2003 BELTWIDE COTTON CONFERENCES, NASHVILLE, TN – JANUARY 6-10

# COTTON SEEDLING DISEASE SURVEY FOR THE TEXAS HIGH PLAINS

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## Abstract

A survey was conducted on 84 cotton fields in the Northern High Plains of Texas. Seed emergence was increased from and average of 24 % without seed treatment to an average of 72 % when a fungicide active against *Pythium* was added to the seed. When seed was treated with Vitavax-PCNB, but not treated with a *Pythium* active material, then seed emergence averaged 59 %. Seed emergence averaged 79 % when a complete fungicide package was used with activity against *Thielaviopsis basicola*, *R. solani*, and *Pythium* spp. Emergence of cotton seed was similar for first-year cotton fields as for fields with at least three years of cotton production. Emergence when seed was not protected against *Pythium* was poorest for fields in a corn or grain rotation than for fields in a rotation with peanut or sorghum. Hypocotyl injury was slightly increased with increasing years of cotton production, and percent root necrosis was greatly increased with multiple years of cotton production. *Pythium* spp., *T. basicola*, and *R. solani* were isolated from root or hypocotyls lesions in 39, 36, and 5 % of the fields, respectively.

## Introduction

Seedling diseases account for either the highest or second highest category of disease losses in cotton production throughout the U. S. Fungi which cause preemergence stand losses include *Rhizoctonia solani* Kuhn, and *Pythium* spp. Hypocotyl and root lesions can also be produced by these same fungi, which can result in postemergence damping off and reduced plant vigor. Root necrosis can also be caused by the fungus *Thielaviopsis basicola* [(Berk. & Broome) Ferraris]. The fungi which cause stand problems have wide host ranges and are not pathogens solely of cotton (Agrios, 1988). *Thielaviopsis basicola* also has a wide host range, though it does not infect moncots (Johnson, 1916). Conditions which enhance seedling disease include planting into cool, wet soils . Crop residue which occurs with conservation tillage has also been associated with enhanced levels of seedling disease caused by *R. solani* (Rickerl et al., 1992; Rothrock and Kirkpatrick, 1995; Wheeler et al., 1997).

The Northern High Plains of Texas has recently increased its cotton acreage. Since heat units are one of the most limiting constraints to yield production in this area, producers plant cotton early into cool soils. In some counties, the entire county has been planted at least two weeks before soil temperatures are high enough for germination to occur. Therefore, seedling disease is of great concern in this area. A survey was taken to determine the potential for seedling disease pathogens.

## Materials and Methods

Composite soil samples were taken 30 days after planting, between June 17$^{th}$ and July 1$^{st}$. A soil sample was taken on a 40-acre area of the field, with a maximum of three samples per field and a maximum of 10 fields sampled per county. Additional information taken from each sampled field included number of years in cotton production, irrigation practices (irrigated vs. dryland), tillage practices (conventional, minimal, no-till), and crop rotation patterns for the last three years (cotton, sorghum, corn, wheat, peanuts, sunflowers, soybeans).

Each soil sample was split into four sections and then each of the sections was divided into five pots (Cone-Tainers, (diam. 3.8 cm, length 14 cm; Stewe & Sons, Inc., Corvallis, OR)). Each pot was planted with three seed (Paymaster 2326 BG/RR) containing one of the following seed treatments: none; Allegiance FL (0.75 oz/100 lb seed); Vitavax-PCNB (6 oz/100 lb seed); Allegiance FL + Vitavax-PCNB (0.75 + 6 oz/100 lb seed); and Baytan 30 + Allegiance FL + Ascend 30 (0.5 + 0.75 + 1.5 oz/100 lb seed). There was a total of 12 seed planted for each seed treatment for each sample of soil. The pots were placed in a growth chamber at 19°C for 21 days. After 21 days, the number of plants that had emerged for each pot was counted. The roots of surviving plants were rated for hypocotyl lesion severity and % root necrosis. The hypocotyl rating scale was from 0 to 3 with 0 = no lesions; 1 = superficial lesion; 2 = sunken lesion; and 3 = lesion killing the plant. After rating, all surviving plants from a soil sample were combined, and four plants were selected to isolate from a root or hypocotyl lesion. No plants were selected if the roots were completely healthy. Plants were preferentially selected for hypocotyl lesion if available and secondly for root lesions or necrosis. Selected plants were washed for 3-5 min. and then allowed to dry. The lesion from each plant was cut in two pieces under sterile conditions, and one piece was transferred to water agar (1.5 %) while the second piece was transferred to a *Pythium* selective media (Jeffers and Martin, 1986). From 3-7 days after plating out the diseased tissue, transfers were made from colonies growing on the water agar or selective media to potato dextrose agar (PDA). After the fungus had grown out on the PDA plate it was identified to genus. If a single colony of *Pythium* or

