

# IMPACT OF FUNGICIDES ON THE CONTROL OF ANTHRACNOSE BASAL ROT, TURFGRASS QUALITY, AND ALGAE ON A GOLF COURSE PUTTING GREEN

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## 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. Turfgrass used for the fungicide evaluation was a mixed-stand of creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass. Annual bluegrass, however, was the dominant species and was visually rated as covering approximately 60 to 80% of the study site. The area was maintained as a mixed-stand putting green and mowed six days per week to a height of 0.090 to 0.125 in. To control brown patch (*Rhizoctonia solani*) and dollar spot (*Sclerotinia homoeocarpa*) in the study site, ProStar and Emerald were applied on 28 Jul at a rate of 2.5 oz and 0.18 oz per 1000 sq ft, respectively. In an effort to increase disease pressure, the area was topdressed and brushed on 3 Aug. Urea was applied at a .25 lb N/1000 ft<sup>2</sup> on 10 Aug using a walk behind sprayer.

All fungicide treatments were applied with a CO<sub>2</sub> pressurized (40 psi) sprayer equipped with an air-induction flat fan nozzle, and calibrated to deliver 2.0 gal water per 1000 ft<sup>2</sup>. Treatments were initiated on 30 May and reapplied on a 14-d interval for a total of five applications. Plots measured 3 ft x 6 ft and were arranged in a randomized complete block with four replications. All rating scales and descriptions of each are listed in the data tables.

## RESULTS

**Anthracnose.** Anthracnose severity within this study was low and variable throughout the season. Disease symptoms were not observed until the date of the fourth application and disease activity remained low (Table 1). Following the ratings on 24 Jul, the decision was made to apply a fifth and final application and then to allow the disease to progress as fungicide efficacy naturally decreased over time. During this period, however, we did several cultural practices to increase the potential for disease symptoms including lowering mowing height and vertical mowing. When plots were rated on 24 Aug (1 month after last application), disease levels were highly variable and ranged from 0.0% to 16%. The variability of anthracnose severity within this study could be observed within the untreated control plots which averaged between 4.7% and 11.3%. Based on this variability, we are reluctant to interpret meaningful conclusions from this data.

**Turfgrass quality, color and injury.** Noticeable differences in turfgrass quality color and injury were observed on various dates throughout the study. When quality was first rated on 10 Jul (just prior to the 4<sup>th</sup> application), few differences in quality were observed among treatments and the untreated control plots (Table 2). Plots treated with Triton FLO + Chipco Signature + Daconil Ultrex + Primo MAXX, Reserve + Chipco Signature, and Reserve (3.2 fl oz) had significantly higher visual quality when compared to the untreated control plots. Except for Reserve (3.2 fl oz) on a single date, the aforementioned treatments exhibited higher visual quality than the untreated control plots on all four rating dates. On 10 Jul, excellent quality ( $\geq 8.0$ ) was also observed within plots treated with Reserve (3.6 fl oz) and A13703G (0.32 fl oz). On the other hand, plots treated with experimental fungicide A9898A resulted in poor visual quality and was significantly lower than the untreated control plots for much of the study. Overall, the following treatments provided acceptable visual quality ( $\geq 7.0$ ) on all rating dates: Disarm C, Triton FLO + Chipco Signature + Daconil Ultrex + Primo MAXX, Reserve + Chipco Signature, Reserve (both rates), A17601A (0.81 fl oz), Headway + Daconil Ultrex + Primo

MAXX + Concert + Medallion + Fore + Heritage, and Honor (1.11 oz). Color ratings on 10 Aug generally correlated with quality ratings on that date (Table 2).

Approximately 2 weeks following the fifth and final application, noticeable injury was observed within select plots. Although turf within the untreated control plots was injured due to the aggressive topdressing and brushing on 3 Aug, several plots were discolored beyond what was caused by the cultural practices. The most severely injured turfgrass was observed within plots received 5 consecutive applications of A9898A (Table 3). Less severe, but statistically similar injury was observed within plots treated with both rates of A67980 and A14212C. Plots treated with Triton FLO + Chipco Signature + Daconil Ultrex + Primo MAXX and Reserve + Chipco Signature, however, did not exhibit any visual signs of injury on 10 Aug.

