# Grant Report, 2020
# Maryland Soybean Board

**Project title:** Evaluation of Miravis Top Fungicide for Soybean Production in Maryland

**Principal investigator(s):** Andrew Kness, Agriculture Extension Agent
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**Project location(s):** Wye Research & Education Center, Queenstown, MD (Wye)
Western Maryland Research & Education Center, Keedysville, MD (WMREC)

**Experimental design:** Spatially-balanced complete block design[1], 5 treatments x 5 replications

**Plot size:** 11'x30' (both sites)

**Variety:** Mid-Atlantic Seed 4077 (untreated)

**Previous crop & tillage:** Soybean, no-till (both sites)

**Planting:** 150,000 seeds/A with a no-till drill, 7.5" rows (both sites).
Dates: 5/21/20 at Wye, 5/5/20 at WMREC

**Treatments:**

1. Untreated control
2. Miravis Top, single application @ R1 (13.7 oz/A)
3. Miravis Top @ R1 + Miravis Top 14 days after first application (both rates= 13.7 oz/A)
4. Priaxor @ R1 (8 fl oz/A)
5. Priaxor @ R1 + Priaxor 14 days after first application (both rates= 8 fl oz/A)

**Treatment application:**

- Fungicides applied using a tractor-mounted sprayer
    - R1 application @ Wye: 7/15/20
        - Treatments receiving second application: 7/29/20
    - R1 application @ WMREC: 7/7/20
        - Treatments receiving second application: 7/21/20

**Harvest:** 5'x30' from center of each plot using small plot combine. All yields were adjusted to 13% moisture for data analysis.
Harvest dates: 11/20/20 at Wye, 11/18/20 at WMREC

**Samples & other data collection:**

- NDVI ratings recorded using a handheld Greenseeker by walking down the center row of each plot from front to back (length of the plot). Greenseeker held approximately 2' above plant canopy. No NDVI ratings were taken from plots at the Wye due to a severe marestail infestation.
    - WMREC Dates: 9/3, 9/9, and 9/24/2020
- Both Wye and WMREC had ratable disease (Frogeye Leaf Spot, FLS)
    - FLS rating (0-10, 0=0% of leaves infected, 10=100% of leaves infected) @ R6.

        - Dates: 9/7/20 at Wye and 9/3/20 at WMREC
    - FLS incidence= number of infected leaflets per 12 leaflets. Reported here as percentage of infected leaflets @ R6.
        - Dates: 9/7/20 at Wye and 9/3/20 at WMREC
- Green stem ratings were collected at maturity (R8) at both locations by counting the number of green stem plants (not mature color) from the center rows of each plot (8 rows at WMREC; 3 rows at Wye).
    - Collected on 10/6/20 at both locations

**Data analysis:** Mixed model ANOVA with blocks as random effects, Student's t-test for mean separation using JMP (SAS, Inc.) statistical software. A 90% confidence interval was used for data analysis ($\alpha$=0.10).

**Notes:**

- Severe marestail infestation at the Wye location due to herbicide resistance.

**Background & justification:** Adepidyn is a new fungicide from Syngenta, marketed under Miravis Top for soybeans, and combines active ingredients from FRAC groups 3 and 7. The product is touted for having superior management of foliar diseases of soybean, reduced risk of fungicide resistance, and plant health benefits to bump yields (mainly stay-green/green stem properties) even in the absence of disease. Limited university research on adepidyn's utility in soybeans has been conducted. We propose to evaluate this fungicide's effect on yield, plant health, and stay-green properties on full season soybeans in Maryland through replicated field trials. During the course of this two-year project, we will measure the effect of adepidyn on foliar fungal disease and yield on full-season soybeans in Maryland.

**Objectives:**

1. Compare adepydin to an untreated control and a known standard (Priaxor) to evaluate yield, green stem, and grain quality for Maryland soybean production.

**Results:** Excessive rains at Wye and drought conditions at WMREC caused a significant yield swing between the two locations (35.2 bu/A at WMREC and 44.4 bu/A at Wye). Due to this location effect, yields were transformed to "relative yield" by dividing individual plot yields by the average of the untreated control at each location and reported as a percentage. This allows for comparisons of yields across locations relative to their performance vs the control mean. Values above 100% indicate the treatment yielded better than the control. This analysis revealed no significant treatment effect (P=0.1595).

When the data were analyzed by trial location, there was a significant treatment effect for yield and grain moisture at the Wye location and green stem ratings at both locations (Table 1). Treatments did not significantly affect test weight.

