

# 2008 Turfgrass Research Report



## IN COOPERATION WITH THE



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No endorsement is intended for products mentioned, nor is lack of endorsement meant for products not mentioned. The authors and the Pennsylvania State University assume no liability resulting from the use of pesticide applications detailed in this report.

## Preemergence Control of Smooth Crabgrass J. A. Borger, M. B. Naedel, M. T. Elmore<sup>1</sup>

## Introduction

Preemergence control of smooth crabgrass (*Digitaria ischaemum*) was evaluated on a mature stand of 'Midnight' Kentucky bluegrass (*Poa pratensis*, L.) at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine the efficacy of selected preemergence herbicides for the control of smooth crabgrass and safety to desired species.

## **Methods and Materials**

This study was a randomized complete block design with three replications. Treatments were applied on April 24, 2008 (PRE) and June 17, 2008 (8 WAT) using a three foot CO<sub>2</sub> powered boom sprayer calibrated to deliver 80 gpa using one, flat fan, 11008E nozzle at 40 psi. After the applications the entire test site received approximately 0.5 inch of water. On May 10, 2008 0.5 lb N/M was applied from urea and 0.5 lb N/M from a 31-0-0 IBDU fertilizer was applied to the entire test area. The site was mowed once per week with a rotary mower at one inch with clippings returned to the site.

The test site was overseeded with a native source of smooth crabgrass seed in the fall of at least two of the pervious growing seasons. The test site had approximately 90% cover of smooth crabgrass in the non treated areas at the conclusion of the study.

Smooth crabgrass germination was first noted in the non treated areas of the test site on April 29, 2008.

## **Results and Discussion**

Turfgrass phytotoxicity was rated twice (Table 1). No phytotoxicity was observed during the study. The control of smooth crabgrass was rated on August 20, 2008. No treated turfgrass provided commercially acceptable control (85% or greater). It should be noted that the addition of Tenacity to the split application of Barricade at 0.38 la ai/A did reveal a trend of greater control.

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<u>**Table 1**</u>. Evaluations of turfgrass phytotoxicity where 0 = worst, 7 = acceptable, and 10 = no phytotoxicity, taken in 2008.

Treatment	Form	Rate Timing		(Phytotoxicity)		
		lb ai/A		5/5	6/27	
BARRICADE	4FL	0.75	PRE	10.0	10.0	
CHECK				10.0	10.0	
BARRICADE	4FL	0.38	PRE/8 WAT	10.0	10.0	
BARRICADE	4FL	0.38	PRE/8 WAT	10.0	10.0	
TENACITY	4SC	0.156	8 WAT			

<u>**Table 2**</u>. Evaluations of the percent control of smooth crabgrass in 2008. Commercially acceptable control was considered to be 85% and above.

Treatment	Form	Rate	Timing	(% Control)
		lb ai/A		August 20, 2008
BARRICADE	4FL	0.75	PRE	61.7
CHECK				0.0
BARRICADE	4FL	0.38	PRE/8 WAT	63.3
BARRICADE	4FL	0.38	PRE/8 WAT	78.3
TENACITY	4SC	0.156	8 WAT	

## Annual Bluegrass Control in Fairway Height Creeping Bentgrass J. A. Borger, M. B. Naedel, M. T. Elmore<sup>1</sup>

## Introduction

This study was conducted on a mature stand of 'Penneagle' creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass (*Poa annua*) at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine if selected materials could reduce the annual bluegrass population under simulated fairway conditions.

#### **Methods and Materials**

This study was a randomized complete block design with three replications. Treatments were applied on May 23 (SHTR) and October 25, 2007 (OCT) using a three foot  $CO_2$  powered boom sprayer calibrated to deliver 40 gpa using one, flat fan, 11004E nozzle at 40 psi. The test area was maintained at 0.5 inch using a five-plex reel mower that collected clippings. Turfgrass was irrigated on an as needed basis to prevent moisture stress. The study was fertilized prior to green up with 1 lb N/M from IBDU and again in May with 1 lb N/M from urea. The test area received maintenance fungicide applications to control disease.

The test site consisted of approximately 35 percent creeping bentgrass and 65 percent annual bluegrass at the initiation of the study. The annual bluegrass population was visually evaluated on May 22, 2007 and May 8, 2008, on a plot by plot basis, to determine the baseline population and percent change of the population in each plot.

### **Results and Discussion**

Turfgrass phytotoxicity was rates four times during the study (Table 1). Only slight phytotoxicity was observed on any of the rating dates, but never below the 7.0 acceptable level.

Turfgrass green-up was rated on April 14<sup>th</sup> and 24<sup>th</sup>, 2008 (Table 2). On the April 14<sup>th</sup> rating date turfgrass treated with Trimmit applied in October, at any rate, alone or in combination with other materials fell below that of untreated (6.7).

The percent control of annual bluegrass was rated on May 8, 2008 (Table 3). There was no significant annual bluegrass control found when treated turfgrass was compared to non treated turfgrass. It should be noted that the annual bluegrass population increased in the non treated turfgrass area by almost 30%.

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Treatment	Form	Rate	Timing	(	Phyt	otoxicity	)
		oz/M	U	5-30	6-5	6-18	11-5
TRIMMIT	2SC	1	SHTR	10.0	9.7	10.0	10.0
TRIMMIT	2SC	1	SHTR	10.0	8.8	10.0	10.0
EMBARK	0.2SL	10 oz/A	SHTR				
TRIMMIT	2SC	1	SHTR	10.0	9.2	10.0	10.0
EMBARK	0.2SL	10 oz/A	SHTR				
ECO-N (24-0-0)	2.2L	0.25 lb N/M	SHTR				
TRIMMIT	2SC	1	SHTR	10.0	9.0	10.0	10.0
EMBARK	0.2SL	10 oz/A	SHTR				
ECO-N (24-0-0)	2.2L	0.25lb N/M	SHTR				
PRIMO MAXX	1MEC	0.125	SHTR				
TRIMMIT	2SC	0.375 lb ai/A	SHTR	10.0	9.8	10.0	10.0
CHECK				10.0	10.0	10.0	10.0
TRIMMIT	2SC	1	OCT	10.0	10.0	10.0	9.8
TRIMMIT	2SC	1	OCT	10.0	10.0	10.0	9.2
EMBARK	0.2SL	10 oz/A	OCT				
TRIMMIT	2SC	1	OCT	10.0	10.0	10.0	8.7
EMBARK	0.2SL	10 oz/A	OCT				
ECO-N (24-0-0)	2.2L	0.25lb N/M	OCT				
TRIMMIT	2SC	1	OCT	10.0	10.0	10.0	8.0
EMBARK	0.2SL	10 oz/A	OCT				
ECO-N (24-0-0)	2.2L	0.25lb N/M	OCT				
PRIMO MAXX	1MEC	0.125	OCT				
TRIMMIT	2SC	0.375 lb ai/A	OCT	10.0	10.0	10.0	8.8

<u>**Table 1.**</u> Phytotoxicity on a scale of 0-10, where 0 = dead turf, 7 = acceptable, and  $10 = \text{no phytotoxicity in a mixed fairway height sward of 'Penneagle' creeping bentgrass and annual bluegrass in 2007.$ 

<u>**Table 2.**</u> Spring green up ratings on a scale of 0-10, where 0 = dormant turf and 10 = full green up, of a mixed fairway height sward of 'Penneagle' creeping bentgrass and annual bluegrass in 2008.

Treatment	Form Rate		Timing	(Green Up)		
		oz/M	0	4-14	4-24	
TRIMMIT	2SC	1	SHTR	6.8	10.0	
TRIMMIT	2SC	1	SHTR	7.2	10.0	
EMBARK	0.2SL	10 oz/A	SHTR			
TRIMMIT	2SC	1	SHTR	6.8	10.0	
EMBARK	0.2SL	10 oz/A	SHTR			
ECO-N (24-0-0)	2.2L	0.25 lb N/M	SHTR			
TRIMMIT	2SC	1	SHTR	7.0	10.0	
EMBARK	0.2SL	10 oz/A	SHTR			
ECO-N (24-0-0)	2.2L	0.25lb N/M	SHTR			
PRIMO MAXX	1MEC	0.125	SHTR			
TRIMMIT	2SC	0.375 lb ai/A	SHTR	6.8	10.0	
CHECK				6.7	10.0	
TRIMMIT	2SC	1	OCT	5.3	10.0	
TRIMMIT	2SC	1	OCT	5.2	10.0	
EMBARK	0.2SL	10 oz/A	OCT			
TRIMMIT	2SC	1	OCT	6.5	10.0	
EMBARK	0.2SL	10 oz/A	OCT			
ECO-N (24-0-0)	2.2L	0.25lb N/M	OCT			
TRIMMIT	2SC	1	OCT	5.2	10.0	
EMBARK	0.2SL	10 oz/A	OCT			
ECO-N (24-0-0)	2.2L	0.25lb N/M	OCT			
PRIMO MAXX	1MEC	0.125	OCT			
TRIMMIT	2SC	0.375 lb ai/A	OCT	5.8	10.0	

Treatment	Form	Rate	Timing	(% Control <sup>1, 2</sup> )
		(lb Ai/A)		5/8/08
TRIMMIT	2SC	1	SHTR	5.2ab
TRIMMIT	2SC	1	SHTR	2.8ab
EMBARK	0.2SL	10 oz/A	SHTR	
TRIMMIT	2SC	1	SHTR	-28.1ab
EMBARK	0.2SL	10 oz/A	SHTR	
ECO-N (24-0-0)	2.2L	0.25 lb N/M	SHTR	
TRIMMIT	2SC	1	SHTR	-53.3b
EMBARK	0.2SL	10 oz/A	SHTR	
ECO-N (24-0-0)	2.2L	0.25lb N/M	SHTR	
PRIMO MAXX	1MEC	0.125	SHTR	
TRIMMIT	2SC	0.375 lb ai/A	SHTR	1.2ab
CHECK				-29.8ab
TRIMMIT	2SC	1	OCT	-3.8ab
TRIMMIT	2SC	1	OCT	16.7a
EMBARK	0.2SL	10 oz/A	OCT	
TRIMMIT	2SC	1	OCT	2.8ab
EMBARK	0.2SL	10 oz/A	OCT	
ECO-N (24-0-0)	2.2L	0.25lb N/M	OCT	
TRIMMIT	2SC	1	OCT	-0.8ab
EMBARK	0.2SL	10 oz/A	OCT	
ECO-N (24-0-0)	2.2L	0.25lb N/M	OCT	
PRIMO MAXX	1MEC	0.125	OCT	
TRIMMIT	2SC	0.375 lb ai/A	OCT	-11.4ab

<u>**Table 3.**</u> Percent control of annual bluegrass in a mixed fairway height sward with 'Penneagle' creeping bentgrass in 2008.

1 – Negative numbers indicate an increase in annual bluegrass populations and positive numbers a decrease in population.

## Evaluation of Late Season Applications of Experimental Compounds Applied to Fairway Height Creeping Bentgrass/Annual Bluegrass J.A. Borger, M.B. Naedel, M. T. Elmore<sup>1</sup>

## Introduction

This study was conducted on a mature stand of 'Penneagle' creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass (*Poa annua*) at the Valentine Turfgrass Research Center, Penn State University, University Park, Pa. The objective of the study was to determine the efficacy of late season applications of materials to control annual bluegrass using phytotoxicity and percent population change ratings.

## **Methods and Materials**

This study was a randomized complete block design with three replications. The plot size was  $30ft^2$ . Treatments were applied on November 2 (NOV) and November 27, 2007 (21 DAT) using a three foot CO<sub>2</sub> powered boom sprayer calibrated to deliver 87.12 gpa using one, flat fan, 11008E nozzle at 40 psi. The test site was maintained similar to that of a golf course fairway with respect to irrigation, fertilization, and mowing.

Percent control of annual bluegrass was rated on May 8, 2008 and data were transformed using an Abbot's transformation (ARM). This transformation uses the untreated test plots as the baseline population to determine percent change in the population of the treated test plots.

## **Results and Discussion**

Turfgrass spring greenup was rated twice during the study (Table 1). On the last rating date, 4/24/08, all treated turfgrass had a slight delay in greenup compared to non treated turfgrass.

The percent control of annual bluegrass was rated on May 8, 2008 (Table 2). All treated turfgrass significantly reduced the annual bluegrass population compared to non treated.

<u>**Table 1.**</u> Spring green up ratings on a scale of 0-10, where 0 = dormant turf and 10 = full green up, of a mixed fairway height sward of 'Penneagle' creeping bentgrass and annual bluegrass in 2008.

Treatment	Form	Rate	Rate Timing		(Green Up)		
		oz/M		4/14/08	4/24/08		
PROGRASS	EC	1.5	NOV/21DAT	6.2	8.7		
NORTON SC	SC	0.563	NOV/21DAT	6.2	8.5		
CHECK				6.8	10.0		
NORTON SC	SC	0.563	NOV/21DAT	6.5	8.5		
MSO	L	1 qt/A					
POA CONSTRICTOR	EC	0.563	NOV/21DAT	6.5	8.7		

<u>**Table 2.**</u> Percent annual bluegrass population change in a mixed fairway height sward with 'Penneagle' creeping bentgrass taken in 2008.

Treatment	Form	Rate	Timing	(% Change <sup>1</sup> )		
		oz/M		5/8/08		
PROGRASS	EC	1.5	NOV/21DAT	48.3b		
NORTON SC	SC	0.563	NOV/21DAT	83.6a		
CHECK				0.0c		
NORTON SC	SC	0.563	NOV/21DAT	67.2ab		
MSO	L	1 qt/A				
POA CONSTRICTOR	EC	0.563	NOV/21DAT	73.9a		

1 - Means followed by the same letter do not significantly differ (P = 0.05, Duncan's New MRT).