*Algae.* Algae was first observed within the study area on 24 Jul. Although algae was noted, conditions were not favorable for obtaining a percent plot area blackened. Therefore, plots were rated for the presence (1) or absence (0) of algae within each plot (Table 4). No differences were noted among treatments on this rating date using this rating, but algae within plots continued to increase and by 14 Aug plots had highly visible algae present within selection plots. On 14 Aug, percent plot blackened by algae within the untreated control plots averaged 6.3 to 8.7. The greatest percent plot area affected by algae was exhibited within plots receiving Triton FLO (0.75 fl oz). There were no differences, however, in algae ratings among plots treated with Triton FLO (0.75 fl oz) and those receiving applications of Triton FLO (1.0 fl oz) and A14212C. Although not significantly different than the untreated control due to large variations in percent algae within individual plots, complete suppression of algae symptoms was observed within plots treated with Vitalonil, Disarm C, Daconil Ultrex, Triton FLO + Chipco Signature + Daconil Ultrex + Primo MAXX (rotational program), Reserve + Chipco Signature, and Headway + Daconil Ultrex + Primo MAXX + Concert + Medallion + Fore + Heritage (rotational program). Moderate to severe algae infestations were observed within plots treated with Disarm M (both rates), Eagle, A6780L (both rates), A1684A (both rates), A13703G (0.32 fl oz), A8122B (both rates), Trinity, Trinity + Insignia and the high rate of Honor.

## DISCUSSION

Anthracoze severity was low in 2009 at the study site and therefore few meaningful results were observed. Quality and injury differences, however, resulting from the repeated use of the same product provided interesting results. In the case of turfgrass quality, it appeared that fungicide programs and select pre-mix fungicides were able to consistently provide acceptable visual turfgrass quality throughout the season. In addition, plots treated with Chipco Signature on a 14-day interval were able to mask or eliminate injury from aggressive cultural practices during early Aug. Due to the increased potential for discoloration and/or regulation, additional work will be needed with several chemistries (A6780L, A14212C, and A9898A) to determine application rates and application intervals prior to their commercial release.

Algae infestations observed in this study were moderate to severe. Select fungicides resulted in moderate to poor suppression of algae and may have been enhanced following repeated applications of select fungicides. In general, fungicides within the sterol inhibiting class resulted in moderate to severe infestations of algae. On the other hand, plots treated with fungicides or fungicide combinations that included chlorothalonil resulted in complete or near complete suppression of algae in this study. These findings are similar to previous results which indicate that repeated applications of sterol inhibiting fungicides may result in a regulation and thinning of the turf during the summer months which makes the turf stand more susceptible to algae infestations. Many studies have also shown to the contrary that chlorothalonil, when applied preventively, can help to reduce or suppress algae infestations on putting greens. Our results continue to confirm these reports.

Although disease activity in this trial in 2009 was low and variable, steps were taken at the conclusion of this study to ensure increased annual bluegrass populations and increased disease activity in 2010. An area to be used for anthracnose trials in 2010 was treated with fusillade to selectively remove the creeping bentgrass and intensively core cultivated to promote the germination and establishment of a near 100% annual bluegrass putting green. The area will be fertilized heavily with a water soluble nitrogen source in the spring. When complete coverage is achieved and the nitrogen fertility begins to wear off, treatments will be initiated.

## ACKNOWLEDGEMENTS

The Pennsylvania State University Turfgrass Science Program would like to thank the students and staff of the Valentine Turfgrass Research Facility for assisting in the maintenance and upkeep of these plots. We also thank Arysta, BASF, Bayer, Luxembourg Industries, and Syngenta for their financial support.

Table 1. Anthracnose severity of a creeping bentgrass/annual bluegrass green treated with various fungicides for the control of anthracnose, 2009.

