

# ANTHRACNOSE BASAL ROT SUPPRESSION ON AN ANNUAL BLUEGRASS RESEARCH PUTTING GREEN WITH VARIOUS FUNGICIDES AND FUNGICIDE PROGRAMS, 2010

J.E. Kaminski and T. Lulis

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

## INTRODUCTION

Anthracnose basal rot (*Colletotrichum cereale*), continues to emerge as a chronic disease of annual bluegrass (*Poa annua*) putting greens. While various cultural practices and fertility programs have been developed to reduce disease symptoms, fungicides are generally required to provide additional and/or complete suppression to an acceptable level. Another confounding factor in understanding the efficacy of fungicides used to control anthracnose is the potential for pathogen resistance. For this reason, it is important to evaluate existing commercially available fungicides as well as new and emerging experimental chemistries to continue to improve our ability to manage the disease. The objective of this research was to evaluate various commercially available and experimental fungicides as well as fungicide programs for their ability to suppress anthracnose basal rot. A secondary objective was to assess the impact of repeated applications of individual fungicides on turfgrass quality and other turfgrass pests.

## 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 2.7% organic matter. Prior to initiation of the study, the area was treated with a herbicide in an effort to eradicate the majority of any creeping bentgrass (*Agrostis stolonifera*) within the site. The area was treated twice in the fall of 2009 with fusillade. When treatments were initiated in 2010, annual bluegrass was the dominant species covered  $\geq 80\%$  of the study site. The area was mowed six days per week to a height of 0.125 in. Urea was applied at a rate of 0.5 lb N per 1000 ft<sup>2</sup> on 25 Mar, but no fertilizer was applied thereafter.

Plots measured 3 ft x 6 ft and were arranged in a randomized complete block with four replications. 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>. Treatments were initiated on 28 May and reapplied approximately every 14-d for a total of six applications. All treatments are listed in the data tables. Anthracnose was rated visually on a 0 to 100% scale where 0 = no anthracnose observed and 100 = entire plot area affected by anthracnose basal rot. In addition to percent plot area affected by anthracnose rating, a year-end percent plot area covered with creeping bentgrass was rated. This was an important factor and was indicative of plots in which anthracnose was severe and bentgrass had grown into the voids. Turfgrass quality was rated on a 1 to 9 scale where 1 = entire plot area brown or dead; 7 = minimum acceptable quality for a golf course putting green; and 9 = optimum greenness and density.

## RESULTS

Disease activity began to appear in late May and early June, but only trace levels were present when plots were initially rated on 4 Jun (Table 1). On 18 Jun (1 week after the second application), slight differences among treatments were observed with regards to percent plot area affected by anthracnose. At this time, plots treated with Trinity, Insignia + Trinity, Honor (both rates), Torque and the untreated control had the greatest level of anthracnose. Following this rating, however, plots treated with the aforementioned sterol inhibiting fungicides provide excellent to moderate anthracnose suppression. Disease pressure continued to increase during the month of July and disease activity peaked on 28 Jul. Over the course of the study, excellent suppression ( $\leq 5.0\%$ ) was provided by A16422A, Daconil Ultrex + A14658A, A13817A + A14658A, Daconil Ultrex + Chipco Signature and the rotational treatments of

Concert + Primo + Renown, A16422A + A14658A + Primo + Renown + Concert + A14658D, Chipco Signature + Triton FLO + Daconil Ultrex, and Torque + Affirm + Spectro. Moderate disease suppression was afforded by plots receiving Trinity, Insignia + Trinity, Daconil Ultrex, Renown, A16422A + Primo MAXX + Concert, and Chipco Signature + Triton FLO + Interface. Only plots receiving Honor (both rates) provide poor control of anthracnose during the study. Percent of the plot area containing creeping bentgrass was evaluated on the final rating date. On 13 Aug, percent plot area was indicative of anthracnose suppression from each fungicides and the greatest percent anthracnose was found within plots treated with Honor (56 to 63%) and the untreated control plots (65 to 71%). The least amount of creeping bentgrass (19%) was observed within plots treated with A13817A + A14658A. However, there were no differences in creeping bentgrass populations among this experimental tank mix and eight other treatments which provide excellent to moderate suppression of anthracnose. Moderate levels of bentgrass (38 to 49%) were observed in all other treatments. Turfgrass quality (Table 3) varied throughout the study and was highly dependent upon anthracnose severity.

