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Pumpkin Powdery Mildew Fungicide Demonstration Trial Report - 2017

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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 (Solid Gold, Rupp Seeds) to determine the efficacy of compounds on foliage health. No yield data was taken.

Methods

The trial was direct seeded June 1st using a Monosem vacuum seeder. Each plot consisted of two 70' long rows of Solid Gold pumpkin planted on 5' centers and thinned to a final density of 3' 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.

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 (5 pt /A) plus Dual Magnum (1.3 pt /A) broadcast pre emerge on June 2nd. Sandea (1.0 oz/A) plus glyphosate (32 oz/A) were applied between the plots via a shielded sprayer prior to vine tip on June 30th. Any weed escapes between the rows or in 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 recommendations, no P or K was added to the field. On June 9th, 75 pounds of nitrogen in the form of liquid 28-0-0 was side dressed 6 inches away from the row, approximately 2 inches deep in the soil.

In 2017, steps were taken to prevent Downy Mildew from being a confounding factor while rating the plots. Ranman (2.75 oz/A) was alternated with Zampro (14 oz/A) and applied to all plots on the same day but after the PM treatments were applied. Kocide 3000 (0.5 lb/A)

was tank mixed with each application of either Ranman or Zampro to limit bacterial infections. No DM was detected in the plots but moderate levels of bacterial leaf spot were detected on the foliage and fruit in all treatments. None of these products should have an impact on PM efficacy.

Powdery mildew was first detected in the trial on July 24th, 10 days later than 2016. According to protocol, this detection initiated scouting and treatment applications.

On July 26th, all treatments were scouted for an initial disease rating on both the upper and lower leaf surfaces. Subsequent PM evaluations were conducted on August 2nd, August 10th, August 17th, August 25th, August 31st, and September 7th.

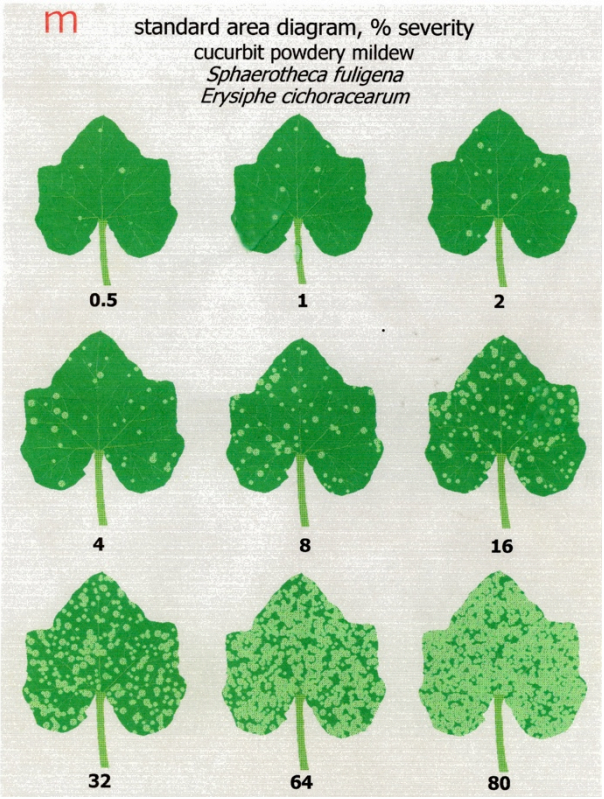

Figure 1. Percent powdery mildew infection chart.

In each plot, powdery mildew development was evaluated at 9-10am on six randomly chosen leaves. Each leaf was examined on the upper and lower surface for powdery mildew colonies. Prior to each rating a pictorial guide (**Fig. 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.

Fungicide treatment sprays were applied immediately after the disease rating session starting July 26th, followed by August 2nd, August 10th, August 17th, August 25th, and August 31st. All treatments were applied using a hydraulic boom sprayer at 32 GPA using hollow cone nozzles at 65 PSI.

Results

Fungicide treatments are listed in **Table 1.** Rating data for the seven evaluations can be found in **Tables 2-8**. Recall that treatment 8 is an "untreated check" created by taking two leaves from each untreated plot area, for an average of 14 leaves per rating.