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# Post Emergence Control of Broadleaf Weeds and Phytotoxicity Evaluations J. A. Borger, M. B. Naedel, and M. T. Elmore<sup>1</sup>

## Introduction

Broadleaf weed control and phytotoxicity evaluations were conducted on a stand of mature 'SR-4200' perennial ryegrass (*Lolium perenne* L.) at The Valentine Turfgrass Research Center, Penn State University, University Park, Pa. The objectives of the study were to determine the efficacy of selected broadleaf weed herbicides for the control of dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*), and buckhorn plantain (*Plantago lanceolata*) in perennial ryegrass and the phytotoxicity of these compounds on perennial ryegrass.

#### **Methods and Materials**

All plots were rated for the percent dandelion, white clover, and buckhorn plantain, prior to the application of any treatment, on a plot by plot basis. The test plots were 21  $\text{ft}^2$  and had approximately 80 percent broadleaf weed cover.

The study was a randomized complete block design with three replications. All of the treatments were applied on May 30, 2008 using a three foot  $CO_2$  powered boom sprayer calibrated to deliver 40 gpa using one, flat fan, 11004E nozzle at 40 psi.

The test site was mowed at three inches weekly with a rotary mower with clippings returned to the site. The test site was irrigated to prevent moisture stress.

## **Results and Discussion**

Turfgrass phytotoxicity was rated three times during the study (Table 1). No turfgrass phytotoxicity was observed on any rating date.

The control of dandelion, white clover, and buckhorn plantain was rated three times during the study (Table 2). Broadleaf weed control was variable. On the final rating date, July 25<sup>th</sup>, all treated turfgrass revealed a significant reduction in the dandelion and white clover populations when compared to non-treated turfgrass. Finally, the buckhorn plantain population was significantly reduced by all treatments except Q-P Quinclorac at 1 lb/A and Trimec Classic when compared to non-treated turfgrass.

It should be noted that all treated broadleaf weed populations changed to some degree over time. One final observation, the addition of Triclopyr to Q-P Quinclorac generally increased the efficacy of Q-P Quinclorac but is not always significant across the study.

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Treatment	Form	Rate	(	Phytotoxicity	y)
		lb/A	6/13	6/27	7/25
Q-P QUINCLORAC	75DF	0.5	10.0	10.0	10.0
Q-P QUINCLORAC	75DF	1	10.0	10.0	10.0
TRICLOPYR 4	4EC	0.5 qt/A	10.0	10.0	10.0
TRICLOPYR 4	4EC	1 qt/A	10.0	10.0	10.0
Q-P QUINCLORAC	75DF	0.5	10.0	10.0	10.0
TRICLOPYR 4	4EC	0.5 qt/A			
CHECK		_	10.0	10.0	10.0
Q-P QUINCLORAC	75DF	0.5	10.0	10.0	10.0
TRICLOPYR 4	4EC	1 qt/A			
Q-P QUINCLORAC	75DF	1	10.0	10.0	10.0
TRICLOPYR 4	4EC	0.5 qt/A			
Q-P QUINCLORAC	75DF	1	10.0	10.0	10.0
TRICLOPYR 4	4EC	1 qt/A			
TRIMEC CLASSIC	3.32EC	4 pt/A	10.0	10.0	10.0

<u>**Table 1.**</u> Evaluations of turfgrass phytotoxicity in 2008 where 0 = dead turf, 7 = acceptable, and 10 = no phytotoxicity.

Table 2. Percent control of the dandelion, white clover, and buckhorn plantain populations following applications of selected herbicides.

Treatment	Form	Rate	(	June 13, 200	)8 <sup>1</sup> )(	June 2	27, 2008	) (	July 2	5, 2008	)
		lb/A	Dand	Clover	Plant	Dand	Clover	Plant	Dand	Clover	Plant
Q-P QUINCLORAC	75DF	0.5	38.1c	61.7a	93.3a	38.1c	61.7a	93.3a	56.2c	97.3a	93.3a
Q-P QUINCLORAC	75DF	1	45.6bc	57.8a	100.0a	45.6bc	57.8a	100.0a	81.3b	100.0a	60.0ab
TRICLOPYR 4	4EC	0.5 qt/A	81.1a	67.1a	66.7ab	81.1a	67.1a	66.7ab	41.7c	83.8b	0.0b
TRICLOPYR 4	4EC	1 qt/A	87.8a	92.2a	91.1a	87.8a	92.2a	91.1a	90.8ab	98.9a	75.6a
Q-P QUINCLORAC	75DF	0.5	84.2a	77.8a	93.3a	84.2a	77.8a	93.3a	96.2ab	100.0a	86.7a
TRICLOPYR 4	4EC	0.5 qt/A									
CHECK		-	0.0d	0.0b	0.0b	0.0d	0.0b	0.0b	0.0d	0.0c	0.0b
Q-P QUINCLORAC	75DF	0.5	86.3a	75.7a	100.0a	86.3a	75.7a	100.0a	98.7a	100.0a	90.0a
TRICLOPYR 4	4EC	1 qt/A									
Q-P QUINCLORAC	75DF	1	70.8ab	73.8a	76.7ab	70.8ab	73.8a	76.7ab	98.9a	99.3a	80.0a
TRICLOPYR 4	4EC	0.5 qt/A									
Q-P QUINCLORAC	75DF	1	91.2a	90.0a	100.0a	91.2a	90.0a	100.0a	98.3a	100.0a	93.3a
TRICLOPYR 4	4EC	1 qt/A									
TRIMEC CLASSIC	3.32EC	4 pt/A	69.7ab	90.0a	100.0a	69.7ab	90.0a	100.0a	85.9ab	100.0a	63.3ab

# Post Emergence Control of Broadleaf Weeds and Phytotoxicity Evaluations J. A. Borger, M. B. Naedel, and M. T. Elmore<sup>1</sup>

## Introduction

Broadleaf weed control and phytotoxicity evaluations were conducted on a stand of mature 'SR-4200' perennial ryegrass (*Lolium perenne* L.) at The Valentine Turfgrass Research Center, Penn State University, University Park, Pa. The objectives of the study were to determine the efficacy of selected broadleaf weed herbicides for the control of dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*), and buckhorn plantain (*Plantago lanceolata*) in perennial ryegrass and the phytotoxicity of these compounds on perennial ryegrass.

#### **Methods and Materials**

All plots were rated for the percent dandelion, white clover, and buckhorn plantain, prior to the application of any treatment, on a plot by plot basis. The test plots were 21  $\text{ft}^2$  and had approximately 80 percent broadleaf weed cover.

The study was a randomized complete block design with three replications. Treatments were applied on May 8 (PRE), May 30 (1-2 LF), June 2 (3 WAT), June 11 (4 WAT), and June 25, 2008 (6 WAT) using a three foot  $CO_2$  powered boom sprayer calibrated to deliver 80 gpa using one, flat fan, 11008E nozzle at 40 psi.

The test site was mowed at three inches weekly with a rotary mower with clippings returned to the site. The test site was irrigated to prevent moisture stress.

#### **Results and Discussion**

Turfgrass phytotoxicity was rated five times during the study (Table 1). No unacceptable turfgrass phytotoxicity was observed on any rating date.

The control of dandelion, white clover, and buckhorn plantain was rated four times during the study (Table 2). Broadleaf weed control was variable. On the final rating date, July 16<sup>th</sup>, all treated turfgrass revealed a significant reduction in the buckhorn plantain populations when compared to non-treated turfgrass. Only turfgrass treated A15879 at 0.5 lb ai/A applied PRE/6 WAT, Dimension plus Escalade 2, and Escalade 2 significantly reduced the dandelion populations when compared to non treated. Similarly, only turfgrass treated with A15879 at 0.5 lb ai/A applied PRE/3WAT, Tenacity at 0.25 lb ai/a plus Barricade at 0.75 lbs ai/A applied PRE/3WAT , Dimension plus Escalade 2, A15879 at 0.5 lb ai/A PRE plus Tenacity 3WAT, and Escalade 2 significantly reduced the white clover populations when compared to non treated.

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Treatment	Form	Rate	Timing	(	q	)		
		lb ai/A	0	5/28	6/5	6/18	7/2	7/30
A15879	3.95SC	1	PRE	15.0	0.0	0.0	0.0	0.0
TENACITY	4SC	0.25	PRE	5.0	0.0	0.0	0.0	0.0
BARRICADE	4FL	0.75	PRE					
DIMENSION	2EW	0.25	PRE	0.0	0.0	0.0	0.0	0.0
A15879	3.95SC	1	1-2 LF	0.0	1.7	0.0	0.0	0.0
ACTIVATOR 90	L	0.25% v/v	1-2 LF					
A15879	3.95SC	0.5	PRE/1-2 LF	3.3	0.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25% v/v	1-2 LF					
A15879	3.95SC	0.5	PRE/3 WAT	3.3	5.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25% v/v	3 WAT					
CHECK				0.0	0.0	0.0	0.0	0.0
TENACITY	4SC	0.25	PRE/3 WAT	8.3	10.0	0.0	0.0	0.0
BARRICADE	4FL	0.75	PRE/3 WAT					
ACTIVATOR 90	L	0.25% v/v	3 WAT					
A15879	3.95SC	0.5	PRE/4 WAT	6.7	0.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25% v/v	4 WAT					
A15879	3.95SC	0.5	PRE/6 WAT	1.7	0.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25% v/v	6 WAT					
DIMENSION	2EW	0.25	PRE	6.7	0.0	0.0	0.0	0.0
ESCALADE 2	SL	2 pt/A	6 WAT					
ACTIVATOR 90	L	0.25% v/v	6 WAT					
A15879	3.95SC	0.5	PRE	6.7	10.0	0.0	0.0	0.0
TENACITY	4SC	0.25	3 WAT					
ACTIVATOR 90	L	0.25% v/v	3 WAT					
ESCALADE 2	SL	2 pt/A	6 WAT	0.0	0.0	0.0	0.0	0.0

<u>**Table 1**</u>. Evaluations of percent turfgrass phytotoxicity in 2008 where 0-10% = slightly noticeable to researcher but acceptable, 10-30% = noticeable to researcher and homeowner but acceptable, and >30% = unacceptable.

Treatment	Form	Rate	Timing	(	-June 5, 2008	; <sup>1</sup> )	(June 18, 2008)			
		lb ai/A		Dand	Clover	Plant	Dand	Clover	Plant	
<u>A15879</u>	3.95SC	1	PRE	81.2a	14.3ab	100.0a	81.4cd	9.5c	93.3a	
TENACITY	4SC	0.25	PRE	78.4a	16.7ab	86.7a	76.1d	11.6c	93.3a	
BARRICADE	4FL	0.75	PRE							
DIMENSION	2EW	0.25	PRE	0.0c	0.0b	0.0b	0.0e	0.0c	0.0b	
A15879	3.95SC	1	1-2 LF	32.4b	0.0b	53.3a	98.4a	61.6ab	93.3a	
ACTIVATOR 90	L	0.25% v/v	1-2 LF							
A15879	3.95SC	0.5	PRE/1-2 LF	91.0a	14.8ab	100.0a	98.9a	46.4b	100.0a	
ACTIVATOR 90	L	0.25% v/v	1-2 LF							
A15879	3.95SC	0.5	PRE/3 WAT	73.8a	26.7ab	100.0a	98.1a	61.6ab	100.0a	
ACTIVATOR 90	L	0.25% v/v	3 WAT							
CHECK				0.0c	0.0b	0.0b	0.0e	0.0c	0.0b	
TENACITY	4SC	0.25	PRE/3 WAT	91.7a	54.2a	86.7a	98.5a	78.6a	100.0a	
BARRICADE	4FL	0.75	PRE/3 WAT							
ACTIVATOR 90	L	0.25% v/v	3 WAT							
A15879	3.95SC	0.5	PRE/4 WAT	68.8a	15.5ab	53.3a	94.4ab	21.8c	86.7a	
ACTIVATOR 90	L	0.25% v/v	4 WAT							
A15879	3.95SC	0.5	PRE/6 WAT	72.2a	0.0b	66.7a	86.8bc	0.0c	90.0a	
ACTIVATOR 90	L	0.25% v/v	6 WAT							
DIMENSION	2EW	0.25	PRE	0.0c	0.0b	0.0b	0.0e	0.0c	0.0b	
ESCALADE 2	SL	2 pt/A	6 WAT							
ACTIVATOR 90	L	0.25% v/v	6 WAT							
A15879	3.95SC	0.5	PRE	80.1a	44.1a	86.7a	99.2a	77.0a	100.0a	
TENACITY	4SC	0.25	3 WAT							
ACTIVATOR 90	L	0.25% v/v	3 WAT							
ESCALADE 2	SL	2 pt/A	6 WAT	0.0c	0.0b	0.0b	0.0e	0.0c	0.0b	

Table 2. Percent control of the dandelion, white clover, and buckhorn plantain populations following applications of selected herbicides.