## DISCUSSION

In this study, anthracnose was considered to be severe. Despite this, several fungicides and fungicide tank-mixes or rotations provided moderate to excellent disease suppression. Except for one rating date (18 Jun), plots treated with Torque provided excellent anthracnose suppression. This is similar to previous efficacy trials with this fungicide. It is worth to note, however, that increased anthracnose was observed within plots receiving consecutive applications of a sterol inhibiting fungicides (Torque and Trinity). Growth regulation was noted within these plots and discoloration and regulation may have contributed to the higher appearance of anthracnose. This is further supported by other treatments in which no sharp increase in disease rating was observed in situations where the DMI fungicide was rotated with fungicides of other chemical classes. The lack of suppression by Honor (pyraclostrobin + boscalid) in this study indicates that *C. cereale* resistance to the QoI fungicides may be present in the trial location. This is further supported in the treatment comparison in which Signature + Triton FLO were applied with either Daconil or Interface (trifloxystrobin + Iprodione). In the case of the later, anthracnose control broke down as disease pressure increased. When the tank-mix included a rotation of Daconil, excellent suppression was achieved throughout the study. This is in line with previous research that has shown limited efficacy from Iprodione on anthracnose.

The use of QoI for anthracnose control is becoming more limited as increased cases of resistance are reported. Based on this information, it is likely that the moderate level of disease suppression observed within other plots receiving a QoI is due to the tank-mix and/or rotational partners. As pre-mix fungicides become more prevalent in the turfgrass fungicide market, future research on the effective programs will be essential to ensure that golf course superintendents understand the active ingredients being applied and the potential risk related to overuse of any one active ingredient. The similarities within many of the pre-mix products will further confuse and complicate the selection process and may lead to the overuse of certain products. While the pre-mix and tank-mix combinations may represent a broad spectrum of disease suppression, golf course superintendents should be cautious about the overuse of select chemistries such as the QoIs which may lead to resistance and/or the DMIs which may lead to either resistance or injury due to growth regulation. Future studies should continue to focus on the safety and efficacy combination of the DMIs when used alone or in rotation with other fungicides effective against anthracnose basal rot.

## 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 Bayer Environmental Science, BASF, Syngenta and the Pennsylvania Turfgrass Council.

Table 1. Percent anthracnose basal rot (*Colletotrichum cereale*) in an annual bluegrass putting green treated preventively with various fungicides, 2010.