Table 1. 2017 Powdery mildew fungicide trial treatments.

TRT	**Product, Rate, FRAC Sprays 1, 3, and 5**	**Product, Rate, FRAC Sprays 2, 4, and 6**
1	Fontelis (1 pt/A) [FRAC 7] + 0.25% v/v Chemsurf 90	Quintec (4 oz/A) + Manzate (2.5lb/A) [FRAC 13 + M]
2	Fontelis (1 pt/A) [FRAC 7] + 0.25% v/v Chemsurf 90	Procure (8 oz) + Manzate (2.5 lb/A) [FRAC 3 + M]
3	Luna Sensation (6oz) + Manzate (2.5 lb/A) + Chemsurf 90 (0.125 v/v) (FRAC 7,11 + M)	Procure (8 oz) + Manzate (2.5 lb/A) [FRAC 3 + M]
4	Quintec (6 oz/A) + Manzate (2.5 lb/A) [FRAC 13 + M]	Procure (8 oz) + Manzate (2.5 lb/A) [FRAC 3 + M]
5	Merivon (4.0 oz/A) + Manzate (2.5 lb/A) Chemsurf 90 (0.25 v/v) [FRAC 7,11 + M]	Procure (8 oz) + Manzate (2.5 lb/A) [FRAC 3 + M]
6	LifeGard + Manzate + Chemsurf 90 [FRAC P06 + M]	Procure (8 oz) + Manzate (2.5 lb/A) [FRAC 3 + M]
7	Sodium Hypochlorite 0.3% + Manzate (2.5lb/A) [FRAC M]	Sodium Hypochlorite 0.3% + Manzate (2.5lb/A) [FRAC M]
8 (UTC)	Untreated Check (eastern 15' of each plot)	

In the first PM evaluation on July 26th, no treatments had PM colonies detected on the upper leaf surface except the UTC. On the lower leaf surface, all treatments including the untreated check, ranged between 0 and 0.3%. These levels of PM are barely detectable, showing a very early infection.

Table 2. Percent powdery mildew and standard deviation of eight fungicide treatments for July 26th sorted by lower leaf surface.

	% PM Upper Leaf Surface		**% PM Lower Leaf Surface**	
TRT	**Mean ± SD**		**Mean ± SD**	
2	0	± 0	0	± 0
3	0	± 0	0	± 0
4	0	± 0	0.1	± 0.2
5	0	± 0	0.1	± 0.2
6	0	± 0	0.1	± 0.2
8 (UTC)	0	± 0.1	0.1	± 0.3
1	0	± 0	0.2	± 0.3
7	0	± 0	0.3	± 0.4

In the second PM evaluation on August 2nd, treatments 1, 2, and 5 have no PM detections on the upper leaf surface, but show initial infections ranging from 0.3 to 1.0% on the lower leaf surface. Treatments 3, 4, 6 and 7 have detections from 0.1 to 1% on the upper leaf and 0.3 to 1.2% on the lower leaf. The untreated check had the highest infection at 1.3% for the

upper leaf surface and 3.3% for the lower leaf surface; powdery mildew infestation was on the rise.

Table 3. Percent powdery mildew and standard deviation of eight fungicide treatments for August 2nd sorted by lower leaf surface.

	% PM Upper Leaf Surface		% PM Lower Leaf Surface	
TRT	**Mean ± SD**		**Mean ± SD**	
1	0.0	± 0	0.3	± 0.4
3	0.1	± 0.2	0.3	± 0.3
5	0.0	± 0	0.4	± 0.5
4	0.3	± 0.4	0.7	± 0.3
6	1.0	± 0.6	0.8	± 0.3
2	0.0	± 0	1.0	± 1.5
7	0.8	± 1.6	1.2	± 1.6
UTC	1.3	± 1.6	3.3	± 3.1

In the third evaluation on August 10th, all upper leaf surface treatments were still quite low between 0.1 and 5.8%, but the lower leaf surface values were over double digits for treatments 6 and 7. The untreated check was highest on the upper leaf surface at 29.9% with the lower leaf reading at 20%. Differences between the treatments and the UTC can be seen at this point.