Treatments and rate per 1000 sq ft	Application Code <sup>y</sup>	Anthracnose Percent <sup>z</sup>			
		26 Jun	10 Jul	24 Jul	24 Aug
Vitalonil 5.2F 7.0 fl oz.....	A-E	0 a <sup>x</sup>	1.0 b-g	1.8 b-g	0.2 e
Disarm 4SC 0.36 fl oz .....	A-E	0 a	0.5 d-g	0.8 d-g	5.5 b-e
Disarm C 4.4 fl oz.....	A-E	0 a	0.0 g	0.3 efg	0.3 e
Disarm M 0.5 fl oz .....	A-E	0 a	1.5 b-g	1.7 b-g	16.0 a
Disarm M 1.0 fl oz .....	A-E	0 a	2.0 a-d	0.4 efg	11.3 a-d
Veranda 11.3WDG 0.9 oz.....	A-E	0 a	0.7 c-g	0.7 d-g	0.5 e
Eagle 20EW 1.4 fl oz.....	A-E	0 a	2.0 a-d	1.3 b-g	3.3 de
Daconil Ultrex 82.5WDG 2.7 oz .....	A-E	0 a	0.4 d-g	1.2 c-g	4.7 cde
Triton Flo 3SC0.75 fl oz .....	A-E	0 a	0.3 efg	0.9 d-g	0.3 e
Triton Flo 3SC 1.0 fl oz .....	A-E	0 a	0.2 efg	1.2 c-g	0.3 e
Triton Flo 3SC 0.5 fl oz w/ Chipco Signature 80WDG 4.0 oz w/ Daconil Ultrex 82.5WDG 3.2 oz w/ Primo Maxx 11.3MEC .....	AC A-E BDE BDE	0 a	0.0 g	0.0 g	0.0 e
Reserve 4.8SC 3.2 fl oz + Chipco Signature 80WDG 4.0 oz.....	A-E	0 a	0.0 fg	0.0 g	0.0 e
Reserve 4.8SC 3.2 fl oz .....	A-E	0 a	0.0 g	0.2 fg	1.3 e
Reserve 4.8SC 3.6 fl oz .....	A-E	0 a	0.0 fg	0.0 g	0.0 e
Concert 5.0 fl oz .....	A-E	0 a	1.0 b-g	1.5 b-g	0.3 e
A6780L 1.0 fl oz .....	A-E	0 a	3.2 a	4.0 a	12.7 abc
A6780L 1.5 fl oz .....	A-E	0 a	2.3 abc	3.3 ab	6.7 b-e
A16841A 0.247 fl oz.....	A-E	0 a	1.8 a-e	0.7 d-g	7.0 b-e
A16841A 0.494 fl oz.....	A-E	0 a	0.9 b-g	1.2 c-g	2.0 e
A17595A 1.7 fl oz.....	A-E	0 a	0.2 efg	0.2 fg	3.0 e
A17601A 0.81 fl oz.....	A-E	0 a	0.0 g	0.1 g	4.7 cde
A17601A 1.61 fl oz.....	A-E	0 a	0.2 fg	1.3 b-g	1.7 e
A13703G 0.32 fl oz .....	A-E	0 a	0.1 fg	0.5 d-g	5.0 b-e
A13703G 0.50 fl oz .....	A-E	0 a	0.3 efg	0.2 fg	7.0 b-e
A8122B 0.157 fl oz.....	A-E	0 a	1.0 b-g	1.8 b-g	0.5 e
A8122B 0.314 fl oz.....	A-E	0 a	1.2 b-g	1.2 c-g	2.0 e
A14212C 1.5 fl oz.....	A-E	0 a	0.9 b-g	3.0 abc	2.0 e
Headway F 3.0 fl oz w/ Daconil Ultrex 82.5WDG 3.2 oz w/ Primo Maxx 11.3MEC w/ Concert 4.0 fl oz w/ Medallion 50WP 0.25 oz w/ Fore 80WP 4.0 oz w/ Heritage TL 2.0 fl oz w/ .....	A ACE A-E BD BD BD CE	0 a	0.7 d-g	0.0 g	0.0 e
A9898A 0.61 fl oz.....	A-E	0 a	1.0 b-g	2.5 a-d	3.8 de
Trinity 1.0 fl oz.....	A-E	0 a	1.7 a-f	2.2 a-f	0.2 e
Insignia 20WDG 0.70 oz + Trinity 1.0 fl oz...	A-E	0 a	2.4 ab	1.4 b-g	1.3 e
Honor WDG 0.83 oz.....	A-E	0 a	0.2 fg	0.9 d-g	13.0 ab
Honor WDG 1.11 oz.....	A-E	0 a	0.0 g	0.0 g	4.2 de
Untreated.....	-	0 a	0.5 d-g	1.4 b-g	5.2 b-e
Untreated.....	-	0 a	1.5 b-g	2.3 a-e	11.3 a-d
Untreated.....	-	0 a	0.5 d-g	3.0 abc	4.7 cde