		Application	Anthracnose basal rot (%) <sup>z</sup>					
Treatment and rate per 1000 sq ft <sup>y</sup>		Code	4 Jun	18 Jun	2 Jul	14 Jul	28 Jul	13 Aug
1	Trinity 1.0 fl oz.....	ABCDEF	<1 a <sup>x</sup>	12 abc	4 c	1 b	13 ef	8 c-g
2	Insignia SC 0.54 fl oz	ABCDEF						
	Trinity 1.0 fl oz.....	ABCDEF	<1 a	13 ab	6 bc	1 b	10 efg	7 c-g
3	Honor 0.83 oz .....	ABCDEF	<1 a	8 a-e	20 a	28 a	64 a	30 a
4	Honor 1.1 oz .....	ABCDEF	<1 a	9 a-d	19 a	26 a	64 a	30 a
5	A16422A 3.6 fl oz.....	ABCDEF	<1 a	2 ef	1 c	2 b	<1 g	4 d-g
6	A18035A 8.0 fl oz.....	ABCDEF	<1 a	4 def	2 c	2 b	3 fg	6 d-g
7	Daconil Ultrex 3.2 oz.....	ABCDEF	<1 a	4 def	3 c	5 b	11 efg	9 c-g
8	A13817A 5.0 fl oz.....	ABCDEF	<1 a	6 c-f	2 c	1 b	<0 g	2 fg
9	Daconil Ultrex 3.2 oz	ABCDEF						
	A14658A6.0 fl oz.....	ABCDEF	<1 a	2 ef	2 c	3 b	2 fg	3 efg
10	A13817A 5.0 fl oz	ABCDEF						
	A14658A 6.0 fl oz.....	ABCDEF	<1 a	1 f	1 c	1 b	<1 g	1 fg
11	Daconil Ultrex 3.2 oz	ABCDEF						
	Chipco Signature 4.0 oz.....	ABCDEF	<1 a	1 f	2 c	2 b	1 g	2 fg
12	Renown 2.5 fl oz .....	ABCDEF	<1 a	2 ef	6 bc	7 b	25 d	11 b-e
13	Concert II 4.5 fl oz	ACE						
	Primo MAXX 0.2 fl oz	ABCDE						
	Renown 4.5 fl oz .....	BDF	<1 a	3 def	1 c	2 b	1 fg	3 efg
14	A16422A 3.6 fl oz	AC						
	D14658D 4.0 fl oz	F						
	Primo MAXX 0.2 fl oz	ABCDEF						
	Renown 4.5 fl oz	BDF						
	Concert II 5.0 fl oz	E						
	A14658D 4.0 fl oz .....	EF	<1 a	2 ef	2 c	2 b	1 fg	1 g
15	A16422A3.6 fl oz	AC						
	Primo MAXX 0.2 fl oz	ABCDEF						
	A17601A 0.625 lf oz	BDF						
	Concert II 5.0 fl oz.....	E	<1 a	3 def	4 c	5 b	31 cd	12 bcd
16	Chipco Signature 4.0 oz	ABCDEF						
	Triton FLO0.5 fl oz	ACE						
	Daconil Ultrex 3.2 oz.....	BDF	<1 a	1 f	<1 c	2 b	1 g	5 d-g
17	Chipco Signature 4.0 oz	ABCDEF						
	Triton FLO 0.5 fl oz	ACE						
	Interface 3.0 fl oz .....	BDF	0 a	<1 f	<1 c	<1 b	19 de	10 b-f
18	Torque 0.6 fl oz .....	ABCDEF <sup>w</sup>	<1 a	13 a	2 c	<1 b	<1 g	1 g
19	Torque 0.6 fl oz	ACE <sup>w</sup>						
	Affirm 0.9 oz	BDF						
	Spectro 2.0 oz.....	BDF	<1 a	2 ef	< c	<1 b	1 fg	2 g
20	Untreated .....	-	<1 a	6 b-f	14 ab	25 a	47 b	19 b
21	Untreated .....	-	<1 a	8 a-e	21 a	23 a	39 bc	16 bc

<sup>z</sup> Anthracnose basal rot was rated visually on a 0 to 100 percent scale where 0 = no anthracnose observed within plots and 100 = entire plot area affected by anthracnose.

<sup>y</sup> Treatments were applied as follows: A = 28 May or 2 Jun; B = 10 Jun ; C = 24 Jun; D = 8 Jul; E = 23 Jul; and F = 6 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.

<sup>w</sup> For treatments 18 and 19 application A was applied on 2 Jun.

Table 2. Percent creeping bentgrass (*Agrostis stolonifera*) within plots treated preventively with various fungicides for the suppression of anthracnose basal rot, 2010.