**Table 1.** Treatment effect on yield, test weight, moisture, and green stem by location.

| Treatment | *Yield (bu/A)* | | *Test Wt. (lbs)* | | *Moisture (%)* | | *Green Stem (%)* | |
|---|---|---|---|---|---|---|---|---|
| | *WMREC* | *Wye* | *WMREC* | *Wye* | *WMREC* | *Wye* | *WMREC* | *Wye* |
| Miravis Top @ R1 + 14 days after | 36.2 | 47.2 ab | 52.3 | 55.0 | 14.5 | 10.7 ab | 13.4 a | 40 a |
| Miravis Top @ R1 | 36.6 | 50.7 a | 52.2 | 54.4 | 14.4 | 10.6 b | 10.6 a | 20 bc |
| Priaxor @ R1 | 36.0 | 42.2 bc | 52.3 | 56.0 | 14.5 | 11.0 a | 4.7 b | 12 cd |
| Priaxor @ R1 + 14 days after | 37.2 | 40.3 c | 52.2 | 55.8 | 14.4 | 11.0 a | 11.5 a | 24 b |
| Untreated | 31.1 | 42.0 bc | 52.1 | 55.7 | 14.7 | 11.0 a | 1.6 b | 8 d |
| **(P) > F* | *0.4757* | *0.0816* | *0.9878* | *0.5054* | *0.9080* | *0.0812* | *0.0016* | *0.0007* |

*Mixed model ANOVA results and mean separation using Student's t-test. Highlighted cells indicate a significant difference at α=0.10. Levels not connected by same letter are significantly different.

Due to heavy marestail weed pressure at the Wye location, NDVI ratings were excluded. Fungicide applications significantly affected R6-R7 NDVI ratings at WMREC (Table 2). Plants were greener with all fungicide treatments when compared to the control (Figure 1); however, no significant differences were measured once plants reached R7 due to the senescing foliage. This greening effect (higher NDVI rating) was carried through to maturity when the fungicide treated plots had significantly greater green stem ratings than the controls (Table 1).

**Table 2.** Treatment effect on NDVI (greenness) at WMREC.

| Treatment | **NDVI Rating Date (growth stage)** | | |
|---|---|---|---|
| | *Sept. 3 (R6)* | *Sept. 9 (R7)* | *Sept. 24 (R7)* |
| Miravis Top @ R1 + 14 days after | 0.85 ab | 0.76 a | 0.37 |
| Miravis Top @ R1 | 0.86 a | 0.75 a | 0.36 |
| Priaxor @ R1 | 0.84 bc | 0.76 a | 0.37 |
| Priaxor @ R1 + 14 days after | 0.86 a | 0.78 a | 0.38 |
| Untreated | 0.83 c | 0.66 b | 0.27 |
| **(P) > F* | *0.0509* | *0.0091* | *0.1458* |

*Mixed model ANOVA results and mean separation using Student's t-test for NDVI. Highlighted cells indicate a significant difference at α=0.10. Levels not connected by same letter are significantly different.

**Figure 1.** Example visual differences in plant greenness and leaf retention between treatments at WMREC. Treatments clockwise from top left: Untreated control, Miravis applied at R1, and Miravis applied at R1 + 14 days after, Priaxor applied at R1.

Frogeye leaf spot (FLS), caused by the fungal pathogen, *Cercospora sojina* was the predominant disease present at both locations. Frogeye leaf spot severity was approximated by visually assessing FLS lesions on soybean leaves (FLS ratings) using a 0-10 scale (Table 3). FLS incidence was also assessed from sampling 12 random leaflets per plot and recorded as the percentage of leaflets with at least one FLS lesion (Table 3). All fungicide treatments significantly reduced FLS severity compared to the untreated control at both locations, with the exception of the single R1 application of Priaxor at Wye, which did not differ from the control (Table 3). Overall disease severity was higher at WMREC than Wye. There

were no significant differences in FLS incidence between treated and untreated plots at Wye, likely due to the marestail infestation. Fungicides significantly reduced FLS incidence at the WMREC location.