<sup>z</sup> Percent of plot area affected by anthracnose was assessed visually on a linear 0 to 100% scale, where 0 = entire plot area healthy and 100 = entire plot affected.

<sup>y</sup> Treatments were applied as follows: A = 30 May, B = 12 Jun, C=26 Jun, D= 10 Jul, E=24 Jul .

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

Table 2. Quality of a creeping bentgrass/annual bluegrass green treated with various fungicides for the control of anthracnose, 2009.

Treatments and rate per 1000 sq ft	Application Code <sup>y</sup>	Quality (1-9) <sup>z</sup>			
		10 Jul	24 Jul	10 Aug	24 Aug
Vitalonil 5.2F 7.0 fl oz.....	A-E	7.7 abc <sup>x</sup>	7.7 b-e	6.3 c-f	7.0 a-d
Disarm 4SC 0.36 fl oz .....	A-E	7.0 b-e	7.0 d-g	6.7 b-e	7.0 a-d
Disarm C 4.4 fl oz.....	A-E	7.7 abc	7.7 b-e	7.3 abc	7.3 abc
Disarm M 0.5 fl oz .....	A-E	5.7 fgh	6.0 ghi	5.7 ef	5.0 f
Disarm M 1.0 fl oz .....	A-E	6.0 e-h	6.7 e-h	6.0 def	5.3 ef
Veranda 11.3WDG 0.9 oz.....	A-E	6.7 c-f	6.3 f-i	6.0 def	7.0 a-d
Eagle 20EW 1.4 fl oz.....	A-E	6.0 e-h	6.0 ghi	5.7 ef	6.3 c-f
Daconil Ultrex 82.5WDG 2.7 oz .....	A-E	7.3 a-d	7.7 b-e	6.3 c-f	7.0 a-d
Triton Flo 3SC0.75 fl oz .....	A-E	6.3 d-g	6.7 e-h	6.3 c-f	7.3 abc
Triton Flo 3SC 1.0 fl oz .....	A-E	7.0 b-e	6.7 e-h	6.7 b-e	6.7 b-e
Triton Flo 3SC 0.5 fl oz w/ Chipco Signature 80WDG 4.0 oz w/ Daconil Ultrex 82.5WDG 3.2 oz w/ Primo Maxx 11.3MEC .....	AC A-E BDE BDE	8.3 a	8.7 ab	8.0 a	7.3 abc
Reserve 4.8SC 3.2 fl oz + Chipco Signature 80WDG 4.0 oz.....	A-E	8.3 a	9.0 a	8.0 a	7.0 a-d
Reserve 4.8SC 3.2 fl oz .....	A-E	8.3 a	7.7 b-e	7.3 abc	7.3 abc