	Treatment and rate per 1000 sq ft <sup>y</sup>	Application	Creeping bentgrass (%) <sup>z</sup>
		Code	13 Aug
1	Trinity 1.0 fl oz .....	ABCDEF	39 def <sup>x</sup>
2	Insignia SC 0.54 fl oz	ABCDEF	
	Trinity 1.0 fl oz .....	ABCDEF	38 def
3	Honor 0.83 oz .....	ABCDEF	63 ab
4	Honor 1.1 oz .....	ABCDEF	56 abc
5	A16422A 3.6 fl oz .....	ABCDEF	20 gh
6	A18035A 8.0 fl oz .....	ABCDEF	28 fgh
7	Daconil Ultrex 3.2 oz.....	ABCDEF	38 def
8	A13817A 5.0 fl oz .....	ABCDEF	25 fgh
9	Daconil Ultrex 3.2 oz	ABCDEF	
	A14658A6.0 fl oz .....	ABCDEF	26 fgh
10	A13817A 5.0 fl oz	ABCDEF	
	A14658A 6.0 fl oz .....	ABCDEF	19 h
11	Daconil Ultrex 3.2 oz	ABCDEF	
	Chipco Signature 4.0 oz .....	ABCDEF	25 fgh
12	Renown 2.5 fl oz .....	ABCDEF	49 bcd
13	Concert II 4.5 fl oz	ACE	
	Primo MAXX 0.2 fl oz	ABCDE	
	Renown 4.5 fl oz.....	BDF	30 e-h
14	A16422A 3.6 fl oz	AC	
	D14658D 4.0 fl oz	F	
	Primo MAXX 0.2 fl oz	ABCDEF	
	Renown 4.5 fl oz	BDF	
	Concert II 5.0 fl oz	E	
	A14658D 4.0 fl oz .....	EF	45 cde
15	A16422A3.6 fl oz	AC	
	Primo MAXX 0.2 fl oz	ABCDEF	
	A17601A 0.625 lf oz	BDF	
	Concert II 5.0 fl oz.....	E	45 cde
16	Chipco Signature 4.0 oz	ABCDEF	
	Triton FLO0.5 fl oz	ACE	
	Daconil Ultrex 3.2 oz.....	BDF	29 e-h
17	Chipco Signature 4.0 oz	ABCDEF	
	Triton FLO 0.5 fl oz	ACE	
	Interface 3.0 fl oz .....	BDF	36 d-g
18	Torque 0.6 fl oz.....	ABCDEF <sup>w</sup>	33 d-h
19	Torque 0.6 fl oz	ACE <sup>w</sup>	
	Affirm 0.9 oz	BDF	
	Spectro 2.0 oz.....	BDF	39 def
20	Untreated .....	-	71 a
21	Untreated .....	-	65 ab

<sup>z</sup> Percent creeping bentgrass was visually rated on a percent scale where 0 = no creeping bentgrass present within the plot and 100 = entire plot area covered with creeping bentgrass.

<sup>y</sup> Treatments were applied as follows: A = 28 May or 2 Jun; B = 10 Jun ; C = 24 Jun; D = 8 Jul; E = 23 Jul; and F = 6 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.

<sup>w</sup> For treatments 18 and 19 application A was applied on 2 Jun.

Table 3. Overall turfgrass quality of an annual bluegrass putting green treated preventively with various fungicides, 2010.