Treatment	Form	Rate	Timing	(,	July 2, 2008	<sup>1</sup> )	(July 16, 2008)		)
		lb ai/A		Dand	Clover	Plant	Dand	Clover	Plant
<u>A15879</u>	3.95SC	1	PRE	35.2cd	0.0c	60.0ab	19.4b	0.0e	93.3a
TENACITY	4SC	0.25	PRE	28.8d	0.0c	33.3ab	3.0b	0.0e	93.3a
BARRICADE	4FL	0.75	PRE						
DIMENSION	2EW	0.25	PRE	0.0e	0.0c	0.0b	0.0b	0.0e	0.0b
A15879	3.95SC	1	1-2 LF	85.5a	30.5b	93.3a	25.8b	9.5cde	100.0a
ACTIVATOR 90	L	0.25% v/v	1-2 LF						
A15879	3.95SC	0.5	PRE/1-2 LF	50.5bcd	21.3bc	60.0ab	23.1b	5.6de	100.0a
ACTIVATOR 90	L	0.25% v/v	1-2 LF						
A15879	3.95SC	0.5	PRE/3 WAT	59.5b	26.7b	50.0ab	19.0b	20.7bcd	93.3a
ACTIVATOR 90	L	0.25% v/v	3 WAT						
CHECK				0.0e	0.0c	0.0b	0.0b	0.0e	0.0b
TENACITY	4SC	0.25	PRE/3 WAT	62.5ab	59.4a	86.7a	8.3b	24.3bc	100.0a
BARRICADE	4FL	0.75	PRE/3 WAT						
ACTIVATOR 90	L	0.25% v/v	3 WAT						
A15879	3.95SC	0.5	PRE/4 WAT	85.0a	12.1bc	66.7a	26.5b	6.1de	100.0a
ACTIVATOR 90	L	0.25% v/v	4 WAT						
A15879	3.95SC	0.5	PRE/6 WAT	83.2a	0.0c	90.0a	76.9a	0.0e	100.0a
ACTIVATOR 90	L	0.25% v/v	6 WAT						
DIMENSION	2EW	0.25	PRE	0.0e	0.0c	0.0b	83.5a	97.9a	93.3a
ESCALADE 2	SL	2 pt/A	6 WAT						
ACTIVATOR 90	L	0.25% v/v	6 WAT						
A15879	3.95SC	0.5	PRE	58.1bc	54.1a	93.3a	16.7b	33.7b	93.3a
TENACITY	4SC	0.25	3 WAT						
ACTIVATOR 90	L	0.25% v/v	3 WAT						
ESCALADE 2	SL	2 pt/A	6 WAT	0.0e	0.0c	0.0b	86.7a	96.7a	93.3a

Table 2 (continued). Percent control of the dandelion, white clover, and buckhorn plantain populations following applications of selected herbicides.

# Post Emergence Control of Broadleaf Weeds and Phytotoxicity Evaluations J. A. Borger, M. B. Naedel, and M. T. Elmore<sup>1</sup>

## Introduction

Broadleaf weed control and phytotoxicity evaluations were conducted on a stand of mature 'SR-4200' perennial ryegrass (*Lolium perenne* L.) at The Valentine Turfgrass Research Center, Penn State University, University Park, Pa. The objectives of the study were to determine the efficacy of selected broadleaf weed herbicides for the control of dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*), and buckhorn plantain (*Plantago lanceolata*) in perennial ryegrass and the phytotoxicity of these compounds on perennial ryegrass.

### **Methods and Materials**

All plots were rated for the percent dandelion, white clover, and buckhorn plantain, prior to the application of any treatment, on a plot by plot basis. The test plots were 21  $\text{ft}^2$  and had approximately 80 percent broadleaf weed cover.

The study was a randomized complete block design with three replications. All Treatments were applied on May 14, 2008 (MAY) and then reapplied on June 6, 2008 (3 WAT) using a three foot  $CO_2$  powered boom sprayer calibrated to deliver 40 gpa using one, flat fan, 11004E nozzle at 40 psi.

The test site was mowed at three inches weekly with a rotary mower with clippings returned to the site. The test site was irrigated to prevent moisture stress.

#### **Results and Discussion**

Turfgrass phytotoxicity was rated seven times during the study (Table 1). No unacceptable turfgrass phytotoxicity was observed on any rating date.

The control of dandelion, white clover, and buckhorn plantain was rated six times during the study (Table 2). Broadleaf weed control was variable. On the final rating date, August 13<sup>th</sup>, all treated turfgrass revealed a significant reduction in the buckhorn plantain populations when compared to non-treated turfgrass. Only turfgrass treated with A14203 at 0.156 lb ai/A significantly reduced the dandelion populations when compared to non-treated. With regard to clover control, only turfgrass treated with EXC3937 at 10 oz/A and A14203 at 0.156 lb ai/A did not significantly reduce the white clover populations when compared to non-treated.

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Treatment	Form	rm Rate	Timing	(% Phytotoxicity)						
		% v/v	-	5/28	6/11	6/18	7/2	7/16	7/30	8/13
TENACITY	4SC	5 oz/A	MAY/3 WAT	8.3	0.0	5.0	0.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25	MAY/3 WAT							
TENACITY	4SC	8 oz/A	MAY/3 WAT	15.0	0.0	15.0	0.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25	MAY/3 WAT							
EXC3937	2SC	10 oz/A	MAY/3 WAT	8.3	1.7	8.3	0.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25	MAY/3 WAT							
CHECK				0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXC3937	2SC	16 oz/A	MAY/3 WAT	11.7	0.0	15.0	0.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25	MAY/3 WAT							
A14203	50WG	0.156 lb ai/A	MAY/3 WAT	6.7	3.3	8.3	0.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25	MAY/3 WAT							
A14203	50WG	0.25 lb ai/A	MAY/3 WAT	10.0	0.0	16.7	0.0	0.0	0.0	0.0
ACTIVATOR 90	L	0.25	MAY/3 WAT							

<u>**Table 1**</u>. Evaluations of percent turfgrass phytotoxicity in 2008 where 0-10% = slightly noticeable to researcher but acceptable, 10-30% = noticeable to researcher and homeowner but acceptable, and >30% = unacceptable.

Table 2. Percent control of the dandelion, white clover, and buckhorn plantain populations following applications of selected herbicides.

Treatment	Form	Rate	Timing	(	-June 11, 200	8 <sup>1</sup> )	(June 18, 2008)			
		%0V/V	-	Dand	Clover	Plant	Dand	Clover	Plant	
TENACITY	4SC	5 oz/A	MAY/3 WAT	97.8a	73.2abc	96.7a	99.3a	66.3a	100.0a	
ACTIVATOR 90	L	0.25	MAY/3 WAT							
TENACITY	4SC	8 oz/A	MAY/3 WAT	98.0a	88.9a	97.8a	99.4a	88.9a	100.0a	
ACTIVATOR 90	L	0.25	MAY/3 WAT							
EXC3937	2SC	10 oz/A	MAY/3 WAT	98.7a	78.3ab	100.0a	98.7ab	62.5a	100.0a	
ACTIVATOR 90	L	0.25	MAY/3 WAT							
CHECK				0.0b	0.0d	0.0c	0.0c	0.0b	0.0b	
EXC3937	2SC	16 oz/A	MAY/3 WAT	98.7a	53.4c	100.0a	99.3a	74.2a	100.0a	
ACTIVATOR 90	L	0.25	MAY/3 WAT							
A14203	50WG	0.156 lb ai/A	MAY/3 WAT	98.0a	70.2abc	86.1b	98.7ab	59.8a	100.0a	
ACTIVATOR 90	L	0.25	MAY/3 WAT							
A14203	50WG	0.25 lb ai/A	MAY/3 WAT	98.5a	65.6bc	96.7a	97.7b	69.4a	100.0a	
ACTIVATOR 90	L	0.25	MAY/3 WAT							

Treatment	Form	Rate	Timing	(July 2, 2008 <sup>1</sup> ) (July 16, 2008)		)			
		%ov/v		Dand	Clover	Plant	Dand	Clover	Plant
TENACITY	4SC	5 oz/A	MAY/3 WAT	63.2a	78.4ab	100.0a	49.5a	71.7a	100.0a
ACTIVATOR 90	L	0.25	MAY/3 WAT						
TENACITY	4SC	8 oz/A	MAY/3 WAT	63.6a	84.2ab	70.0a	45.5a	78.9a	100.0a
ACTIVATOR 90	L	0.25	MAY/3 WAT						
EXC3937	2SC	10 oz/A	MAY/3 WAT	67.5a	71.7ab	66.7a	62.0a	58.3a	98.3a
ACTIVATOR 90	L	0.25	MAY/3 WAT						
CHECK				0.0b	0.0c	0.0b	0.0b	0.0b	0.0b
EXC3937	2SC	16 oz/A	MAY/3 WAT	61.1a	86.8a	100.0a	55.6a	67.9a	96.7a
ACTIVATOR 90	L	0.25	MAY/3 WAT						
A14203	50WG	0.156 lb ai/A	MAY/3 WAT	74.9a	59.4b	100.0a	61.3a	27.0b	98.3a
ACTIVATOR 90	L	0.25	MAY/3 WAT						
A14203	50WG	0.25 lb ai/A	MAY/3 WAT	69.2a	69.9ab	100.0a	57.5a	64.8a	100.0a
ACTIVATOR 90	L	0.25	MAY/3 WAT						

Table 2 (continued). Percent control of the dandelion, white clover, and buckhorn plantain populations following applications of selected herbicides.

Treatment	Form	Rate	Timing	(	July 30, 200	8 <sup>1</sup> )	(A	ugust 13, 20	08)
		%ov/v		Dand	Clover	Plant	Dand	Clover	Plant
TENACITY	4SC	5 oz/A	MAY/3 WAT	8.9b	29.1ab	93.3a	29.2ab	54.8a	100.0a
ACTIVATOR 90	L	0.25	MAY/3 WAT						
TENACITY	4SC	8 oz/A	MAY/3 WAT	6.1b	42.2a	100.0a	9.1b	45.6a	100.0a
ACTIVATOR 90	L	0.25	MAY/3 WAT						
EXC3937	2SC	10 oz/A	MAY/3 WAT	13.2ab	25.0ab	96.7a	29.5ab	41.7ab	98.3a
ACTIVATOR 90	L	0.25	MAY/3 WAT						
CHECK				0.0b	0.0b	0.0b	0.0b	0.0b	0.0c
EXC3937	2SC	16 oz/A	MAY/3 WAT	15.0ab	30.7ab	100.0a	23.3b	52.4a	100.0a
ACTIVATOR 90	L	0.25	MAY/3 WAT						
A14203	50WG	0.156 lb ai/A	MAY/3 WAT	28.8a	20.4ab	95.0a	54.1a	20.4ab	75.0b
ACTIVATOR 90	L	0.25	MAY/3 WAT						
A14203	50WG	0.25 lb ai/A	MAY/3 WAT	3.3b	40.3a	90.0a	15.0b	48.1a	100.0a
ACTIVATOR 90	L	0.25	MAY/3 WAT						

Table 2 (continued). Percent control of the dandelion, white clover, and buckhorn plantain populations following applications of selected herbicides.

## Annual Bluegrass Control in Lawn Height Perennial Ryegrass J. A. Borger and M. B. Naedel<sup>1</sup>

## Introduction

This study was conducted on a mature stand of 'Triplex' perennial ryegrass (*Lolium perenne* L.) and annual bluegrass (*Poa annua*) at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine if selected materials could reduce the annual bluegrass population in lawn height perennial ryegrass.

## **Methods and Materials**

This study was a randomized complete block design with three replications. Treatments were applied on June 7 (JUNE), June 21 (2 WAT), June 29 (4 WAT), July 25 (8 WAT), August 22 (12 WAT), September 20 (16 WAT), October 25 (20 WAT), and November 27, 2007 (24 WAT) using a three foot  $CO_2$  powered boom sprayer calibrated to deliver 40 gpa using one, flat fan, 11004E nozzle at 40 psi. The test area was maintained at 2 inches using a rotary mower that returned clippings to the site. Turfgrass was irrigated on an as needed basis to prevent moisture stress. The study was fertilized after green up with 2 lb N/M from IBDU and again in September with 0.5 lb N/M from urea. The test area received maintenance fungicide applications to control disease.

The test site consisted of approximately 60 percent perennial ryegrass and 40 percent annual bluegrass at the initiation of the study. The annual bluegrass population was visually evaluated on June 6, 2007 and May 8, 2008, on a plot by plot basis, to determine the baseline population and percent change of the population in each plot.

## **Results and Discussion**

Turfgrass phytotoxicity was rated ten times during the study (Table 1). No unacceptable phytotoxicity (below 7.0) was found on any rating date.

Turfgrass spring greenup was rated twice during the study (Table 2). On the April 14<sup>th</sup> rating date, turfgrass treated with Trimmit at 11.5 oz/A applied six times, Tenacity at 5 oz/A applied 4/8/12WAT or applied 20/24 WAT, and Velocity had similar greenup to non treated turfgrass. All other treated turfgrass tended to have a slight delay in greenup. There was only a slight difference in spring greenup on the April 24, 2008 rating date.

Annual bluegrass control was rated on May 8, 2008 (Table 3). Only turfgrass treated with Trimmit at 11.5 oz/A applied six times, Trimmit at 21 oz/A applied JUNE plus Tenacity at 2 oz/A applied 4/8/12 WAT plus Trimmit applied 20/24 WAT, and Prograss significantly reduced the annual bluegrass population compared to non treated turfgrass. It should be noted that the annual bluegrass population increased by about 55% in the sward of non treated turfgrass.

