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Pumpkin Powdery Mildew Fungicide Demonstration Trial Report - 2019

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Introduction

A powdery mildew (PM) fungicide evaluation trial was conducted on pumpkin at the Western Ag Research Station in South Charleston, OH at 39.857672, -83.667513. All treatments were applied to a powdery mildew susceptible hybrid (Hybrid Pam, Rupp Seeds) to determine the efficacy of compounds on foliage health. No yield data was taken.

This goal of this powdery mildew demonstration trial is to evaluate the contribution and effectiveness of a primary fungicide when used in combination with rotational fungicides such as Procure, Manzate Pro Stick, Vivando, Microthiol and Topsin M to determine leaf and canopy health, ostensibly to maximize marketable fruit and handle quality.

These fungicide programs have been designed to primarily manage powdery mildew and may have inherent weaknesses against specific diseases such as downy mildew and bacterial diseases as described in the introduction.

The upper leaf surface and upper canopy is easier to protect with fungicides, and therefore typically has lower levels of powdery mildew infestation. The lower leaf surface and mid to lower canopy is more difficult to protect due in part to known limitations in spray application technology and complex plant architecture, but can reveal the extent to which materials are mobile or locally systemic. **Using that criteria, this report focuses primarily on how well the lower leaf surface is protected.** All products in the trial are known to have some level of systemic activity, with the exception Microthiol.

The scouting threshold for PM is conservative and uses initial detection to determine the onset of fungicide applications. In terms of relative product comparisons, lower percent infestation is considered better. When leaves become colonized by PM in the 70+% range, they quickly begin to show symptoms of chlorosis, necrosis, and disintegrate, leaving fruit exposed to possible sunburn and marketable loss.

Remember that the pumpkin hybrid we **intentionally** used in this trial is **susceptible** to PM, which helps us to separate the genetic resistance the plant may offer from the efficacy of the fungicide program. As part of our IPM program standard recommendations, we strongly

recommend growers select a PM tolerant or resistant hybrid when possible to maximize foliage and handle quality throughout the season. Even marginal spray programs provide much better control when used in combination with these other tolerant or resistant hybrids.

In the 2019 trial, the weather was very different than previous year's trials. In the early spring and summer, the station experienced very heavy rain and flooding conditions, followed by near drought conditions through the summer and early fall. From July 1 - September 11, the station recorded only 3.7" of rain. While this likely reduced the development of downy mildew and bacterial diseases, powdery mildew is one of only a few fungi that can develop in the absence of water, needing only high humidity to infest foliage.

Methods

The trial was transplanted June 8 using a Mechanical Transplanter, model 912. Each plot consisted of one 75' long row of Hybrid Pam pumpkin planted 3.5' within the row. Fifteen feet on the east side of each plot was not sprayed and served as an "untreated check" section to confirm the presence of PM and reflect the condition of untreated foliage.

Treated plots were separated by a 15' drive lane on each side with a 20' fallow buffer between the header and end of each plot. These spacing measures were designed to minimize spray drift between plots. The seeds were treated with FarMore (thiamethoxam) to limit striped cucumber beetle feeding and minimize transmission of bacterial wilt.

Weeds were managed by spraying Strategy (4 pints/A), Dual (1.3 pints/A), and glyphosate (32 oz/A) as a burn down on June 7, followed by a shielded post application of Sandea (1oz/A) and glyphosate (32oz/A) between the rows prior to vine tip on July 1. Any weed escapes in the row or between the plots were hand pulled or hoed out. The prior crop was soybean, and no cover crop was planted in the field.

Based on soil test results, no P or K was added to the field. On June 26, 75 pounds of nitrogen in the form of liquid 28-0-0 was side dressed six inches away from the row, approximately two inches deep in the soil.

In 2019, Downy Mildew (DM) was never confirmed in Ohio on pumpkin. Regardless, the plots were protected by alternating Ranman (2.75 oz/A) and Zampro (14 oz/A) Aug. 15, Aug. 21, Aug. 29, and Sept. 5. Bacterial Leaf Spot was not detected on the foliage or fruit in any of the treatments, therefore no copper protectant sprays were applied. None of the Downy products should have an impact on PM development.

Powdery mildew was first detected in the trial on July 23, and the first treatments were applied on July 25. Subsequent PM scouting and treatments occurred on Aug. 2, Aug. 9, Aug. 19, Aug. 29, and Sept. 5. Disease ratings were taken at 10 AM with fungicide treatment sprays applied immediately afterwards. The final scouting was Sept. 11 with no treatments applied after. All treatments were applied using a hydraulic boom sprayer at 38 GPA using hollow cone nozzles at 65 PSI.

