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# 2021 Maryland Soybean Fungicide Efficacy Trials

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## JUSTIFICATION

Fungicides are becoming increasingly popular in full season soybean production. Land grant institutions across the US and in surrounding states have robust applied research programs where industry ag chemical companies submit new products and formulations for testing for the management of soybean diseases; such a project has been absent in Maryland for several years, creating a dearth in knowledge of fungicide efficacy for our soybean producers in Maryland. This project will provide data that soybean producers would benefit from, such as: fungicide efficacy for managing common fungal diseases of soybean, monitor fungicide resistant pest populations, and track the economic impact of foliar fungicide applications over multiple years and environments unique to Maryland.

## RESEARCH OBJECTIVES

1. Evaluate the efficacy of select foliar fungicides on full season soybeans grown on two research farms in Maryland by measuring foliar disease incidence and severity.
2. Determine any greening or green stem effects of the fungicides.
3. Monitor fungicide active ingredient efficacy over time and identify any fungicide insensitive foliar fungal pathogens.
4. Determine the yield impact of foliar fungicides and their economic impact.

## METHODS

*Plot Design*

Field trials were established at two University of Maryland Research farms: Western Maryland Research & Education Center in Keedysville, MD (WMREC) and Wye Research and Education Center in Queenstown, MD (WYE). Plots were 11'x30' arranged in a randomize complete block design with five replicates. Planting details are outlined in Table 1. Plots were planted behind soybeans in order to create conditions conducive for developing foliar diseases on soybean.

**Table 1.** Planting and harvest specifications.

| | **WMREC** | **WYE** |
|---|---|---|
| Seed: | Soybean, Mid-Atlantic Seed 3720 E3/STS | |
| Previous Crop: | Soybean | |
| Tillage: | No-till | |
| Plant Date: | 4/26/2021 | 5/18/2021 |
| Planter: | John Deere 1590 | Great Plains EWNT-10 |
| Row Spacing: | 7.5" | 7.5" |
| Population: | 150,000 seeds/acre | 150,000 seeds/acre |
| Harvest Date: | 11/24/2021 | 11/23/2021 |
| Harvester: | Almaco R1 research combine | Almaco R1 research combine |
| Harvest Area: | 30' from Center 5' of plot | 30' from Center 5' of plot |

*Fungicide Applications*

Fungicides (Table 2) were applied at the R3 growth stage (July 28 at WMREC and August 2 at WYE) using a $CO_2$ powered backpack sprayer equipped with TeeJet 8003 nozzles calibrated to deliver 20 GPA at 35 psi to the center 80 inches of each plot. Treatments with R3+14 days applications were made on August 16 at WYE and August 11 at WMREC.

**Table 2.** Fungicide treatments.

| Treatment | Product Name<br>***Active Ingredient(s)*** | Application Rate<br>**(& Timing)** |
|---|---|---|
| Non-treated Control | None | N/A |
| Headline | Headline 2.09 EC/SC<br>*Pyraclostrobin* | 6.0 fl oz/A (R3) |
| Veltyma | Veltyma<br>*Mefentrifluconazole + Pyraclostrobin* | 7.0 fl oz/A (R3) |
| Lucento | Lucento 4.17 CS<br>*Bixafen + Flutriafol* | 5.0 fl oz/A (R3) |
| Revytek | Revytek<br>*Fluxapyroxad + Pyraclostrobin + Mefentrifluconazole* | 8.0 fl oz/A (R3) |
| Revytek @ R3+14 days | Revytek<br>*Fluxapyroxad + Pyraclostrobin + Mefentrifluconazole* | 8.0 fl oz/A (R3 and R3+14 days) |
| Miravis Top | Miravis Top 1.67 SC<br>*Pydiflumetofen + Difenoconazole* | 13.7 fl oz/A (R3) |
| Miravis Top @ R3+14 days | Miravis Top 1.67 SC<br>*Pydiflumetofen + Difenoconazole* | 13.7 fl oz/A (R3 and R3+14 days) |

*Disease Rating*

Foliar diseases were rated prior to fungicide application at R3 and approximately every two weeks following up until approximately R6. Disease severity from frogeye leaf spot (FGL; *Cercospora sojina*) was visually rated as the percent leaf area infected in the upper canopy from the center four rows of each plot.

