PREVALENCE AND DISTRIBUTION OF *THIELAVIOPSIS BASICOLA*

C. S. Rothrock
Department of Plant Pathology,
University of Arkansas
Fayetteville, AR

The perceived importance and distribution of the pathogen *Thielaviopsis basicola*, which causes black root rot on cotton, is in large part due to the techniques available for the detection of the pathogen. This fungus is often overlooked when isolating from plants or soil using conventional media and techniques because of the slow growth of the pathogen compared to other pathogens or soil microorganisms. Techniques used to detect this pathogen include direct observation, baiting on carrot disks or seedlings, and nonselective or selective media, media developed to preferentially encourage the growth of this pathogen while inhibiting the growth of many other soil microorganisms. One of the most widely used selective media is the TB-CEN medium developed by Specht and Griffin (1985). For example, using water agar *T. basicola* was detected at two sites in the 1993 National Cottonseed Treatment Program versus six sites when seedlings were transferred to TB-CEN (Rothrock, 1994). Similarly, isolation frequency from seedlings from these two sites was 93% and 33% for the TN site and 79% and 17% for the LA2 site for TB-CEN and water agar, respectively (Rothrock, unpublished).

Early studies on the distribution of *T. basicola* in soils were conducted by Yarwood (1974) in California. Using a carrot disk assay, the pathogen was detected in 197 of 402 soils. The pathogen was found in 46% of 152 samples from virgin soils and 54% of 250 collections from cultivated soils. Yarwood and Levkina (1976) in a similar study found the pathogen was associated with 27 of 46 crops at the Moscow Botanical Garden. Soils having the greatest populations were associated with plants in the Fabaceae and Malvaceae, while lowest populations were detected under plants in the Poaceae.

Some of the most extensive and detailed research on soil populations and distribution of *T. basicola* have been conducted on tobacco. Anderson and Welacky (1988) using a carrot disk method found *T. basicola* populations in 95% of 195 burley tobacco fields in Ontario. The mean soil population was 42 colony forming units (cfu)/g of soil (range 0-726 cfu/g). Meyer et al (1989) in North Carolina using the TB-CEN medium detected *T. basicola* populations in 47 of 80 burley tobacco fields (40 cfu/g of soil, range 2-219 cfu/g). Black root rot was observed in 68% of infested fields and disease severity was positively correlated with soil populations.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:75-77 (1997)
National Cotton Council, Memphis TN

T. basicola was initially reported on Pima cotton in Arizona (King and Barker, 1939), where it was later recognized as causing a seedling disease problem (King and Presley, 1942). Presley (1947) reported the pathogen causing a seedling disease on Upland cotton in Mississippi. Black root rot on cotton has historically been considered a greater problem in the Southwestern United States. Recent studies in the San Joaquin Valley of California found the pathogen in 24 of 27 cotton field soils using the selective medium TB-CEN (Holtz and Weinhold, 1994). The mean density was 78 cfu/g of soil with a range in populations from 1 to 221 cfu/g. Disease severity was positively correlated with inoculum density. In Texas, recent survey work by Wheeler (unpublished) using seedlings as baits to assess seedling disease pressure for 142 cotton soils from 20 counties in the High Plains found incidence in counties to vary from 0 to 100%.

In the Mid-south, *T. basicola* has been known to be present for a long time, however its distribution was not thoroughly investigated. Research in Tennessee using seedlings as baits and isolating on water agar found incidence ranged from 0 to 13%, with a mean of 2%, in 45 fields in 1982 and 0 to 10%, with a mean of 0.1%, in 43 fields in 1983 (Johnson and Doyle, 1986). In Mississippi, Roy and Bourland (1982) found the pathogen associated with seedlings from 18 of 36 cotton fields. The mean incidence was 16%, with four locations having 100% incidence. They found it difficult to detect the pathogen on the isolation medium PDA amended with streptomycin and aureomycin and direct observation of the plant tissue was often necessary to detect the pathogen. Batson (unpublished) using carrot disks or TB-CEN medium detected the pathogen in 55 of 336 soil samples in Mississippi. From the 12 counties surveyed, isolation frequency varied from 0% to 60% of the fields assayed. Extensive soil surveys of cotton field soils using TB-CEN medium in Ashley County, Arkansas, found *T. basicola* in 79% of 230 fields and 69% of 203 fields in 1995 and 1996, respectively. Seventy-seven and 51 fields had populations over 100 cfu/g, with a range of populations from 0 to 843 cfu/g and 0 to 850 cfu/g in 1995 and 1996, respectively.

