

BIOLOGICAL AND CHEMICAL CONTROL OF COTTON SEEDLING DISEASE IN ALABAMA

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Abstract

The low rate of in-furrow granular application of pentachloronitrobenzene (PCNB) and etridiazole combined with *Bacillus* spp. at 5.5 lb/A improved seedling stand, less skippy, promoted early bloom set and boll set based on percent open bolls, and increased seed cotton yield. The high rate of PCNB/etridiazole/*Bacillus* spp. applied at 7.4 lb/A increased seedling vigor and reduced severity of root rot. The low rate of application of azoxystrobin (5.6 fl oz/A) increased root weight. A beneficial compatible relationship between PCNB-etridiazole and *Bacillus* spp. was demonstrated by controlling *Pythium* spp.

Introduction

Seedling diseases cause the largest yield losses of any cotton disease in the United States (Wang and Davis, 1997). A complex of pathogens has been implicated to cause seedling diseases which includes *Rhizoctonia solani*, *Pythium* spp., *Thielaviopsis basicola*, *Fusarium* spp., among others. Fungicide seed treatments have been the most effective control measure to combat seedling diseases. Few studies have been conducted to control cotton seedling diseases using a bacterial control agent as an alternative approach or supplement to fungicides. The main objective of the study was to evaluate the efficacy of in-furrow granular and liquid formulations of fungicides and *Bacillus* spp. on seedling emergence, skips, vigor, root weight, root disease index, earliness, and seed cotton yield.

Discussion

Treatments

DPL 33B variety was planted late April. Planting rate was at 5 seeds per ft row. Plot size was 4 rows x 25 ft x 3 ft with 4 replications arranged in a randomized complete block design. All rows were inoculated with *Pythium* spp. on millet grains applied at the rate of 3 g per 25 ft. The two middle rows were evaluated for agronomic characters. Three granular and five liquid formulations were applied which included: 1=metalaxyl + PCNB (.075 fl oz/1000 rft

+ 64 fl oz/A); 2=azoxystrobin (5.6 fl oz/A); 3=azoxystrobin (8.4 fl oz/A); 4=etridiazole (3 fl oz/A); 5=etridiazole (4 fl oz/A); 6=PCNB/etridiazole/*Bacillus* spp. (5.5 lb/A); 7=PCNB/etridiazole/*Bacillus* spp. (7.4 lb/A); 8=PCNB/etridiazole (7 lb/A); 9=untreated control (black seed check).

Soil Temperature and Rainfall

Soil temperature at planting (4 in. depth) was about 55 °F and 65 °F in Belle Mina and Headland, respectively. Generally, there was a gradual increase in soil temperature till June and July followed by a gradual decline till October. Throughout the growing season was generally dry especially in Belle Mina and rainfall fluctuated much in Headland with more than 14 in. of rain in September that occurred late in the growing season.

Seedling Stand, Skip, and Vigor

At 14 days after planting (DAP), low rate of PCNB/etridiazole/*Bacillus* spp. applied at 5.5 lb/A increased seedling stand (75) in Belle Mina. PCNB/etridiazole (applied at 7 lb/A) and the high rate of PCNB/etridiazole/*Bacillus* spp. (applied at 7.4 lb/A) with 74 and 71 stand counts per 50 ft row, respectively were equally effective in improving stand compared to the untreated control with 32 stand counts.

In Belle Mina, at 28 DAP, low rate of PCNB/etridiazole/*Bacillus* spp. had low skip index (1.0) including PCNB/etridiazole (1.6), the high rates of etridiazole alone (2.2) and PCNB/etridiazole/*Bacillus* spp. (2.6) compared to the untreated control (9.8).

At 14 DAP, the high rate of PCNB/etridiazole/*Bacillus* spp. improved seedling vigor (4.8) followed by the two rates of azoxystrobin (4.2) compared to the untreated control (3.2) under Headland conditions.

