

# INFLUENCE OF FUNGICIDES AND FUNGICIDE PROGRAMS ON DISEASE AND ALGAE SUPPRESSION AND TURFGRASS QUALITY OF A CREEPING BENTGRASS PUTTING GREEN, 2010

J.E. Kaminski and T. Lulis

Department of Crop and Soil Science  
The Pennsylvania State University, University Park

## INTRODUCTION

Dollar spot (*Sclerotinia homoeocarpa*) is a common disease of golf course fairways throughout Pennsylvania and the entire United States. Although there are several cultural management practices that can assist in reducing disease severity, the use of protective chemicals usually is necessary to control the disease during periods favorable for growth of the pathogen. The objectives of this study were to evaluate the ability of various fungicides, rates, and application intervals for their ability to preventively suppress dollar spot.

## MATERIALS & METHODS

This study was initiated at the Valentine Turfgrass Research Center located in University Park, PA. Soil was a sandy loam with a pH 7.1 and an OM of 1.77%. Turfgrass used for the fungicide evaluation was a mixed stand of predominantly creeping bentgrass (*Agrostis stolonifera*) with a small amount of annual bluegrass (*Poa annua*). The area was maintained as a bentgrass green and mowed six times per week to a height of 0.125in. All fungicide treatments were applied with a CO<sub>2</sub> pressurized (40 psi) sprayer equipped with an air-induction flat fan nozzle (AI9508E), and calibrated to deliver 2.0 gal water per 1000 ft<sup>2</sup>. A few dollar spot infection centers were noticed within the within the study area on the same day treatments were initiated. Treatments were initially applied on 20 May and reapplied eleven times every 7 to 14 days depending upon each treatment's schedule. All treatments and application dates are listed in the data tables.

Plots measured 3 ft x 6 ft and were arranged in a randomized complete block with four replications. Dollar spot severity was assessed by counting the number of infection centers within each plot or by estimating the disease severity on a 0 to 100% scale where 0 = no disease present and 100 = entire plot area affected by dollar spot. Turfgrass quality and/or color were also visually rated on a 1 to 9 scale where 1 = entire plot brown or dead and 9 = optimum greenness and density. Percent algae was rated on a single date on a 0 to 100% scale where 0 = no algae present and 100 = entire plot area blackened by algae. All data were subjected to analysis of variance and means were separated at  $P \leq 0.05$  according to Fisher's Protected Least Significant Difference Test.

## RESULTS

Dollar spot. Although a few active dollar spot infection centers (DSIC) were present when treatments were initiated on 20 May, disease pressure quickly increased over the next two week. In addition, disease pressure was not consistent throughout the trial and severe variation within treatments was observed. When plots were first rated on 4 Jun (14 days after initial treatments DAT), there were no significant differences among plots despite averages ranging from 0 to 73 DSIC per plot (Table 1). Although differences in DSIC were present on 14 Jun, these differences were likely the continued result of uneven pressure within the plots. Following 3-5 applications of the various treatments, significant and meaningful differences were observed. On 28 Jun, plots treated with all fungicide except Honor provided the greatest level of suppression when compared to the untreated control plots and no differences were observed among treatments. Although Honor did not provide acceptable suppression of dollar spot, it was observed that a single treatment of Iprodione Pro mistakenly was applied on its own as opposed to be integrated as

a rotation with the Honor treatments, thus resulting in reduced efficacy of Honor due to the lack of suppression for over 3 weeks. Once consecutive treatments were applied of each of the fungicides, recovery from the high dollar spot pressure was observed. When plots were rated on 28 Jul, plots treated with Reserve (all rates), Concert, Interface (all rates), Iprodione Pro (multiple applications), Emerald, Banner MAXX, and both rotational programs resulted in excellent suppression of dollar spot and had less than 1% disease per plot (Table 2). For treatments ending on 15 Jul, plots treated with Emerald provided the greatest suppression of dollar spot with only 2% disease observed within plots when rated on 26 Aug. No differences in dollar spot, however, were observed between the aforementioned treatment and within plots treated with Concert.

