Effect of Soybean Seed Treatments on Diseases and Yield

RFR-A1999

Shrishail S. Navi, associate scientist
Ruye Liu, graduate research assistant
XB Yang, professor
Department of Plant Pathology and Microbiology

Introduction

Damping off/root rot (caused by Oomycete pathogens *Pythium* spp.), *Phytophthora* root rot (caused by *Phytophthora sojae), Rhizoctonia* root/stem rot (caused by a Basidiomycete fungus *Rhizoctonia solani* Kühn) and sudden death syndrome (caused by an Ascomycete fungus *Fusarium virguliforme)* are among the most common soilborne diseases of soybean. These pathogens cause problems in stand establishment, reduce seedling emergence, pre- and post-emergence damping off, kill emerged seedlings, and in severe cases leads to replanting. Seed treatment is the most widely used method to reduce losses due to these diseases in interfering life cycle of the pathogens. The objective of this study was to assess efficacy of seed treatments on disease incidence and grain yield.

Material and Methods

Experiment set up. Trials were set in a randomized complete block design (RCBD) with six replications each with 10 ft wide (four 30 in. rows) x 17.5 ft long plots at the Hinds Research Farm and Curtiss Research Farm, Ames, Iowa. Commercially untreated soybean seed (Pioneer 22T24X and Pioneer 27A17X) was procured from DuPont Pioneer (1116 Giddings St, Kelley, Iowa 50134). Seed were treated at Green and Grow Inc., or at Eurofins facility. The treated and untreated seeds of both the varieties were subsampled at 700 seeds in 8.5 cm x 20.3 cm envelopes per replication of 4-row plots. Also, *Rhizoctonia* inoculum increased on white milo was subsampled at 350 cc per envelope (8.5 cm x 20.3 cm) per 4-row plot (at 5 cc linear ft).

Seeds from each individual treatment and the inoculum subsampled separately in envelopes were placed into a 4-row cone plot planter and planted using an ALMACO 4-row plot planter. Post-emergence herbicide was applied to plots when required. Plots were evaluated for stand counts, vigor rating at V5 on a 1 (poor) to 9 (excellent), symptomatic plants of *Rhizotonia*, *Phytophthora*, sudden death syndrome (SDS), and white mold. Dates of planting, stand counts, vigor rating, disease rating, and harvesting details of both the locations is provided in Tables 1 and 2. Also, the plots were evaluated for vigor rating at the V5 growth stage on a 1 (poor) to 9 (excellent) vigor rating scale. Disease incidence was calculated by the formula (infected plants x 100) ÷ total plants in each plot, and SDS index was calculated by the formula: (SDS incidence x SDS Severity)/9. Plots were harvested using an ALMACO Research Plot Combine. Yields were adjusted to 13 percent grain moisture and measured in bushels/acre.

Data analysis. Effects of seed treatments on soybean stand counts, plant vigor, disease incidence and grain yields were analyzed using PROC ANOVA in SAS 9.4. (SAS, LLC, Cray, NY). Fisher's least significant difference was used to detect the significant differences among the means (P = 0.05).

Results and Discussion

Hinds Farm. *Rhizoctonia* root rot (RRR) was observed on both varieties. No significant difference in RRR incidence percent and in grain yield was observed in treated plots compared with either untreated and un-inoculated (UT and UI), or untreated but

inoculated (UT and I) plots on variety P22T24X. However, the yield advantage of 1.48 bushels/acre and 2.35 bushels/acre was observed in plots treated with GGI19A104 over UT and UI and UT and I treatments, respectively (Table 1). On variety P27A17X, significantly low RRR incidence (%) was observed in plots treated with GGI19A105 compared with UT and I plots. Significant yield difference was observed between plots treated with GGI19A105 and GGI19A104, but not over UT and I and or UT and UI plots (Table 1). Similar to P22T24X, the yield advantage of 1.65 bushels/acre and 3.22 bushels/acre was observed in plots treated with GGI19A104 over UT and UI and UT and I treatments, respectively (Table 1).

Curtiss Farm. *Phytophthora* root rot (PRR) and SDS was observed on both the varieties, but on variety P27A17X, in addition to PRR and SDS, white mold was observed (Table 2).There were no significant differences in SDS-DX and white mold incidence among the treatments on both varieties. However, plots treated with GGI19A104 and GGI19A105 showed significantly lower PRR incidence percent compared with UT and UI treatment on variety P27A24X but not on P27A17X. In both varieties, no significant yield difference was observed among the treatments, but yield advantage of 0.02 to 0.09 bushels/acre in plots treated with GGI19A104 over UT and UI and UT and I plots in variety P22T24X was recorded. Yield advantage was recorded of 1.42 bushels/acre and 1.65 bushels/acre in plots treated with GGI19A104 and 1.61 bushels/acre and 1.84 bushels/acre in plots treated with GGI19A105 over UT and UI and UT and I treatments, respectively (Table 2).

At both farm locations, plots were inoculated only with *R. solani* (except treatment 1) at planting, and RRR was observed at the Hinds Farm but not at the Curtiss Farm. On the contrary, PRR, SDS, and white mold diseases were observed at the Curtiss Farm but not at the Hinds Farm. Interestingly, across varieties, grain yields at Hinds Farm varied between 43 and 50 bushels/acre (Table 1), and at the Curtiss Farm, between 64 and 70 bushels/acre (Table 2). Differences in diseases and yield ranges between these farms probably was due to soil types (well-drained soils at Hinds and black soil at Curtiss), and planting dates (Hinds Farm, May 16 and Curtiss Farm, June 3).

