *Mesocriconema*, *Helicotylenchus*, *Scutellonema*, and *Paratrichodorus*, also are frequently detected in soil samples from cotton fields.

This survey was conducted to determine the relative distribution and infestation levels of plant-parasitic nematode species on cotton in South Carolina. These data are valuable to growers and county agents in determining the frequency of potentially damaging infestations in fields in South Carolina and to scientists for determining areas of research emphasis.

MATERIALS AND METHODS

Sixteen counties in the coastal plain region, representing over 90% of the cot-

ton hectareage in South Carolina (Fig. 1), were sampled during 1989–1992. A total of 1,219 fields were sampled: 184 in 1989, 95 in 1990, 477 in 1991, and 463 in 1992. Soils in the majority of the sampled fields were typical southern coastal plain soils, in the Norfolk-Coxville-Wagram or Faceville associations.

Samples were taken in all years from mid-October through mid-December to represent at-harvest sampling times. In each year, numbers of samples collected per county were weighted by hectareage planted to sample approximately 5% of the hectareage in that county, based on a single sample representing 8.1 ha. Each field was represented by a single sample consisting of 20 soil cores (2.5 cm in diameter × 20 cm deep) collected from within the rows in a zigzag pattern, at right angles to row orientation. Cores were mixed, and approximately 1,000 cm³ was submitted for assay. Fields were selected arbitrarily in each county, and an effort was made to avoid sampling adjacent fields. Each composite sample was sealed in a plastic bag and stored in a cooler before transfer to a cool storage room (15 C). Samples were assayed within 1 mo of collection by the Clemson University Nematode Assay Laboratory. From each submitted sample, a 500-cm³ aliquot was assayed by elutriation (3) followed by sugar flotation/centrifugation (7). Plant-parasitic nematodes were identified to genus or species on the basis of morphology. Population densities were compared with nematode damage thresholds for cotton in South Carolina by the Clemson University Cooperative Extension Service.

RESULTS

Among species considered damaging to cotton, *H. columbus*, *Meloidogyne*

spp., and *R. reniformis* were detected (Table 1). Over all counties and years, mean detection of *H. columbus* was 61%, with 37% exceeding a damage threshold of 100/100 cm³ of soil. Incidence and infestation levels of *H. columbus* were relatively high in counties that have historically produced a major portion of the total cotton crop in the state, such as Lee, Marlboro, Darlington, Calhoun, Orangeburg, Sumter, and Dillon. *Meloidogyne* spp. were detected in all 16 counties (Table 1); mean detection was 25%, with 7% exceeding a damage threshold of 100/100 cm³ of soil. Although juveniles were not measured, the majority of root-knot nematode juveniles were most likely *M. incognita* race 3 or 4, because *M. arenaria* (Neal) Chitwood, *M. javanica* (Treub) Chitwood, and *M. hapla* Chitwood do not reproduce on cotton (11). *R. reniformis* was detected in 11 of 16 counties; mean detection was 12%, with 3% exceeding a damage threshold of 500/100 cm³ of soil. The damage threshold for *R. reniformis* was based on previous reports of such levels (2) and personal observations (J. D. Mueller and S. B. Martin, unpublished).

Other genera of plant-parasitic nematodes detected (Table 2), depending on year, included spiral types *Helicotylenchus* and *Scutellonema* spp. in 17–81% of fields, *Pratylenchus* spp. in 0.1–19% of fields, *Paratrichodorus* spp. in 0.2–28% of fields, *Tylenchorhynchus* spp. in 0.4–43% of fields, and *Mesocriconema* spp. in 2.6–34% of fields. *B. longicaudatus* was detected in only one field in Dillon County in 1989 and one field in Marlboro County in 1992.