**Table 3.** Treatment effect on frogeye leaf spot disease severity and incidence.

| | ***FLS Severity*** | | ***FLS Incidence (%)*** | |
|---|---|---|---|---|
| **Treatment** | *WMREC* | *Wye* | *WMREC* | *Wye* |
| Miravis Top @ R1 + 14 days after | 1.6 a | 1.0 a | 21.7 a | 48.3 |
| Miravis Top @ R1 | 4.2 c | 1.2 a | 61.7 b | 71.7 |
| Priaxor @ R1 | 3.0 bc | 4.2 b | 35.0 a | 60.0 |
| Priaxor @ R1 + 14 days after | 2.0 ab | 1.6 a | 33.3 a | 51.7 |
| Untreated | 8.8 d | 4.6 b | 86.7 c | 56.7 |
| **(P) > F* | *<0.0001* | *<0.0001* | *0.0002* | *0.5772* |

*Mixed model ANOVA results and mean separation using Student's t-test for foliar disease ratings at WMREC. Highlighted cells indicate a significant difference at α=0.10. Levels not connected by same letter are significantly different.

**Combined 2019-2020 data:** Data from 2020 and 2021 trials were combined for greater statistical power and analysis over multiple environments (Table 3). Averaged across both trial years and locations, Miravis provided a 6-8 bushel increase over the untreated control, which was significant (P=0.0003). Compared to Priaxor, the known standard in the test, Miravis performed slightly better. The 2X treatment of Miravis provided the greatest increase in yield. The single application of Miravis and the single application of Priaxor performed similarly in the test, and the single application of Miravis performed similarly to the 2X application. However, the 2X application of Priaxor yielded significantly less than the Miravis 2X treatment. All fungicide treatments significantly increased the percentage of green stem at maturity; however there was no treatment effect on grain moisture or test weight at harvest.

**Table 3.** Treatment effect on yield, test weight, moisture, and green stem, combined 2019-20 dataset.

| Treatment | *Yield (bu/A)* | *Test Wt. (lbs)* | *Moisture (%)* | *Green Stem (%)* |
|---|---|---|---|---|
| Miravis Top @ R1 + 14 days after | 49.0 a | 53.9 | 14.1 | 25.3 a |
| Miravis Top @ R1 | 46.8 ab | 54.4 | 14.0 | 13.3 bc |
| Priaxor @ R1 | 45.3 b | 54.0 | 14.0 | 9.5 cd |
| Priaxor @ R1 + 14 days after | 43.9 bc | 54.2 | 14.1 | 17.5 b |
| Untreated | 40.1 c | 53.5 | 14.1 | 5.9 d |
| **(P) > F* | *0.0003* | *0.9325* | *0.9109* | *<0.0001* |

*Mixed model ANOVA results and mean separation using Student's t-test for foliar disease ratings at WMREC. Highlighted cells indicate a significant difference at α=0.10. Levels not connected by same letter are significantly different.

**Conclusions and discussion:** The 2020 growing season at Wye and WMREC were very different. Wye received 47 inches of rain from May 1-November 1, 2020, while WMREC revived 19.8 inches over that same timeframe (Appendix 1 & 2). Wye plots also had a severe infestation of herbicide-resistant marestail that likely lowered the yield potential and affected the severity and incidence of FLS. All fungicide treatments significantly reduced FLS severity at both locations. All fungicide treatments affected NDVI by keeping the plants greener for longer, as well as increased the occurrence of green stem.

For the second year in a row we observed a significant increase in yield from fungicide-treated plots at the higher yielding, early planted trial location, with Miravis treatments performing significantly better than Priaxor and Priaxor performing better than the untreated control. No yield differences were detected at WMREC, which is likely due to the very low and poor yields due to droughty conditions and disease was not likely the major yield-limiting factor.

Combined 2019 and 2020 data reveal a significant 6-9 bushel increase in yield with the Miravis treatments, and a 3-5 bushel increase in yield with Priaxor. Based on this data and data from other institutions, Miravis may benefit soybean production by providing protection against common foliar diseases of soybean and help increase yields under early planted, high yield potential soybeans.

