Prevelance of *Thielaviopsis basicola* in Cotton Soils in Arkansas and its Association with the Root Rot Nematode

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ABSTRACT

Historically, research based on isolations on non-selective media suggested that black root rot caused by Thielaviopsis basicola was not an important component of the seedling disease complex on cotton in the Midsouth of the USA. Recent research with selective media or direct observation suggests that it is, in fact, a common problem in many fields. An intensive survey of cotton fields in Ashley County, Arkansas was undertaken on soils collected following harvest in 1995 and 1996 to determine the prevalence of T. basicola, using the selective medium TB-CEN. In addition, the association between T. basicola and root knot nematode, Meloidogyne incognita, was examined as a result of an observed early season seedling death and reduced growth caused by an interaction between these two pathogens. The survey results indicate that T. basicola is widespread in the Midsouth and that where M. incognita reaches threshold populations, T. basicola is also common.

Introduction

The perceived importance of black root rot on cotton, caused by *Thielaviopsis basicola* (Berk and Broome) Ferraris (syn. *Chalara elegans* Nag Raj and Kendrick) has been dependent on the techniques used to detect the pathogen. The fungus is often not detected when isolating from plant materials using non-selective media or techniques because of the slow growth of the pathogen. Historically, research has suggested that *T. basicola* is important on cotton in the south-western U.S.A., but not an important component of the seedling disease complex on cotton in the Midsouth. In Tennessee, using seedling baits and nonselective media, pathogen detection was 0 to 13% (mean 2%) and 0 to 10% (mean 0.1%) for 45 sites in 1982 and 43 sites in 1983, respectively (Johnson and Doyle, 1986). In contrast, by direct observation of seedlings used for isolation in Mississippi, the pathogen was detected from 18 of 36 cotton fields, with four locations having 100% incidence (Roy and Bourland, 1982). Newly developed selective media have aided in quantifying soil populations of this pathogen and disease incidence. For example, Holtz and Weinhold (1994) detected the pathogen in 24 of 27 cotton field soils in California using a modification of the selective medium TB-CEN (Specht and Griffin, 1985).

An intensive survey of cotton fields in Ashley County, Arkansas, was undertaken on soils collected in 1995 and 1996 to determine the prevalence of *T. basicola* using the selective medium TB-CEN. In addition, the association of *T. basicola* with the occurrence of the root-knot nematode, *Meloidogyne incognita*, was examined as there is an interaction between these two pathogens, causing early season seedling death and reduced plant growth and development.

Materials and Methods

Soil samples were collected from cotton fields throughout Ashley county, Arkansas, following harvest in 1995 and 1996. Soils were sampled by taking 20 cores (0 to 15 cm deep) within the row from an area not greater than 20 hectares. Soil samples were split into samples for fertility or nematode analysis, with a subsample of the nematode sample being used for *T. basicola* assay. Soil samples for *T. basicola* were stored at 2-5^{o}C prior to assay. Twenty-five grams of soil (equivalent dry weight) were diluted with water agar (0.2%) to a volume of 250 ml and shaken for 20 minutes with a wrist action shaker. One ml of the resulting suspension was placed in each of 10 Petri dishes and the selective medium TB-CEN, amended with penicillin G (60 mg/l), was poured into the dishes and the dishes swirled to mix the soil suspension. Dishes were incubated in the dark for 14 days prior to counting the number of colonies of the pathogen growing on each plate. Counts were converted to propagules per gm (ppg) of soil to express populations. Root-knot nematode populations, second-stage juveniles, were estimated from a 500 cm^3 soil sample using a semi-automatic elutriator (Byrd *et al.*, 1976) followed by centrifugal flotation (Jenkins, 1964). Fertility analyses were conducted by the state soil testing laboratory. Pearson's product-moment correlation method was used to determine the correlation coefficients between *T. basicola*, the root knot nematode, and soil fertility data.

Results and Discussion

T. basicola occurred in 70% (384/550) of fields surveyed. The percentage of fields having 20 to less than 100 ppg was 17% (95), and the percentage of

fields having 100 or greater ppg was 29% (161). Populations ranged from 0 to 850 ppg of soil, with a mean of 75 ppg. These frequencies are similar to those in California, where the pathogen is accepted as an important factor in limiting production (Holtz and Weinhold, 1994). The mean density in the California study was 78 ppg of soil, with a range of 1 to 221 ppg. The California study also indicated a good correlation between soil populations and black root rot. Meyer *et al.* (1989) also found a positive correlation between soil populations and disease severity in Burley tobacco fields in North Carolina.

A positive correlation was found between root-knot nematode and *T. basicola* populations, 0.25 (P=0.0001). Of 39 fields having 250 or more root-knot nematodes per 500 cm^3 of soil, 25 of these fields had *T. basicola* populations of 100 ppg or greater.

Cropping history is one of the most important factors in determining occurrence of *T. basicola*. Yarwood and Levkina (1976) found soil populations were associated with plants in the families Fabaceae and Malvaceae. In the San Joaquin Valley in California, higher inoculum densities were found in fields planted for three or more years to cotton than in fields planted to other crops or summer flooded (Holtz and Weinhold, 1994). Soil populations also have been associated with the frequency of planting tobacco or soybeans in fields in Ontario, Canada (Andersen and Welacky, 1988). However, cropping history does not appear to be a primary factor explaining the distribution of the pathogen in this study as there is little rotation of cotton with other crops in this county. A number of soil physical factors favour black root rot, including soil pHs above 5.6, cool soil temperatures and high soil water contents (Rothrock, 1992). Field observations also suggest black root rot may be more severe in finer textured soils. However, using fertility data from 115 fields, no association between any soil factor was found with *T. basicola* population, including pH, P, K and cation exchange capacity. Textural analyses have yet to be conducted on selected soils having different levels of the pathogens.

This study indicates that *T. basicola* is widespread in the Midsouth. In addition, *T. basicola* is more common in fields having threshold populations of the root-knot nematode, indicating an increased likelihood of an interaction between the two pathogens and thus increased plant damage.

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