Concomitant populations of *H. columbus*, *Meloidogyne* spp., and *R. reniformis* were detected but were rare when *H. columbus* or *R. reniformis* exceeded damage thresholds (Table 3). When *H. columbus* exceeded damage thresholds, *Meloidogyne* spp. and *R. reniformis* were also detected at some level in 14 and 7% of samples, respectively. When *R. reniformis* exceeded damage thresholds, *Meloidogyne* spp. and *H. columbus* were also detected at some level in only 3 and 8% of samples, respectively. When *Meloidogyne* spp. exceeded damage thresholds, *H. columbus* was detected in 43% of samples but *R. reniformis* was not detected. Eleven fields had above-threshold levels of both *H. columbus* and *Meloidogyne* spp. but only two fields had above-threshold levels of *H. columbus*

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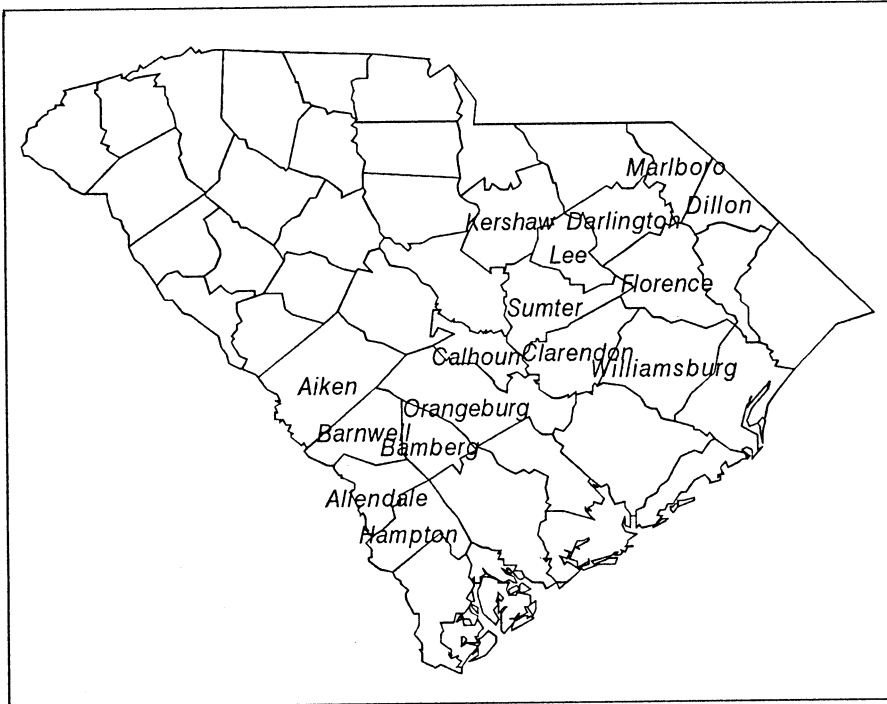


Fig. 1. Counties in South Carolina with cotton production.

Table 1. Detection of *Hoplolaimus columbus*, *Meloidogyne* spp., and *Rotylenchulus reniformis* in cotton fields by county in South Carolina, 1989–1992

County	No. of fields	<i>H. columbus</i>		<i>Meloidogyne</i> spp.		<i>R. reniformis</i>	
		No. detected	No. >thrhd ^a	No. detected	No. >thrhd	No. detected	No. >thrhd
Aiken	13	5	2	1	0	0	0
Allendale	15	4	0	7	1	0	0
Bamberg	5	4	1	1	0	0	0
Barnwell	22	14	7	10	4	0	0
Calhoun	115	81	54	46	12	7	4
Hampton	20	1	0	16	6	0	0
Orangeburg	113	88	53	38	17	1	0
Clarendon	46	23	13	12	4	3	2
Darlington	184	121	82	57	16	9	0
Dillon	85	30	16	22	9	25	6
Florence	26	3	3	6	0	1	0
Kershaw	16	9	7	4	1	2	0
Lee	247	163	86	41	6	64	16
Marlboro	150	125	89	15	4	12	1
Sumter	93	51	28	14	4	11	4
Williamsburg	69	27	11	10	3	11	4
Total	1,219	749	452	300	87	146	37

^a Number above damage threshold.