Algae. Moderate levels of black algae developed within the study site towards the end of the treatments. When plots were rated on 13 Aug, algae levels ranged from 0 to 18% and significant differences were observed (Table 3). Plots receiving programmatic treatments involving chlorothalonil and applied 2 weeks prior to the rating had no visible algae present. Other treatments containing chlorothalonil, but applied approximately 4 weeks prior to rating, had similar levels of algae when compared to the aforementioned programs. Although not significantly different from each other, plots treated with Concert had the least amount of algae (1%) and plots treated with reserve appeared to have increasing algae levels with reduced rates (2 to 4%). Other treatments appeared to have little positive or negative impact on algae and severity was variable even within the untreated control plots (7 to 13%).

Quality and Color. Turfgrass quality and color was rated during the study and was only determined based on the visual appearance of the healthy turf (i.e., excluding dollar spot injury). The highest quality was observed within plots treated with Reserve, Interface, Emerald, or the 2 programmatic treatments (Table 4). These treatments all had acceptable quality on 5 rating dates between 4 Jun and 28 Jul (approximately 2 or 3 weeks after the last application). Due to the extended treatments (last application on 13 Aug), the programmatic treatments had acceptable quality (>7.0) on all 6 rating dates. Plots treated with Concert, Iprodione Pro (repeated applications), Honor, and Iprodione Pro (single application) had acceptable turfgrass quality on 3, 3, 2, and 1 of the six ratings dates, respectively. Only plots treated repeated with Banner MAXX had unacceptable quality on all rating dates. Similar observations were made in color ratings.

## **DISCUSSION**

Disease severity in this study occurred very rapidly and sporadically within the study site. For this reason, disease severity was highly variable and only after repeated applications were true agronomic assessments able to be made. Once dollar spot severity was under control, all fungicide treatments (except Honor) provided similar levels of disease suppression. As mentioned previously, plots receiving Honor missed an application of Iprodione Pro which likely would have resulted in a significant improvement in disease suppression. In light of this missed application, the plots were not treated with any fungicide for nearly 4 weeks. Interface, Reserve, Emerald and the 2 programmatic treatments resulted in acceptable to excellent quality and color during the study, while variable results were observed in other fungicide treated plots. It is important to note that quality and color were rated independently of dollar spot severity. Plots treated only once with Iprodione or repeatedly with Banner MAXX generally had unacceptable quality throughout the study. Side benefits from some of these products included those containing chlorothalonil which resulted in the additional benefit of algae suppression.

## **ACKNOWLEDGEMENTS**

We thank David Livingston and the staff at the Valentine Turfgrass Research Facility for assisting in the maintenance of the research plots. This research was funded in part by BASF, Bayer Environmental Science, and the Pennsylvania Turfgrass Council.

Table 1. Dollar spot severity on a creeping bentgrass putting green following the application various fungicides and fungicide programs, 2010