In each treatment plot, powdery mildew development was evaluated around 10am on six randomly chosen leaves. Each leaf selected was examined on the upper and lower surface for

powdery mildew colonies. Prior to each rating, a pictorial guide (**Figure 1**) representing percent PM infestation was used to calibrate visual assessment to fairly approximate the percent infestation seen on each leaf surface. This chart was carried during the evaluation and periodically referred to for accuracy. During each evaluation period an effort was made to randomly choose leaves of a consistent age from both the middle and upper canopy that represented the product efficacy fairly. These two factors, chart calibration and leaf age consistency, are key to producing a reliable powdery mildew efficacy data set. The percent powdery mildew of each leaf surface was recorded and a mean value plus its standard deviation was calculated for use in the tables below.

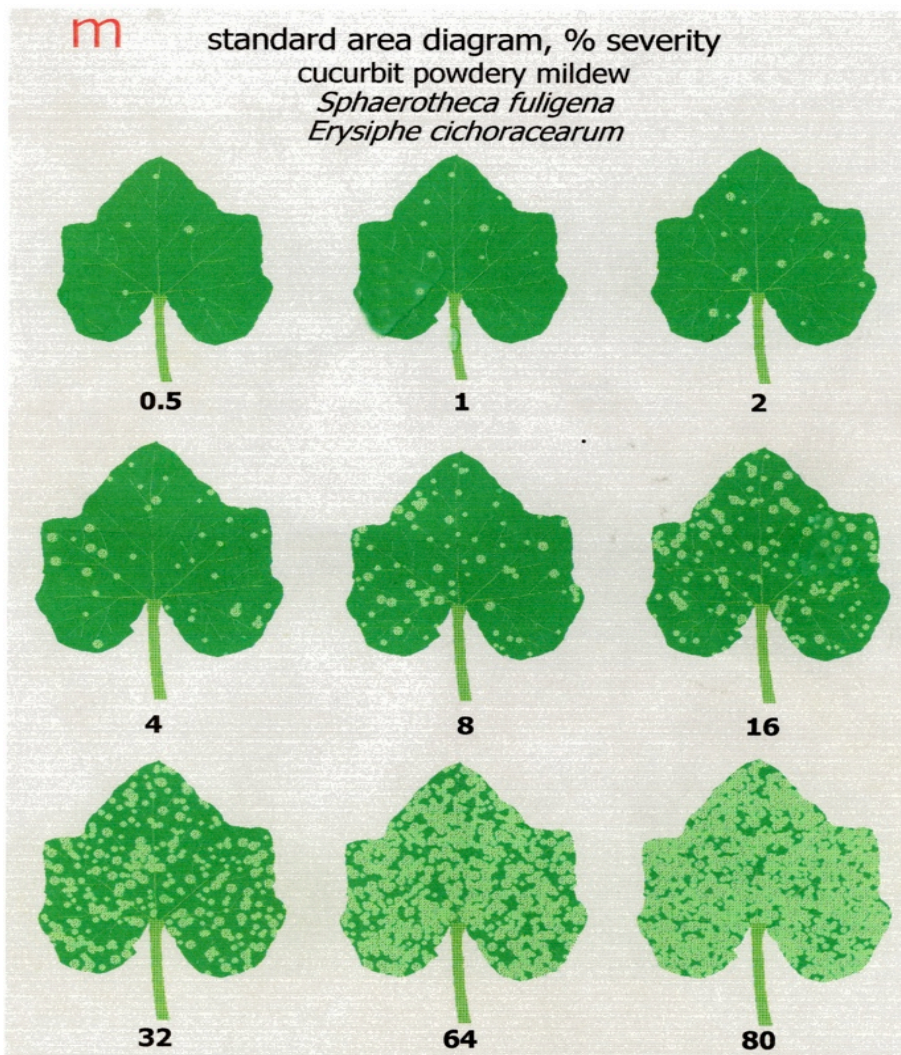


Figure 1. Percent powdery mildew infection chart.

Results

Fungicide treatments are listed in **Table 1**. Rating data for the seven evaluations can be found in **Tables 2-8**. The “untreated check” was created by taking two leaves from each untreated plot area, for an average of 14 leaves per rating, on both the upper and lower surface.

Table 1. 2019 Powdery mildew fungicide trial treatment rates per acre, FRAC and companies.