Table 2. Soil samples from South Carolina cotton fields containing *Pratylenchus* spp., *Paratrichodorus* spp., *Tylenchorhynchus* spp., *Mesocriconema* spp., and spiral types, 1989–1992

Genus	No. of fields in which detected			
	1989	1990	1991	1992
<i>Pratylenchus</i> spp.	16	18	1	42
<i>Paratrichodorus</i> spp.	52	44	1	22
<i>Tylenchorhynchus</i> spp.	45	41	15	2
<i>Mesocriconema</i> spp.	10	32	14	12
Spiral types ^a	91	77	86	80

^a *Helicotylenchus* spp. and *Scutellonema* spp.

and *R. reniformis* and none had above-threshold levels of *Meloidogyne* spp. and *R. reniformis*.

DISCUSSION

Results from this survey demonstrated that *H. columbus*, *R. reniformis*, and *Meloidogyne* spp. infest approximately 60% of the cotton hectareage in South Carolina and exceed damage thresholds on approximately 50% of that hectareage. These infestation levels are estimated to cause a loss of approximately 10,000 bales annually, with a cash value of \$3.5 million (1).

The only species of *Hoplolaimus* detected in this survey was *H. columbus*. *H. galeatus* (Cobb) Thorne has frequently been reported from cotton in other states (12,13) and is common in turfgrasses in South Carolina (S. B. Martin, personal observation). In contrast to nematode pests in most other cotton-producing states, *H. columbus* predominates in South Carolina, causing a yield loss on 37% of cotton hectareage and a potential loss on an additional 25%. The damage thresholds used to make these conclusions are based on recently published data by Noe (10). The high infestation levels of *H. columbus* may be due to continuous cropping with susceptible hosts, such as cotton, corn, and soybean (9), although a recent survey of soybean fields (8) detected *H. columbus* at only one-third the overall level detected in our cotton survey. Continuous cotton production may maintain high infestation levels of *H. columbus* better than continuous soybean or crop rotations (9).

In other states, *M. incognita* and *R. reniformis* are reported as the primary species damaging to cotton (1). Reports of the incidence of *R. reniformis* are increasing in southeastern states (6). In our survey, detections of *H. columbus* and

Table 3. Detection in South Carolina cotton fields of mixed populations of *Hoplolaimus columbus*, *Meloidogyne* spp., and *Rotylenchulus reniformis*, 1989–1992

Species detected	No. of fields	Frequency
> damage threshold		
<i>Meloidogyne</i> spp.		
Alone	50	0.57
+ <i>H. columbus</i>	37	0.43
+ <i>R. reniformis</i>	0	...
<i>H. columbus</i>		
Alone	358	0.79
+ <i>Meloidogyne</i>	64	0.14
+ <i>R. reniformis</i>	30	0.07
<i>R. reniformis</i>		
Alone	33	0.89
+ <i>Meloidogyne</i>	1	0.03
+ <i>H. columbus</i>	3	0.08
Two species		
<i>R. reniformis</i>		
+ <i>Meloidogyne</i>	0	...
<i>R. reniformis</i>		
+ <i>H. columbus</i>	2	...
<i>H. columbus</i>		
+ <i>Meloidogyne</i>	11	...

Meloidogyne spp. were relatively uniform among counties, even though South Carolina cotton hectareage nearly doubled from 1989 to 1992. Detections of *R. reniformis*, however, were limited to 11 counties (Table 1), each of which has traditionally grown cotton on a substantial hectareage. Although *R. reniformis* was first detected in 1967 (4), we suspect that this nematode will spread and/or be detected in other counties in which cotton production persists. In this regard, Heald and Robinson (6) reported economically damaging populations of *R. reniformis* to be associated with continuous cotton production.

M. incognita, traditionally associated with yield losses in cotton, can be detected through observation of root galling symptoms and detection of juveniles from soil sampling. However, *H. columbus* and *R. reniformis* are not routinely detected through visual observation of roots. Rather, detection of these species and management decisions must be based on predictive soil sampling. Results of this survey indicate that three potentially damaging species of plant-

parasitic nematodes are prevalent in cotton production fields in South Carolina and that two of these species must be detected by soil sampling. These infestations represent a serious potential yield loss on a statewide and local field basis.

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