Evaluation of soybean fungicide seed treatments

Andrew Kness, University of Maryland Extension
Nathan Kleczewski, University of Delaware

Background and Justification

Soybean fungicide seed treatments are touted as important, value-added products to successful soybean production by seed and chemical companies. Additionally, some growers choose to utilize fungicide seed treatments even when fungal soilborne disease potential is low. Reasons for this include perceived plant health benefits and insurance against potential disease. However, there is no unbiased University research in Maryland, Delaware, or the mid-Atlantic region, to support or refute this claim. Research in other areas of the US show that fungicide seed treatments may have a positive effect on protecting soybeans from soilborne diseases, improve stands, increase yields, and may increase profitability compared to untreated controls in highly infested fields[1-4]. The question still remains if these seed treatments are effective or economical in low-pressure disease situations. During the first year of a multi-year project, we measured the effect of fungicide seed treatments on soybean emergence, stand, fungal disease, test weight and yield to determine if fungicide seed treatments are worth the extra cost under typical production scenarios here in Maryland and Delaware.

Objectives

1. Determine the yield impact (if any) of fungicide seed treatments on soybean yield under standard management practices for various locations in Maryland and Delaware.
2. Determine the effects of fungicide seed treatments on soybean emergence and stands under standard management practices for the various locations.
3. Determine if there are any economic benefits of fungicide seed treatments based on a yield response (if any) and the cost of the seed treatment (economic return).

Methods

- Commercial soybean variety SS 4514N R2 was chosen for the trials because of its good yield stability across the region and resistance to soybean cyst nematode. Seed was treated by Southern States in Bridgeville, DE with commercial rates of: Acceleron (metalaxyl + fluxapryoxad + pyraclostrobin), Trilex (trifloxystrobin) and ILeVO (fluopyram). Untreated seed was included as a control.

- Treated and untreated seed was direct seeded into no-till soybean residue on 4 site locations (Western Maryland Research & Education Center (WMREC), Keedysville, MD; Central Maryland Research & Education Center (CMREC), Beltsville, MD; Wye Research & Education Center (Wye), Queenstown, MD; and Carvel Research & Education Center (UDREC), Georgetown, DE). We chose to plant into soybean residue as a “worse case” management scenario. Planting into soybean residue will maximize our chances observing disease, which has potential to be managed by the seed treatments. Plots were sown on 15 inch rows, 10 feet wide by 30 feet

long, arranged in a spatially-balanced complete block design[5] to minimize field variation. Each treatment was replicated five times per location to maximize statistical power. Control treatments were untreated soybean seed. Planting dates for the various locations are shown in Table 1.

- Fertility and crop management (weeds and insects) were managed in accordance with Extension guidelines. Foliar fungicides were not used.
- Weather data was collected throughout the growing season via weather stations located on the research farms and used to monitor and evaluate growing conditions and disease potential.
- Emergence and stand counts were conducted 14 days after planting by counting the number of fully emerged and delayed emerged plants per foot of row.
- Because of the lack of root and stem diseases, disease ratings were omitted.
- Plots were harvested with a small plot combine at maturity. Harvest dates are shown in Table 1.
- Data were transformed to fit a normal distribution and analyzed using a mixed model. Treatment effects were separated statistically using Fisher's LSD.
- Yield data was used in conjunction with the cost of the seed treatments, crop budgets for growing no-till soybeans in Maryland, and market price of soybean to determine if there was any economic benefit to using soybean fungicide seed treatments.

Table 1. Plant and harvest dates.

Location	Planted	Harvested
UDREC	May 17, 2017	October 19, 2017
WMREC	May 31, 2017	October 25, 2017
Wye	June 6, 2017	October 23, 2017
CMREC	July 3, 2017*	November 21, 2017

*delayed due to wet weather and equipment failure.

Results and Discussion

Table 2 shows a significant treatment effect (P=0.0203) on relative emergence (calculated as a percent compared to the mean emergence for untreated control for the trial location) but no significant treatment effect (P=0.3023) on yield or test weight (P=1.000).