TRT	Product, Rate, FRAC Sprays 1, 3, and 5	Product, Rate, FRAC Sprays 2, 4, and 6
1	Luna Experience (6 fl oz) + NIS (0.125 v/v) [FRAC 7,3] (Bayer)	Vivando (15.4 fl oz) + Manzate (2.5lb) + NIS (0.125 v/v) FRAC [U8 + M] (BASF and UPL)
2	Luna Sensation (6 fl oz) + NIS (0.125 v/v) (FRAC 7,11) (Bayer)	Vivando (15.4 fl oz) + Manzate (2.5 lb) + NIS (0.125 v/v) FRAC [U8 + M] (BASF and UPL)
3	Microthiol (4lb) + Topsin M (8oz) (FRAC M + 1) (UPL)	Trionic (8oz) + Manzate (2.5 lb) (FRAC 3+M) (UPL)
4	Microthiol (4lb) + Topsin M (8oz) (FRAC M + 1) (UPL)	Procure (8oz) + Manzate (2.5 lb) (FRAC 3 + M) (UPL/Arysta)
5	Miravis Prime (11.4oz, FRAC 7 + 12) + NIS (0.125 v/v) (Syngenta)	Procure (8 oz) + Manzate (2.5 lb) + NIS (0.125 v/v) [FRAC 3 + M] (UPL / Arysta)
6	Inspire Super (20oz, FRAC 9 + 3)+ NIS (0.125 v/v) (Syngenta)	Vivando (15.4 fl oz) + Manzate (2.5lb) + NIS (0.125 v/v) FRAC [U8 + M] (BASF and UPL)
7	Miravis Prime (11.4 oz, FRAC 7 + 12) + NIS (0.125 v/v) (Syngenta)	Inspire Super (20oz) + Manzate (2.5lb) + NIS (0.125 v/v) (FRAC 9 + 3, M) (Syngenta)

The first PM evaluation was conducted on July 23 (Table 2) and provided a baseline to verify that PM infections could be found at very low levels on both upper and lower leaf surfaces (<0.5%) throughout the trial; no fungicides have been applied yet.

Table 2. Percent powdery mildew and standard deviation of seven fungicide treatments plus an untreated check for July 23, sorted by lower leaf surface.

Treatment	Avg PM % Upper Leaf	St. Dev. (±)	Avg PM % Lower Leaf	St. Dev. (±)
Luna Experience	0.0	0.0	0.0	0.0
Luna Sensation	0.0	0.0	0.0	0.0
Trionic	0.0	0.0	0.0	0.0
Procure	0.0	0.0	0.0	0.0
Inspire Super	0.0	0.0	0.0	0.0
Miravis alt. w/ Inspire	0.4	0.9	0.0	0.0
Untreated Check	0.0	0.0	0.0	0.0
Miravis Prime	0.4	0.9	0.5	0.9

In the second PM evaluation on August 2 (Table 3), disease pressure remained very low with the untreated check (UTC) showing only 1.8% on the upper leaf and 0.4% on the lower leaf. Miravis Prime had the highest lower leaf rating at 1.2%.

Table 3. Percent powdery mildew and standard deviation of seven fungicide treatments plus an untreated check for August 2, sorted by lower leaf surface.

Treatment	Avg PM % Upper Leaf	St. Dev. (±)	Avg PM % Lower Leaf	St. Dev. (±)
Untreated Check	1.8	4.5	0.4	0.4
Luna Experience	0.7	0.8	0.5	0.4
Luna Sensation	0.1	0.2	0.5	0.3
Procure	0.6	0.8	0.5	0.4
Inspire Super	0.1	0.2	0.5	0.4
Miravis alt. w/ Inspire	0.0	0.0	0.6	0.4
Trionic	0.4	0.8	0.8	0.7
Miravis Prime	0.9	2.0	1.2	1.4

In the third evaluation on August 9 (Table 4) five treatments had slightly less pressure than the UTC for the lower leaf rating, one treatment was slightly higher, but Miravis Prime was over 10% higher. The UTC upper leaf surface had the most powdery mildew of all treatments, at nearly 14%, with the other seven treatments below 4%.

Table 4. Percent powdery mildew and standard deviation of seven fungicide treatments plus an untreated check for August 9, sorted by lower leaf surface.