Acknowledgements

Authors thank Greg Gebhart, Plant Pathology and Microbiology, for planting; Kent Berns**,** Central Iowa Farms, for field operations; Jeff Erb, Ag Engineering/Agronomy Farm for harvesting; and Gary Nijak, Jr, President and CEO, Green and Grow, Inc. for funding.

Table 1. Efficacy test of seed treatments with Green and Grow products against *Rhizoctonia solani* (RS) on two soybean varieties at ISU Hinds Farm, Ames, IA.[3, 4]

Seed treatments[1]	Stand Counts	Plant vigor	RS, Inc.%	Yield bu/ac	Yield change (bu/ac) over UT and UI	Yield change (bu/ac) over UT and I
Variety P22T24X						
1. UT and UI	565.83a	8.00a	5.06ba	44.55a	0	0.87
2. UT and I	530.17ba	7.75a	5.43ba	43.68a	-0.87	0
3. Fluidoxonil (0.08 oz/cwt) and Metalaxyl (0.5 oz/cwt)	513.50b	7.75a	6.36a	43.04a	-1.51	-0.64
4. Biofungicide (1.04 oz/cwt)[2]	521.17b	8.33a	4.61b	46.03a	1.48	2.35
5. Combination of 3 and 4	540.67ba	8.00a	5.04b	43.96a	-0.59	0.28
Variety P27A17X						
1. UT and UI	446.67a	7.92ba	5.12b	48.05ba	0	1.57
2. UT and I	404.33a	7.92ba	7.43a	46.48ba	-1.57	0
3. Fluidoxonil (0.08 oz/cwt) and Metalaxyl (0.5 oz/cwt)	447.17a	7.75b	6.51ba	46.45ba	-1.60	-0.03
4. Biofungicide (1.04 oz/cwt)[2]	432.17a	8.33a	5.57ba	49.70a	1.65	3.22
5. Combination of 3 and 4	448.17a	7.92ba	5.30b	45.87b	-2.18	-0.61

[1]UT and UI = untreated and un-inoculated, UT and I = untreated but inoculated with *R. solani* fermented on white milo.
[2]Green and Grow cannot fully describe the biofungicide at this point because of intellectual property agreements.
[3]Means are average of six replications. Planted May 16, stand counts May 31, June 21, September 25, vigor and symptomatic plant counts June 21, harvest October 20.
[4]Means within column followed by the same letter(s) are not significantly different from each other at 5% level of significance ($P < 0.05$). Stand counts are from all four rows of each plot.

Table 2. Efficacy test of seed treatments with Green and Grow products against *Rhizoctonia* root rot, sudden death syndrome, white mold and *Phytophthora* root rot, on two soybean varieties at ISU Curtiss Farm, Ames, IA.[1,4,5]

Seed treatments[2]	Stand Count	Plant vigor	SDS DX	WM, Inc. %	PRR, Inc.%	Yield bu/ac	Yield change (bu/ac) over UT and UI	Yield change (bu/ac) over UT and I
Variety P27A24X								
1. UT and UI	585.33a	8.00a	0a	0a	4.98a	69.66a	0	0.07
2. UT and I	547.50a	8.33a	0a	0a	4.30ba	69.59a	-0.07	0
3. Fluidoxonil (0.08 oz /cwt) and Metalaxyl (0.5 oz/cwt)	578.50a	8.00a	0.05a	0a	3.74ba	69.68a	0.02	0.09
4. Biofungicide (1.04 oz/cwt)[3]	582.83a	8.00a	0a	0a	3.06b	67.73a	-1.93	-1.86
5. Combination of 3 and 4	554.67a	8.00a	0a	0a	3.08b	66.97a	-2.69	-2.62
Variety P27A17X								
1. UT and UI	501.50a	6.50b	1.48a	0.00a	6.82a	64.85a	0	0.23
2. UT and I	463.00a	7.83a	1.91a	0.00a	4.64a	64.62a	-0.23	0
3. Fluidoxonil (0.08 oz /cwt) and Metalaxyl (0.5 oz/cwt)	498.83a	7.33ba	1.59a	0.00a	4.16a	64.16a	-0.69	-0.46
4. Biofungicide (1.04 oz/cwt)[3]	480.33a	8.17a	1.82a	0.04a	2.49a	66.27a	1.42	1.65
5. Combination of 3 and 4	486.17a	7.83a	2.15a	0.03a	4.04a	66.46a	1.61	1.84

[1]Plots were inoculated (except treatment 1) with *Rhizoctonia solani* fermented on white milo.

[2]UT and UI = untreated and un-inoculated, UT and I = untreated but inoculated with *R. solani* fermented on white milo.

[3]Green and Grow cannot fully describe the biofungicide at this point because of intellectual property agreements. SDSDX = sudden death syndrome (*Fusarium virguliforme*) disease index = (SDS incidence x SDS Severity)/9. WM = white mold caused by *Sclerotinia scleotiorum*, PRR= *Phytophthora* root rot caused by *Phytophthora sojae.*

[4]Planted June 3, stand counts June 15, July 1, vigor July 1, and SDS, WM and PRR ratings September 17 and harvest October 16.

[5]Means are average of six replications. Means within column followed by the same letter(s) are not significantly different from each other at 5% level of significance ($P < 0.05$). Stand counts are from all four rows of each plot. Note: SDS, WM, and PS were natural infestations.