

Fungicide Alternatives Management of Microdochium Patch and Anthracnose

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Introduction

Previous trials indicated promising results for the control of *Microdochium* patch on *Poa annua* putting greens using the combination of the mineral oil Civitas One with sulfur and/or potassium phosphite, as well as a sulfur and potassium phosphite combination. Other previous trial results have indicated that iron sulfate heptahydrate has shown the potential for control of *Microdochium* patch on *Poa annua* putting greens. However, some questions remain, namely concerning abiotic damage that was observed when rolling was used in combination with Civitas One. This is a major concern for turfgrass managers as rolling and other forms of mechanical stress are typical cultural practices used to maintain high quality putting surfaces. Another concern is turfgrass thinning associated with frequent high rates of iron sulfate heptahydrate.

Considering these concerns, in the fall of 2015 and 2016 a series of new trials were initiated to explore methods for alleviating abiotic damage caused by these fungicide alternative methods for *Microdochium* patch management. The first goal of these trials was to identify minimum effective rates using alternative product combinations and rotations of Civitas One, phosphite and sulfur (**Experiments 1-3**). The second goal was to determine if increased water carrier volumes or application timing intervals of iron sulfate heptahydrate would continue to suppress *Microdochium* patch while alleviating turfgrass thinning compared to the original two-week interval or 2 gal/M carrier volume (**Experiments 4 and 5**). In addition, a trial exploring the combination of a phosphite product and iron sulfate heptahydrate, an alternative product

combination not previously explored, was also initiated (**Experiment 6**). Other new trials include exploring alternative crop oils; Civitas One, Superior Oil and TriTek Oil (**Experiment 7**), and phosphite products, PK Plus vs. Duraphite 12 used in combination with sulfur (**Experiment 8**). Experiments 1-4, 6 and 7 all receive replicated golfer traffic in order to mimic real-world conditions and assess any abiotic damage that may result.

Finally, a previous trial using the wetting agent “Revolution” to control the turfgrass disease anthracnose on *Poa annua* putting greens without fungicides has shown promising results (**Experiment 9**). This trial concluded in September 2016 and preliminary results are included.

Research on all of the following 9 experiments is being conducted on *Poa annua* putting greens at the Lewis-Brown Turf Farm, Corvallis, OR that were constructed in either 2009 (1-4, 6, 7 and 9) or 2013 (5 and 8) using the California method consisting of 100% USGA specified sand established vegetatively using aerification cores.

Experiment 1:

Objective: Determine the most reliable and cost effective rate of the combination of the mineral oil Civitas One, sulfur DF and the potassium phosphite product PK Plus to control Microdochium patch on *Poa annua* putting greens, while assessing abiotic damage under replicated golfer traffic.

Treatments were applied every other week from Sept. 2015 to May 2016 and are currently being replicated from Sept. 2016 to May 2017 (**Table 1**).

1. 4.25 oz/M Civitas One + 0.125 lbs. S/M every two weeks (M = 1 000ft²)
2. 4.25 oz/M Civitas One + 0.25 lbs. S/M every two weeks
3. 4.25 oz/M Civitas One + 3.0 oz/M PK Plus every two weeks
4. 4.25 oz/M Civitas One + 6.0 oz/M PK Plus every two weeks
5. 8.50 oz/M Civitas One + 0.125 lbs. S/M every two weeks
6. 8.50 oz/M Civitas One + 0.25 lbs. S/M every two weeks
7. 8.50 oz/M Civitas One + 3.0 oz/M PK Plus every two weeks
8. 8.50 oz/M Civitas One + 6.0 oz/M PK Plus every two weeks
9. Control (Not treated)

Trial update: The first year of the experiment was successfully implemented and the second year of applications was begun in September 2016. This trial reproduced the abiotic damage that was previously observed in other trials. The most striking damage was observed whenever Civitas One was applied with Sulfur regardless of rates although all applications including Civitas One at the 8.5 oz. / M every two weeks had unacceptable abiotic damage during the winter months. Microdochium patch disease was greatly suppressed by all applications compared to the control treatment (Image 1).