Seed quality ratings were also recorded at the WMREC location due to the presence of *Diaporthe* spp. (stem canker), which can also infect seeds. A random sample of seeds were saved from each plot harvested at WMREC and then the number of discolored seeds per 100 seeds were counted.

*NDVI Rating*

Plant greenness, or normalized difference vegetation index (NDVI), was measured using a handheld GreenSeeker® at different dates during pod fill.

*Harvest and Statistics*

Yield data were collected by harvesting the center 5 feet of each plot using an Almaco R1 research combine. All data reported are adjusted to 13% moisture. Plots were harvested on November 24 at WMREC and November 23 at WYE. Statistics related to profitability and economics were calculated using the current cash market price for soybean at $12.00 per bushel. Data were analyzed using ANOVA and significant differences between treatments were separated using Fisher's Least Significant Difference (LSD; α=0.10).

## RESULTS & DISCUSSION

*Disease Rating*

Growing conditions were generally very favorable and we did not observe any ratable fungal diseases at either trial location. This is likely due to the weather conditions around pod fill, as well as the resistance package in the soybean variety; Mid-Atlantic Seed 3720 E3/STS has a frogeye leafspot resistance rating of 8 on a 10-point scale (10 being the most resistant).

At the WMREC trial location, soybeans were identified that were infected with stem canker (*Diaporthe* spp.). Stem canker is a stem/root disease that causes premature plant death and may also infect developing seeds, affecting seed quality. Plots treated with foliar fungicides increased seed quality compared to the control, with Veltyma, and two applications of Revytek and Miravis Top, providing the best control of *Diaporthe* and improved seed quality (Figure 1, P=0.0034).