*Rhizoctonia* was identified, then the field (regardless of how many samples were examined) was considered positive for that organism. To identify the presence of *T. basicola*, thin slices from roots with necrotic areas were examined under a compound microscope at 250 magnification for dark chlamydo-yype spores typical of *T. basicola*.

## Results and Discussion

Emergence was very low (average of 24 %) when no seed treatment was applied. Emergence was excellent for all fungicide combinations which protected against *Pythium* (Fig. 1), suggesting that *Pythium* is the most serious preemergent pathogen. When seed was protected with Vitavax-PCNB which has activity against *R. solani*, but is a poor material against *Pythium*, average emergence was 59 % (Fig. 1). When seed was treated against both pathogens, average emergence ranged from 77 to 79 %, depending on products applied. Seed emergence was similar whether cotton had been in production for at least three years, or if only one crop of cotton had been produced (Fig. 1). This suggests that the seed pathogens were also able to survive on other rotational crops. Hypocotyl ratings were more severe with continuous cotton than with first year cotton for all seed treatments except when Baytan 30 + Allegiance FL + Ascend 30 were combined (Fig. 2). The pathogens which are capable of causing hypocotyls or root disease were increasing on the cotton rotation, which contrasted with the pathogens present that caused seed death. Percent root necrosis was more severe with cotton planted for at least three years than with first year cotton (Fig. 3). Root necrosis appeared to be caused primarily by *T. basicola*, since with almost all roots with necrosis symptoms (as opposed to rot symptoms), chlamydo-type spores of *T. basicola* were found. *Thielaviopsis basicola, Pythium* spp. *and R. solani* were isolated or identified from plants grown in soil from 36, 39, and 5 % of the fields, respectively. Conventional tillage fields had a higher incidence of *T. basicola* (46 %) than minimum tillage fields (8 %). Previous studies on tillage systems and cotton seedling disease had only indicated an increase in *R. solani* with conservation tillage systems as opposed to conventional tillage systems (Rickerl et al., 1992; Rothrock and Kirkpatrick, 1995; and Wheeler et al., 1997). It is not known if this correlation between *T. basicola* incidence and conventional tillage is a “real” phenomena. This association was not present in a cotton field with *T. basicola*, which was tested for four years with both conventional and conservation tillage in a replicated and randomized design (Wheeler et al., 1997). When seed was protected against *R. solani*, but not protected against *Pythium* spp., then average cotton emergence was lower in soil taken from fields with a history of corn or a mixture of different grain crops (Table 1). This is an indication that *Pythium* can affect both monocot and cotton crops. The incidence of *T. basicola* was increased when cotton was planted for at least three years or when cotton was rotated with peanuts. The incidence of *T. basicola* was high in fields with consecutive planting of sorghum. However, sorghum is not a host of *T. basicola*, and these results cannot be explained. (Table 1).

In conclusion, producers planting cotton even for the first time should be concerned about seedling disease and take appropriate measures (using fungicides and planting when weather conditions are conducive for fast emergence). For those producers planting cotton for multiple years, there will be an increase in both hypocotyls lesions and root necrosis. Again it is important to use fungicide seed treatments and plant under warm soil conditions. Crop rotation with grain crops such as corn and wheat can help reduce the amount of root necrosis caused by *T. basicola*.

