EFFICACY OF BIOLOGICAL AGENTS AS SEED TREATMENTS FOR COTTON STAND ESTABLISHMENT

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Abstract

Potential biological control agents were evaluated for control of seedling diseases of cotton at twelve sites across the cottonbelt. Seedling disease pressure varied across sites and seedling survival ranged from 17 to 86% of seed planted. Several biological agents significantly increased stands of seedlings at one or more sites over the nontreated control. *T. virens* (TV-117and Tv-111) significantly increased stands at four sites. *Rhizoctonia solani* was the most prevalent seedling disease pathogen isolated form seedlings.

Introduction

Soilborne plant pathogens limit production and quality of essentially all plant species. Cotton is particularly vulnerable to seedling diseases caused by *Pythium spp.* and *Rhizoctonia solani.* Crop losses across the cottonbelt over the past 46 years have averaged 2.8 percent annually.

Control options for seedling disease pathogens are limited and frequently incompatible with environmental goals. Soil fumigants, fungicides and seed treatment chemicals are becoming less available for disease control, and genetic resistance to these pathogens is generally lacking. The introduction of biocontrol agents that reduce disease severity will provide a critical component of an effective program for disease control.

While an extensive national chemical seed treatment trial exists for cotton, none exists for biological seed treatments. This lack of uniform testing of candidate biocontrol agents has limited their development and use. Regional Research Project S-269 attempts to fill this gap by conducting limited standardized biological seed treatment tests for control of seedling diseases of cotton.

Materials and Methods

Seven fungal, eight bacterial and two fungal-bacterial combination treatments (Table 1) were evaluated for control of cotton seedling disease compared to nontreated and standard chemical seed treatments at 12 sites in 11 states as part of a cooperative effort of Southern Regional Research Project S-269. A common protocol was estqblished for these evaluations. Plots were single rows, 25-40 ft long on 30-40 in. centers, planted with 100 seeds. The experiment was arranged in a randomized complete block design with five replications.

A common lot of Deltapine 50 nontreated seed was used for all treatments.
Candidate biocontrol agents and carrier controls were, except for *Trichoderma harzianum* (T-22), applied by suppliers of the isolates. Immediately after treatment, seed were assembled at a central location (Mississippi), and packets were prepared , along with appropriate carrier and

chemical controls, for shipment to individual sites for evaluation. *T. harzianum* (T-22) was applied to seed by cooperators at each test site prior to planting. Seedling survival was determined at 28 days after planting (28 DAP). Root systems from ten seedlings from the nontreated control at each site were plated for pathogen identification on 2% water agar amended with 10 mg^{-L} rifampicin, 250 mg^{-L} ampicillin and 0.5 μl^{-L} Danitol (Valent Chemical Co.). Seedling survival data was analyzed by the GLM procedure using SAS (SAS Institute Inc., Cary, NC). Means of seedling counts were separated by Fisher's Protected LSD (P = 0.05).

Results and Discussion

Planting dates ranged from 15 April 98 to 19 May 98. Mean seedling survival ranged from 17 to 86%, suggesting a difference in seedling disease pressure across sites. There was a significant site, treatment, and site x treatment effect for counts of seedlings at 28 DAP indicating that treatment response was dependent upon environment at the particular site. The combination chemical control treatment significantly increased seedling survival over the nontreated check at seven of twelve sites. One or more biological treatments significantly increased stands (Alabama, Arkansas, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina and Tennessee) over the nontreated control and were equal to one or more of the standard chemical seed treatments. Several biological treatments increased stands significantly over the nontreated control at more than one site (Figure 1). *T. virens* (Tv-117 and Tv-111) significantly increased stands at four sites. To the contrary, the *T. virens* (G-6)- *P. macerans* (GB49) combination significantly reduced stands at four sites. *R. solani* was the most frequently isolated pathogen from seedlings from Alabama, Arkansas, Georgia, Louisiana, North Carolina, South Carolina and Texas. Seedlings from Mississippi yielded both *R. solani* and *Thielaviopsis basicola*. *T. basicola* was the most frequently isolated pathogen from cotton seedlings from Tennessee.

Acknowledgement

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Table 1. List of treatments and isolate sources.

Identification	Source
Trichoderma virens (TV-111)	Howell
T. virens (TV-116)	Howell
TV-116 + *Paemibacillus macerans* (GB49)	Howell
T. virens (TV-117)	Howell
T. virens (G-6)	Howell
G-6 + GB49	Howell
TV ck	Howell
T. harzianum (OK110)	Conway
Laetisaria arvalis (OK206)	Conway
Burkholderia cepacia (OK1)	Conway
Pseudomonas fluorescens (Dagger G)	Rothrock
B. cepacia (5.5b)	Benson
CMC ck	Benson
T. harzianum (T-22)	Bioworks
P. macerans (GB49)	Gustafson
P. pabuli (GB51)	Gustafson
Bacillus sp. (GB35)	Gustafson
B. subtilis (GB29)	Gustafson
B. subtilis (GB03)	Gustafson
Bilt-plate ck	Gustafson
B. megaterium (mix)	Schneider
Talc/arabinose ck	Schneider
Vitavax PCNB/Metalaxyl ck	Batson
Metalaxyl ck	Batson
Vitavax PCNB ck	Batson
Nontreated ck	Batson

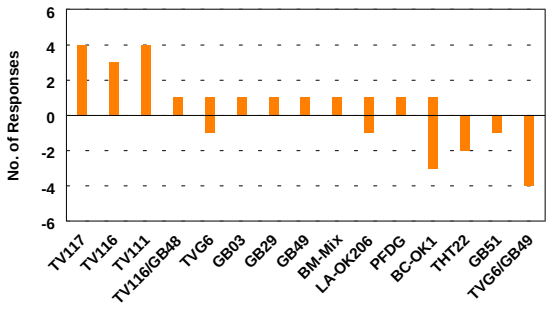

Figure 1. Number and direction of significant comparisons for biologicals to the nontreated control.