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Treatment Form Rate Timing			Timing	(Phytotoxicity)						
		oz/A	-	6-14	6-21	7-5	7-19	7-26		
TRIMMIT	2SC	21	JUNE/4/8/12/16/20 WAT	10.0	10.0	10.0	10.0	10.0		
TRIMMIT	2SC	11.5	JUNE/4/8/12/16/20 WAT	10.0	10.0	10.0	10.0	10.0		
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	5	JUNE/20/24 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	4	JUNE/20/24 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	2	JUNE/20/24 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	5	4/8/12 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
CHECK				10.0	10.0	10.0	10.0	10.0		
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	4	4/8/12 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	2	4/8/12 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TENACITY	4SC	5	4/8/12 WAT	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	5	20/24 WAT	10.0	10.0	10.0	10.0	10.0		
VELOCITY	80SP	30	JUNE/2 WAT	8.7	7.2	7.8	10.0	10.0		
PROGRASS	1.5EC	1.5 oz/M	20/24 WAT	10.0	10.0	10.0	10.0	10.0		
PROGRASS	1.5EC	4.0 oz/M	20/24 WAT	10.0	10.0	10.0	10.0	10.0		

<u>**Table 1.</u>** Phytotoxicity on a scale of 0-10, where 0 = dead turf, 7 = acceptable, and  $10 = \text{no phytotoxicity in a mixed lawn height sward of 'Triplex' perennial ryegrass and annual bluegrass in 2007.</u>$ 

Treatment	Form	Rate	Timing	(Phytotoxicity						
		oz/A		8-2	8-15	9-6	9-20	10-16		
TRIMMIT	2SC	21	JUNE/4/8/12/16/20 WAT	10.0	10.0	10.0	10.0	10.0		
TRIMMIT	2SC	11.5	JUNE/4/8/12/16/20 WAT	10.0	10.0	10.0	10.0	10.0		
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	5	JUNE/20/24 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	4	JUNE/20/24 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	2	JUNE/20/24 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	7.8	10.0	10.0	8.8	10.0		
TENACITY	4SC	5	4/8/12 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
CHECK				10.0	10.0	10.0	10.0	10.0		
TRIMMIT	2SC	21	JUNE	7.7	10.0	10.0	8.3	10.0		
TENACITY	4SC	4	4/8/12 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TRIMMIT	2SC	21	JUNE	10.0	10.0	10.0	10.0	10.0		
TENACITY	4SC	2	4/8/12 WAT							
TRIMMIT	2SC	11.5	20/24 WAT							
TENACITY	4SC	5	4/8/12 WAT	7.7	10.0	10.0	8.3	10.0		
TENACITY	4SC	5	20/24 WAT	10.0	10.0	10.0	10.0	10.0		
VELOCITY	80SP	30	JUNE/2 WAT	10.0	10.0	10.0	10.0	10.0		
PROGRASS	1.5EC	1.5 oz/M	20/24 WAT	10.0	10.0	10.0	10.0	10.0		
PROGRASS	1.5EC	4.0 oz/M	20/24 WAT	10.0	10.0	10.0	10.0	10.0		

<u>**Table 1** (continued).</u> Phytotoxicity on a scale of 0-10, where 0 = dead turf, 7 = acceptable, and  $10 = \text{no phytotoxicity in a mixed lawn height sward of 'Triplex' perennial ryegrass and annual bluegrass in 2007.$ 

Treatment	Form	Rate	Timing	(Green Up		
		oz/A	_	4/14/08	4/24/08	
TRIMMIT	2SC	21	JUNE/4/8/12/16/20 WAT	6.3	10.0	
TRIMMIT	2SC	11.5	JUNE/4/8/12/16/20 WAT	7.0	10.0	
TRIMMIT	2SC	21	JUNE	6.5	10.0	
TRIMMIT	2SC	11.5	20/24 WAT			
TRIMMIT	2SC	21	JUNE	5.0	7.5	
TENACITY	4SC	5	JUNE/20/24 WAT			
TRIMMIT	2SC	11.5	20/24 WAT			
TRIMMIT	2SC	21	JUNE	5.0	8.3	
TENACITY	4SC	4	JUNE/20/24 WAT			
TRIMMIT	2SC	11.5	20/24 WAT			
TRIMMIT	2SC	21	JUNE	5.0	7.8	
TENACITY	4SC	2	JUNE/20/24 WAT			
TRIMMIT	2SC	11.5	20/24 WAT			
TRIMMIT	2SC	21	JUNE	5.0	8.2	
TENACITY	4SC	5	4/8/12 WAT			
TRIMMIT	2SC	11.5	20/24 WAT			
CHECK				7.2	10.0	
TRIMMIT	2SC	21	JUNE	5.0	8.7	
TENACITY	4SC	4	4/8/12 WAT			
TRIMMIT	2SC	11.5	20/24 WAT			
TRIMMIT	2SC	21	JUNE	4.7	7.2	
TENACITY	4SC	2	4/8/12 WAT			
TRIMMIT	2SC	11.5	20/24 WAT			
TENACITY	4SC	5	4/8/12 WAT	7.0	10.0	
TENACITY	4SC	5	20/24 WAT	7.0	10.0	
VELOCITY	80SP	30	JUNE/2 WAT	7.0	10.0	
PROGRASS	1.5EC	1.5 oz/M	20/24 WAT	6.7	10.0	
PROGRASS	1.5EC	4.0 oz/M	20/24 WAT	6.0	8.7	

<u>**Table 2.</u>** Spring green up ratings on a scale of 0-10, where 0 = dormant turf and 10 = full green up, of a mixed lawn height sward of 'Triplex' perennial ryegrass and annual bluegrass in 2008.</u>

Treatment	Form	Rate	Timing	(% Control <sup>1, 2</sup> )
		oz/A		5/8/2008
TRIMMIT	2SC	21	JUNE/4/8/12/16/20 WAT	79.4a
TRIMMIT	2SC	11.5	JUNE/4/8/12/16/20 WAT	11.1a-d
TRIMMIT	2SC	21	JUNE	-100.0ef
TRIMMIT	2SC	11.5	20/24 WAT	
TRIMMIT	2SC	21	JUNE	38.9abc
TENACITY	4SC	5	JUNE/20/24 WAT	
TRIMMIT	2SC	11.5	20/24 WAT	
TRIMMIT	2SC	21	JUNE	-5.6a-e
TENACITY	4SC	4	JUNE/20/24 WAT	
TRIMMIT	2SC	11.5	20/24 WAT	
TRIMMIT	2SC	21	JUNE	44.4ab
TENACITY	4SC	2	JUNE/20/24 WAT	
TRIMMIT	2SC	11.5	20/24 WAT	
TRIMMIT	2SC	21	JUNE	2.8a-d
TENACITY	4SC	5	4/8/12 WAT	
TRIMMIT	2SC	11.5	20/24 WAT	
CHECK				-55.6b-f
TRIMMIT	2SC	21	JUNE	11.1a-d
TENACITY	4SC	4	4/8/12 WAT	
TRIMMIT	2SC	11.5	20/24 WAT	
TRIMMIT	2SC	21	JUNE	51.1a
TENACITY	4SC	2	4/8/12 WAT	
TRIMMIT	2SC	11.5	20/24 WAT	
TENACITY	4SC	5	4/8/12 WAT	-80.6def
TENACITY	4SC	5	20/24 WAT	-141.7f
VELOCITY	80SP	30	JUNE/2 WAT	-63.9c-f
PROGRASS	1.5EC	1.5 oz/M	20/24 WAT	54.4a
PROGRASS	1.5EC	4.0 oz/M	20/24 WAT	96.9a

Table 3. Percent control of annual bluegrass in a mixed lawn height sward with 'Triplex' perennial ryegrass in 2008.

2 - Negative numbers indicate an increase in annual bluegrass populations and positive numbers a decrease in population.

## Preemergence and Post Emergence Control of Smooth Crabgrass J. A. Borger, M. B. Naedel, and M. T. Elmore<sup>1</sup>

## Introduction

Preemergence and post emergence control of smooth crabgrass (*Digitaria ischaemum*) was evaluated on a mature stand of 'Midnight' Kentucky bluegrass (*Poa pratensis*, L.) at the Valentine Turfgrass Research Center, Penn State University, University Park, PA. The objective of the study was to determine the efficacy of selected preemergence and pos emergence herbicides for the control of smooth crabgrass and safety to desired species.

## **Methods and Materials**

This study was a randomized complete block design with three replications. Treatments were applied on April 24 (PRE), June 6 (2-4 LF), and June 25, 2008 (1-2 TILL) using a three foot  $CO_2$  powered boom sprayer calibrated to deliver 80 gpa using one, flat fan, 11008E nozzle at 40 psi. Within 24 hours after each application, the entire test site received approximately 0.5 inch of water. On May 10, 2008 0.5 lb N/M was applied from urea and 0.5 lb N/M from a 31-0-0 IBDU fertilizer was applied to the entire test area. The site was mowed once per week at one inch with a rotary mower at one inch with clippings returned to the site.

The test site was overseeded with a native source of smooth crabgrass seed in the fall of at least two of the pervious growing seasons. The test site had approximately 90% cover of smooth crabgrass in the non-treated areas at the conclusion of the study.

Smooth crabgrass germination was first noted in the non treated areas of the test site on April 29, 2008.

## **Results and Discussion**

Turfgrass phytotoxicity was rated six times during the study (Table 1). No unacceptable turfgrass phytotoxicity was observed on any rating date.

The percent control of the smooth crabgrass was rated five times during the study (Table 2). There was no control of smooth crabgrass found on the first two rating dates, May 22<sup>nd</sup> and June 5<sup>th</sup>. On the last rating date, August 20<sup>th</sup>, turfgrass treated with A15879 at 1 lb ai/A applied PRE Tenacity at 0.125 plus Activator applied 1-2 TILL, Tenacity at 0125 plus Barricade at 0.38lus Activator at PRE/1-2 TILL, A15879 at 0.5 applied PRE/1-2 TILL plus Activator applied 1-2 TILL, Dimension at 0.25 applied PRE plus Acclaim at 20 oz/A applied 1-2 TILL plus Activator applied 1-2 TILL, and Dimension at 0.25 applied PRE/2-4 LF provided commercially acceptable control (85% or greater).

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Treatment	Form	Rate	Timing	(	(% Phytotoxicity)						
		lb ai/A	U	5/8	5/22	6/5	6/19	7/17	8/20		
A15879	3.96SC	1	PRE	0.0	3.3	5.0	0.0	0.0	0.0		
TENACITY	4SC	0.25	PRE	0.0	3.3	10.0	3.3	0.0	0.0		
BARRICADE	4FL	0.75	PRE								
DIMENSION	2EW	0.25	PRE	0.0	0.0	8.3	5.0	0.0	0.0		
A15879	3.96SC	1	2-4 LF	0.0	0.0	0.0	13.3	0.0	0.0		
ACTIVATOR 90	L	0.25% v/v	2-4 LF								
DIMENSION	2EW	0.25	2-4 LEAF	0.0	6.7	0.0	5.0	0.0	0.0		
ACTIVATOR 90	L	0.25% v/v	2-4 LF								
A15879	3.96SC	1	PRE	0.0	3.3	0.0	0.0	0.0	0.0		
TENACITY	4SC	0.125	1-2 TILL								
ACTIVATOR 90	L	0.25% v/v	1-2 TILL								
TENACITY	4SC	0.125	PRE/1-2 TILL	0.0	1.7	3.3	1.7	0.0	0.0		
BARRICADE	4FL	0.38	PRE/1-2 TILL								
ACTIVATOR 90	L	0.25% v/v	1-2 TILL								
CHECK				0.0	0.0	0.0	0.0	0.0	0.0		
A15879	3.96SC	0.5	PRE/1-2 TILL	0.0	5.0	1.7	0.0	0.0	0.0		
ACTIVATOR 90	L	0.25% v/v	1-2 TILL								
DIMENSION	2EW	0.25	PRE	0.0	5.0	13.3	8.3	0.0	0.0		
ACCLAIM	EC	20 oz/A	1-2 TILL								
ACTIVATOR 90	L	0.25% v/v	1-2 TILL								
DIMENSION	2EW	0.5	PRE	0.0	3.3	8.3	3.3	0.0	0.0		
DIMENSION	2EW	0.25	PRE/2-4 LF	0.0	0.0	0.0	1.7	0.0	0.0		
BARRICADE	4FL	0.75	PRE	0.0	1.7	5.0	6.7	0.0	0.0		
BARRICADE	4FL	0.5	PRE	0.0	0.0	1.7	0.0	0.0	0.0		
BARRICADE	4FL	0.25	2-4 LF								
ACCLAIM	EC	20 oz/A	1-2 TILL	0.0	0.0	0.0	0.0	0.0	0.0		

<u>**Table 1**</u>. Evaluations of percent turfgrass phytotoxicity in 2008 where 0-10% = slightly noticeable to researcher but acceptable, 10-30% = noticeable to researcher and homeowner but acceptable, and >30% = unacceptable.

Treatment	Form	Rate	Timing	(% Control <sup>1</sup> )					
		lb ai/A		5/22	6/5	6/19	7/17	8/20	
<u>A15879</u>	3.96SC	1	PRE	0.0	0.0	98.7	92.3	83.3	
TENACITY	4SC	0.25	PRE	0.0	0.0	98.3	76.7	56.7	
BARRICADE	4FL	0.75	PRE						
DIMENSION	2EW	0.25	PRE	0.0	0.0	96.0	71.7	61.7	
A15879	3.96SC	1	2-4 LF	0.0	0.0	99.0	97.7	84.7	
ACTIVATOR 90	L	0.25% v/v	2-4 LF						
DIMENSION	2EW	0.25	2-4 LEAF	0.0	0.0	97.7	43.3	30.0	
ACTIVATOR 90	L	0.25% v/v	2-4 LF						
A15879	3.96SC	1	PRE	0.0	0.0	98.7	99.0	97.3	
TENACITY	4SC	0.125	1-2 TILL						
ACTIVATOR 90	L	0.25% v/v	1-2 TILL						
TENACITY	4SC	0.125	PRE/1-2 TILL	0.0	0.0	97.7	99.0	96.0	
BARRICADE	4FL	0.38	PRE/1-2 TILL						
ACTIVATOR 90	L	0.25% v/v	1-2 TILL						
CHECK				0.0	0.0	0.0	0.0	0.0	
A15879	3.96SC	0.5	PRE/1-2 TILL	0.0	0.0	98.3	99.0	95.7	
ACTIVATOR 90	L	0.25% v/v	1-2 TILL						
DIMENSION	2EW	0.25	PRE	0.0	0.0	96.0	99.0	92.7	
ACCLAIM	EC	20 oz/A	1-2 TILL						
ACTIVATOR 90	L	0.25% v/v	1-2 TILL						
DIMENSION	2EW	0.5	PRE	0.0	0.0	99.0	93.0	81.7	
DIMENSION	2EW	0.25	PRE/2-4 LF	0.0	0.0	98.7	99.0	99.0	
BARRICADE	4FL	0.75	PRE	0.0	0.0	97.3	66.7	50.0	
BARRICADE	4FL	0.5	PRE	0.0	0.0	99.0	92.7	83.3	
BARRICADE	4FL	0.25	2-4 LF						
ACCLAIM	EC	20 oz/A	1-2 TILL	0.0	0.0	0.0	98.3	84.3	

<u>**Table 2.**</u> Evaluations of the percent control of smooth crabgrass in 2008. Commercially acceptable control was considered to be 85% and above.