Treatment and rate per 1000 sq ft	Application Code <sup>y</sup>	Dollar spot infection centers <sup>z</sup>			
		4 Jun	14 Jun	28 Jun	14 Jul
1 Reserve 4.8 SC 2.5 fl oz.....	ABCDFGH	27 a <sup>x</sup>	12 cde	2 b	0 e
2 Reserve 4.8 SC 3.2 fl oz.....	ACEGI	43 a	21 cde	9 b	3 de
3 Reserve 4.8 SC 3.5 fl oz.....	ACEGI	20 a	10 cde	2 b	1 e
4 Concert 5.5 fl oz.....	ACEGI	27 a	5 cde	1 b	0 e
5 Interface 3.0 fl oz .....	ACEGI	3 a	1 e	1 b	0 e
6 Interface 4.0 fl oz .....	ACEGI	2 a	1 e	0 b	0 e
7 Interface 5.0 fl oz .....	ACEGI	0 a	1 e	0 b	0 e
8 Iprodione Pro 2SE 4.0 fl oz.....	ACEGI	4 a	2 de	1 b	3 de
9 Emerald 0.13 oz.....	ACEGI	42 a	28 cde	3 b	0 e
10 Honor 0.83 oz .....	ACGI	55 a	39 bc	60 a	49 c
11 Iprodione Pro 2SE 4.0 fl oz.....	E	67 a	37 b-e	4 b	23 d
12 Chipco Signature 4.0 oz	ACEGIKM				
Triton FLO 0.5 fl oz	AE				
Daconil Ultrex 3.2 oz	CGK				
Interface 3.0 fl oz .....	IM	52 a	28 cde	18 b	20 de
13 Chipco Signature 4.0 oz	ACEGIKM				
Interface 3.0 fl oz	AM				
Daconil Ultrex 3.2 oz	CGK				
Triton FLO 0.5 fl oz	E				
Tartan 1.5 fl oz.....	I	1 a	2 e	2 b	6 de
14 Banner MAXX 1.0 fl oz .....	ACEGI	47 a	38 bcd	18 b	10 de
15 Untreated .....	-	47 a	70 ab	73 a	114 a
16 Untreated .....	-	73 a	76 a	85 a	91 b

<sup>z</sup> Dollar spot was rated by counting the number of infection centers per plot.

<sup>y</sup> Treatments were applied as follows: A = 20 May; B = 27 May; C = 4 Jun; D = 10 Jun; E = 17 Jun; F = 25 Jun; G = 1 Jul; H = 8 Jul; I = 15 Jul; K = 29 Jul; and M = 13 Aug.

<sup>x</sup> Means in a column followed by the same letter are not significantly different at  $P \leq 0.05$  level according to the Fisher's protected least significant difference t-test.

Table 2. Percent plot area affected by dollar spot on a creeping bentgrass putting green following the application various fungicides and fungicide programs, 2010

Treatment and rate per 1000 sq ft	Application Code <sup>y</sup>	Percent dollar spot <sup>z</sup>			
		28 Jul	13 Aug	26 Aug	8 Sep
1 Reserve 4.8 SC 2.5 fl oz .....	ABCDEFGH	<1 b <sup>x</sup>	5 de	25 c-f	26 bcd
2 Reserve 4.8 SC 3.2 fl oz .....	ACEGI	<1 b	7 de	32 cde	22 cde
3 Reserve 4.8 SC 3.5 fl oz .....	ACEGI	0 b	4 de	19 ef	20 c-f
4 Concert 5.5 fl oz .....	ACEGI	0 b	1 e	11 fg	10 fg
5 Interface 3.0 fl oz.....	ACEGI	<1 b	5 de	26 cde	22 c-f
6 Interface 4.0 fl oz.....	ACEGI	<1 b	5 de	21 def	20 c-f
7 Interface 5.0 fl oz.....	ACEGI	0 b	3 de	17 ef	16 ef
8 Iprodione Pro 2SE 4.0 fl oz .....	ACEGI	<1 b	6 de	22 def	17 def
9 Emerald 0.13 oz .....	ACEGI	0 b	1 de	2 g	3 gh
10 Honor 0.83 oz.....	ACGI	5 b	13 bc	35 bcd	28 bc
11 Iprodione Pro 2SE 4.0 fl oz .....	E	5 b	15 b	39 bc	33 b
12 Chipco Signature 4.0 oz	ACEGIKM				
Triton FLO 0.5 fl oz	AE				
Daconil Ultrex 3.2 oz	CGK				
Interface 3.0 fl oz.....	IM	<1 b	1 de	<1 g	<1 gh
13 Chipco Signature 4.0 oz	ACEGIKM				
Interface 3.0 fl oz	AM				
Daconil Ultrex 3.2 oz	CGK				
Triton FLO 0.5 fl oz	E				
Tartan 1.5 fl oz .....	I	0 b	<1 e	0 g	<1 h
14 Banner MAXX 1.0 fl oz.....	ACEGI	<1 b	8 cd	31 cde	25 b-e
15 Untreated.....	-	17 a	30 a	55 a	45 a
16 Untreated.....	-	18 a	25 a	48 ab	34 b

<sup>z</sup> Dollar spot was rated by visually assessing the percent disease on a 0 to 100 scale where 0 = no disease symptoms present and 100 = entire plot area affected by dollar spot.