Table 2. Mix model ANOVA results for all sites replicated in Delaware and Maryland.

	Relative Emergence		Yield		Test Wt.	
Source	**F Ratio**	**Prob > F**	**F Ratio**	**Prob > F**	**F Ratio**	**Prob > F**
Treatment	3.4761	0.0203	1.2385	0.3023	0.2944	1.000

Figure 1 shows treatment separation for relative emergence. The seed treatments Acceleron and Trilex had the greatest emergence with a relative emergence of 108% and 105%, respectively. ILeVO had the

poorest emergence at 95.7% relative emergence across all locations. Fluopyram, the active ingredient in ILeVO, is known to stunt plants and potentially decrease germination under some conditions.

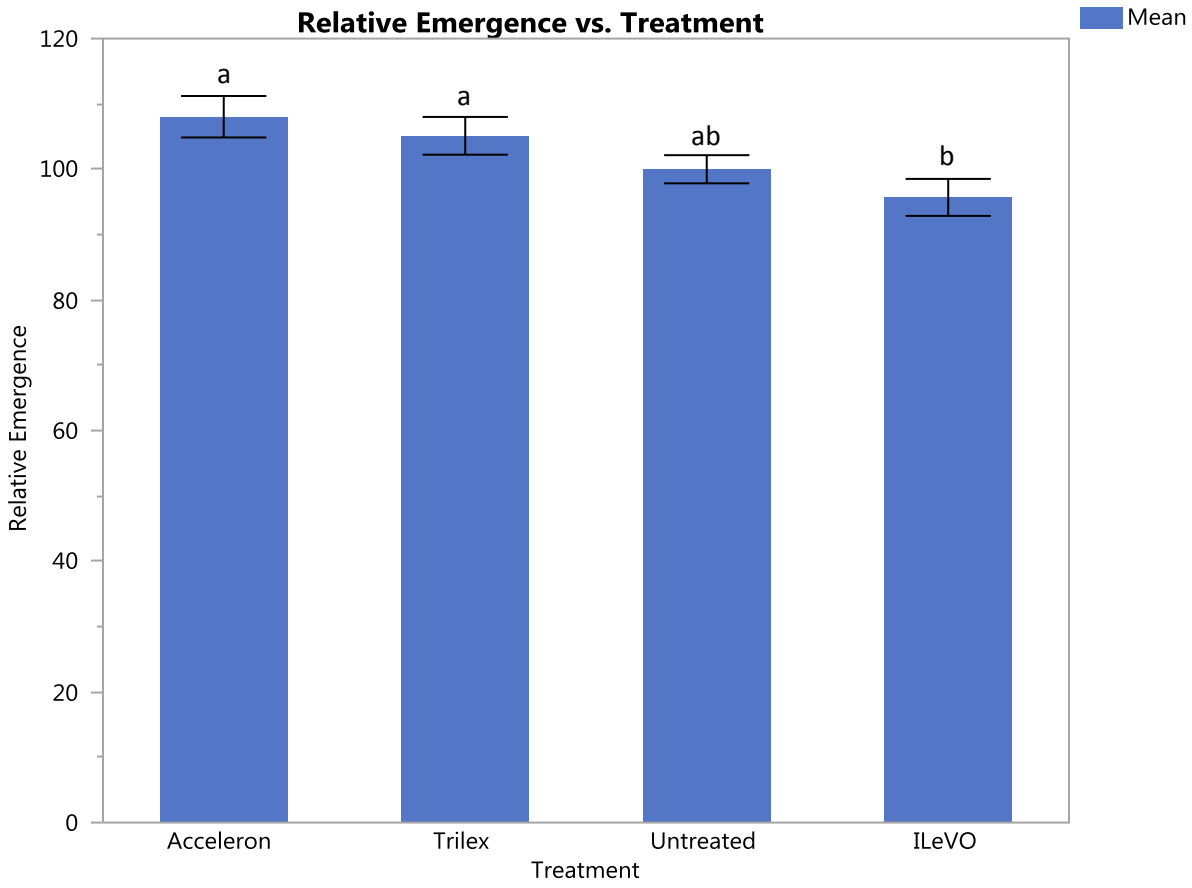


Figure 1. Relative emergence vs. treatment for all tested locations. Each error bar is constructed using 1 standard error from the mean. Treatments connected with the same letter are not significantly different from each other (α=0.05).