# Post Emergence Control of Broadleaf Weeds and Phytotoxicity Evaluations J. A. Borger, M. B. Naedel, and M. T. Elmore<sup>1</sup>

### Introduction

Broadleaf weed control and phytotoxicity evaluations were conducted on a stand of mature 'SR-4200' perennial ryegrass (*Lolium perenne* L.) at The Valentine Turfgrass Research Center, Penn State University, University Park, Pa. The objectives of the study were to determine the efficacy of selected broadleaf weed herbicides for the control of dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*), and buckhorn plantain (*Plantago lanceolata*) in perennial ryegrass and the phytotoxicity of these compounds on perennial ryegrass.

### **Methods and Materials**

All plots were rated for the percent dandelion, white clover, and buckhorn plantain, prior to the application of any treatment, on a plot by plot basis. The test plots were 21  $\text{ft}^2$  and had approximately 80 percent broadleaf weed cover.

The study was a randomized complete block design with three replications. All of the treatments were applied on May 30, 2008 using a three foot  $CO_2$  powered boom sprayer calibrated to deliver 40 gpa using one, flat fan, 11004E nozzle at 40 psi.

The test site was mowed at three inches weekly with a rotary mower with clippings returned to the site. The test site was irrigated to prevent moisture stress.

## **Results and Discussion**

Turfgrass phytotoxicity was rated three times during the study (Table 1). Phytotoxicity was observed on the first rating date, 6/13/08, but did not fall below the level of acceptability 7.0. No phytotoxicity was observed following that rating date.

The control of dandelion, white clover, and buckhorn plantain was rated three times during the study (Table 2). Broadleaf weed control was variable. On the final rating date, July 25<sup>th</sup>, all treated turfgrass revealed a significant reduction in the dandelion population when compared to non treated turfgrass. All treated turfgrass, except that treated with V10142 combined with SILWET L-77 significantly reduced the white clover population compared to non treated turfgrass. Finally, the buckhorn plantain population was significantly reduced by all treatments except V10142 combined with Velocity compared to non-treated.

It should be noted that all treated broadleaf weed populations changed to some degree over time.

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Treatment	Form	Kate	(	(Phytotoxicity			
		lb ai/A	6/13	6/27	7/25		
V10142	75WG	0.5	9.3	10.0	10.0		
SILWET L-77	L	0.25% v/v					
V10142	75WG	0.5	7.0	10.0	10.0		
TURFLON ESTER	4EC	1 qt/A					
V10142	75WG	0.25	7.3	10.0	10.0		
TURFLON ESTER	4EC	1 qt/A					
CHECK			10.0	10.0	10.0		
V10142	75WG	0.5	8.3	10.0	10.0		
TURFLON ESTER	4EC	0.5 qt/A					
TURFLON ESTER	4EC	1 qt/A	7.7	10.0	10.0		
SPEEDZONE	2.2EC	2 qt/A	8.3	10.0	10.0		
V10142	75WG	0.5	9.7	10.0	10.0		
VELOCITY	17.6SG	10.0 g ai/A					

Table 1.Evaluations of turfgrass phytotoxicity in 2008 where 0 = dead turf, 7 = acceptable, and 10 = no phytotoxicity.TreatmentFormRate(------Phytotoxicity------)

Table 2. Percent control of the dandelion, white clover, and buckhorn plantain populations following applications of selected herbicides.

Treatment	Form	Rate	(	June 13, 200	<b>)8</b> <sup>1</sup> )(	June	27, 2008	) (	July 2	25, 2008	)
		lb ai/A	Dand	Clover	Plant	Dand	Clover	Plant	Dand	Clover	Plant
V10142	75WG	0.5	55.4ab	21.7b	80.0a	93.9a	21.7c	33.3bc	68.5b	28.3cd	60.0ab
SILWET L-77	L	0.25% v/v									
V10142	75WG	0.5	79.6a	76.0a	100.0a	98.2a	94.4a	100.0a	86.2a	96.6a	90.7a
TURFLON ESTER	4EC	1 qt/A									
V10142	75WG	0.25	80.2a	82.4a	93.3a	96.2a	98.4a	93.3a	86.0a	99.3a	93.3a
TURFLON ESTER	4EC	1 qt/A									
CHECK		-	0.0c	0.0b	0.0b	0.0b	0.0c	0.0c	0.0c	0.0d	0.0c
V10142	75WG	0.5	72.2ab	65.0a	50.0ab	96.2a	84.2a	56.7ab	74.4ab	64.2ab	30.0bc
TURFLON ESTER	4EC	0.5 qt/A									
TURFLON ESTER	4EC	1 qt/A	82.8a	77.3a	100.0a	95.3a	97.5a	100.0a	73.9ab	99.5a	80.0ab
<b>SPEEDZONE</b>	2.2EC	2 qt/A	69.0ab	70.9a	66.7ab	95.7a	95.8a	100.0a	79.7ab	91.0a	100.0a
V10142	75WG	0.5	43.9b	16.2b	33.3ab	92.8a	56.2b	66.7ab	72.2ab	48.3bc	26.7bc
VELOCITY	17.6SG	10.0 g ai/A	L								

#### **CURATIVE CONTROL OF WHITE CLOVER IN A KENTUCKY BLUEGRASS LAWN, 2008**

#### JUNE-AUGUST

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#### INTRODUCTION

White clover (*Trifolium repens*) is a common broadleaf weed of home lawns and golf and athletic field turf due to its ability to tolerate close mowing, fix atmospheric nitrogen, and survive a range of soil conditions. On athletic field or in high quality lawns, its presence is discouraged because it disrupts stand uniformity and may present safety issues for athletes. The objective of this study was to evaluate the efficacy of several herbicides for white clover when applied at varying rates and/or with sequential applications.

#### **MATERIALS & METHODS**

This study was initiated at the University of Connecticut Plant Science Research Facility located in Storrs, CT. Prior to initiation of the treatment the study area was established to 'Langara' Kentucky bluegrass (*Poa pratensis* L.) in October 2006. In 2008, a natural infestation of white clover was observed in the study area. All treatments are listed in the data tables. Briefly, treatments included Confront (triclopyr + clopyralid), Drive (quinclorac), Tenacity (mesotrione), Q4 (quinclorac + sulfentrazone + 2,4-D + dicamba), Surge (AI), Speedzone (dicamba + 2,4-D + carfentrazone + MCPP), Lontrel (clopyralid), and Trimec Classic (2,4-D + MCPA + dicamba). Treatments were applied at various rates and applied either as a single or sequential application. Initial application of all treatments occurred on 26 Jun and all plots receiving sequential treatments were applied on 15 Jul.

Plots measured 3 ft x 6 ft and were arranged in a randomized complete block with 3 replications. All treatments were applied with a  $CO_2$  pressurized (40 psi) backpack sprayer equipped with a flat-fan nozzle and calibrated to deliver 1.0 gal water per 1000 ft<sup>2</sup>. Plots were rated for injury to the clover, percent clover, percent crabgrass, and overall turfgrass quality. Any discoloration to the desirable Kentucky bluegrass species was also noted. Descriptions of all evaluations are outlined in the footnotes of each data table.

#### **RESULTS DISCUSSION**

Clover. Clover injury was noted within a few days of the initial applications on 26 Jun. On 30 Jun, the greatest level of injury to the clover species was exhibited in plots treated with Q4, Speedzone and Lontrel (Table 1). Equal levels of injury, however, were observed within the aforementioned treated plots and plots treated with Surge and Trimec Classic. By 3 Jul (1 week after initial treatment; WAIT), the high rate of Speedzone (1.8 fl oz per 1000 ft<sup>2</sup>) provided the greatest level of injury to the clover (4.0) and was statistically similar to Speedzone applied at 1.1 fl oz. Desirable injury levels (≥3.0) were observed within plots treated with Q4 and Lontrel when plots were rated 1 WAIT. On the final injury rating date (20 Jul), only plots treated with Tenacity or Surge (sequential applications only) exhibitied injury to the surviving clover.

When plots were first rated for clover control on 20 Jul, all treatments except Tenacity resulted in excellent suppression of white clover. On 20 Jul, percent plot area covered with clover was 63 to 79% in plots treated with Tenacity. All other treated plots had little to no clover on 20 Jul (~ 3.5 WAIT). Percent clover remained low within most treatments when rated on 1 Aug, while those plots treated with sequential applications of Tenacity began to exhibit moderate levels of clover control (18 to 29%) when compared to the untreated control plots (62%). On the final rating date (15 Aug), all plots except those treated with Tenacity resulted in complete or near complete (<1.0%) control of white clover. Moderate, but unacceptable clover control was achieved within plots treated with sequential applications of Tenacity, with the higher rate providing greater control.

Crabgrass. Crabgrass (*Digitaria* spp.) populations increased within plots during the summer months, but only low to moderate levels of the grassy weed species were present on the final rating date. On 1 Aug, the greatest level of

crabgrass suppression was afforded by sequential treatments of Tenacity (Table 2). Statistically similar levels of crabgrass, however, were found within plots treated with Confront, Drive, Tenacity (single applications, both rates), and Q4. On the final rating date, crabgrass pressure was moderate and a total of 17% was observed within the untreated control plots. On 15 Aug, only plots treated with sequential applications of Tenacity provided complete control of crabgrass within the study. Acceptable levels of crabgrass control ( $\leq$  5.0%) were achieved within plots treated with Drive, Tenacity (8.0 fl oz), and sequential applications of Q4. Poor control of crabgrass was exhibited within plots treated with Confront, Surge, Speedzone, Lontrel and Trimec Classic.

#### DISCUSSION

Except for Tenacity, all products evaluated provided good to excellent control of white clover after a single or sequential application. On the other hand, Tenacity (2 applications) was the only product that provided complete control of crabgrass when applied postemergently. Based on data from this study, various individual or combination products can provide excellent suppression of crabgrass and perhaps other weeds. Although unclear, the increased crabgrass populations within specific plots may have been caused by the rapid decline and control of clover which created voids in the canopy. For the greatest level of weed suppression where white clover and crabgrass are present, applications of products containing quinclorac may provide the greatest suppression of both species. In states where quinclorac is not registered (e.g., New York), multiple applications of Tenacity ( $\geq$  3 applications) or application of separate products that provide white clover and crabgrass control may be necessary.

Table 1. Injury and percent white clover following the application of various herbicides to a Kentucky bluegrass lawn, 2008.

	Application <sup>z</sup>	Application <sup>z</sup> Clover injury <sup>y</sup>		у <sup>у</sup>	Percent clover <sup>x</sup>		
Treatment and rate per 1000 sq ft	timing	30 Jun	3 Jul	20 Jul	20 Jul	1 Aug	15 Aug
Confront 0.37 fl oz	А	1.7 de <sup>w</sup>	2.0 de	0.0 c	0 c	2 d	<1 cd
Drive 0.50 lb ai/A +MSO	А	1.7 de	2.0 de	0.0 c	0 c	1 d	0 d
Drive 0.75 lb ai/A +MSO	А	1.3 e	1.7 de	0.0 c	0 c	1 d	0 d
Tenacity 5.0 fl oz/a + X-77	А	0.3 e	1.3 ef	0.7 bc	67 b	47 b	27 b
Tenacity 8.0 fl oz/a + X-77	А	0.3 f	0.7 fg	0.7 bc	79 a	67 a	45 a
Tenacity 5.0 fl oz/a + X-77	AD	0.3 f	1.3 ef	1.7 ab	63 b	29 c	23 b
Tenacity 8.0 fl oz/a + X-77	AD	0.0 f	0.7 fg	2.3 a	77 a	18 c	11 c
Q4 3.0 fl oz	А	3.0 ab	3.0 bc	0.0 c	0 c	<1 d	0 d
Q4 3.0 fl oz	AD	2.7 bc	3.0 bc	0.0 c	0 c	0 d	0 d
Surge 1.5 fl oz	А	2.0 cde	2.0 de	0.0 c	0 c	0 d	< 1 cd
Surge 1.5 fl oz	AD	2.3 bcd	2.3 cd	1.0 bc	2 c	0 d	0 d
Speedzone 1.1 fl oz	А	3.0 ab	3.3 ab	0.0 b	0 c	1 d	<1 cd
Speedzone 1.8 fl oz	А	3.7 ab	4.0 a	0.0 c	0 c	0 d	0 d
Lontrel 0.25 fl oz	А	3.0 ab	3.0 bc	0.0 c	0 c	0 d	0 d
Trimec Classic 1.5 fl oz	А	2.3 bcd	2.0 de	0.0 c	0 c	0 d	0 d
Untreated	-	0.0 f	0.0 g	0.0 c	81 a	62 a	39 a

<sup>z</sup> Application timing was as follows: A = 26 Jun, D = 15 Jul.

<sup>y</sup> Injury to clover was visually rated on a 0 to 5 scale where 0 = no visible injury and 5 = entire plot area brown or dead.
<sup>x</sup> Percent plot area infested with clover was visually rated on a 0 to 100 percent scale where 0 = no clover present and

100 = entire plot area covered with clover.

