Grant Report, 2019
Maryland Soybean Board

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

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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], 4 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 (both sites). 7.5" rows at WMREC, 15" rows at Wye
6/5/19 at Wye
5/17/19 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)

Treatment application:
- Fungicides applied using a tractor-mounted sprayer
    - R1 application @ Wye: 7/16/19
        - Second Miravis Top application @ Wye: 7/30/19
    - R1 application @ WMREC: 7/3/19
        - Second Miravis Top application @ WMREC: 7/17/19

Harvest: 5'x30' from center of each plot using small plot combine.
11/7/19 at Wye
11/15/19 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.
    - Wye NDVI rating #1: 9/19/19, R6
    - Wye NDVI rating #2: 9/27/19, R8
    - WMREC NDVI rating #1 (only one at this location): 9/16/19, R7
- Only the WMREC location had ratable disease (Frogeye Leaf Spot, FLS)

    - FLS rating (0-10, 0=0% of leaves infected, 10=100% of leaves infected).
        - FLS #1 done on 8/9/19, R4
        - FLS #2 done on 8/15/19, R5
    - FLS incidence= number of infected leaflets per 12 leaflets. Reported here as percentage of infected leaflets.
        - Completed 8/15/19, R5
- 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 10/10/19 at Wye and 10/9/19 at WMREC
- Grain quality ratings were assessed from a subsample of grain. Reported as number of infected seeds per 20g sample.
    - Purple seeds= purple seed stain (*Cercospora kikuchii*)
    - White seeds= Phomopsis seed decay (*Diaporthe longicolla*)
    - Brown/small seeds= Anthracnose (*Colletotrichum*)
- 50 count seed weight reported as total weight of 50 seeds (grams)

Data analysis: Mixed model ANOVA with blocks as random effects, Student's t-test for mean separation.

Notes:
- Plots 101 and 201 at Wye were weedy (fall Panicum)
- No yield data for pass #1 at Wye (plots 101, 201, 301, 401, 501) due to combine failure.

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

Summary of methods: All plots were flagged prior to any work and blocked for soil type and soil moisture.

Plots were seeded into no-till soybean residue to increase risk of developing foliar disease (ex: frogeye leaf spot).

NDVI ratings were recorded using a handheld Greenseeker held two feet above the crop canopy.

Visual disease rating were conducted at the WMREC location, which was the only location with ratable disease (frogeye leaf spot, FLS). Visual ratings were assessed on a scale of 0-10; 0 being no FLS, 10 being 100% of leaves infected with FLS. Disease incidence data were collected from 12 random soybean leaflets per plot and rated for presence of FLS.

Plots were harvested using a small plot combine when they approached 13% moisture. Yield, test weight, and moisture data were collected at this time. Lodging scores were also conducted at the WMREC location at harvest (no lodging at Wye).

All data were analyzed using statistical methods in the statistical software, JMP (SAS, Inc.). A 90% confidence interval was used for data analysis (α=0.10). Student's t-test was performed for mean separation.

Results: Yields were good and statistically there were no differences in yield between trial locations (combined yield results shown in Figure 1). There was a significant treatment effect for yield and green stem ratings at both locations (Table 1). Treatments did not significantly affect test weight or moisture at harvest at either location.