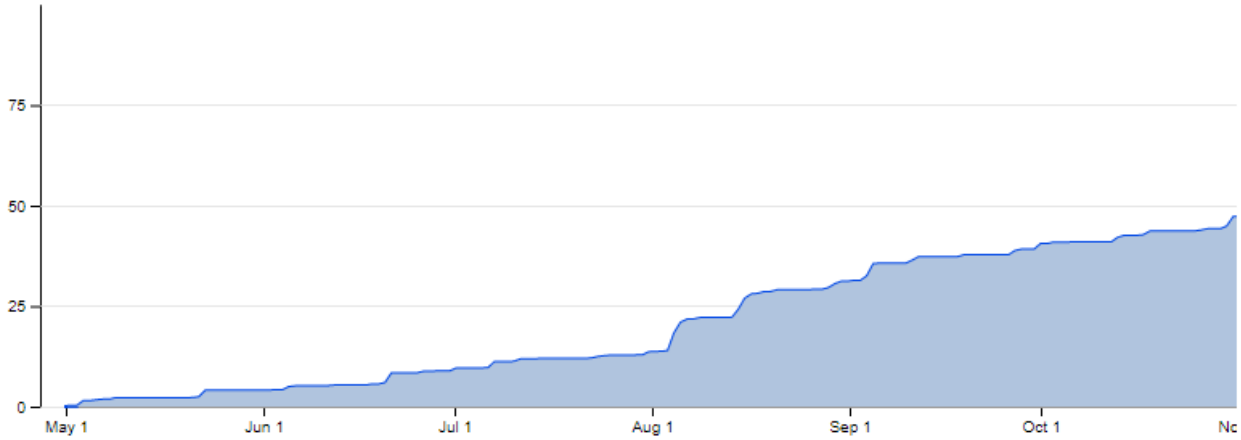
**Acknowledgements:** This research is funded by the Maryland Soybean Board and conducted with support from the Maryland Agriculture Experiment Station at the Wye Research & Education Center and the Western Maryland Research & Education Center.

**References:**

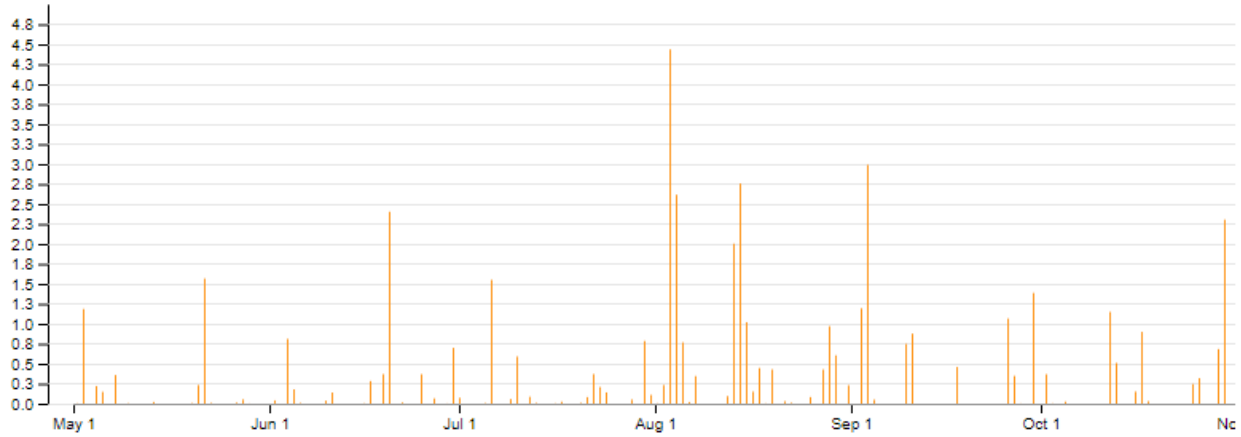
1. H.M. van Es, C.P. Gomes, M. Sellmann, and C.L. van Es. Spatially-Balanced Complete Block designs for field experiments. Geoderma 140(4):346-352. doi: http://dx.doi.org/10.1016/j.geoderma.2007.04.017

