EFFECT OF TEMPERATURE ON THE INTERACTION BETWEEN BLACK ROOT ROT (*Thielaviopsis basicola*) AND THE ROOT KNOT NEMATODE (*Meloidogyne incognita)*

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RESEARCH PROBLEM

Both the root-knot nematode (*Meloidogyne incognita*) and the soilborne fungus that causes black root rot of seedling cotton (*Thielaviopsis basicola*) are widely distributed in cotton field soils in Arkansas. Both of these pathogens are capable of causing significant crop damage and yield loss, primarily through damage to the root systems of infected plants. When root-knot nematode or *T. basicola* infection occurs alone in fields, cotton plants may be damaged, but these pathogens seldom kill plants. In 1995, fields in Southeast Arkansas were found with extremely severe seedling disease problems that resulted in significant stand losses. In all cases, both the root-knot nematode and *T. basicola* were isolated from infected plants and from soil from the fields. Subsequent studies in microplots demonstrated the possibility that a synergistic disease complex occurred between these pathogens on seedling cotton, and the severity of the interaction appeared to be temperature-dependent. Growth chamber studies were conducted to determine the role of soil temperature in the severity of the interaction.

BACKGROUND INFORMATION

The root-knot nematode is found in about 25% of cotton fields in Arkansas, with an incidence over 40% in the southeastern counties (Bateman and Kirkpatrick, 1998). This parasite can cause major yield suppression in cotton. Root-knot nematodes are active throughout the growing season, with infection and reproduction favored by warm soil temperatures (Carter, 1975). *Thielaviopsis basicola* is also widely distributed throughout the cotton production regions of Arkansas (Rothrock, 1997). The fungus colonizes the cortical tissue of cotton seedlings, causing a dark brown or black discoloration of the root and hypocotyl, which results in stunted, slow-developing plants. In contrast to root-knot, *T. basicola* is most severe early in the growing season, when soil temperature is below 75°F and soil water content is high (Rothrock, 1992). Studies using microplots indicate that cotton seedling mortality during the first 6 wk after planting can be significantly higher when both organisms are present than with either of the

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pathogens alone (Walker *et al.*, 1998). Based on the results of these multiple-year studies, it appeared that the severity of this interaction was mediated, at least in part, by soil temperature during the seedling development phase of crop development. Controlled temperature studies were conducted to determine the role of soil temperature in this interaction and its effects on cotton seedlings.

MATERIALS AND METHODS

Seeds of the cotton cultivar 'Deltapine 50' were planted in pots containing 1,500 g of methyl bromide-fumigated Smithdale fine sandy loam soil. Soil in the pots was infested with either *T. basicola* (100 chlamydospores/g), *M. incognita* (10 eggs/g), or both pathogens together at these rates. Noninfested pots served as controls. Pots were placed in growth chambers with a 12-h photoperiod at constant temperatures of 68, 75, or 82°F or two cyclic regimes in which temperatures ranged between 58 and 90°F or 64 and 82°F in 24 h. Each chamber contained five replications of each treatment in a randomized complete-block design. After 42 days, plants were removed from soil, washed, and weighed. Root systems were rated for disease severity on a scale of 1 to 5 where 1=0, 2=1 to 10%, 3=11 to 25%, 4=26 to 50% and 5=51 to 100% of the root system discolored. Fresh plant weights were also recorded.

RESULTS

Plant fresh weight was reduced by the combination of root-knot and *T. basicola* compared with either pathogen alone at all temperatures except 28°F where weights were comparable for the root-knot alone and the combination treatment (Table 1). Differences between the combination treatment and those with the pathogens individually were more dramatic at cooler temperatures. Weights were reduced by *T. basicola* alone at 20 and 24°F in comparison with the control of the nematode-alone treatments. Root discoloration for both treatments that contained *T. basicola* was higher at all temperatures than with either the control or the nematode alone (Table 2).

PRACTICAL APPLICATION

Where both the root-knot nematode and *T. basicola* occur together, cotton seedling growth and development are significantly decreased in comparison with situations where only one or the other of the pathogens are present. The severity of the damage by the combination of pathogens and for *T. basicola* alone was greater at cooler temperatures. Delayed planting of fields where both pathogens are present until the soil is above 75°F could improve seedling growth and development to a certain degree. However, it appears from this study that control of the root-knot nematode in addition to planting into warmer soil may be necessary to minimize the effects of the interaction between these organisms on seedlings.

LITERATURE CITED

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Table 1. Fresh plant weight (g) of cotton seedlings grown in soils infested by *Thielaviopsis basicola* and root-knot nematodes at various temperatures.

	Temperature (ºF)				
Treatment	68	75	82	68-90	64-82
Control	2.86 a[z]	2.28 a	3.85 a	2.34 a	3.32 a
T. basicola	2.33 b	2.02 b	3.92 a	2.20 a	3.01 a
Root-knot	2.72 a	2.33 a	3.64 ab	2.49 a	3.09 a
T. basicola + root-knot	1.49 c	1.51 c	3.36 b	1.80 b	1.71 b

[z] Means within columns followed by the same letter are not different at (P = 0.05) by Fisher's Protected Least Significant Difference Test.

Table 2. Root discoloration of cotton seedlings in soil infested with *T. basicola* and root-knot nematodes at various temperatures.

	Temperature (ºF)				
Treatment	68	75	82	68-90	64-82
Control	0.00 d[z]	0.02 c	0.00 c	0.08 c	0.04 c
T. basicola	3.96 b	4.43 a	2.64 a	3.02 b	3.94 a
Root-knot	0.32 c	0.47 b	0.20 b	0.40 c	0.94 b
T. basicola + root-knot	5.00 a	4.62 a	2.82 a	4.58 a	4.54 a

[z] Means within columns followed by the same letter are not different at (P = 0.05) by Fisher's Protected Least Significant Difference Test.