Reserve 4.8SC 3.6 fl oz .....	A-E	8.0 ab	8.0 a-d	7.0 a-d	8.0 ab
Concert 5.0 fl oz .....	A-E	7.0 b-e	6.0 ghi	5.3 f	7.0 a-d
A6780L 1.0 fl oz .....	A-E	5.7 fgh	5.3 i	6.0 def	5.3 ef
A6780L 1.5 fl oz .....	A-E	5.3 gh	5.7 hi	5.3 f	6.3 c-f
A16841A 0.247 fl oz.....	A-E	7.0 b-e	6.7 e-h	6.3 c-f	6.3 c-f
A16841A 0.494 fl oz.....	A-E	6.3 d-g	6.0 ghi	6.3 c-f	6.3 c-f
A17595A 1.7 fl oz.....	A-E	7.3 a-d	6.7 e-h	7.3 abc	6.7 b-e
A17601A 0.81 fl oz.....	A-E	7.7 abc	7.3 c-f	7.0 a-d	7.0 a-d
A17601A 1.61 fl oz.....	A-E	7.3 a-d	6.3 f-i	7.3 abc	7.0 a-d
A13703G 0.32 fl oz .....	A-E	8.0 ab	6.3 f-i	7.0 a-d	6.7 b-e
A13703G 0.50 fl oz .....	A-E	7.3 a-d	7.3 c-f	7.3 abc	6.0 c-f
A8122B 0.157 fl oz.....	A-E	7.0 b-e	6.7 e-h	7.0 a-d	7.0 a-d
A8122B 0.314 fl oz.....	A-E	6.3 d-g	6.3 f-i	6.0 def	6.3 c-f
A14212C 1.5 fl oz.....	A-E	6.0 e-h	5.3 i	5.7 ef	6.0 c-f
Headway F 3.0 fl oz w/ Daconil Ultrex 82.5WDG 3.2 oz w/ Primo Maxx 11.3MEC w/ Concert 4.0 fl oz w/ Medallion 50WP 0.25 oz w/ Fore 80WP 4.0 oz w/ Heritage TL 2.0 fl oz w/.....	A ACE A-E BD BD BD CE	7.7 abc	8.3 abc	7.0 a-d	8.3 a
A9898A 0.61 fl oz.....	A-E	5.0 h	5.3 i	4.0 g	6.7 b-e
Trinity 1.0 fl oz.....	A-E	6.0 e-h	6.0 ghi	6.3 c-f	7.3 abc
Insignia 20WDG 0.70 oz + Trinity 1.0 fl oz...	A-E	5.7 fgh	6.0 ghi	6.7 b-e	6.3 c-f
Honor WDG 0.83 oz.....	A-E	7.3 a-d	7.0 d-g	7.3 abc	5.7 def
Honor WDG 1.11 oz.....	A-E	7.7 abc	7.7 b-e	7.7 ab	7.3 abc
Untreated.....	-	6.7 c-f	6.0 ghi	6.3 c-f	6.7 b-e
Untreated.....	-	6.3 d-g	5.3 i	6.0 def	5.7 def
Untreated.....	-	7.0 b-e	5.7 hi	6.3 c-f	5.3 ef