Root Weight and Root Disease Index

In Headland, at 42 DAP, increase in root weight was provided by the low rate of azoxystrobin followed by the high rates of azoxystrobin and PCNB/etridiazole/*Bacillus* spp. with 2.8, 2.3, and 2.2 g fresh weight, respectively compared to the untreated control (1.7 g). However, evaluation of root disease index in Belle Mina indicated that the high rate of fungicide-biological combination had less root discoloration (1.3) followed by the low rate of azoxystrobin (1.4).

Earliness and Yield

At 100 DAP, the low rate of fungicide-biological combination promoted earliness based on percent open bolls (55.9%) in Headland. This was followed by the in-furrow application of etridiazole (applied at 3 fl oz/A), high rates of fungicide-biological combination, and etridiazole (applied at 4 fl oz/A) with 46.5%, 46.2%, and 46% open bolls, respectively.

In Headland, the low rate of PCNB/etridiazole/*Bacillus* spp. provided an increase in seed cotton yield followed by azoxystrobin (applied at 8.4 fl oz/A), and etridiazole (applied at 3 fl oz/A) with 2686, 2483, and 2403 lb/A, respectively.

Incorporation of in-furrow fungicides and a biological control agent such as *Bacillus* spp. could provide opportunities for enhancement and greater efficiencies in suppression of seedling disease (Zaki et al., 1998; Conway et al., 1997).

Summary

The low rate of in-furrow granular application of pentachloronitrobenzene (PCNB) and etridiazole combined with *Bacillus* spp. at 5.5 lb/A improved seedling stand, less skippy, promoted early bloom set and boll set based on percent open bolls, and increased seed cotton yield. Increased stands and less skips were also observed with PCNB/etridiazole. The high rate of PCNB/etridiazole/*Bacillus* spp. applied at 7.4 lb/A increased seedling vigor and reduced severity of root rot. Increased seedling vigor and less root rot severity were also provided with the low rate of application of azoxystrobin (5.6 fl oz/A). The low rate of application of azoxystrobin (5.6 fl oz/A) increased root weight followed by the high rates of PCNB/etridiazole/*Bacillus* spp. and azoxystrobin. A beneficial compatible relationship between PCNB- etridiazole and *Bacillus* spp. was demonstrated by controlling *Pythium* spp. at two locations in Alabama.

References

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- Zaki, K., I. J. Misaghi, A. Heydari, and M. N. Shatla. 1998. Control of cotton seedling damping-off in the field by *Burkholderia (Pseudomonas) cepacia*. *Plant Dis.* 82: 291-293.

Table 1. Efficacy of in-furrow fungicides and a biological agent on seedling stand, skip, and vigor at 28 DAP.

Treatment	Stand	Skip Index	Vigor
1	65	3.4	4.0
2	60	5.0	4.2
3	57	4.0	4.2
4	60	4.4	4.0
5	59	2.2	3.9
6	75	1.0	3.8
7	71	2.6	4.8
8	74	1.6	3.5
9	34	9.8	3.2

Stand counts per 50 ft row assessed 28 DAP

Skip Index (1=1-1.5 ft gap between seedlings in a ft row; 10=5.5-6 ft gap between seedlings in a ft row) assessed 28 DAP

Vigor (1=poor vigor; 5=excellent vigor) assessed 28 DAP

Table 2. Effect of in-furrow fungicides and a biological control agent on root weight and root disease index at 42 DAP, % open bolls at 100 DAP, and seed cotton yield.

Treatment	Root Weight Index (g)	Root Disease	%Open Bolls	Yield (lb/A)
1	2.1	1.7	43.8	2178
2	2.8	1.4	42.1	2214
3	2.3	1.7	42.9	2483
4	2.0	2.1	46.5	2403
5	2.1	1.9	46.0	2040
6	2.1	1.9	55.9	2686
7	2.2	1.3	46.2	2287
8	1.8	1.7	40.2	1888
9	1.7	2.5	39.3	2055

Root disease index assessed at 42 DAP (1=no symptoms; 5=>50% of root system discolored)