Response of Cotton to Infection by 
_Hoplolaimus columbus_

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Abstract: Three field experiments were established in 1987 to determine the reaction of five cotton cultivars to infection by _Hoplolaimus columbus_ and the efficacy of selected nematicides against this nematode. At two sites in Calhoun County, South Carolina, early season plant growth and subsequent yields were greater in plots treated with aldicarb, fenamiphos, and 1,3-dichloropropene. _Hoplolaimus columbus_ suppressed yields approximately 10% at site 1 and 25% at site 2; however, greater yield suppression at site 2 may have been influenced by low levels of _Meloidogyne incognita_. At one site in Barnwell County, South Carolina, nematicide treatments did not increase plant growth or yield. At sites 1 and 2 where yield losses occurred, no differences in infection rate or yield among untreated cultivars were observed, nor was any nematicide more effective than another in preventing yield losses.

Key words: aldicarb, chemical control, Columbia lance nematode, cotton, fenamiphos, _Gossypium hirsutum_, _Hoplolaimus columbus_, _Meloidogyne incognita_, nematicide, 1,3-dichloropropene, root-knot nematode.

The Columbia lance nematode, _Hoplolaimus columbus_ Sher, has been associated with yield losses in cotton (_Gossypium hirsutum_ L.) in South Carolina (8,12-14). The nematode was also associated with the cotton stunt disease complex; however, failure of roots to penetrate hardpans was shown to be the primary cause of this malady (4). Nematicides reduced populations of _H. columbus_ and, when combined with subsoiling, increased yields (5,6,10).

Limited information comparing resistance of cotton cultivars to _H. columbus_ is available. McNair 511 may support fewer _H. columbus_ than Stoneville 213 (4). Lockett had a Pf/Pi ratio of 7.4 compared with 2.0 for Deltapine 16. Deltapine 16, however, sustained a yield loss, whereas Lockett did not (14). Thus, nematode reproduction and yield may not be related. Our objectives were to compare host suitability and yield in cotton infected by _H. columbus_ and to determine the efficacy of nematicides in preventing yield losses.

Materials and Methods

Two experiments were established on 23 April 1987 in Calhoun County, South Carolina, in a Magnolia sandy loam soil (74% sand, 19% silt, 7% clay, 1% organic matter; pH 6.3). Sites 1 and 2 had initial _H. columbus_ population densities of 230 (range 57-575)/100 cm~2~ soil and 238 (range 36-680)/100 cm~2~ soil, respectively. A third experiment was established on 6 May 1987 in Barnwell County, South Carolina, in a Varina loamy sand (86% sand, 7% silt, 7% clay, 1% organic matter; pH 6.2) infested with 83 (range 6-260) _H. columbus_/100 cm~3~ soil. The fields were cropped to cotton and soybean the previous 5 years, and yield losses caused by _H. columbus_ had been observed. Trace levels of _Meloidogyne incognita_ (Kofoid & White) Chitwood were detected in soil samples taken at planting in site 2 in Calhoun County.

Site 1 in Calhoun County contained six replications of cotton cultivars Coker 315, Deltapine 50, Deltapine 90, PD 1, and PD 3 in a split-plot within a randomized complete block design with nematicide as main-plots and cultivars as subplots to compare yield losses sustained by the cultivars. The nematicide treatment was 1,3-dichloropropene (1,3-D) plus aldicarb.

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At site 2 in Calhoun County nematicides tested on Coker 315 were aldicarb, fenamiphos, and 1,3-D plus aldicarb. Treatments were arranged in a randomized complete block design and were replicated five times.

At Barnwell County (site 3) nematicides tested on Coker 315 were aldicarb, fenamiphos, and 1,3-D plus aldicarb. Treatments were arranged in a randomized complete block design and replicated six times.

Nonfumigant nematicides were applied at planting in-furrow with an electric powered Gandy applicator (Gandy Company, Owatonna, MN). 1,3-D was applied 25 cm deep with a single chisel per row using a gravity flow applicator with the chisel slit sealed by the press wheel. Rates and times of application are listed in Tables 1–3. All plots, each consisting of four 11-m-long rows on 96-cm centers, were subsoiled 30 cm deep at planting. Seeding rate was 20 seed/m of row.

Population densities of *H. columbus* per plot were determined at planting and at midseason. Soil samples consisted of a composite of 12 cores (2.5-cm-d and 20-cm deep) from the rhizosphere of the center two rows. Nematodes were extracted from 100 cm³ soil using centrifugal-flotation (11). Six weeks after planting 10 root systems were excavated at random from the first and fourth rows of each plot and *H. columbus* was extracted from ca. 15 g fresh weight of roots using a modified mist apparatus (2). Roots were oven dried at 60°C for 72 hours after removal from the mist chamber. Recovery of nematodes from roots was expressed as nematodes per gram dry weight of root. Before nematode extraction percentages of plants with root pruning or excessive branching induced by *H. columbus* and galling (1 = no galling, 10 = 100% galled) by *M. incognita* (2) were recorded.