## References


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Table 1. Influence of crop rotation on emergence and incidence of *Thielaviopsis basicola*.

| **Crop Rotation**[a] | **% Emergence with Vitavax-PCNB**[b] | **% of Fields with T. basicola** |
|---|---|---|
| Cotton | 57 ab[c] | 60 ab |
| Peanut | 70 a | 44 abc |
| Sorghum | 76 a | 75 a |
| Wheat | 74 a | 17 bc |
| Corn | 41 b | 11 c |
| Grain | 38 b | 17 bc |

[a]All fields were planted with at least a single cotton crop. The listed crop indicates that there were multiple years of the rotation crop. Grain indicates a mixture of monocot crops.

[b]Seed was treated with Vitavax-PCNB at 6 oz/100 lb seed before planting.

[c]Means were separated using the Waller-Duncan k-ratio t test with $P = 0.05$.

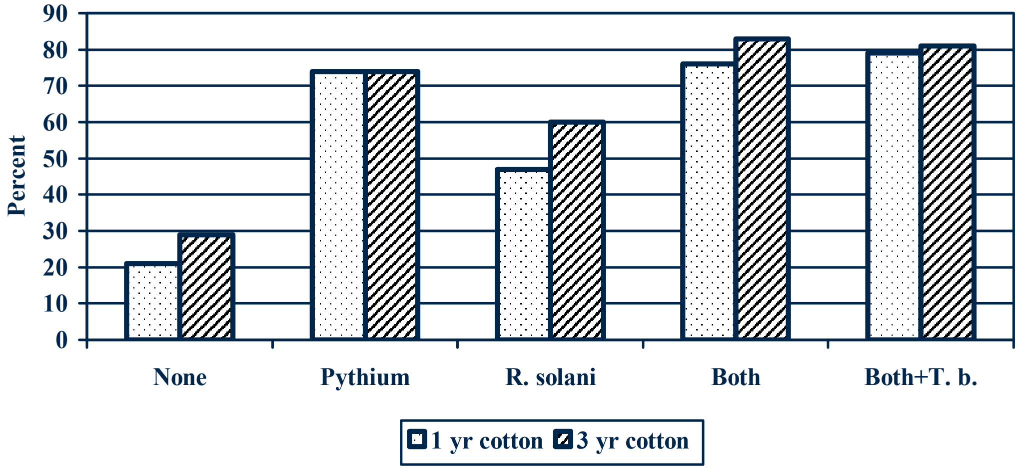


Figure 1. The effect of fungicide seed treatments on cotton emergence. Seed was planted with no fungicide (None), treated with a fungicide active against *Pythium* (Allegiance FL) (labeled Pythium), treated with a fungicide active against *R. solani* (Vitavax-PCNB) (labeled R. solani), treated with both Allegiance and Vitavax-PCNB (labeled both), or treated with fungicides active against *T. basicola*, *R. solani*, and *Pythium* (Baytan 30 + Allegiance FL + Ascend) (labeled Both + T. b).