Image 1: Effects of high rates of Civitas One + Sulfur (left), and Civitas One + PK Plus (right) compared to the control plot in January 2016.

Experiment 2:

Objective: Determine if applications of the combinations of Civitas One and Sulfur DF or Civitas One and PK Plus in rotation with Sulfur DF and PK Plus will lead to acceptable control of *Microdochium* patch on *Poa annua* putting greens while lessening any effects of abiotic damage previously observed in bi-weekly combinations of the mineral oil Civitas One.

The following treatments were applied every other week from September 2015 to May 2016 and are currently being replicated from Sept. 2016 to May 2017.

- 1a. 8.50 oz/M Civitas One + 0.25 lbs. S/M every four weeks (M = 1 000ft²)
- 1b. 0.25 lbs. S/M + 6.0 oz/M PK Plus every four weeks
- 2a. 8.50 oz/M Civitas One + 6.0 oz/M PK Plus every four weeks
- 2b. 0.25 lbs. S/M + 6.0 oz/M PK Plus every four weeks
3. 0.25 lbs. S/M + 6.0 oz/M PK Plus every two weeks
4. Control (Not treated)

Trial update: The first year of the experiment was successfully implemented and the second year of applications was begun in September 2016. As was shown in Experiment 1, whenever Civitas One was applied in combination with sulfur, abiotic damage occurred in the winter months (Image 2). The treatment 2 rotation (2a & 2b) showed very promising results with no winter damage and very good Microdochium patch suppression in the first year of this experiment in Corvallis, OR.

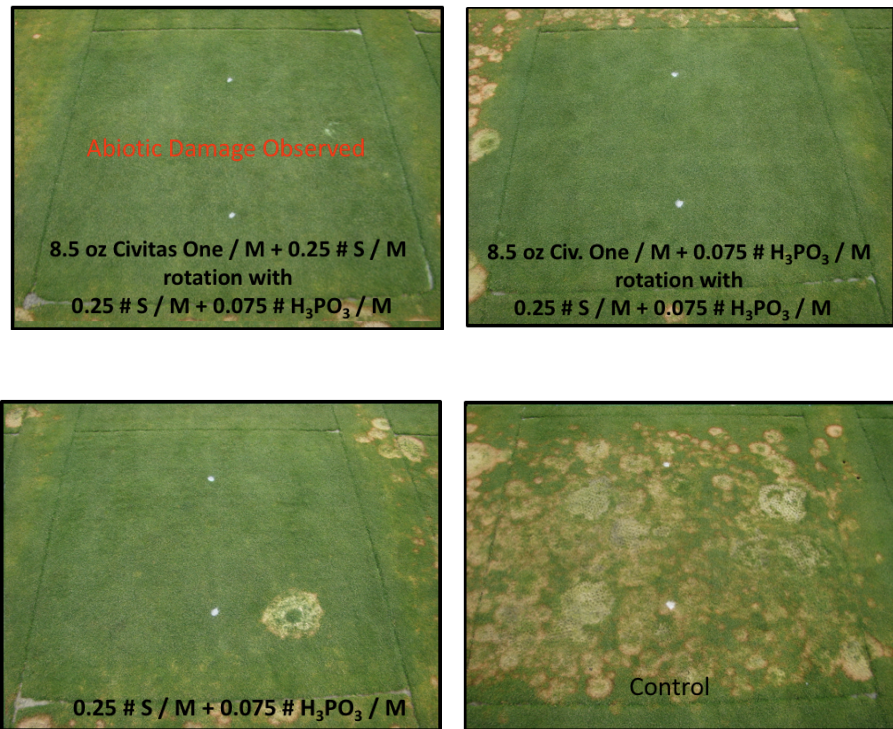


Image 2: Effects of Civitas One and Sulfur DF or Civitas One and PK Plus in rotation with Sulfur DF and PK Plus in March 2016.