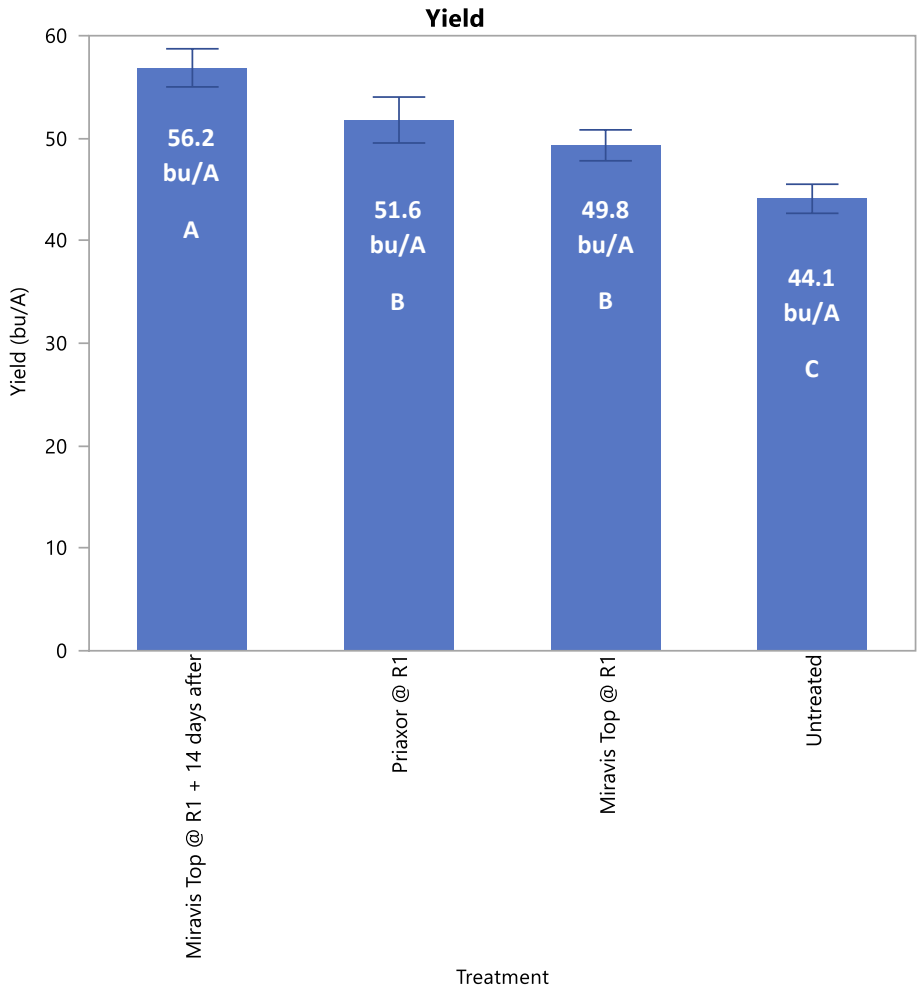

Figure 1. Treatment yield (adj. to 13% moisture) averaged across locations. Each error bar is constructed using 1 standard error from the mean. Levels not connected by same letter are significantly different.

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

Treatment	Yield (bu/A)		Test Wt. (lbs)		Moisture (%)		Green Stem	
	WMREC	*Wye*	*WMREC*	*Wye*	*WMREC*	*Wye*	*WMREC*	*Wye*
Miravis Top @ R1 + 14 days after	57.7 a	54.3 a	54.4	55.7	16.1	14.9	16.6 a	11.2 a
Miravis Top @ R1	51.4 b	48.0 ab	54.9	55.2	16.0	15.3	3.4 b	3.8 b
Priaxor @ R1	51.5 b	51.6 a	54.9	53.0	15.8	14.9	5.8 b	3.8 b
Untreated	44.4 c	43.7 b	54.4	50.2	15.8	15.1	2.2 b	3.2 b
**(P) > F*	*<0.0001*	*0.0902*	*0.2984*	*0.8724*	*0.3287*	*0.3534*	*0.0002*	*0.0756*

*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.

The fungicide applications significantly affected NDVI ratings at the Wye but not WMREC. This could be a function of the later planting date at the Wye. Plants were greener with the two applications of Miravis Top compared to the other treatments. Priaxor on the second NDVI rating had a similar effect as the double Miravis Top treatment (Table 2). This greening effect (higher NDVI rating) was carried through to maturity when the double Miravis Top treatment had significantly greater green stem ratings (Table 1).

Table 2. Treatment effect on NDVI (greenness).

Treatment	NDVI 1		NDVI 2
	WMREC	*Wye*	*Wye*
Miravis Top @ R1 + 14 days after	0.40	0.54 a	0.26 a
Miravis Top @ R1	0.36	0.49 b	0.23 b
Priaxor @ R1	0.38	0.49 b	0.25 ab
Untreated	0.36	0.44 b	0.23 b
**(P) > F*	*0.7365*	*0.0226*	*0.0805*

*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.

The Wye location did not have any significant ratable diseases present during the growing season; however, at WMREC there were foliar diseases present; mainly frogeye leaf spot (FLS) caused by the fungal pathogen, *Cercospora sojina* (Figure 2). Frogeye leaf spot severity was approximated by visually assessing FLS lesions on soybean leaves (FLS ratings) using a 0-10 scale. 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. All fungicide treatments significantly reduced FLS rating and incidence compared to the untreated control (Table 3, Figure 2).

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

Treatment	*FLS Rating*	*FLS Incidence (%)*
Miravis Top @ R1 + 14 days after	2.2 a	80 a
Miravis Top @ R1	2.0 ab	67 a
Priaxor @ R1	3.8 b	78 a
Untreated	7.8 c	100 b
**(P) > F*	*<0.0001*	*0.0290*

*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.