<sup>z</sup> Turfgrass quality was rated visually on a 0 to 9 scale where 0 = brown dead turf; 9 = optimum density.

<sup>y</sup> Treatments were applied as follows: A = 30 May, B = 12 Jun, C=26 Jun, D= 10 Jul, E=24 Jul .

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

Table 3. Other ratings of a creeping bentgrass/annual bluegrass green treated with various fungicides for the control of anthracnose, 2009.

Treatments and rate per 1000 sq ft	Application Code <sup>x</sup>	Color (1-9) <sup>z</sup>	Injury (0-5) <sup>y</sup>
		10 Aug	10 Aug
Vitalonil 5.2F 7.0 fl oz .....	A-E	5.7 f <sup>w</sup>	1.0 fgh
Disarm 4SC 0.36 fl oz .....	A-E	7.0 b-e	1.7 d-g
Disarm C 4.4 fl oz .....	A-E	7.3 a-d	1.0 fgh
Disarm M 0.5 fl oz.....	A-E	7.0 b-e	2.0 c-f
Disarm M 1.0 fl oz.....	A-E	6.7 c-f	1.7 d-g
Veranda 11.3WDG 0.9 oz .....	A-E	6.3 def	1.7 d-g
Eagle 20EW 1.4 fl oz.....	A-E	6.0 ef	2.3 b-e
Daconil Ultrex 82.5WDG 2.7 oz .....	A-E	6.0 ef	1.0 fgh
Triton Flo 3SC0.75 fl oz .....	A-E	7.3 a-d	2.0 c-f
Triton Flo 3SC 1.0 fl oz.....	A-E	7.3 a-d	1.3 efg
Triton Flo 3SC 0.5 fl oz w/ Chipco Signature 80WDG 4.0 oz w/ Daconil Ultrex 82.5WDG 3.2 oz + Primo Maxx 11.3MEC.....	AC A-E BDE		0.0 h
Reserve 4.8SC 3.2 fl oz + Chipco Signature 80WDG 4.0 oz.....	A-E	8.0 ab	0.0 h
Reserve 4.8SC 3.2 fl oz .....	A-E	8.0 ab	0.0 h
Reserve 4.8SC 3.6 fl oz .....	A-E	7.3 a-d	1.3 efg
Reserve 4.8SC 3.6 fl oz .....	A-E	7.3 a-d	1.7 d-g
Concert 5.0 fl oz .....	A-E	7.0 b-e	2.7 bcd
A6780L 1.0 fl oz.....	A-E	6.3 def	3.3 ab
A6780L 1.5 fl oz.....	A-E	7.0 b-e	3.3 ab
A16841A 0.247 fl oz .....	A-E	7.0 b-e	2.0 c-f
A16841A 0.494 fl oz .....	A-E	6.3 def	2.7 bcd
A17595A 1.7 fl oz .....	A-E	6.3 def	2.7 bcd
A17595A 1.7 fl oz .....	A-E	6.7 c-f	1.0 fgh
A17601A 0.81 fl oz .....	A-E	7.0 b-e	1.3 efg
A17601A 1.61 fl oz .....	A-E	7.0 b-e	0.7 gh
A13703G 0.32 fl oz.....	A-E	7.7 abc	0.7 gh
A13703G 0.50 fl oz.....	A-E	7.0 b-e	1.0 fgh
A8122B 0.157 fl oz .....	A-E	7.3 a-d	1.3 efg
A8122B 0.314 fl oz .....	A-E	7.7 abc	2.0 c-f
A14212C 1.5 fl oz.....	A-E	7.0 b-e	3.0 abc
Headway F 3.0 fl oz w/ Daconil Ultrex 82.5WDG 3.2 oz w/ Primo Maxx 11.3MEC w/ Concert 4.0 fl oz +Medallion 50WP 0.25 oz Fore 80WP 4.0 oz w/ Heritage TL 2.0 fl oz.....	A ACE A-E BD CE		1.7 d-g
A9898A 0.61 fl oz .....	A-E	8.3 a	1.7 d-g
Trinity 1.0 fl oz .....	A-E	6.0 ef	4.0 a
Insignia 20WDG 0.70 oz + Trinity 1.0 fl oz.....	A-E	7.7 abc	2.0 c-f
Honor WDG 0.83 oz .....	A-E	7.3 a-d	1.3 efg
Honor WDG 1.11 oz .....	A-E	8.0 ab	1.0 fgh
Honor WDG 1.11 oz .....	A-E	7.0 b-e	1.0 fgh
Untreated.....	-	6.7 c-f	2.0 c-f
Untreated.....	-	6.0 ef	1.7 d-g
Untreated.....	-	7.0 b-e	2.0 c-f

<sup>z</sup> Turfgrass quality was rated visually on a 0 to 9 scale where 0 = brown dead turf; 9 = dark green turf.

<sup>y</sup> Turfgrass injury was rated visually on a 0 to 5 scale where 0 = no injury to turf; 5 = brown or dead turf.

<sup>x</sup> Treatments were applied as follows: A = 30 May, B = 12 Jun, C=26 Jun, D= 10 Jul, E=24 Jul .

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

Table 4. Other ratings of a creeping bentgrass/annual bluegrass green treated with various fungicides for the control of anthracnose, 2009.