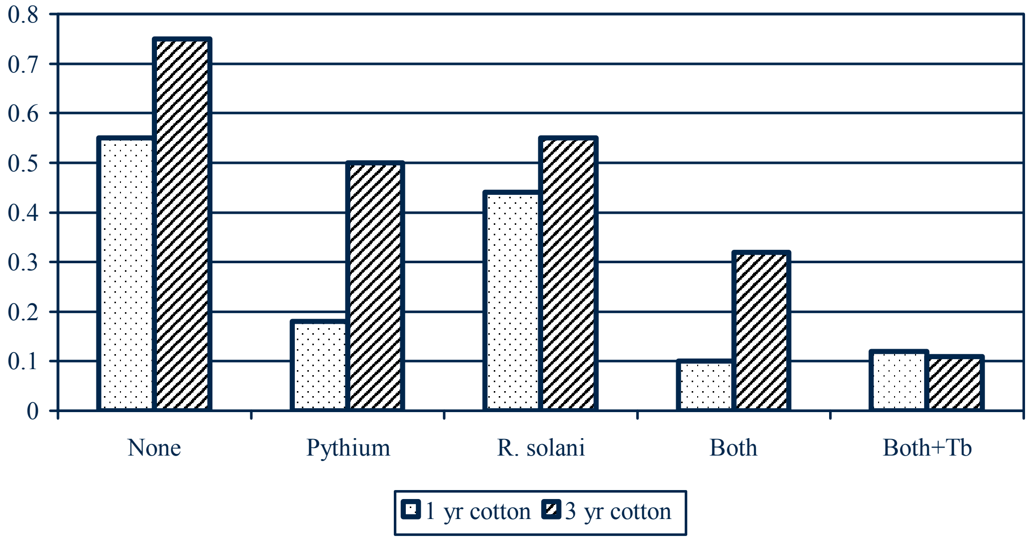


Figure 2. The effect of fungicide seed treatments on hypocotyl lesions. Seed was planted with no fungicide (None), treated with a fungicide active against *Pythium* (Allegiance FL) (labeled Pythium), treated with a fungicide active against *R. solani* (Vitavax-PCNB) (labeled R. solani), treated with both Allegiance and Vitavax-PCNB (labeled both), or treated with fungicides active against *T. basicola*, *R. solani*, and *Pythium* (Baytan 30 + Allegiance FL + Ascend) (labeled Both + T. b). Means are an average based on fields with a history of only a single cotton crop, or with at least three cotton crops.

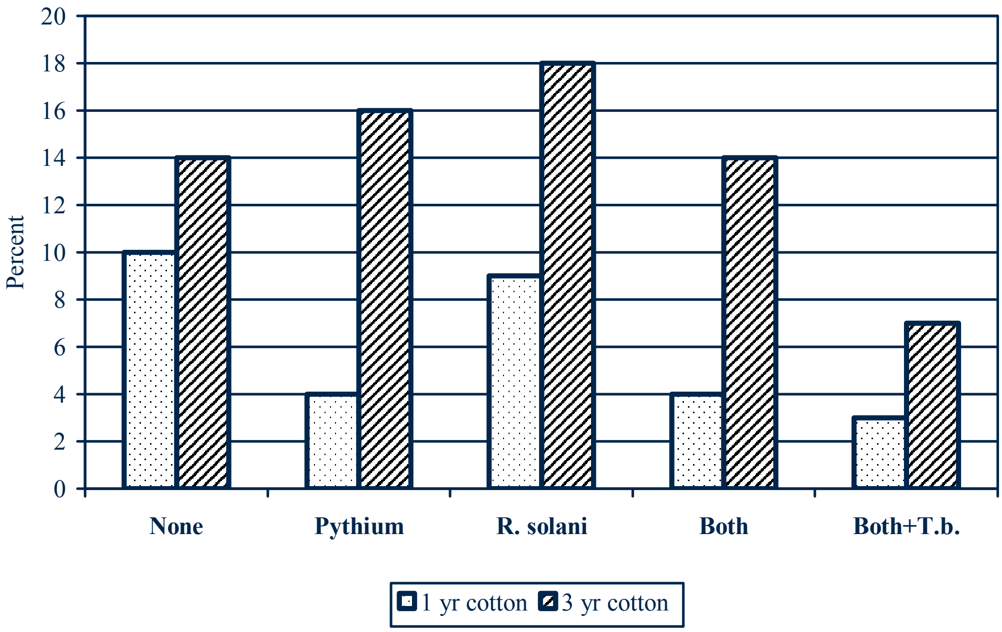


Figure 3. Effect of fungicide seed treatments on percent root necrosis. Seed was planted with no fungicide (None), treated with a fungicide active against *Pythium* (Allegiance FL) (labeled Pythium), treated with a fungicide active against *R. solani* (Vitavax-PCNB) (labeled R. solani), treated with both Allegiance and Vitavax-PCNB (labeled both), or treated with fungicides active against *T. basicola*, *R. solani*, and *Pythium* (Baytan 30 + Allegiance FL + Ascend) (labeled Both + T. b). Means are an average based on fields with a history of only a single cotton crop, or with at least three cotton crops.