Figure 2 shows treatment effect on average yield across all locations. There were no significant differences in yield between treatments. Figure 3 shows average yield vs. treatment broken out by location. There was a significant treatment effect at two locations (Wye and UDREC) where fungicide seed treatments significantly decreased yield compared to the untreated control. At those locations, untreated controls yielded the highest and ILeVO the lowest.

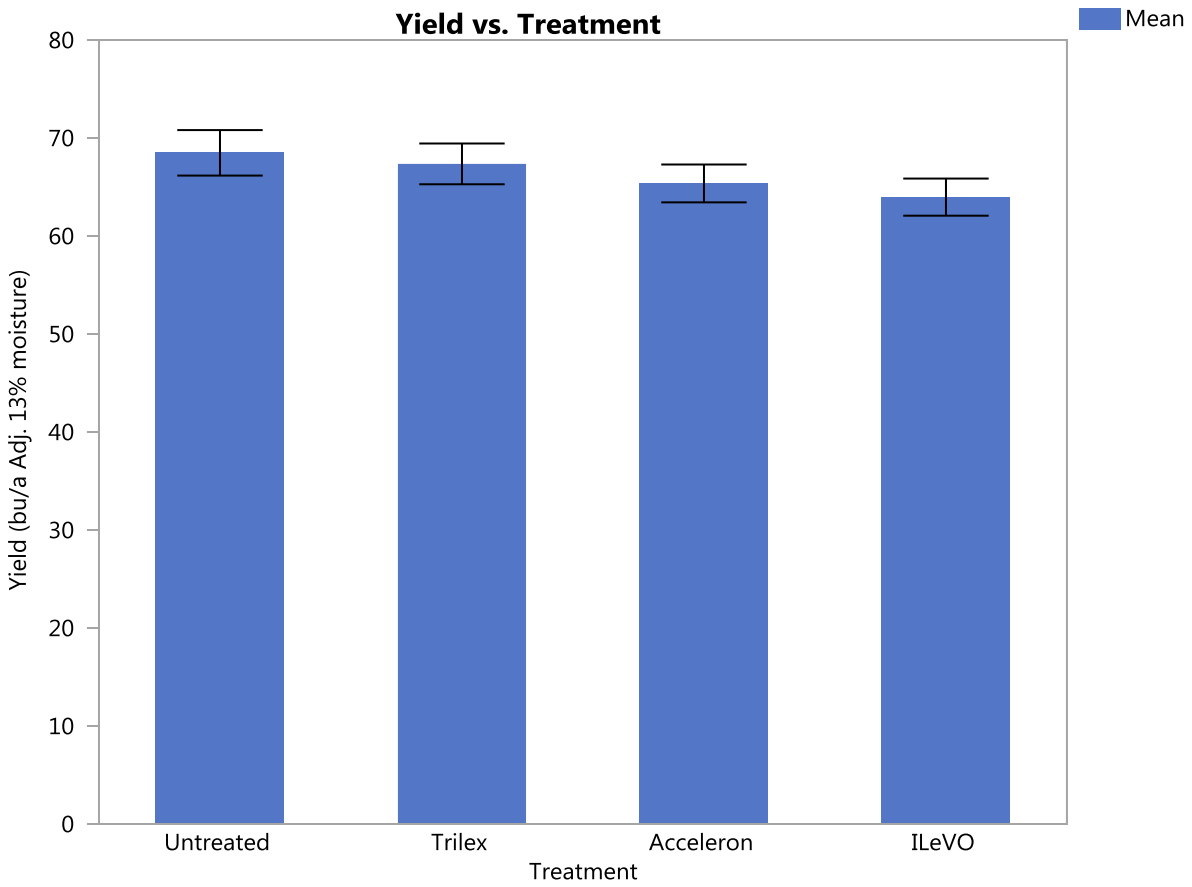
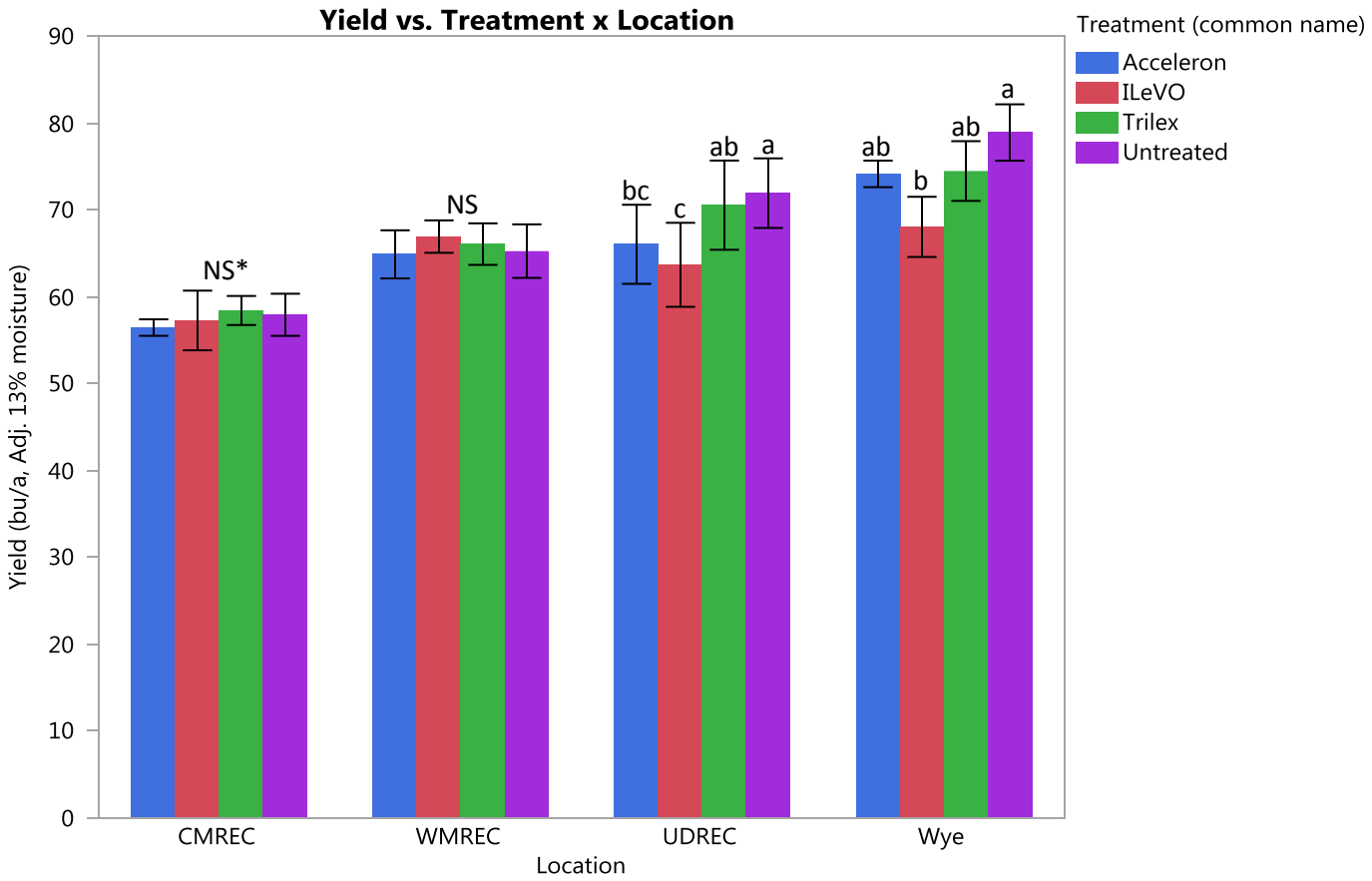