Sites included in the National Cottonseed Treatment Trial also indicated the widespread distribution of *T. basicola*. The pathogen was isolated from seedlings at cooperator sites in 6 of 16 sites, 8 of 18 sites, 8 of 17 sites, and 3 of 18 sites in 1993-1996, respectively. States where the pathogen was isolated from seedlings included Alabama, Arkansas, California, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas.

Unlike the seedling disease pathogens *Rhizoctonia solani* and *Pythium* spp., *T. basicola* is not as ubiquitous in cotton field soils. One of the critical factors determining pathogen distribution is cropping history. The study by Holtz and Weinhold (1994) in the San Joaquin Valley found higher inoculum densities in fields planted for three or more years

to cotton than fields rotated to other crops (safflower, wheat, or barley) or summer flooded. This supports the earlier work by Yarwood and Levkina (1976) where soil populations were associated with plant species in the Fabaceae and Malvaceae. Similarly, populations in tobacco fields in Ontario were related to the frequency of tobacco and soybean production in fields (Anderson and Welacky, 1988). However, factors other than cropping history must be associated with distribution of *T. basicola* since in many cotton producing areas cropping history varies little, with fields being planted annually to cotton. Soil characteristics may affect survival of the pathogen or the development of black root rot and thus reproduction of the pathogen (Rothrock, 1992). Soil characteristics favoring black root rot include cool soil temperatures (< 26 C), high soil water potentials, and soil pHs above 5.6. Field observations also suggest black root rot may be more severe on finer textured soils.

Research evidence is accumulating that the pathogen *T. basicola* is widespread throughout the cottonbelt. Additional research is needed to identify factors associated with the presence of the pathogen in cotton soils and related to populations shifts and disease damage.

References

Anderson, T. R., and T. W. Welacky. 1988. Populations of *Thielaviopsis basicola* in burley tobacco field soils and the relationship between soil inoculum concentration and severity of disease on tobacco and soybean seedlings. Can. J. Plant Pathol. 10:246-251

Holtz, B. A., and A. R. Weinhold. 1994. Thielaviopsis basicola in San Joaquin valley soils and the relationship between inoculum density and disease severity of cotton seedlings. Plant Dis. 78:986-990.

Johnson, L. F., and J. H. Doyle. 1986. Relationships of seedling disease of cotton to characteristics of loessial soils in Tennessee. Phytopathology 76:286-290.

King, C. J., and H. D. Barker. 1939. An internal collar rot on cotton. (Abstr.) Phytopathology 29:751.

King, C. J., and J. T. Presley. 1942. A root rot of cotton caused by *Thielaviopsis basicola*. Phytopathology 32:752-761.

Meyer, J., H. D. Shew, and P. B. Shoemaker. 1989. Populations of *Thielaviopsis basicola* and the occurrence of black root rot on burley tobacco in western North Carolina. Plant Dis. 73:239-242.

Presley, J. T. 1947. *Thielaviopsis* root rot of cotton in Mississippi. (Abstr.) Plant Dis. Rep. 31:152.

Rothrock, C. S. 1992. Influence of soil temperature, water, and texture on *Thielaviopsis basicola* and black root rot on cotton. Phytopathology 82:1202-1206.

Rothrock, C. S. 1994. Report of the cottonseed treatment committee for 1993. Proceedings of the Beltwide Cotton Conferences. 216-218.

Roy, K. W., and F. M. Bourland. 1982. Epidemiological and mycofloral relationships in cotton seedling disease in Mississippi. Phytopathology 72:868-872.

Specht, L. P., and G. J. Griffin. 1985. A selective medium for enumerating low populations of *Thielaviopsis basicola*. Can. J. Plant Pathol. 7:438-441.

Yarwood, C. E. 1974. Habitats of Thielaviopsis in California. Plant Dis. Rep. 58: 54-56.

Yarwood, C. E., and L. M. Levkina. 1976. Crops favoring Thielaviopsis. Plant Dis. Rep. 60:347-349.