Treatments and rate per 1000 sq ft	Application Code <sup>x</sup>	Algae (0-1) <sup>z</sup>	
		24 Jul	Percent algae <sup>y</sup> 14 Aug
Vitalonil 5.2F 7.0 fl oz .....	A-E	0.0 a <sup>w</sup>	0.0 i
Disarm 4SC 0.36 fl oz .....	A-E	0.3 a	6.3 d-i
Disarm C 4.4 fl oz .....	A-E	0.0 a	0.0 i
Disarm M 0.5 fl oz.....	A-E	0.7 a	12.0 b-f
Disarm M 1.0 fl oz.....	A-E	0.7 a	15.3 bcd
Veranda 11.3WDG 0.9 oz .....	A-E	0.0 a	5.7 e-i
Eagle 20EW 1.4 fl oz.....	A-E	0.3 a	12.0 b-f
Daconil Ultrex 82.5WDG 2.7 oz .....	A-E	0.0 a	0.0 i
Triton Flo 3SC0.75 fl oz .....	A-E	1.0 a	26.3 a
Triton Flo 3SC 1.0 fl oz.....	A-E	0.7 a	18.0 ab
Triton Flo 3SC 0.5 fl oz w/ Chipco Signature 80WDG 4.0 oz w/ Daconil Ultrex 82.5WDG 3.2 oz + Primo Maxx 11.3MEC.....	AC A-E BDE		
Reserve 4.8SC 3.2 fl oz + Chipco Signature 80WDG 4.0 oz.....	A-E	0.0 a	0.0 i
Reserve 4.8SC 3.2 fl oz .....	A-E	0.0 a	2.0 ghi
Reserve 4.8SC 3.6 fl oz .....	A-E	0.0 a	0.3 hi
Concert 5.0 fl oz .....	A-E	0.0 a	0.7 hi
A6780L 1.0 fl oz.....	A-E	0.7 a	12.7 b-f
A6780L 1.5 fl oz.....	A-E	0.0 a	9.3 b-h
A16841A 0.247 fl oz .....	A-E	0.3 a	11.7 b-f
A16841A 0.494 fl oz .....	A-E	0.3 a	12.7 b-f
A17595A 1.7 fl oz .....	A-E	0.7 a	8.7 c-i
A17601A 0.81 fl oz .....	A-E	0.3 a	9.0 b-i
A17601A 1.61 fl oz .....	A-E	0.3 a	7.7 d-i
A13703G 0.32 fl oz.....	A-E	0.7 a	11.7 b-f
A13703G 0.50 fl oz.....	A-E	0.3 a	7.7 d-i
A8122B 0.157 fl oz .....	A-E	0.3 a	10.0 b-g
A8122B 0.314 fl oz .....	A-E	0.0 a	14.0 b-e
A14212C 1.5 fl oz.....	A-E	0.7 a	17.3 abc
Headway F 3.0 fl oz w/ Daconil Ultrex 82.5WDG 3.2 oz w/ Primo Maxx 11.3MEC w/ Concert 4.0 fl oz + Medallion 50WP 0.25 oz + Fore 80WP 4.0 oz w/ Heritage TL 2.0 fl oz w/ .....	A ACE A-E BD CE		
A9898A 0.61 fl oz .....	A-E	0.0 a	0.0 i
Trinity 1.0 fl oz .....	A-E	0.0 a	7.3 d-i
Insignia 20WDG 0.70 oz + Trinity 1.0 fl oz.....	A-E	0.3 a	10.0 b-g
Honor WDG 0.83 oz .....	A-E	0.3 a	15.3 bcd
Honor WDG 1.11 oz .....	A-E	0.3 a	4.7 f-i
Untreated.....	-	0.3 a	9.3 b-h
Untreated.....	-	0.0 a	6.3 d-i
Untreated.....	-	0.3 a	8.7 c-i
Untreated.....	-	0.0 a	7.3 d-i

<sup>z</sup> Algae was rated for its presence or absence as indicated by 1 or 0, respectively.

<sup>y</sup> Percent of plot area affected by algae was assessed visually on a linear 0 to 100% scale, where 0 = entire plot area green; 100 = entire plot blackened by algae.

<sup>x</sup> Treatments were applied as follows: A = 30 May, B = 12 Jun, C=26 Jun, D= 10 Jul, E=24 Jul .

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