Figure 2. Yield (bu/a) vs. treatment for all tested locations. Each error bar is constructed using 1 standard error from the mean. There was no significant treatment effect on yield (α=0.05).



*NS = not significant

Figure 3. Each error bar is constructed using 1 standard error from the mean. Treatments within the same trial location connected by the same letter are not significantly different from each other (α=0.05).

As part of an economic analysis, we calculated net profit for each treatment based on planting population (150,000 seeds/acre), local market price for soybean ($9.10), retail prices for seed ($50.95/bag of 140,000 seeds), seed treatment (Acceleron=$19.20/bag, Trilex=$5.50/bag, ILeVO=$15.00/bag) and production costs, including variable and fixed costs. Variable and fixed costs were calculated using the 2017 University of Maryland Crop Budget Calculator[6].

Table 3 shows a significant treatment effect on net profit per acre. As seen in figure 4, untreated soybean seed returned the highest average profit per acre ($368.31) across all locations, statistically greater than all other treatments (P=0.0002). Seed treatment ILeVO returned the lowest net income, with an average across all locations of $193.29 per acre.

Table 3. Mix model ANOVA results for net profit for all sites replicated in Delaware and Maryland.

	Net income	
Source	**F Ratio**	**Prob > F**
Treatment	7.6032	0.0002

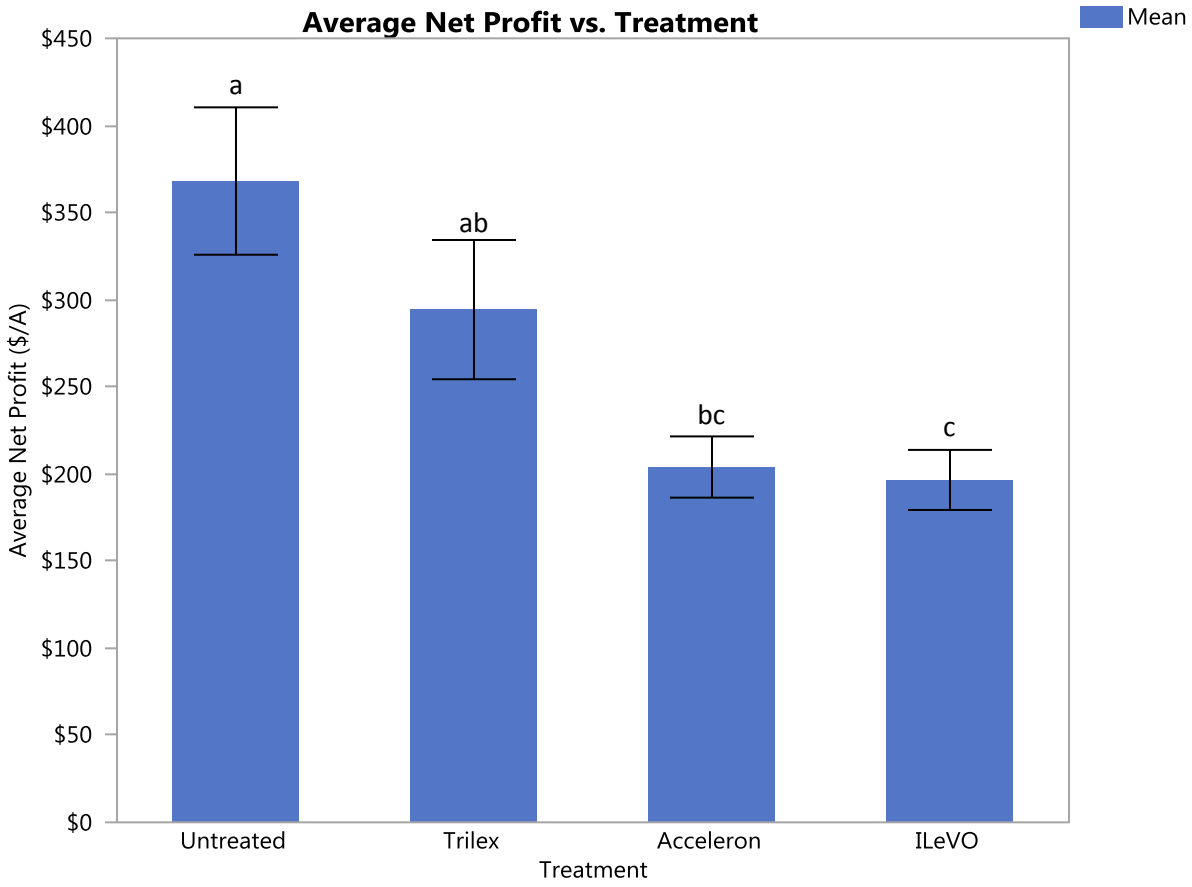


Figure 4. Each error bar is constructed using 1 standard error from the mean. Treatments connected with the same letter are not significantly different from each other (α=0.05).

Summary

Data from first-year trials indicate that fungicide seed treatments may increase soybean emergence over untreated seed in low-pressure soilborne disease situations; however, this increase in emergence and stand did not translate into a statistically significant increase in yield when compare to untreated controls. Yields were also significantly lower in treated seed at two of the locations. In addition, fungicide seed treatments did not increase profitability; the added expense for treated seed coupled with no increase in yield resulted in an average loss of $136.50 per acre compared to untreated seed.