Experiment 3:

Objective: Determine if alternative product rotations avoiding winter application of Civitas One can reduce abiotic damage caused by this product.

The following treatments are being applied according to the schedule below from September 2016 to May 2017 and then will be repeated in September 2017 to May 2018.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Trt 1	Civ + Dur X 2wks		Sulfur + Dur X 2wks			Civ + Dur X 2wks	
Trt 2	Civ + Dur X 2wks			Sulfur + Dur X 2wks		Civ + Dur X 2wks	
Trt 3	Civ + Dur X 2wks			Sulfur + Dur X 2wks			Civ + Dur X 2wks
Trt 4	Civ + Dur X 2wks	Sulfur + Dur X 2wks				Civ + Dur X 2wks	
Trt 5	Civ + Dur X 4 wks in rotation with Sulfur + Dur X 4wks						
Trt 6	Civ + Dur X 2wks						
Trt 7	Sulfur + Dur X 2wks						
Trt 8	Civ + Dur X 3wks		Sulfur + Dur X 3wks			Civ + Dur X 3wks	
Trt 9	Civ + Dur X 3wks			Sulfur + Dur X 3wks		Civ + Dur X 3wks	
Trt 10	Civ + Dur X 3wks			Sulfur + Dur X 3wks			Civ + Dur X 3wks
Trt 11	Civ + Dur X 3wks	Sulfur + Dur X 3wks				Civ + Dur X 3wks	
Trt 12	Civ + Dur X 6 wks in rotation with Sulfur + Dur X 6wks						
Trt 13	Civ + Dur X 3wks						
Trt 14	Sulfur + Dur X 3wks						
Trt 15	Fungicide Control (monthly applications using a fungicide rotation)						
Trt 16	Untreated Control						

^z Civ = Civitas One applications of 8.5 oz/M; ^y Dur = Duraphite 12 applications of 3.2 oz/M; ^x Sulfur = 0.25 # Sulfur / M

Experiment 4:

Objective: Compare different water carrier volumes for iron sulfate heptahydrate applications in order to assess if a higher dilution will lead to less turfgrass thinning while at the same time continue to manage Microdochium patch on *Poa annua* putting greens.

The following treatments were applied every other week from September 2015 to May 2016 and are currently being replicated from September 2016 to May 2017.

1. 2.0 #/M FeSO₄ Heptahydrate applied using a 2.5 gal/M spray volume every two weeks (M = 1 000ft²)
2. 2.0 #/M FeSO₄ Heptahydrate applied using a 5.0 gal/M spray volume every two weeks
3. 2.0 #/M FeSO₄ Heptahydrate applied using a 7.5 gal/M spray volume every two weeks
4. 2.0 #/M FeSO₄ Heptahydrate applied using a 10.0 gal/M spray volume every two weeks
5. Control (Not treated)

Trial update: The first year of the experiment was successfully implemented and the second year of applications was begun in September 2016. There is suggestion that the water carrier volume does not play a large role in the ability of the application of 2 # FeSO₄ / M every two weeks to suppress Microdochium patch. There is suggestion that there is a minor advantage of using a larger water carrier to decrease the blackening of the turfgrass leaves and to have a slight reduction in turfgrass thinning due to the frequent applications of iron sulfate (Image 3).