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

	Application <sup>z</sup>	Percent of	crabgrass <sup>y</sup>
Treatment and rate per 1000 sq ft or acre	timing	1 Aug	 15 Aug
Confront 0.37 fl oz	А	11 b-f <sup>x</sup>	12 b-g
Drive 0.50 lb ai/A +MSO	A	2 ef	5 ef
Drive 0.75 lb ai/A +MSO	A	2 ef	2 f
Tenacity 5.0 fl oz/a + X-77	А	6 c-f	7 c-f
Tenacity 8.0 fl oz/a + X-77	A	5 c-f	5 def
Tenacity 5.0 fl oz/a + X-77	AD	0 f	0 f
Tenacity 8.0 fl oz/a + X-77	AD	0 f	0 f
Q4 3.0 fl oz	A	4 def	6 def
Q4 3.0 fl oz	AD	<1 ef	<1 f
Surge 1.5 fl oz	A	15 bcd	19 bcd
Surge 1.5 fl oz	AD	20 ab	24 ab
Speedzone 1.1 fl oz	A	11 b-e	10 c-f
Speedzone 1.8 fl oz	A	17 ab	19 bcd
Lontrel 0.25 fl oz	A	28 a	35 a
Trimec Classic 1.5 fl oz	А	15 bc	19 bc
Untreated	-	15 bcd	17 b-e

Table 2. Percent crabgrass following the application of various herbicides for the control of clover in a Kentucky bluegrass lawn, 2008.

<sup>z</sup> Application timing was as follows: A = 26 Jun, D = 15 Jul.

<sup>y</sup> Percent plot area infested with crabgrass was visually rated on a 0 to 100 percent scale where 0 = no crabgrass present and 100 = entire plot area covered with crabgrass.

\* Means in a column followed by the same letter are not significantly different at P ≤ 0.05 according to Fisher's protected least significant difference test.

	Application <sup>z</sup>	Phytotoxcity <sup>y</sup>	Qual	ity <sup>x</sup>
Treatment and rate per 1000 sq ft	timing	30 Jun	1 Aug	15 Aug
Confront 0.37 fl oz	А	23 efg <sup>w</sup>	7.7 abc	8.3 a
Drive 0.50 lb ai/A +MSO	A	17 fgh	7.3 bc	7.7 a
Drive 0.75 lb ai/A +MSO	A	13 ghi	8.0 ab	8.3 a
Tenacity 5.0 fl oz/a + X-77	A	5 hij	7.3 bc	7.7 a
Tenacity 8.0 fl oz/a + X-77	A	2 ij	7.0 cd	7.7 a
Tenacity 5.0 fl oz/a + X-77	AD	2 ij	6.3 de	8.3 a
Tenacity 8.0 fl oz/a + X-77	AD	0 j	6.0 e	8.3 a
Q4 3.0 fl oz	A	47 ab	8.0 ab	8.3 a
Q4 3.0 fl oz	AD	32 cde	7.3 bc	8.7 a
Surge 1.5 fl oz	A	25 efg	8.0 ab	7.7 a
Surge 1.5 fl oz	AD	28 def	8.0 ab	7.7 a
Speedzone 1.1 fl oz	A	43 abc	7.7 abc	8.0 a
Speedzone 1.8 fl oz	A	52 a	8.0 ab	8.0 a
Lontrel 0.25 fl oz	A	38 bcd	7.3 bc	7.7 a
Trimec Classic 1.5 fl oz	А	23 efg	8.3 a	7.7 a
Untreated	-	0 j	7.0 cd	7.7 a

Appendix 3. Phytotoxicity to the white clover and Kentucky bluegrass quality following the application of various herbicides for the control of white clover, 2008.

<sup>z</sup> Application timing was as follows: A = 26 Jun, D = 15 Jul.

<sup>y</sup> Percent clover exhibiting phytotoxic symptoms was visually rated on a 0 to 100 percent scale where 0 = no injury present and 100 = entire plot area exhibiting phytotoxic symptoms.

Overall quality of the Kentucky bluegrass was rated visually on 0 to 9 scale where 0 = entire plot area brown or dead; 6 = minimum acceptable quality for a home lawn; and 9 = optimum density and dark green color.

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

#### SPECIES SPECIFIC OF CLOVER AND KENTUCKY BLUEGRASS WITH ROUNDUP PROMAX, 2008

#### JUNE-AUGUST

J.E. Kaminski and J. Machnicki

#### Department of Plant Science University of Connecticut, Storrs, CT

#### SUMMARY

Glyphosate is commonly used as a non-selective herbicide during the renovation of inadequate or poorly conditioned turf areas. Applications may be made 1 to 2 weeks prior to renovation in order to suppress weed species that can compete with new seedings. The objective of this study was to evaluate four new formulations of glyphosate (Roundup<sup>®</sup>) for their ability to control a dense stand of clover and Kentucky bluegrass.

#### **MATERIALS & METHODS**

This study was initiated at the University of Connecticut Plant Science Research Facility located in Storrs, CT. Prior to treatment initiation, the study area was established to 'Langara' Kentucky bluegrass (*Poa pratensis*) in October 2006. In 2008, a natural infestation of white clover was observed in the study area. All treatments are listed in the data tables.

Plots measured 3 ft x 6 ft and were arranged in a randomized complete block with 4 replications. All treatments were applied with a  $CO_2$  pressurized (40 psi) backpack sprayer equipped with a flat-fan nozzle and calibrated to deliver 2.0 gal water per 1000 ft<sup>2</sup>. Treatments were applied on 26 Jun. At the time of application, air and soil temperatures were 79°F and 75°F, respectively. Plots were rated for injury to the clover and Kentucky bluegrass, percent plot area exhibiting phytotoxic symptoms and percent turfgrass and weed species living in each plot. Descriptions of all evaluations are outlined in the footnotes of each data table.

#### **RESULTS AND DISCUSSION**

Injury to all weed and grass species within treated plots was first observed within 24 hours of application. Within 4 days, clover and bluegrass within plots were severely injured (Table 1). On 30 Jun (4 days after application), plots treated with MON76207 and MON773607 exhibiting the greatest level of injury to the white clover. Severe injury was observed within other treated plots. Injury to the Kentucky bluegrass was slower to manifest and moderate injury was observed from all treatments within 4 days of application. Injury to the clover and Kentucky bluegrass quickly progressed and by 2 Jul (7 days after application), severe phytotoxicity was observed in all plots treated with glyphosate. Percent of the plot area exhibiting severe phytotoxic symptoms from the glyphosate ranged from 28 to 40% and 53 to 65% on 30 Jun and 2 Jul, respectively (Table 2). When plots were rated for Percent cover on 20 Jul, all treatments had resulted in a near complete elimination of both clover and Kentucky bluegrass. Increases in percent cover within the plot area after the complete kill was attributed to the exposure of bareground and subsequent rapid germination and tillering of crabgrass within plots.

Based on the results of this field study, MON 76207 and MON 773607 resulted in the most rapid and effective suppression of white clover and Kentucky bluegrass. In situations where a rapid kill is required prior to establishment, these compounds offer a slight benefit during the initial days following application. In situations where rapid death occurs, however, it would be prudent to rapidly prepare and establish the new seeding and also utilize a preemergent crabgrass herbicide in the seedbed such as Tenacity or Tupersan. Due to variation in the rates applied from the various products, future work may seek to evaluate the impact of rate for controlling various hard to suppress weed species or titrations to determine the lowest effective rate for suppressing various weeds and grasses.

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Tahle 1	Snecies s	necitic control	ot clover ar	nd Kentucky	/ Bluearass w	ith Roundu		2008
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	Clover	injury <sup>y</sup>	Bluegrass injury <sup>x</sup>		
Treatment and rate <sup>z</sup>	30 Jun	2 Jul	30 Jun	2 Jul	
MON 76207 4.67 qt/a	4.0 a <sup>w</sup>	4.3 a	2.3 ab	3.8 a	
MON 77360 7 qt/a	3.8 a	4.3 a	2.5 a	3.8 a	
MON 54154 7 qt/a	3.0 b	4.0 a	2.0 ab	3.3 a	
MON 54155 7 qt/a	3.0 b	3.8 a	1.8 b	3.5 a	
Untreated	0.0 c	0.0 b	0.0 c	0.0 b	
Untreated	0.0 c	0.0 b	0.0 c	0.0 b	

<sup>z</sup> Treatments were applied on 26 Jun.

<sup>y</sup> Clover injury was rated on a 0 to 5 scale where 0 = no injury visible and 5 = entire plot brown or dead.

<sup>\*</sup> Kentucky bluegrass injury was rated on a 0 to 5 scale where 0 = no injury visible and 5 = entire plot brown or dead.

<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.

Tables 2. Phytotoxicity and percent plot area covered with plant material following the application of various glyphosate formulations to a mixed stand of clover and Kentucky bluegrass 2008.

	Phyto	toxicity <sup>y</sup>		Percent cove	cent cover <sup>x</sup>	
Treatment and rate <sup>z</sup>	30 Jun	2 Jul	20 Jul	1 Aug	15 Aug	
MON 76207 4.67 qt/a	40 a <sup>w</sup>	65 a	6 b	25 b	66 b	
MON 77360 7 qt/a	41 a	64 a	4 c	20 b	75 b	
MON 54154 7 qt/a	29 b	53 a	5 bc	26 b	73 b	
MON 54155 7 qt/a	28 b	54 a	4 bc	14 b	67 b	
Untreated	0 c	0 b	100 a	100 a	100 a	
Untreated	0 c	0 b	100 a	100 a	100 a	

<sup>z</sup> Treatments were applied on 26 Jun.

<sup>y</sup> Percent of the plot area exhibiting phytotoxic symptoms was visually rated on a 0 to 100 scale where 0 = no injury present and 100 = entire plot covered exhibiting signs of phytotoxicity.

\* Percent of the plot area covered with living turf and weeds was visually rated on a 0 to 100 scale where 0 = no living ground cover present or 100 = entire plot covered with living plant material. Percent cover in the later rating dates is representative of emerging crabgrass into bare plots.

<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.

#### FINE FESCUE TOLERANCE TO APPLICATIONS OF VELOCITY, 2008

June-August

#### J.E. Kaminski

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#### INTRODUCTION

Annual bluegrass (*Poa annua* L.) and roughstalk bluegrass (*Poa trivialis* L.) are common weeds in various turfgrass situations. Velocity<sup>TM</sup> (bispyribac-sodium) is a relatively new herbicide that can selectively remove these weeds from creeping bentgrass and perennial ryegrass. Although Velocity has been shown to be effective on these species, applications may elicit an undesired discoloration to desirable turf species known as the "yellow flash". Although extensive product testing has been conducted on perennial ryegrass and creeping bentgrass, its safety on other turfgrass species such as fine leaf fescues (*Festuca spp.*) is relatively unknown. The primary objective of this study was to determine the safety of Velocity on fine leaf fescue when applied at varying rates and application intervals.

#### **MATERIALS & METHODS**

This study was conducted at the University of Connecticut Plant Science Research and Education Facility located in Storrs, CT. A three year old stand of 'Jasper' creeping red fescue (*Festuca rubra* ssp. *rubra*) was used for the study and the area received a total of 0.5 lbs N per 1000 ft<sup>2</sup> in the spring prior to initiation of the study. Turf was mowed approximately once per week to a height of 4.0 inches.

Velocity was applied two, three or four times every 1 to 2 weeks at 10 or 30 g ai per acre. All treatments were applied in 1.0 gal water per 1000 sq ft using a  $CO_2$  backpack sprayer equipped with a single 9504E flat fan nozzle. The study area was not irrigated, but was subject to natural rainfall. All treatments and application dates are listed in the data table.

Plots measured 3 ft x 6 ft, and were arranged in a randomized complete block with four replications. The fine leaf fescue was rated visually for overall quality and injury. Injury to the fine leaf fescue from the herbicide treatments was rated on a 0 to 5 scale where 0 = no turfgrass injury; 2.5 = minimum level of acceptable injury for a fine leaf fescue home lawn; and 5 = turfgrass brown or dead. Turfgrass quality was rated visually on a 1 to 9 scale where 1 = brown or dead turf; 6.0 = minimum acceptable quality for a home lawn; and 9 = optimum color and density. In addition, percent of the plot area covered with a natural infestation of clover or crabgrass was rated on a percent scale where 0 = no clover present and 100 = entire plot area covered with clover.

#### **RESULTS & DISCUSSION**

Quality and Injury. Differences in overall turf quality were only observed on the 1 Aug (Table 1). Although no differences among treatments were observed prior to this period, plots treated with 30 g ai/a of Velocity exhibited unacceptable quality (<6.0) on 2 or 4 of the 9 rating dates. For reasons unknown, plots receiving multiple applications of the high Velocity rate did not have a reduction in quality from the additional application. Plots treated with 10 g ai/a of Velocity generally had acceptable quality ratings on all dates. Despite the generally acceptable quality of plots treated with Velocity, injury to the fine leaf fescue was observed on several rating dates. Slight injury was observed within 2 days of the initial application on 18 Jun (Table 2). Although no differences in injury were observed until 1 Aug, plots treated with 30 g ai/a generally exhibited the greatest level of injury when compared to plots receiving 10 g ai/a. Only on 1 Aug did plots receiving multiple applications of 30 g ai/a of Velocity reach a level of injury that was considered unacceptable for a fine leaf fescue home lawn ( $\geq 2.5$ ).

Clover and crabgrass. A natural infestation of white clover was observed within the plots during the course of the study. All plots receiving Velocity, regardless of rate or number of total applications, resulted in a reduction in percent white clover by 1 Aug (Table 3). At this time, plots treated with Velocity had between 0 and 2% clover as compared to 16% within the untreated control plots. Due to escapes of a clover in a select number of individual plots, variance within the study was high and no statistical differences in clover were observed in mid-Aug or on the final rating date in Sep. No differences in crabgrass control were observed on any rating date (Table 3).