Using fungicide seed treatments on soybeans may not provide any significant economic benefit when planted in fields that are not conducive for soilborne disease development and/or that do not have a history of soilborne diseases. This is only the first year of a multi-year study; more data needs to be collected over multiple years and sites to improve the robustness of the dataset and to make sound production recommendations for growers in our region.

Acknowledgements

We would like to thank the Maryland Soybean Board for funding this work; University of Maryland, Agriculture Experiment Station and staff, University of Maryland Variety Trials staff, and University of Delaware, Carvel Research and Education Center and staff, for helping plant, manage and harvest these trials.

References

1. Bradley, C. A. 2008. Effect of fungicide seed treatments on stand establishment, seedling disease, and yield of soybean in North Dakota. Plant Dis. 92:120-125.

2. Poag, P. S., M. Popp, J. Rupe, B. Dixon, C. Rothrock, and C. Boger. 2005. Economic Evaluation of Soybean Fungicide Seed Treatments. Agron. J. 97:1647-1657. doi:10.2134/agronj2005.0095.

3. Mueller, D. S., Hartman, G. L., and Pedersen, W. L. 1999. Development of sclerotia and apothecia of Sclerotinia sclerotiorum from infected soybean seed and its control by fungicide seed treatment. Plant Dis. 83:1113-1115.

4. Guy, S. O., and E. S. Oplinger. 1989. Soybean Cultivar Performance as Influenced by Tillage System and Seed Treatment. J. Prod. Agric. 2:57-62. doi:10.2134/jpa1989.0057.

5. H.M. van Es, C.P. Gomes, M. Sellmann, and C.L. van Es. Spatially-Balanced Complete Block designs for field experiments. Geoderma 140(4):346-352. doi: http://dx.doi.org/10.1016/j.geoderma.2007.04.017.

6. Maryland Crop Budgets. Maryland Grain webpage. University of Maryland Extension. http://extension.umd.edu/grainmarketing/crop-budgets.