<sup>y</sup> Treatments were applied as follows: A = 20 May; B = 27 May; C = 4 Jun; D = 10 Jun; E = 17 Jun; F = 25 Jun; G = 1 Jul; H = 8 Jul; I = 15 Jul; K = 29 Jul; and M = 13 Aug.

<sup>x</sup> Means in a column followed by the same letter are not significantly different at  $P \leq 0.05$  level according to the Fisher's protected least significant difference t-test.

Table 3. Turfgrass color and percent plot area affected by algae on a creeping bentgrass putting green following the application various fungicides and fungicide programs, 2010.

Treatment and rate per 1000 sq ft	Application Code <sup>x</sup>	Color <sup>z</sup>		% Algae <sup>y</sup>
		14 Jun	28 Jun	13 Aug
1 Reserve 4.8 SC 2.5 fl oz.....	ABCDFGH	7.8 abc <sup>w</sup>	8.3 a	5 e-h
2 Reserve 4.8 SC 3.2 fl oz.....	ACEGI	7.8 abc	8.3 a	4 e-h
3 Reserve 4.8 SC 3.5 fl oz.....	ACEGI	7.5 bcd	8.0 ab	2 fgh
4 Concert 5.5 fl oz.....	ACEGI	7.0 bcd	8.3 a	1 gh
5 Interface 3.0 fl oz .....	ACEGI	7.8 abc	8.0 ab	8 d-g
6 Interface 4.0 fl oz .....	ACEGI	7.8 abc	8.3 a	15 abc
7 Interface 5.0 fl oz .....	ACEGI	8.0 ab	8.5 a	10 b-e
8 Iprodione Pro 2SE 4.0 fl oz.....	ACEGI	6.8 cde	7.5 bc	9 c-f
9 Emerald 0.13 oz.....	ACEGI	7.0 bcd	7.3 cd	17 ab
10 Honor 0.83 oz .....	ACGI	6.5 de	7.3 cd	14 abc
11 Iprodione Pro 2SE 4.0 fl oz.....	E	6.5 de	7.3 cd	10 b-e
12 Chipco Signature 4.0 oz	ACEGIKM			
Triton FLO 0.5 fl oz	AE			
Daconil Ultrex 3.2 oz	CGK			
Interface 3.0 fl oz	IM			
Chipco Signature 4.0 oz	ACEGIKM	7.0 bcd	8.0 ab	0 h
13 Interface 3.0 fl oz	AM			
Daconil Ultrex 3.2 oz	CGK			
Triton FLO 0.5 fl oz	E			
Tartan 1.5 fl oz.....	I	8.8 a	8.5 a	0 h
14 Banner MAXX 1.0 fl oz .....	ACEGI	6.8 cde	6.8 d	18 a
15 Untreated .....	-	6.8 cde	7.0 cd	7 d-h
16 Untreated .....	-	5.8 e	6.8 d	13 a-d

<sup>z</sup> Turfgrass color was rated visually on a 1 to 9 scale where 0 = brown or dead turf; 7.0 = minimum acceptable color for a golf course fairway; and 9 = dark green turf.

<sup>y</sup> Algae was rated visually on a percent scale where 0 = no algae was visible within the plots and 100 = entire plot area blackened by algae.

<sup>x</sup> Treatments were applied as follows: A = 20 May; B = 27 May; C = 4 Jun; D = 10 Jun; E = 17 Jun; F = 25 Jun; G = 1 Jul; H = 8 Jul; I = 15 Jul; K = 29 Jul; and M = 13 Aug.

<sup>w</sup> Means in a column followed by the same letter are not significantly different at  $P \leq 0.05$  level according to the Fisher's protected least significant difference t-test.