Treatment	Avg PM % Upper Leaf	St. Dev. (±)	Avg PM % Lower Leaf	St. Dev. (±)
Trionic	0.2	0.3	2.5	1.0
Miravis alt. w/ Inspire	0.7	1.6	2.7	1.8
Procure	0.3	0.4	2.8	2.3
Luna Experience	0.8	0.8	5.7	3.7
Luna Sensation	0.3	0.4	7.3	5.4
Untreated Check	13.7	12.2	7.9	5.2
Inspire Super	3.8	8.0	8.3	6.9
Miravis Prime	1.0	1.5	18.0	24.2

In the fourth evaluation on August 19 (Table 5) the highest PM infestation was found on both the UTC upper and lower leaf surface at 35% and 69% respectively. For the upper leaf surface, all seven treatments had PM infestations below 4%. With the lower leaf surface, Luna Sensation was the lowest at 11.5%, followed by a group of treatments that ranged between 21-28%. The Procure treatment was rated highest for infection at 49%.

Table 5. Percent powdery mildew and standard deviation of seven fungicide treatments plus an untreated check for August 19, sorted by lower leaf surface.

Treatment	Avg PM % Upper Leaf	St. Dev. (±)	Avg PM % Lower Leaf	St. Dev. (±)
Luna Sensation	0.2	0.3	11.5	6.0
Miravis alt. w/ Inspire	0.2	0.3	21.2	21.0
Luna Experience	1.0	1.7	24.2	18.8
Miravis Prime	0.9	1.3	24.7	15.3
Trionic	1.5	2.0	26.2	21.4
Inspire Super	0.8	1.6	27.7	20.5
Procure	3.8	3.8	49.2	20.1
Untreated Check	34.8	20.2	69.2	11.6

The fifth evaluation was conducted on August 29 (Table 6), with the UTC having the highest PM infections for the upper and lower leaf surface, 56% and 83% respectively. For the third rating in a row, the upper leaf surface ratings were below 4% for all seven treatments. For the lower leaf surface, Luna Experience, Luna Sensation, and Inspire Super had the lowest PM infections between 14-18%; followed by both Miravis Prime treatments at 25-27% infestation. Trionic was rated at 46% infestation and Procure again was rated with the highest PM infestation at 73%.

Table 6. Percent powdery mildew and standard deviation of seven fungicide treatments plus an untreated check for August 29, sorted by lower leaf surface.

Treatment	Avg PM % Upper Leaf	St. Dev. (±)	Avg PM % Lower Leaf	St. Dev. (±)
Luna Experience	0.3	0.3	13.8	7.6
Luna Sensation	0.2	0.3	17.0	11.7
Inspire Super	2.7	2.9	18.0	7.3
Miravis Prime	2.2	3.0	24.7	10.6
Miravis alt. w/ Inspire	0.8	2.0	26.8	22.3
Trionic	3.6	3.0	45.8	19.9
Procure	1.6	2.3	72.5	17.2
Untreated Check	56.1	25.5	82.9	15.7

In the sixth evaluation on September 5 (Table 7) the UTC was similar to the previous rating at 60% for the upper leaf surface and 83% for the lower leaf surface, the highest of all treatments. Both Luna and Miravis treatments plus the Inspire Super treatment, were rated below 2% for the upper leaf surface. The Trionic and Procure treatments were 24% and 15% respectively for the upper leaf rating. For the lower surface ratings, Inspire Super had the lowest rating at 28% infection. Next were the Luna treatments at 39-43% infection; followed by the Miravis treatments at 47-53% infection; and finally Trionic and Procure at 69-70% infestation.

Table 7. Percent powdery mildew and standard deviation of seven fungicide treatments plus an untreated check for September 5, sorted by lower leaf surface.

Treatment	Avg PM % Upper Leaf	St. Dev. (±)	Avg PM % Lower Leaf	St. Dev. (±)
Inspire Super	0.8	1.6	28.3	26.4
Luna Experience	1.4	0.9	38.5	27.1
Luna Sensation	1.0	1.3	42.5	18.6
Miravis Prime	1.4	2.4	46.7	20.7
Miravis alt. w/ Inspire	0.8	1.0	52.5	17.8
Trionic	23.5	23.3	69.2	10.7
Procure	15.3	7.5	70.0	17.9
Untreated Check	60.0	24.5	83.3	17.1

In the final evaluation on September 11 (Table 8) the UTC was highest rated for both upper and lower leaf surface at 75 and 96% infestation respectively. For the upper leaf surface, four treatments, Miravis alternated with Inspire, Inspire Super, and both Luna treatments rated 3% infestation or below. Miravis Prime, Trionic, and Procure infestation ranged between 5-8% on the upper leaf surface. Both Miravis alternated with Inspire and Inspire Super treatments had the lowest lower leaf surface infestation ratings at 23% and 26% respectively. Both Luna treatments were rated at 36% and 45% infestation respectively, and Miravis Prime, Trionic and Procure followed up with 57%, 62%, and 65% respectively.