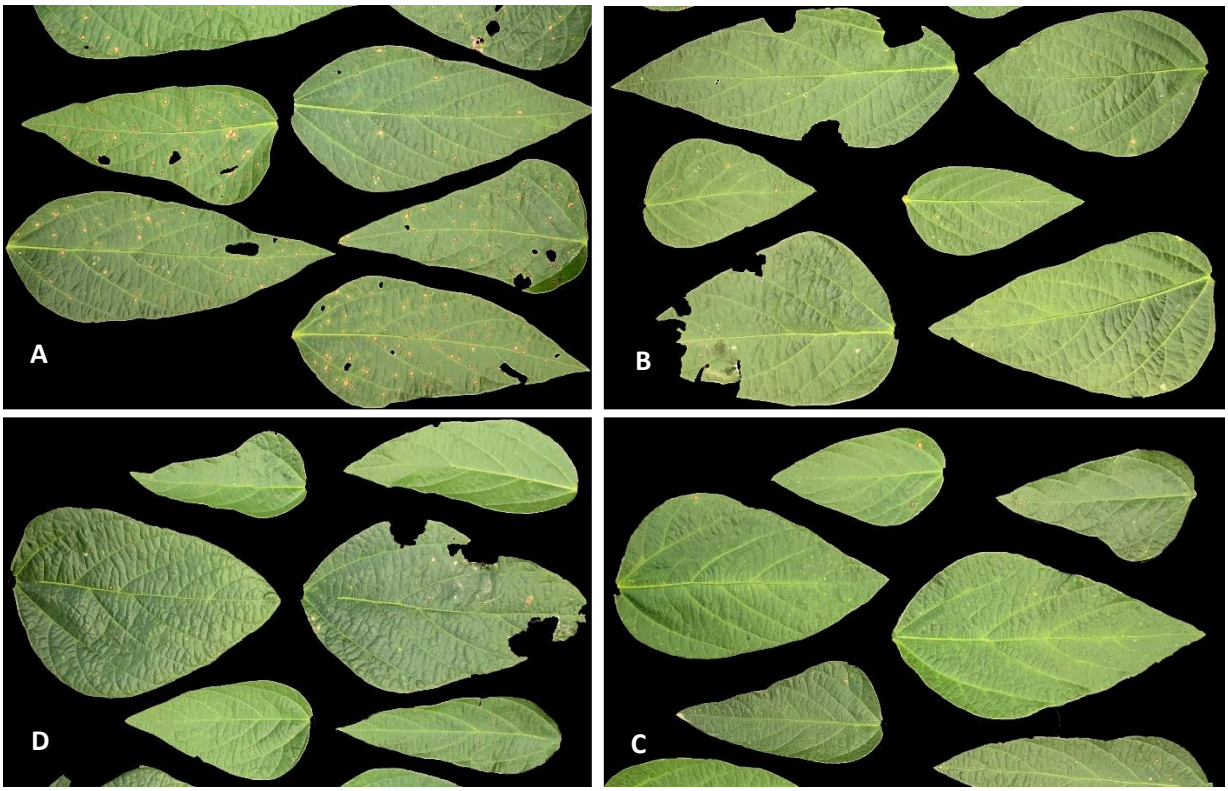

Figure 2. Fungicide effect on managing frogeye leafspot on soybean leaflets. A) untreated control; B) Priaxor @ R1; C) Miravis Top @ R1; D) Miravis Top @ R1 + 14 days after.

There was no treatment effect on grain quality (P=0.2244) or 50 count seed weights (P=0.6827); data not shown.

Conclusions and discussion: Based on this one year of research, Miravis has the potential to be an effective fungicide for full-season soybean production in Maryland. A single application of Miravis at R1 significantly increased yields at both trial locations; as did Priaxor, which was included as a benchmark for comparison. The Miravis Top label allows two applications of the fungicide; treatment at R1 and 14

days after provided an even greater yield boost at WMREC but not the Wye. This is likely due to the fact that there was more disease pressure at WMREC than the Wye, and plots were planted much earlier at WMREC than Wye.

Interestingly, even at the Wye; which had little-to-no disease, the double Miravis treatment and the Priaxor treatment yielded significantly greater than the untreated control (P=0.0902). At WMREC, where there was good infection of frogeye leaf spot, all fungicide treatments significantly reduced disease severity and incidence.

Regarding plant "greenness"; which manufacturers often attribute to "plant health", we observed no significant difference in normalized difference vegetative index (NDVI) at WMREC (P=0.7365); however, at the Wye location, plots treated with Miravis Top at R1 + 14 days after were greener for longer. We observed a significant difference in green stem ratings at both trial locations where all fungicide treatments led to an increase in percent green stem plants at harvest. These green stem plants can be potentially problematic to cut at harvest. Even though there was no significant difference in grain moisture between treatments, the data does suggest a weak but significant correlation (R^2=0.15, P=0.0210) between green stem at maturity and grain moisture, where plots with greater green stem tended to have higher grain moisture. These green stem observations are consistent with other similar fungicide trials conducted on soybeans.

Given that Miravis is still a relatively new product on the market, it would be advisable to repeat this study at least one more year.

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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