Table 4. Overall turfgrass quality of a creeping bentgrass putting green following the application various fungicides and fungicide programs, 2010.

Treatment and rate per 1000 sq ft	Application	Quality <sup>z</sup>					
	Code <sup>y</sup>	4 Jun	14 Jun	28 Jun	14 Jul	28 Jul	13 Aug
1 Reserve 4.8 SC 2.5 fl oz.....	ABCDFGH	7.8 bcd <sup>x</sup>	7.8 ab	7.8 ab	8.5 ab	8.0 ab	5.8 ef
2 Reserve 4.8 SC 3.2 fl oz.....	ACEGI	8.3 ab	7.8 ab	8.0 ab	8.8 a	8.5 a	6.3 de
3 Reserve 4.8 SC 3.5 fl oz.....	ACEGI	7.8 bcd	7.8 ab	8.3 a	8.0 ab	8.3 ab	6.8 cd
4 Concert 5.5 fl oz.....	ACEGI	6.8 ef	7.0 bc	6.8 cd	7.8 bc	6.5 def	8.3 ab
5 Interface 3.0 fl oz .....	ACEGI	8.0 abc	8.0 a	8.0 ab	8.3 ab	8.3 ab	5.8 ef
6 Interface 4.0 fl oz .....	ACEGI	8.0 abc	7.8 ab	7.8 ab	8.5 ab	8.0 ab	5.5 efg
7 Interface 5.0 fl oz .....	ACEGI	8.0 abc	8.0 a	8.3 a	8.5 ab	8.5 a	5.8 ef
8 Iprodione Pro 2SE 4.0 fl oz.....	ACEGI	7.3 c-f	7.0 bc	6.8 cd	7.0 cd	6.8 cde	5.3 fg
9 Emerald 0.13 oz.....	ACEGI	7.5 b-e	7.0 bc	7.3 bc	8.3 ab	7.5 bc	7.5 bc
10 Honor 0.83 oz .....	ACGI	7.0 def	6.3 c	6.8 cd	6.8 d	7.0 cd	4.8 gh
11 Iprodione Pro 2SE 4.0 fl oz.....	E	6.8 ef	6.3 ab	7.3 bc	6.5 d	6.0 ef	4.3 hi
12 Chipco Signature 4.0 oz	ACEGIKM						
Triton FLO 0.5 fl oz	AE						
Daconil Ultrex 3.2 oz	CGK						
Interface 3.0 fl oz .....	IM	8.0 abc	7.8 ab	8.3 a	7.8 bc	8.3 ab	8.3 ab
13 Chipco Signature 4.0 oz	ACEGIKM						
Interface 3.0 fl oz	AM						
Daconil Ultrex 3.2 oz	CGK						
Triton FLO 0.5 fl oz	E						
Tartan 1.5 fl oz.....	I	8.8 a	8.0 a	8.5 a	8.3 ab	8.3 ab	8.8 a
14 Banner MAXX 1.0 fl oz .....	ACEGI	6.5 f	6.3 c	6.0 de	6.8 d	6.3 def	4.8 gh
15 Untreated .....	-	7.0 def	7.0 bc	6.5 cde	6.5 d	7.0 cd	3.8 i
16 Untreated .....	-	6.8 ef	5.3 d	5.8 e	5.5 e	5.8 f	4.0 hi

<sup>z</sup> Turfgrass quality was rated visually on a 1 to 9 scale where 1 = brown or dead turf; 7 = minimum acceptable quality for a golf course fairway; and 9 = optimum density.

<sup>y</sup> Treatments were applied as follows: A = 20 May; B = 27 May; C = 4 Jun; D = 10 Jun; E = 17 Jun; F = 25 Jun; G = 1 Jul; H = 8 Jul; I = 15 Jul; K = 29 Jul; and M = 13 Aug.

<sup>x</sup> Means in a column followed by the same letter are not significantly different at  $P \leq 0.05$  level according to the Fisher's protected least significant difference t-test.