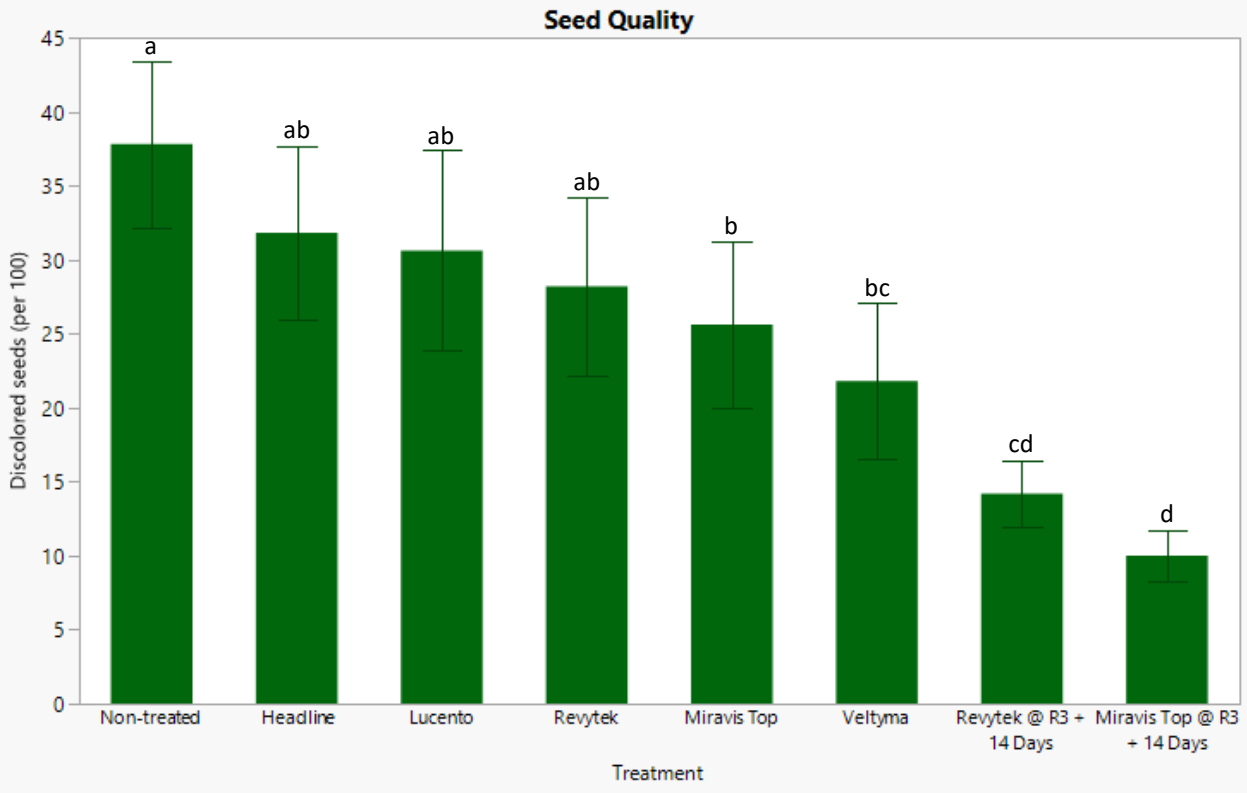


**Figure 1.** Soybean seed quality at WMREC. Each error bar is constructed using 1 standard error from the mean. Treatments with the same letter within the same location are not significantly different (α=0.10).

*NDVI Rating*

All fungicide treatments, with the exception of Headline, significantly increased plant greenness as indicated by the NDVI ratings in Table 3 (and Figure 2). Fungicides with the highest NDVI readings were Revytek, Miravis Top, and Veltyma. These results are consistent with other research in previous years and by others where fungicide applications generally induce a greening effect and cause the plants to retain their leaves for longer. However, this delayed senescence does not always correlate to a significant yield improvement.

**Figure 2.** Soybean fungicide plots at Wye REC in Georgetown, DE. Stay-green effect of fungicides is noticeable from this aerial shot.

**Table 3.** Plant greenness (NDVI) ratings.

| Treatment | NDVI | |
|---|---|---|
| | **WMREC** | **WYE** |
| Revytek @ R3+14 days | 0.54 a* | 0.36 a |
| Revytek | 0.52 a | 0.35 ab |
| Miravis Top | 0.46 ab | 0.35 ab |
| Veltyma | 0.47 ab | 0.34 ab |
| Lucento | 0.41 bc | 0.31 bc |
| Miravis Top @ R3+14 days | 0.50 a | 0.31 bc |
| Headline | 0.35 c | 0.28 c |
| Non-treated Control | 0.35 c | 0.29 c |
| *P>F* | *0.0030* | *0.0282* |

**Treatments with the same letters within the same column are not significantly different than each other (α=0.10).*

*Yield*

Yields were slightly above average at WMREC and exceptional at WYE, with trial averages of 57.9 and 94.5 bushels per acre, respectively (Figure 3). Statistically, there were no significant differences between fungicide treatments and the non-treated control at either location (P=0.4637 at WMREC and P=0.5743 at WYE). There were also no significant differences in grain moisture or test weight (data not shown).