Treatment and rate per 1000 sq ft <sup>y</sup>	Application Code	Quality (1-9) <sup>z</sup>						
		4 Jun	18 Jun	2 Jul	14 Jul	28 Jul	13 Aug	
1 Trinity 1.0 fl oz.....	ABCDEF	6.8 de <sup>x</sup>	5.3 e	6.5 cde	7.0 de	6.0 c	6.8 b-e	
2 Insignia SC 0.54 fl oz	ABCDEF							
Trinity 1.0 fl oz.....	ABCDEF	7.0 cde	5.3 e	6.5 cde	7.5 b-e	6.5 bc	6.8 b-e	
3 Honor 0.83 oz .....	ABCDEF	7.5 abc	6.8 cd	5.5 e	5.0 f	2.5 g	4.3 g	
4 Honor 1.1 oz .....	ABCDEF	7.5 abc	6.5 d	6.0 de	5.0 f	2.8 g	4.3 g	
5 A16422A 3.6 fl oz.....	ABCDEF	7.0 cde	7.8 ab	7.8 ab	8.3 ab	8.0 a	7.8 ab	
6 A18035A 8.0 fl oz.....	ABCDEF	7.5 abc	7.3 a-d	8.0 a	7.5 b-e	7.5 ab	6.8 b-e	
7 Daconil Ultrex 3.2 oz.....	ABCDEF	7.0 cde	7.0 bcd	7.3 abc	7.0 de	6.0 c	6.5 cde	
8 A13817A 5.0 fl oz.....	ABCDEF	7.5 abc	6.5 d	7.8 ab	8.3 ab	8.3 a	7.5 abc	
9 Daconil Ultrex 3.2 oz	ABCDEF							
A14658A6.0 fl oz.....	ABCDEF	7.0 cde	7.3 a-d	7.5 abc	7.5 b-e	7.5 ab	7.3 a-d	
10 A13817A 5.0 fl oz	ABCDEF							
A14658A 6.0 fl oz.....	ABCDEF	7.3 bcd	7.3 a-d	8.0 a	8.3 ab	8.3 a	7.8 ab	
11 Daconil Ultrex 3.2 oz	ABCDEF							
Chipco Signature 4.0 oz.....	ABCDEF	7.8 ab	7.5 abc	8.3 a	8.0 abc	8.3 a	7.8 ab	
12 Renown 2.5 fl oz .....	ABCDEF	7.5 abc	7.3 a-d	7.3 abc	7.3 cde	4.8 de	6.0 ef	
13 Concert II 4.5 fl oz	ACE							
Primo MAXX 0.2 fl oz	ABCDE							
Renown 4.5 fl oz .....	BDF	5.3 f	7.0 bcd	7.8 ab	8.3 ab	8.0 a	7.8 ab	
14 A16422A 3.6 fl oz	AC							
D14658D 4.0 fl oz	F							
Primo MAXX 0.2 fl oz	ABCDEF							
Renown 4.5 fl oz	BDF							
Concert II 5.0 fl oz	E							
A14658D 4.0 fl oz .....	EF	6.5 e	7.3 a-d	7.5 abc	8.0 abc	7.8 a	8.0 a	
15 A16422A3.6 fl oz	AC							
Primo MAXX 0.2 fl oz	ABCDEF							
A17601A 0.625 lf oz	BDF							
Concert II 5.0 fl oz.....	E	6.8 de	7.3 a-d	6.8 bcd	7.0 de	4.8 de	6.3 de	
16 Chipco Signature 4.0 oz	ABCDEF							
Triton FLO0.5 fl oz	ACE							
Daconil Ultrex 3.2 oz.....	BDF	7.8 ab	7.5 abc	7.8 ab	7.8 a-d	8.3 a	7.0 a-e	
17 Chipco Signature 4.0 oz	ABCDEF							
Triton FLO 0.5 fl oz	ACE							
Interface 3.0 fl oz .....	BDF	8.0 a	8.0 a	8.0 a	8.5 a	5.5 cd	6.5 cde	
18 Torque 0.6 fl oz .....	ABCDEF <sup>w</sup>	6.8 de	5.3 e	6.8 bcd	6.8 e	7.8 a	8.0 a	
19 Torque 0.6 fl oz	ACE <sup>w</sup>							
Affirm 0.9 oz	BDF							
Spectro 2.0 oz.....	BDF	7.5 abc	6.8 cd	7.5 abc	7.8 a-d	7.8 a	7.3 a-d	
20 Untreated .....	-	7.3 bcd	6.5 d	5.8 de	5.3 f	3.3 fg	4.8 g	
21 Untreated .....	-	7.0 cde	6.5 d	5.5 e	5.0 f	4.0 ef	5.0 fg	

<sup>z</sup> Quality was rated visually on a 1 to 9 scale where 1 = entire plot area brown or dead; 7 = minimum acceptable quality for a golf course putting green; and 9 = optimum greenness and density.

<sup>y</sup> Treatments were applied as follows: A = 28 May or 2 Jun; B = 10 Jun ; C = 24 Jun; D = 8 Jul; E = 23 Jul; and F = 6 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.

<sup>w</sup> For treatments 18 and 19 application A was applied on 2 Jun.