Table 4. Percent powdery mildew and standard deviation of eight fungicide treatments for August 10th sorted by lower leaf surface.

	% PM Upper Leaf Surface		% PM Lower Leaf Surface	
TRT	**Mean ± SD**		**Mean ± SD**	
2	0.1	± 0.2	0.9	± 1.1
3	0.6	± 0.8	1.5	± 1.6
4	0.2	± 0.3	2.2	± 1.9
5	1.5	± 2.5	4.2	± 4.3
1	1.8	± 2.2	5.3	± 2.7
6	3.6	± 3.4	12.3	± 18.8
7	5.8	± 8	13.5	± 12.1
8 (UTC)	29.9	± 25.5	20	± 21.2

In the fourth evaluation on August 17th, treatment 7 had the highest rating on the upper leaf surface at 10.5% which is still fairly low, but the standard deviation is nearly 20% showing quite a bit of variability in the data. Treatment 1-6 are still below 8% infestation on the upper leaf surface. On the lower leaf surface, treatments 5, 6, and 7 have increased

significantly and range between 26.8 and 54.2%. Treatments 1-4 still remain very low, under 6% during this rating for both leaf surfaces. The UTC for both the upper and lower leaf surface is hovering around 60%.

Table 5. Percent powdery mildew and standard deviation of eight fungicide treatments for August 17th sorted by lower leaf surface.

	% PM Upper Leaf Surface		% PM Lower Leaf Surface	
TRT	**Mean ± SD**		**Mean ± SD**	
2	1	± 1.1	3.7	± 1.6
4	2.3	± 3	4	± 3.3
3	0.6	± 0.7	4.3	± 2.9
1	1.7	± 0.8	6	± 2.8
5	8.1	± 13.7	26.8	± 21.1
6	3	± 3.5	43	± 19.4
7	10.5	± 19.5	54.2	± 35.6
8 (UTC)	59.3	± 24.9	62.9	± 25.0

The fifth evaluation was conducted on August 25th, with treatments 2-6 below 6% on the upper leaf surface. Treatment 1 and 7 increased to 14.8 and 30% respectively on the upper leaf surface. On the lower leaf surface, treatment 3 was the lowest rated at 12%, with all other treatments higher, ranging from 28-71.7%. The upper leaf surface of the UTC approached 80% during this period and the lower leaf surface approached 90%.

Table 6. Percent powdery mildew and standard deviation of eight fungicide treatments for August 25th sorted by lower leaf surface.

	% PM Upper Leaf Surface		% PM Lower Leaf Surface	
TRT	**Mean ± SD**		**Mean ± SD**	
3	0.8	± 1.2	12	± 10.9
2	2.3	± 1.5	28.2	± 23.2
1	14.8	± 9.4	29.2	± 12
4	0.8	± 0.8	34.3	± 26.9
5	2.1	± 1.8	45	± 25.1
6	5.5	± 3.8	52.5	± 19.4
7	30	± 16.7	71.7	± 10.3
8 (UTC)	77.1	± 15.3	87.9	± 7.8

In the 6th evaluation on August 31st, treatments 1-5 have infestations on their upper leaves below 7%, and range between 29-65% on their lower leaf surfaces. Treatments 6 and 7 still have small upper leaf infestations at 11 and 15% respectively, but considerably higher lower leaf colonization at 67 and 83% respectively. The untreated check is approaching

65% infestation on the upper leaf surface and 91% on the lower leaf canopy. Much of the foliage in the untreated check is dying or dead at this point.

Table 7. Percent powdery mildew and standard deviation of eight fungicide treatments for August 31st sorted by lower leaf surface.

	% PM Upper Leaf Surface		% PM Lower Leaf Surface	
TRT	**Mean ± SD**		**Mean ± SD**	
3	3.3	± 2.9	29.7	± 19.4
2	3.2	± 1.8	46.7	± 15.4
1	6.2	± 3.7	55	± 17.6
5	7.2	± 13.7	55	± 17.6
4	4.2	± 4	65	± 11.4
6	11	± 9.4	67.5	± 20.4
7	15.3	± 8	83.3	± 6.1
8 (UTC)	65	± 12.6	91.4	± 4.1

In the final evaluation on September 7th, treatments 1-6 still have a remarkably low level of infestation on the upper leaf surface under 6%; treatment 7 is the highest at 13.5% on the upper leaf surface and 86.7% on the lower leaf surface, which is higher than the untreated check. The untreated check remains near 62% on the upper leaf surface and 85% on the lower leaf surface, but most of the foliage is dead due to PM infestation.