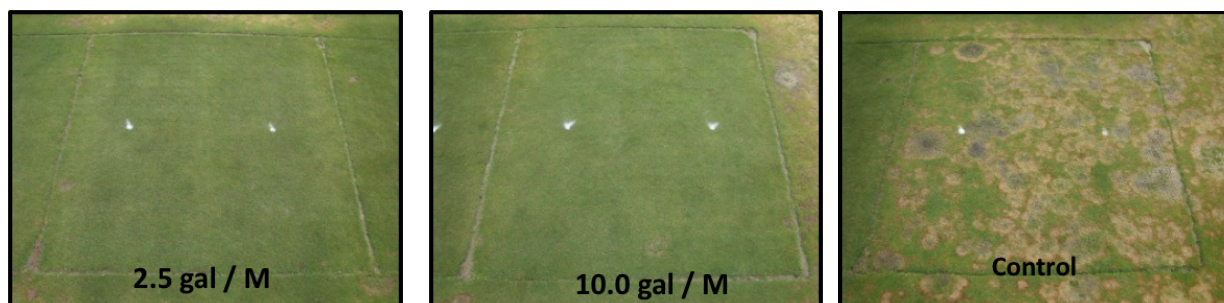


Image 3: Effects of 2.5 (left) and 10.0 gallon/M carrier volume when applying iron sulfate heptahydrate compared to the control (right) in March 2016.

Experiment 5:

Objective: Compare application timings of iron sulfate heptahydrate to quantify the minimum application intervals necessary to suppress *Microdochium* patch on *Poa annua* putting greens.

The following treatments were applied according to the schedule below from October 2015 to May 2016 and are currently being replicated from October 2016 to May 2017

1. 2.0 #/M FeSO₄ Heptahydrate applied using a 5.0 gal/M spray volume every 2 weeks (M = 1 000ft²)
2. 2.0 #/M FeSO₄ Heptahydrate applied using a 5.0 gal/M spray volume every 4 weeks
3. 2.0 #/M FeSO₄ Heptahydrate applied using a 5.0 gal/M spray volume every 6 weeks
4. 2.0 #/M FeSO₄ Heptahydrate applied using a 5.0 gal/M spray volume every 8 weeks
5. Control (Not treated)

Trial update: The first year of the experiment was successfully implemented and the second year of applications was begun in October 2016. There is suggestion that the application frequency of every two weeks (treatment 1) is the only treatment that provided acceptable disease suppression, although turfgrass thinning was also observed leading to unacceptable turfgrass quality (**Image 4**).

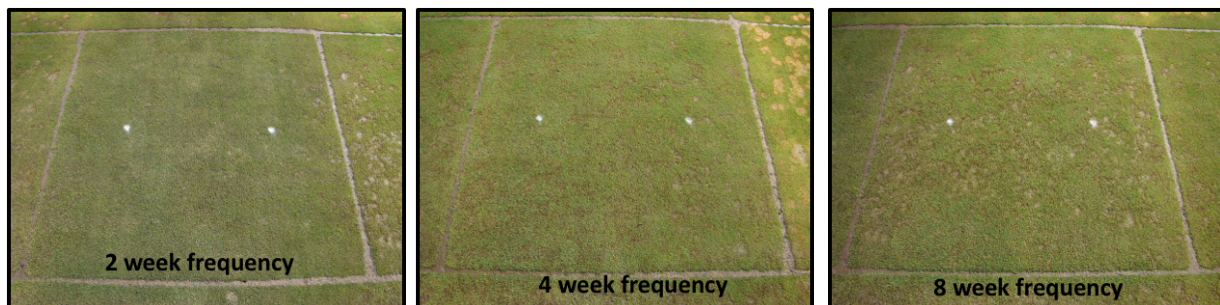


Image 4: Effects of iron sulfate heptahydrate applied every two weeks (left), four (middle) and eight weeks (right) in March 2016.

Experiment 6:

Objective: Evaluate the effects of phosphite applied in combination with varying rates of iron sulfate on an annual bluegrass putting green without fungicides.

Materials: Combinations of phosphite and iron sulfate are currently being applied at the following treatment levels from September 2016 to May 2017 and will be replicated from September 2017 to May 2018.

Factors in this research include the following phosphite and iron sulfate rates

Factor 1: Phosphite

- Duraphite 12 applied at 3.14 oz/M every two weeks
- No phosphite applications

Factor 2: Iron sulfate

- No iron sulfate
- 0.25 # FeSO₄ / M applied every two weeks
- 0.5 # FeSO₄ / M applied every two weeks
- 1.0 # FeSO₄ / M applied every two weeks
- 2.0 # FeSO₄ / M applied every two weeks

Experiment 7:

Objective: Compare three different mineral oils in combination with potassium phosphite in their ability to control Microdochium patch on *Poa annua* putting greens under replicated golfer traffic in order to determine if there are differences in abiotic damage observed and perhaps lead to more cost effective product choices.