**Appendix 1: Wye weather data, May 1-November 1, 2020**

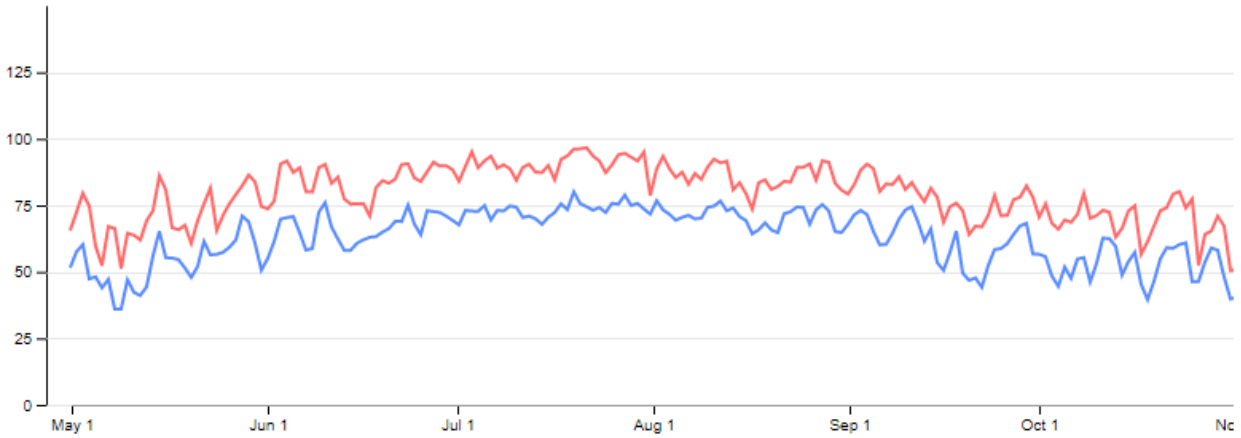
*Accumulated precipitation (in)*




*Daily Precipitation (in)*

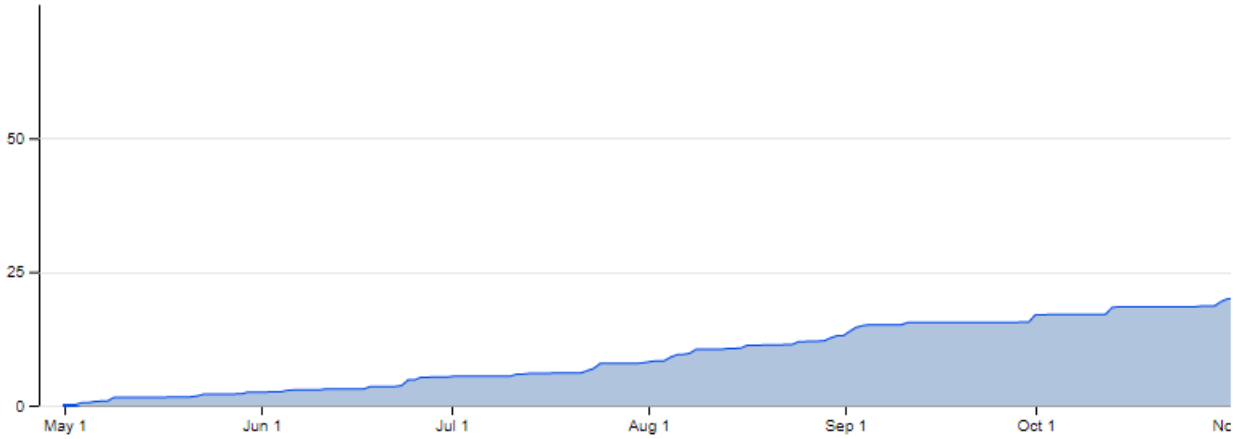



*Daily High and Low Temperature ($^{o}F$)*

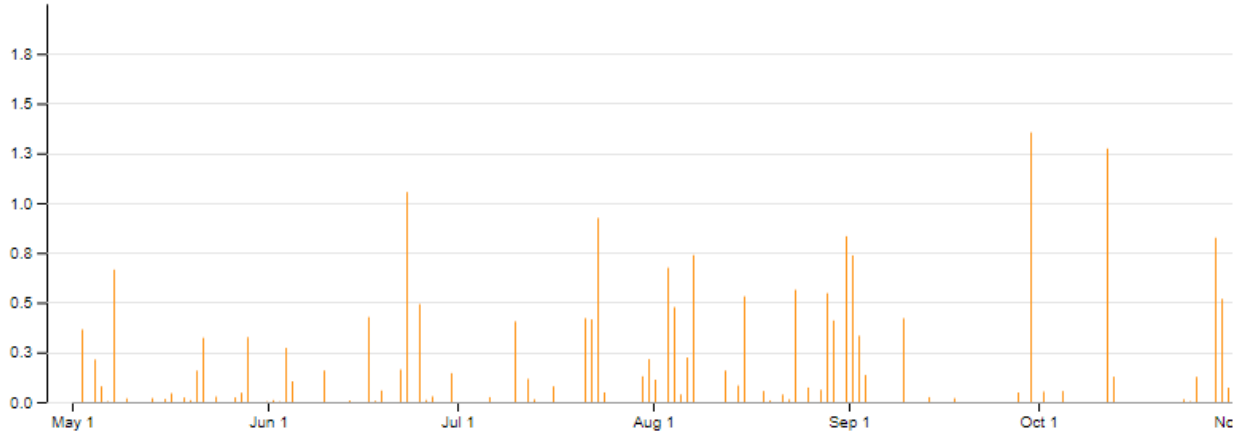


**Appendix 2: WMREC weather data, May 1-November 1, 2020**

*Accumulated precipitation (in)*




*Daily precipitation (in)*




*Daily High and Low Temperature ($^{o}F$)*