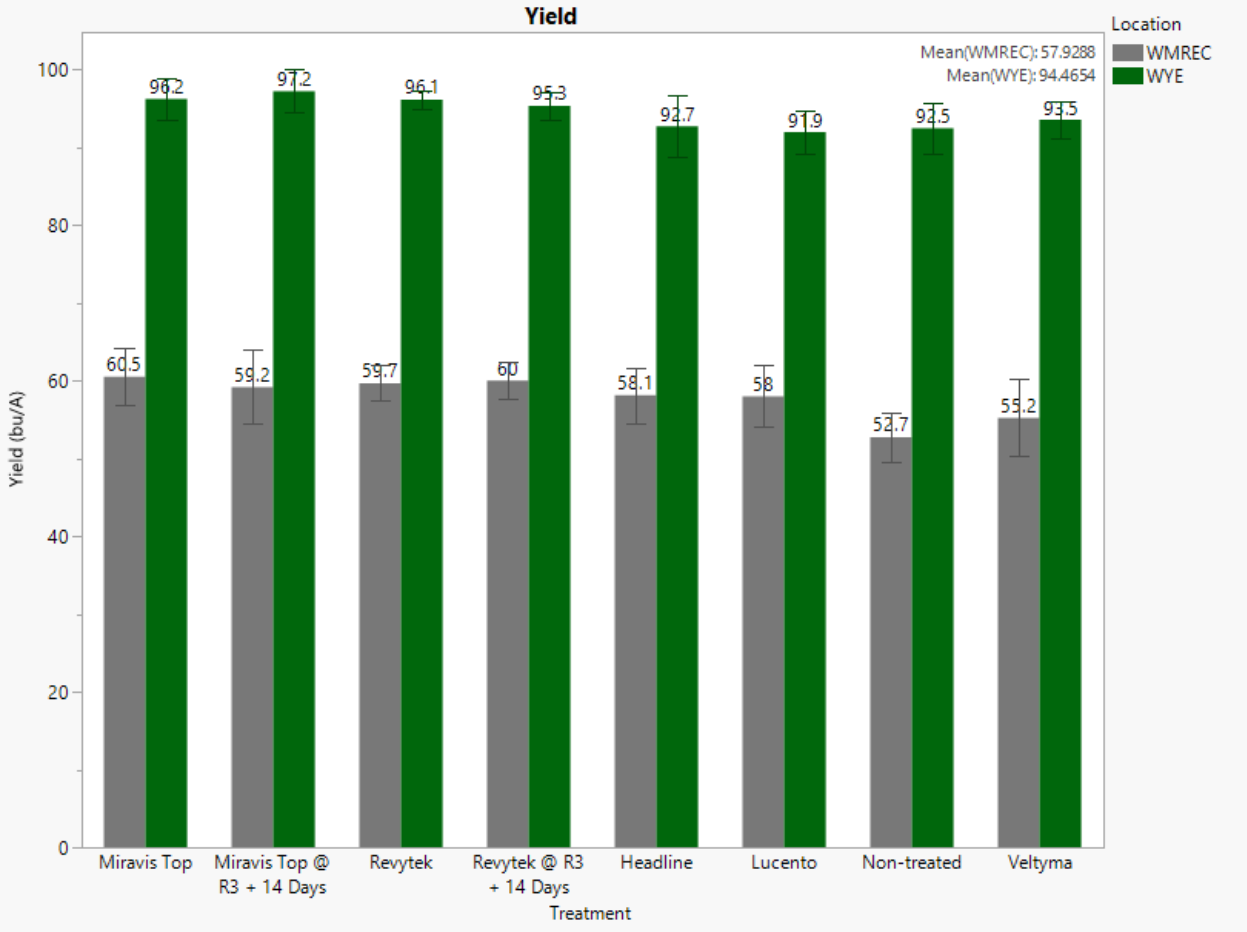


**Figure 3.** Soybean grain yield. Each error bar is constructed using 1 standard error from the mean. One outlier excluded. Treatments with the same letter within the same location are not significantly different (α=0.10).

Since there was a significant difference in yield at the two locations, relative yield was calculated and used as a way to compare yields across locations. Relative yield was calculated by dividing the plot yield by the non-treated control plot yield and reported as a percent. When data were combined this way, no significant differences were observed (P=0.4960, Figure 4).