Injury to the turf generally presented itself as a discoloration and thinning of the turf stand, rather than the typical yellow flash observed when Velocity is applied to perennial ryegrass or creeping bentgrass. For this reason, the injury sustained from the application of Velocity to creeping red fescue is likely to be less noticeable or negligible. Although few differences in quality and injury were observed throughout the duration of this study, slight reductions in turf quality may occur. Variation in quality and injury also may vary by cultivar and species. Therefore, future research on the impact of Velocity on more species and additional cultivars within each species is warranted. It should also be pointed out that while multiple applications of Velocity did not appear to reduce the overall quality of the fine leaf fescue, applications early in the season might result in more injury to desirable species when compared to treatments applied during the middle of the summer.
	App⁴					Quality'				
Treatment and rate in ai/a	timing	20 Jun	25 Jun	2 Jul	9 Jul	16 Jul	20 Jul	1 Aug	15 Aug	9 Sep
Velocity 30 g	А	5.5 a <sup>x</sup>	6.3 a	5.5 a	6.8 a	6.5 a	5.8 a	5.8 c	6.8 a	7.8 a
Velocity 30 g	ACE	5.8 a	6.0 a	5.5 a	6.8 a	6.8 a	6.0 a	6.0 bc	7.3 a	7.8 a
Velocity 10 g	ABCD	6.8 a	6.5 a	5.5 a	7.8 a	6.5 a	6.3 a	6.5 abc	7.0 a	7.3 a
Velocity 10 g	ACEG	7.0 a	6.8 a	6.3 a	7.5 a	7.0 a	6.8 a	7.0 ab	7.3 a	8.0 a
Untreated	-	6.8 a	7.0 a	7.3 a	8.0 a	7.0 a	7.3 a	7.3 a	7.8 a	8.0 a
Days after last treatment	А	2	7	14	21	28	32	44	58	83
	ACE	2	7	14	7	1	5	17	31	56
	ABCD	2	7	7	7	7	11	23	37	51
	ACEG	2	7	14	7	14	18	1	15	29

Table 1. Quality of a fine leaf fescue home lawn following applications of Velocity at various rates and intervals, 2008.

<sup>2</sup> Treatments were applied as follows: A = 18 Jun, B = 25 Jun, C = 02 Jul, D = 09 Jul, E = 15 Jul, and G = 31 Jul

<sup>y</sup> Quality was rated visually on 0 to 9 scale where 0 = entire plot area brown or dead; 6 = minimum acceptable quality for a fine leaf fescue lawn; and 9 = optimum density and color.

\* Means in a column followed by the same letter are not significantly different at P ≤ 0.05 according to Fisher's protected least significant difference test

Table 2. Fine fescue Injury following applications of Velocity at various rates and intervals, 2008.

	Application <sup>z</sup>				Injury <sup>y</sup>			
Treatment and rate in ai/a	timing	20 Jun	25 Jun	2 Jul	9 Jul	16 Jul	20 Jul	1Aug
Velocity 30 g	А	1.0 ax	1.3 a	2.0 a	1.3 a	1.5 a	2.3 a	2.3 a
Velocity 30 g	ACE	1.0 a	1.5 a	2.0 a	1.3 a	1.3 a	2.0 a	2.5 a
Velocity 10 g	ABCD	0.3 a	0.5 a	2.0 a	1.0 a	1.3 a	1.8 a	1.8 ab
Velocity 10 g	ACEG	0.3 a	0.5 a	1.5 a	0.5 a	1.0 a	1.3 a	1.5 ab
Untreated	-	0.0 a	0.3 a	0.8 a	0.3 a	0.8 a	0.8 a	0.8 b

<sup>z</sup> Treatments were applied as follows: A = 18 Jun, B = 25 Jun, C = 02 Jul, D = 09 Jul, E = 15 Jul, and G = 31 Jul

<sup>y</sup> Turfgrass injury was rated on a 0 to 5 scale where 0 = no injury visible and 5 = entire plot brown or dead.

\* Means in a column followed by the same letter are not significantly different at P ≤ 0.05 according to Fisher's protected least significant difference test.

2008.								
	App <sup>z</sup>		Pe	ercent clo	% crab	grass <sup>×</sup>		
Treatment and rate in ai/a	Timing	16 Jul	20 Jul	1 Aug	15 Aug	8 Sept	15 Aug	8 Sep
Velocity 30 g	А	0 a <sup>w</sup>	0 a	1 b	1 a	3 a	9 a	18 a
Velocity 30 g	ACE	5 a	3 a	0 b	0 a	3 a	7 a	15 a
Velocity 10 g	ABCD	2 a	2 a	0 b	0 a	0 a	10 a	14 a
Velocity 10 g	ACEG	5 a	3 a	2 b	0 a	0 a	7 a	13 a

Table 3. Percent clover and Phytotoxicity on Fine fescue following applications of Velocity at various rates and intervals, 2008.

Untreated...... - 19 a 17 a 16 a 20 a 20 a 15 a 20 a  $^{2}$  Treatments were applied as follows: A = 18 Jun, B = 25 Jun, C = 02 Jul, D = 09 Jul, E = 15 Jul, and G = 31 Jul

<sup>y</sup> Percent of the plot area infested by clover was visually rated on a 0 to 100 percent scale where 0 = no clover is present or 100 = entire plot is covered with clover.

\* Percent of the plot area infested with crabgrass was visually rated on a 0 to 100 percent scale where 0 = no crabgrass present or 100 = entire plot covered with crabgrass.

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

### DEMONSTRATION OF NON-SELCTIVE CONTROL OF VARIOUS WEEDS WITH ROUNDUP PROMAX

JULY-AUGUST

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### INTRODUCTION

The objective of this study was to assess the ability of Monsanto's Roundup ProMAX to suppress various weeds with an ultra low (0.134 qt/A) and normal rate (5.44 qt/A) of the herbicide. Roundup ProMAX was applied in 44 gal  $H_2O$  per acre on the dates listed in the data table.

### MATERIALS AND METHODS

This study was initiated at the Error! Reference source not found.'s Plant Science Research and Education Facility located in Storrs, CT. The weedy site was prepared by removing the existing Kentucky bluegrass sod in the fall prior to the initiation of the experiment. Bare soil remained during the winter months and weeds allowed to naturally establish during the fall and spring prior to the study. When treatments were initiated, the plots consisted of a mixed stand of weeds including crabgrass, yellow nutesedge, mouseear chickweed and various other weeds.

The site was mowed approximately every 2 weeks to a height of 3 inches, but was not mowed after treatments were applied. Treatments consisted of two rates of Roundup ProMAX. The first treatment was applied on 2 Jul and mimicked a very low application rate of 0.134 qt/A. The second treatment of 5.44 qt/A was applied on 11 Jul.

All treatments were applied in 1.0 gal water per 1000 sq ft using a  $CO_2$  backpack sprayer equipped with a single Al9504E flat fan nozzle. Treatments were not irrigated, but were subject to natural rainfall. All treatments and application dates are listed in the data table. Plots measured 4 ft x 6 ft, and were arranged in a randomized complete block with four replications. Plots were rated visually for percent plot area exhibiting phytotoxic symptoms and severity of the injury to living plant materials. All ratings and rating descriptions are detailed within or footnoted below the data tables.

### **RESULTS AND DISCUSSION**

Within 9 days of the initial application, low to moderate injury was observed within plots treated with 0134 qt/A of ProMAX. On 11 Jul, 63% of the living plant material within plots were exhibiting phytotoxic symptoms. Injury to the weeds, however, was considered low on 11 and 20 Jul. Nine days after the initial application of ProMAX at the 5.44 qt/A rate, however, severe phytotoxic symptoms and injury were observed. In this case, 98% of the plot area was exhibiting phytotoxic symptoms and severe injury ratings (9.0). All weed species within these plots was essentially dead within the 9 to 10 day period following application. Continued rating of the plots following this death revealed that weeds within plots treated with the low rate of ProMAX began to recover and/or new weeds began to fill in the voids. On 1 Aug, plots treated with the 5.44 qt rate of ProMAX continued to exhibit near complete control of weeds within the plots. Phytotoxicity to the untreated control plots on 1 and 15 Aug was due to drift from the application on 11 Jul. On the final rating date (15 Aug), plots treated with ProMAX at 5.44 qt/a continued to display excellent control, but plots had an average of 7% weeds. For the low rate, weeds continued to encroach into treated plots and approximately 72% of the plot area had living weeds.

Results of this study indicate that while ultra low rates may be effective at reducing weed populations, excellent control can be achieved with Roundup ProMAX applied at the 5.44 qt/A rate. The rapid burndown of weeds following application is highly desirable in situations where renovation to a desirable turfgrass species is required in a short time period. In the future, varying rates may be evaluated to determine the optimum application rate to control varying weed species. Additional research may seek to identify the optimum timing and establishment of desirable turfgrass species following application of ProMAX.

Table 1.	Turforass injur	v and percent	phytotoxicit	v following various	weeds with Round	JD PROMAX.
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	Application <sup>z</sup>		Percent ph	ytotoxicity	у	Injury <sup>x</sup>		
Treatment and rate in qt/a	Timing	11 Jul	20 Jul	1 Aug	15 Aug	11 Jul	20 Jul	
Roundup PROMAX 0.134 qt	А	63 a <sup>w</sup>	52 b	43 b	28 b	3.8 a	3.0 b	
Roundup PROMAX 5.44 qt	В	0 b	98 a	99 a	93 a	0.0 b	9.0 a	
Untreated	-	0 b	0 c	12 c	8 b	0.0 b	0.0 c	

<sup>z</sup> Treatments were applied as follows: A = 02 Jul, B=11 Jul.

у Percent of the plot area exhibiting signs of phytotoxicity was visually rated on a 0 to 100 scale where 0 = nophytotoxicity observed and 100 = entire plot area brown or dead.

\* Turfgrass injury was rated on a 0 to 9 scale where 0 = no injury visible and 9 = entire plot brown or dead. $* Means in a column followed by the same letter are not significantly different at P <math>\leq 0.05$  level according to the Fisher's protected least significant difference t-test.

### SELECTIVE REMOVAL OF CREEPING BENTGRASS FROM KENTUCKY BLUEGRASS WITH TENCACITY

### JULY-AUGUST

### J.E. Kaminski and J. Machnicki

### Department of Plant Science University of Connecticut, Storrs

### INTRODUCTION

Tenacity (mesotrione) is a relatively new herbicide that was released for use within CT in 2008. Although capable of providing control of a variety of weeds commonly found in stands of turf, a unique quality of Tenacity is its ability to selectively remove creeping bentgrass from stands of Kentucky bluegrass. Kentucky bluegrass is widely used as a primary species within home lawns, athletic fields, and on golf courses. To this point, herbicides that can selectively remove creeping bentgrass have yet to be identified and control only has been achievable by physical removal or through the use of a non-selective herbicides. The objective of this study was to evaluate the ability of multiple applications of mesotrione formulations to selectively remove creeping bentgrass from a mature stand of Kentucky bluegrass.

### MATERIALS & METHODS

This study was conducted at the University of Connecticut Plant Science Research Facility located in Storrs, CT. Turf consisted of a monostand of 'Langara' Kentucky bluegrass maintained as a athletic field. The site was severely infested with creeping bentgrass. Mowing was performed approximately 3 times per week to a height of 1.5 to 2.0 in. Plots measure 3 ft x 6 ft, and were arranged in a randomized complete block with four replications. All treatments were applied with a  $CO_2$  pressurized (40 psi) sprayer equipped with a flat-fan nozzle and calibrated to deliver 1.0 gal water per 1000 ft<sup>2</sup>. All treatments and application dates are listed in the data tables.

Data collected from the study included creeping bentgrass injury and percent plot area covered with living bentgrass. Injury to the creeping bentgrass was rated on a 0 to 5 scale where 0 = no bentgrass injury observed; 3 = minimum acceptable level of bentgrass injury; and 5 = entire bentgrass plant brown or dead. Plot area covered with living bentgrass was also rated visually on a percent scale where 0 = entire stand of bentgrass brown or dead and 100 = all bentgrass living and appearing healthy. Other ratings and observations are described in the results and data show in the tables.

### RESULTS

Bentgrass Injury and Turfgrass Quality. Discoloration of the bentgrass was observed within 7 to 10 days of the initial application and appeared as the typical white bleaching of the tissues of susceptible species. No discoloration to the Kentucky bluegrass was observed on any rating date. When plots were first rated on 20 Jul, all mesotrione-treated plots exhibited similar injury to the creeping bentgrass and were all higher than the untreated control (Table 1). Following the second application of mesotrione, injury to the creeping bentgrass generally changed from the bleached white to a brown or tan discoloration. The trend in the injury ratings and the percent plot area with living bentgrass tissues continued through 1 Aug. On 18 Aug, few differences were observed among mesotrione treatments, but differences were not considered agronomically important. Kentucky bluegrass quality within treated plots generally was near or above acceptable levels (≥7.0) (Table 1). Quality within the untreated plots was considered unacceptable due to high creeping bentgrass populations.

Bentgrass Control. When plots were first rated on 1 Aug (4 weeks after initial treatment; WAIT), all plots treated with mesotrione had similar amounts of creeping bentgrass and ranged from 17 to 26% (Table 2). Creeping bentgrass within the untreated plots were higher than all mesotrione-treated plots and averaged 52% on 1 Aug. When plots were rated in Oct, all treatments provided between 91 and 99% control of the creeping bentgrass. While none of the treatments provided complete control, plots treated with four applications of A12738 at 4.0 fl oz provided the greatest suppression and plots only had 1% bentgrass on the final rating date. The least suppression was provided by EXC3937 when applied 3 times at 8 fl oz. In general, plots treated with EXC3937 did not control creeping bentgrass as well as A12738.

Leaf Spot. On the final rating date (16 Oct), moderate decline of the Kentucky bluegrass was observed due to an unidentified leaf spot pathogen. Although disease levels were variable and no statistical differences were observed among treatments and the untreated control, all plots receiving mesotrione had greater levels of leaf spot (7 to 14%) when compared to the untreated control plots (3%) (Table 3).