Table 8. Percent powdery mildew and standard deviation of eight fungicide treatments for September 7th sorted by lower leaf surface.

	% PM Upper Leaf Surface		% PM Lower Leaf Surface	
TRT	**Mean ± SD**		**Mean ± SD**	
3	5.8	± 10.2	45	± 22.4
2	1.2	± 0.8	53.3	± 9.8
4	5.3	± 7.5	53.3	± 23.8
1	3.8	± 4.1	55.8	± 15
5	3.5	± 3.6	60.8	± 18.3
6	5.2	± 6.2	71.7	± 22.1
8 (UTC)	62.1	± 25.7	85.4	± 13.5
7	13.5	± 9	86.7	± 6.1

Conclusions
This goal of this powdery mildew demonstration trial is to evaluate the contribution and effectiveness of specific fungicides when used in combination with standard rotational fungicides (Procure + Manzate Pro Stick) to determine leaf and canopy health, ostensibly to maximize marketable yield, 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, bacterial diseases, and others.

In general, 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 primarily to known limitations in 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 of the general protectant fungicide Manzate Pro Stick.

In terms of performance over the past several years, **treatment 4** (Quintec alternated with Procure) would be considered a "standard" fungicide program. Relative to its performance, other fungicide programs can be compared.

The only threshold we have for PM is initial detection which signals the onset of fungicide applications. In all other comparisons, lower percent infestation is considered better. When leaves become colonized by PM in the 70-80% or higher range, they will shortly begin to show symptoms of chlorosis and begin to die.

In the 2017 trial, all treatment combinations looked very good through August 17th where the first separation of treatments 1-4 from 5-7 were noticeable on the lower leaf surface. By August 31st, the upper leaf surfaces still had low infestation rates but the lower leaf surfaces rose to a low of 30% (trt 3) to a high of 83% (trt 7). This trend largely held for the final rating on September 7th.

The best performing program in this trial based on season long lower leaf surface PM control would be treatment 3, which did not exceed 45% PM infection throughout the life of the trial. The MOAs/FRAC numbers in this treatment not including the alternate spray of Procure and Manzate, were group 7 and 11.

The second tier of fungicide programs in this trial were not far from treatment 3 in terms of efficacy, and include treatments 1, 2, 4, and 5. These treatments all controlled PM very well on the upper leaf surface and had infection rates on the lower leaf surface between 53-61% at the last rating. MOAs/FRAC numbers from groups 7, 11, 13 and M.

Treatments 6 and 7 would fall into the third tier of efficacy. While they gave good control of PM on the upper leaf surface throughout the season, around mid August the lower leaf infestation began to noticeably increase and outpace the other treatments. MOAs / FRAC numbers for these products included P06 and M.

Although there were differences in efficacy between the fungicide treatments in this trial, treatments 1-5 would be considered acceptable for use in commercial spray programs, with treatment 6 performing slightly below the first group but better than not treating foliage at all. Lastly, treatment 7 would be unacceptable on a commercial farm for PM control.

Recall that the pumpkin hybrid we intentionally used in this trial is susceptible to PM, meaning these results reflect the worst case scenario in terms of efficacy. As part of our IPM program standard recommendations, we always suggest growers select a PM tolerant or resistant hybrid when possible to maximize foliage quality throughout the season. Even marginal spray programs provide much better control when used in combination with these other tolerant or resistant hybrids.

When PM protection is equal or nearly equal among several fungicide programs, growers often consider the cost of these programs to help guide their final disease management decisions. For this report I have not factored in the cost of the various programs, or to what extent products that are OMRI labeled may impact grower choice.

As you consider these findings remember that 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 results of this trial, please contact me.

Thank you again for your support of this pumpkin IPM program.