Table 8. Percent powdery mildew and standard deviation of seven fungicide treatments plus an untreated check for September 11, sorted by lower leaf surface.

Treatment	Avg PM % Upper Leaf	St. Dev. (±)	Avg PM % Lower Leaf	St. Dev. (±)
Miravis alt. w/ Inspire	0.7	0.8	22.7	16.6
Inspire Super	2.8	1.8	25.5	17.3
Luna Sensation	0.8	1.6	35.8	20.1
Luna Experience	1.1	0.8	45.0	20.2
Miravis Prime	4.5	6.0	56.7	18.9
Trionic	7.5	9.3	61.7	29.1
Procure	7.5	4.6	65.0	21.7
Untreated Check	75.0	21.8	95.8	7.9

Conclusions

No single treatment was clearly better throughout the trial week after week. In an effort to separate product performance over the season, ratings from Aug. 9 – Sept. 11 were averaged to get a sense of their protective performance over most of the season (Table 9). Because the first two treatment ratings and UTC (7/23 and 8/02) were very low, they were not considered in these concluding remarks.

Overall, the seven treatments could be divided into two groups based on performance. Five of the seven treatments performed similarly throughout the trial (both Miravis, both Luna, and

Inspire Super), allowing for some weekly variation. The remaining two treatments, Trionic and Procure, provided acceptable control compared to the UTC but did not perform at the level of the first treatment group.

Inspire Super, Miravis alternated with Inspire Super, and both Luna treatments all had low leaf infestation values ranging from 22-25%, which revealed a very consistent and high level of protection throughout the season. While the Miravis Prime treatment contains a SDHI compound plus a novel FRAC code, it performed slightly below the other treatments at 34% control.

Table 9. Means of percent powdery mildew and standard deviation of seven fungicide treatments plus an untreated check taken from August 9 - September 11, sorted by lower leaf surface.

Treatment	FRAC or MOA code	Avg PM % Upper Leaf	St. Dev. (±)	Avg PM % Lower Leaf	St. Dev. (±)
Inspire Super	9,3,U8,M	2.2	3.2	21.6	15.7
Luna Sensation	7,11,U8,M	0.5	0.8	22.8	12.4
Miravis alt. w/ Inspire	7,12,9,3,M	0.6	1.1	25.2	15.9
Luna Experience	3,7,U8,M	0.9	0.9	25.4	15.5
Miravis Prime	7,12,3,M	2.0	2.8	34.1	17.9
Trionic	1,3,M	7.3	7.6	41.1	16.4
Procure	1,3,M	5.7	3.7	51.9	15.8
Untreated Check	-	47.9	20.9	67.8	11.5

Four of the five highest performing fungicide treatments in this trial contain a SDHI compound (FRAC 7), a trend observed in previous trials with the Luna products. Two new products in this trial, Miravis Prime and Inspire Super contain novel FRAC codes, 12 and 9, and performed well in this trial. These products will hopefully be re-evaluated in future years to see how they perform over time and under different seasonal conditions. Both Luna and Inspire Super treatments were alternated with Vivando, another strong PM fungicide based on previous trial work.

The next grouping of treatments includes Trionic and Procure, averaging 41% - 52% infestation on the lower leaf surface, still a good rate of PM control especially compared to the UTC. Trionic is a DMI fungicide manufactured by UPL and is chemically the same as Procure, manufactured by Arysta. In previous trial work, Procure has been a widely used strong rotational partner for PM control but appears in this trial to be a bit weaker on PM compared to Trionic. The compounds Microthiol and Topsin M rotated with Trionic and Procure have been shown in previous trials to have lower efficacy than other products, which may account for the lower performance over all of these treatments. Microthiol does a good job of protecting the upper leaf surface but has no systemic activity, therefore later in the season the lower leaf surface can have very high levels of PM infestation.

Because Trionic and Procure have the same active ingredient, their control should be very similar, suggesting any difference in efficacy could be the result of sampling variance or a difference in the manufacturing process. For the past five years, Procure has been used as a strong rotational partner with many other fungicides in this trial so it's decreased efficacy is

something to be aware of and note for future trials. If Trionic and Procure were paired with a different rotational partner such as Vivando, their performance would likely be increased.

As you review this report remember this trial was designed as a large plot demonstration without randomization and replication, therefore no statistical analysis of these treatments is possible, but these observations may reveal a pattern of efficacy worth further exploring.

If you have any questions about the trial results, please contact me.

Respectfully,

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