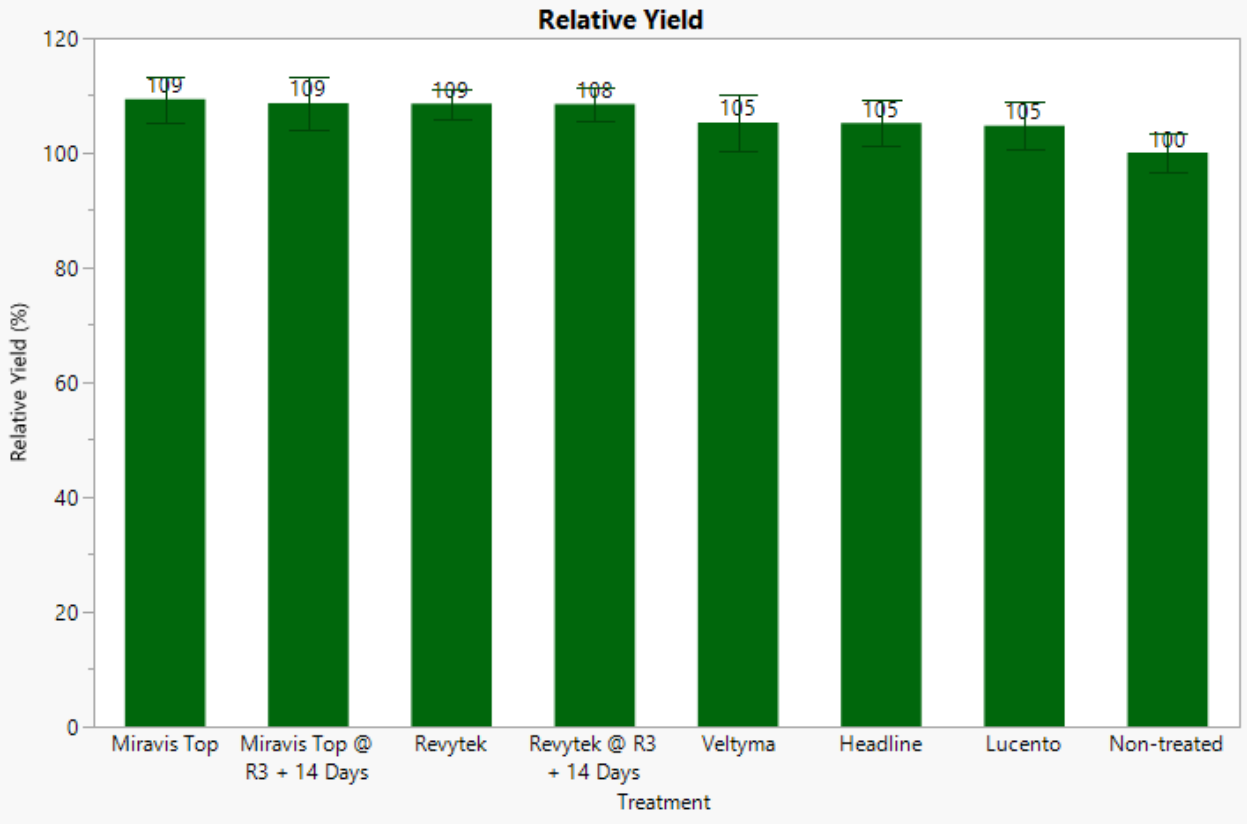


**Figure 4.** Relative grain yield. Each error bar is constructed using 1 standard error from the mean. No significant differences between treatments (α=0.10).

## Conclusions, Implications, and Future Work

Foliar fungicide applications with the selected products tested here provided some benefit on the 2021 growing season related to improved seed quality. Fungicides also significantly increased plant greenness and delayed senescence; however, none of the treatments yielded significantly different than the non-treated control. This is likely due to the fact that no ratable foliar fungal diseases were present in the plots this year. Without the presence of a pathogen, fungicides have reduced odds of improving yields over non-treated plots.

Future work will be focused on replicating similar experiments over more plot-years to gather more data for Maryland's unique growing conditions and to track pathogen resistance and fungicide profitability over time.

## Acknowledgements

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