The following treatments were applied every other week from September 2015 to May 2016 and are currently being replicated from Sept. 2016 to May 2017.

1. 8.50 oz/M Civitas One + 6.0 oz/M PK Plus every two weeks (M = 1 000ft²)
2. 7.92 oz/M Superior Oil + 6.0 oz/M PK Plus + 0.37 oz/M of the pigment PAR every two weeks
3. 7.92 oz/M Superior Oil + 6.0 oz/M PK Plus every two weeks
4. 9.80 oz/M TriTek Oil + 6.0 oz/M PK Plus + 0.37 oz/M of the pigment PAR every two weeks
5. Control (Not treated)

Trial update: The first year of the experiment was successfully implemented and the second year of applications was begun in September 2016. Preliminary results suggest that all mineral oils tested have the potential to suppress Microdochium patch when used in combination with PK Plus. Abiotic damage due to repeated applications every two weeks throughout the winter is still a concern with all products tested.

Experiment 8:

Objective: Compare two phosphite products alone and in combination with Sulfur DF in order to quantify their ability to control Microdochium patch on *Poa annua* putting greens.

The following treatments were applied every other week from October 2015 to May 2016 and are currently being replicated from October 2016 to May 2017.

1. 6.0 oz/M PK Plus every two weeks (M = 1 000ft²)
2. 3.14 oz/M Duraphite 12 every two weeks
3. 6.0 oz/M PK Plus + 0.25 lbs. S/M every two weeks
4. 3.14 oz/M Duraphite 12 + 0.25 lbs. S/M every two weeks
5. 0.25 lbs. S/M every two weeks
6. Control (Not treated)

Trial update: The first year of the experiment was successfully implemented and the second year of applications was begun in September 2016. There is suggestion that all treatments suppress Microdochium patch compared to the control with better disease control observed when either phosphite product is used in combination with sulfur.

Experiment 9:

Objective: To confirm previous results concerning the application of the wetting agent “Revolution” to control anthracnose on *Poa annua* putting greens (**Image 5**).

Trial update: The second year of the experiment was successfully implemented with the trial applications concluding in September 2016. Initial results suggest that when disease pressure was high, as in 2015; treatment 1, followed by treatment 2, followed by treatment 6 and finally by treatment 3 provided significant suppression of anthracnose compared to the control (**Table 8**) as measured using the area under disease progress curve analysis. In 2016, the disease pressure was lower and all treatments were able to significantly suppress anthracnose compared to the control.



Image 5: Effects of Revolution applied at 6 oz/1,000 sq ft twice a week (left), and once every 4-weeks (center), compared a control (right), which did not receive wetting application treatments, September 08, 2015.

Table 8: Area under disease progress curve results for year one (2015) and year two (2016) in Corvallis, OR. The 2015 trial began on Feb. 03, 2015 and ended on Sep. 28, 2015. The 2016 trial began on Feb. 02, 2016 and ended on Sep. 27, 2016.

Rate and frequency	2015	2016
6.0 oz. / M twice a week	24.4 a ^z	3.2 a
6.0 oz. / M once a week	165.3 b	13.1 a
6.0 oz. / M every two weeks	561.4 c	5 a
6.0 oz. / M /every three weeks	578.3 cd	12 a
6.0 oz. / M every four weeks	968.8 cd	15.8 a
1.5 oz. / M once a week	462.7 bc	11 a
3.0 oz. / M every two weeks	745.6 cd	39.7 a
Untreated	1537.1 d	154.2 b

^z Within a column, means followed by the same letter are not significantly different according to Fisher's protected LSD ($P = 0.05$); 'ns' = results of ANOVA not significant.