All plots were maintained using agronomic practices standard in the area (9). Plots in Calhoun County were irrigated as needed using a center pivot system. One meter of cotton was removed from the end of each row and the remaining plants in the center two rows were mechanically harvested. Lint yield was calculated as 33% of the combined seed–lint yield.

Data from site 1 was subjected to analysis of variance for a split-plot design to compare the main effects of nematicide, cultivar, and their interaction. Comparisons of cultivars within nematicide treatments were according to LSD. Data from the two nematicide tests (sites 2 and 3) were subjected to analysis of variance. When a significant (*P = 0.05*) treatment effect was detected, means were separated using Duncan’s new multiple-range test.

### RESULTS AND DISCUSSION

Nematicide treatment increased yields of all cultivars (*P = 0.05*) (Table 1). Comparison of yields of treated vs. untreated individual cultivars at site 1 showed that all except PD 3 sustained ca. a 10% yield loss due to *H. columbus* (Table 1). Comparison of untreated vs. treated Coker 315
Table 2. Cotton lint yield, mean number of *Hoplolaimus columbus* per gram root and percentage of plants damaged 42 days after planting, galling by *Meloidogyne incognita*, and plant fresh weight of Coker 315 cotton as affected by nematicide treatments at site 2 in Calhoun County, South Carolina, 1987.

<table>
<thead>
<tr>
<th>Treatments and g a.i./100 m (broadcast rate)</th>
<th>Yield (kg/ha)</th>
<th>H. columbus/ g root</th>
<th>Damaged roots (%)†</th>
<th>Gall rating‡</th>
<th>Fresh weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,3-D 540 + aldicarb 5.0 (34 kg/ha + 0.5 kg/ha)</td>
<td>1,212 a</td>
<td>7 b</td>
<td>32 ab</td>
<td>0.4 c</td>
<td>57 a 5.0 a</td>
</tr>
<tr>
<td>Aldicarb 8.4 (0.84 kg/ha)</td>
<td>1,081 a</td>
<td>37 b</td>
<td>8 b</td>
<td>0.5 c</td>
<td>44 b 5.1 a</td>
</tr>
<tr>
<td>Fenamiphos 8.4 (0.84 kg/ha)</td>
<td>1,063 a</td>
<td>65 b</td>
<td>44 a</td>
<td>1.2 ab</td>
<td>38 b 3.8 b</td>
</tr>
<tr>
<td>Aldicarb 5.0 (0.5 kg/ha)</td>
<td>1,060 a</td>
<td>41 b</td>
<td>16 ab</td>
<td>1.0 b</td>
<td>41 b 4.3 ab</td>
</tr>
<tr>
<td>Untreated</td>
<td>884 b</td>
<td>2,267 a</td>
<td>44 a</td>
<td>1.7 a</td>
<td>9 c 1.1 c</td>
</tr>
</tbody>
</table>

Data are means of five replications. Means followed by the same letter within a column are not different according to Duncan's new multiple-range test (P = 0.05).† Rates were calculated based on a 96-cm row spacing.‡ Rating scale of 0 (no galls) to 10 (100% of surface area galled).

showed it sustained ca. a 25% yield loss at site 2; however, these higher yield losses may have been due to the additional presence of low levels of *M. incognita* (Table 2). Damage from *H. columbus* was manifested early in the growing season at site 2 as evidenced by the lower shoot and root weights of untreated vs. treated plants 6 weeks after planting (Table 2). Nematicide treatment reduced (P = 0.05) root damage due to *H. columbus* at site 1 (Table 1) but not site 2 (Table 2). This indicated that the subsequent yield losses observed in both tests were due to more than just physical damage to the root system.

The failure to detect differences in recovery of *H. columbus* among untreated cultivars 6 weeks after planting (Table 1) suggests that none of the cultivars were resistant to the nematode. The lower yield of untreated PD 1 relative to Deltapine 90 (Table 1) indicates that some cotton cultivars may exhibit tolerance to *H. columbus* similar to that reported for soybean (7,15).

All nematicides at site 2 reduced recovery of *H. columbus* from roots 6 weeks after planting, thereby increasing early season root and shoot weight and eventual seed yields; however, there were no differences in yield among the nematicides (P = 0.05) (Table 2). Although initial nematode population densities at site 3 were near the threshold of 100 *H. columbus*/100 cm³ soil reported for the soil type (1), recovery of *H. columbus* 6 weeks after planting did not resemble levels recorded at sites 1 and 2 (Table 3). Nematode and nematicide activity may have been greater at sites 1 and 2 than at site 3 because of higher soil moisture content in irrigated soil, greater initial population densities of *H. columbus*, or the presence of low levels of *M. incognita* at site 2.

Galling observed at site 2 was on roots more than 20 cm deep and none was de-
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tected 6 weeks after planting. Meloidogyne incognita activity in the upper 20 cm of soil may have been affected by H. columbus activity (3,12).

Our results indicate that yield losses on cotton caused by H. columbus vary greatly. A more thorough understanding of the effects of edaphic, environmental, and genetic factors on the relationship between H. columbus and yield losses on cotton are needed to devise and implement appropriate management schemes.

LITERATURE CITED