### DISCUSSION

Based on previous research at the University of Connecticut, multiple applications of mesotrione have been shown to effectively control creeping bentgrass within stands of Kentucky bluegrass. Our research suggests that applications should be made on 14 to 21-d intervals to prevent recovery of weed species. A potential negative of this product is the bright white appearance of susceptible weeds following application. A second treatment applied 14-days following the first, however, generally turned the tissue tan or brown and the symptoms became less prominent while still achieving excellent control. In addition to control of creeping bentgrass, trials conducted at the University of Connecticut have shown that mesotrione can effectively control crabgrass, false green kyllinga, clover and other weed species. It is important to note that multiple applications are necessary to provide adequate control and that rates and number of applications must be selected so as not to exceed the annual limit of 16 oz/A.

Results of this study suggest that optimal control of creeping bentgrass can be obtained by applying four applications of mesotrione at 4 fl oz/A every two weeks for a total of 4 applications. While these applications have been show to significantly reduce creeping bentgrass, complete control may require a programmatic approach in which Tenacity may be required every few year to keep populations at bay. Additionally, routine overseeding of bentgrass putting greens and fairways likely would result in the addition of seed populations to undesirable areas. An unexpected observation of this study was the increase in leaf spot of the Kentucky bluegrass in the fall following repeated applications of Tenacity. Future research may seek to identify long-term control of creeping bentgrass as well as the influence of Tenacity on the development of leaf spot and potentially other diseases.

Table 1.	Kentucky	bluegrass	quality	and	bentgrass	injury	following	the	application	of	Tenacity	and	various	mesotric	one
formulati	ions.	-			-										

	Application <sup>z</sup>	Quality <sup>y</sup>		Injury <sup>x</sup>		
Treatment and rate per acre	Timing	1 Aug	18 Aug	20 Jul	1 Aug	18 Aug
A12738 4.0 fl oz	ACE	7.3 a <sup>w</sup>	8.0 a	3.0 a	3.3 a	3.8 a
A12738 5.0 fl oz	ACE	7.3 a	7.0 ab	3.0 a	3.5 a	3.3 ab
A12738 4.0 fl oz	ACEG	7.5 a	7.5 ab	3.0 a	2.8 a	2.8 b
EXC3937 8.0 fl oz	ACE	7.0 a	7.3 ab	2.3 a	3.3 a	3.0 ab
EXC3937 10.0 fl oz	ACE	7.5 a	7.5 ab	2.5 a	3.0 a	2.8 b
EXC3937 8.0 fl oz	ACEG	7.3 a	6.8 b	2.0 a	3.5 a	3.0 ab
A14203 0.125 lb ai/a	ACE	6.8 a	8.0 a	2.8 a	2.8 a	2.8 b
Untreated	-	6.5 a	4.8 c	0.0 b	0.8 b	0.8 c

<sup>z</sup> Treatments were applied as follows: A = 2 Jul, C = 15 Jul, E = 31 Jul, G = 13 Aug.

<sup>y</sup> Quality was rated visually on 0 to 9 scale in which 0 = entire plot area brown or dead, 7 = minumal acceptable quality for a highly maintained lawn or athletic field and 9 = optimum density and color.

<sup>x</sup> Turfgrass injury was rated on a 0 to 5 scale where 0 = no injury visible and 5 = entire plot brown or dead.

<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 2. Percent bentgrass within a stand of Kentucky bluegrass following the application of Tenacity and various mesotrione formulations.

	Application <sup>z</sup>		Percent bentgra	ass <sup>y</sup>
Treatment and rate per acre	Timing	1 Aug	8 Oct	16 Oct
A12738 4.0 fl oz	ACE	18 b <sup>×</sup>	1 b	3 cd
A12738 5.0 fl oz	ACE	26 b	4 b	4 bcd
A12738 4.0 fl oz	ACEG	17 b	1 b	1 d
EXC3937 8.0 fl oz	ACE	25 b	1 b	8 b
EXC3937 10.0 fl oz	ACE	26 b	3 b	7 bc
EXC3937 8.0 fl oz	ACEG	22 b	1 b	2 cd
A14203 0.125 lb ai/a	ACE	22 b	0 b	5 bcd
Untreated	-	52 a	83 a	89 a

Treatments were applied as follows: A = 2 Jul, C = 15 Jul, E = 31 Jul, G = 13 Aug.

<sup>y</sup> Percent of the plot area infested by bentgrass was visually rated on a 0 to 100 scale where 0 = no living bentgrass present or 100 = entire plot covered with living bentgrass.

<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. Percent leaf spot on a stand of Kentucky bluegrass following the application of Tenacity and various mesotrione formulations.

	Application <sup>z</sup>	Leaf Spot <sup>y</sup>
Treatment and rate per acre	Timing	16 Oct
A12738 4.0 fl oz	ACE	13 a
A12738 5.0 fl oz	ACE	14 a
A12738 4.0 fl oz	ACEG	12 a
EXC3937 8.0 fl oz	ACE	11 a
EXC3937 10.0 fl oz	ACE	11 a
EXC3937 8.0 fl oz	ACEG	13 a
A14203 0.125 lb ai/a	ACE	7 a
Untreated	-	3 a

Treatments were applied as follows: A = 2 Jul, C = 15 Jul, E = 31 Jul, G = 13 Aug.

<sup>y</sup> Percent of the plot area infested leaf spot (pathogen not identified) was visually rated on a 0 to 100 scale where 0 = no disease present or 100 = entire plot infested with leaf spot.

\* 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.

### DIMENSION COMBINED WITH ACCLAIM EXTRA FOR POSTEMERGENT CRABGRASS CONTROL

### JULY-AUGUST

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### INTRODUCTION

Crabgrass (*Digitaria* spp.) is perhaps the most problematic weed in turf throughout the mid-Atlantic and Northeastern United States. In situations where a healthy stand of turf free from weeds is desired, preemergent and/or postemergent crabgrass control is often necessary to prevent the turf from becoming dominated by the undesirable weed. When crabgrass is not controlled, large swards can be become dominated by the weed during the summer months only to die at the first hard frost. In this situation, dead weeds may leave voids in the lawn which make the area vulnerable to invasion by other weeds or even susceptible to erosion.

One of the most common herbicides used to control crabgrass in the region is Dimension (dithiopyr). Dimension provides both pre and early-post emergent control of crabgrass. In situations where Dimension is applied to more mature crabgrass, control may be reduced. The objective of this study was to assess the season-long control of tillered crabgrass following applications of Dimension and tank-mix combinations of Dimension with the postemergent herbicides Acclaim Extra (fenoxaprop) and Drive (quinclorac).

### **MATERIALS & METHODS**

The study was conducted at the University of Connecticut's Plant Science Research and Education Facility located in Storrs, CT. The site consisted of an established lawn of 'Jasper' creeping red fescue (*Festuca rubra*) maintained as a low maintenance home lawn. The area was mowed approximately once per week and received only natural irrigation. Prior to initiation of the study, the area received 0.5 lb N/1000 ft<sup>2</sup> from urea in the spring.

All treatments and application timings are shown in the treatment table. Briefly, various combinations of Dimension and tank-mixes of Dimension + Acclaim Extra or Drive were applied to crabgrass. Treatments were applied to crabgrass at the 1-3 or 3-5 tiller stage. All treatments including Drive were applied with methylated seed oil (MSO). All treatments were applied with a  $CO_2$  pressurized (40 psi) sprayer equipped with a flat-fan nozzle and calibrated to deliver 1.0 gal water per 1000 ft<sup>2</sup>.

Plots measured 3 ft x 6 ft, and were arranged in a randomized complete block with four replications. Various visual ratings were taken throughout the course of the study. Injury to the fine leaf fescue from the herbicide treatments was rated on a 0 to 5 scale where 0 = no turfgrass injury; 3.0 = minimum level of acceptable injury for a fine leaf fescue home lawn; and 5 = turfgrass brown or dead. Turfgrass quality was rated visually on a 1 to 9 scale where 1 = brown or dead turf; 6.0 = minimum acceptable quality for a home lawn; and 9 = optimum color and density. Crabgrass and white clover populations were rated on a 0 to 100% scale where 0 = no crabgrass present and 100 = entire plot area covered with crabgrass.

### RESULTS

Percent Clover. During the 2008 season, crabgrass populations were considered low and on the final rating date the untreated plots only had an average of 22 to 43% crabgrass. Additionally, crabgrass populations generally were slow to develop as rain was limited during the period when crabgrass germination was expected. The onset of adequate moisture in late Jul, however, likely brought an additional flush of crabgrass germination and growth. Differences in crabgrass populations among treatments were negligible during the summer months, but clear differences could be seen on the final rating date (8 Sep). On 8 Sep, the greatest suppression of crabgrass was exhibited within plots treated with Dimension + Acclaim (20 fl oz) (Table 1). Although several other treatments had statistically similar crabgrass percentages, the following treatments had acceptable levels ( $\leq$ 5%): Dimension (both rates; 1-3 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Dimension + Acclaim (14 fl oz; 3-5 T timing); Acclaim (14 fl oz; 3-5 T timin

timing). Except for applications made alone and at the 1-3 T timing, Acclaim and its tank-mix combinations provided acceptable control of crabgrass. When Dimension was applied alone, applications made to 1-3 T crabgrass provided acceptable control while applications at the later timing did not provide adequate suppression. In situations where Dimension was applied at a reduced rate (01.25 lb ai/A) and tank-mixed with Drive, acceptable control of crabgrass was only achieved in the early application timing and with the higher rate (0.75 lb/A) of quinclorac. The lower rate of Drive (0.50 lb/A) applied early or either rate applied in the 3-5 T stage of crabgrass did not provide adequate control in this study.

Turfgrass Quality and Injury. In general, quality ratings of all treated plots were at or above acceptable levels ( $\geq$ 6.0) during the study and no statistical differences were observed among treatments on any rating date. However, ratings on 1 Aug revealed several treatments that had unacceptable quality. When applied to crabgrass in the 1-3 tiller stage, quality was considered unacceptable in plots treated with Drive (1.0 lb/A), Dimension + Acclaim (both rates), and Dimension + Drive (0.75 lb/A) (Table 2). When applied to crabgrass with 3-5 tillers, plots treated with Acclaim, Drive, or Dimension + Drive (0.5 and 0.75 lb/A) had unacceptable quality. Despite this reduction on 1 Aug, most treatments had acceptable or near acceptable quality throughout the study. No differences in injury were observed among any treatments or the untreated control (Table 3). Slight injury was observed in several plots for 1 to 3 weeks after treatment, but no treatment caused injury that was considered unacceptable on any rating date.

Percent Clover. White clover was present in varying percentages in plots throughout the study and on the final rating date, the untreated control plots had an average of 15 to 26% clover (Table 3). Due to the high variability within plots, few differences were observed among treatments, but in general plots receiving applications of Drive along or in combination with Dimension provided excellent control of clover. Plots treated with Acclaim, Dimension, or combinations of the two generally provided minimal control of clover.

### DISCUSSION

Dimension effectively suppressed crabgrass in this study, but timing and/or tank-mix combination was an important factor in improving control. Dimension applied early and alone provided acceptable control of crabgrass, but poor control was observed when applied to more mature crabgrass plants. In either timing, the addition of Acclaim improved or provided similar control as Dimension applied alone. With reduced rates of Dimension (0.125 lb/A), higher rates of Drive may be necessary to provide acceptable season-long control of crabgrass and treatments must be applied crabgrass prior to reaching >3 tillers. Future research may investigate the influence of tank-mix combinations of varying rates and sequential applications in which early applications of Dimension are then followed later by applications of post-emergence crabgrass herbicides. This type of research may provide information on a programmatic approach to managing crabgrass in situations where escapes occur. Based on observations of crabgrass breakthroughs with single applications of Dimension in the Northeast in 2008, conducting future studies of pre and post-emergent combinations involving Dimension on highly maintained turfgrass stands such as creeping bentgrass fairways is warranted.

	App. timing <sup>z</sup>	Perc	Percent crabgrass			
Treatment and rate in ai/a	Tillers	1 Aug	15 Aug	8 Sep		
Dimension 2EW 0.18 lb	1-3	1 f <sup>x</sup>	2 efg	4 fgh		
Dimension 2EW 0.25 lb	1-3	<1 f	2 efg	4 fgh		
Acclaim Extra 28 fl oz/a	1-3	3 ef	8 cde	13 c-g		
Drive 75DF 1.0 lb/a + MSO 1.5 pt/a	1-3	<1 f	3 efg	7 e-h		
Dimension 2EW 0.125 lb + Acclaim Extra 14 fl oz	1-3	<1 f	<1 g	2 gh		
Dimension 2EW 0.125 + Acclaim Extra 20 fl oz	1-3	0 f	<1 fg	4 fgh		
Dimension 2EW 0.125 lb + Drive 75DF 0.50 lb/a + MSO 1.5 pt/a	1-3	3 ef	6 d-g	11 d-h		
Dimension 2EW 0.125 lb + Drive 75DF 0.75 lb/a + MSO 1.5 pt/a	1-3	1 f	3 efg	5 e-h		
Dimension 2EW 0.18 lb	3-5	7 cde	10 bcd	19 cd		
Dimension 2EW 0.25 lb	3-5	3 ef	7 c-f	11 d-h		
Acclaim Extra 28 fl oz/a	3-5	<1 f	1 efg	4 fgh		
Drive 75DF 1.0 lb/a + MSO 1.5 pt/a	3-5	4 ef	9 bcd	16 cde		
Dimension 2EW 0.125 lb + Acclaim Extra 14 fl oz	3-5	0 f	<1 fg	3 fg		
Dimension 2EW 0.125 lb +Acclaim Extra 20 fl oz	3-5	<1 f	<1 g	1 h		
Dimension 2EW 0.125 lb + Drive 75DF 0.50 lb/a + MSO 1.5 pt/a	3-5	4 def	9 bcd	14 c-f		
Dimension 2EW 0.125 lb + Drive 75DF 0.75 lb/a + MSO 1.5 pt/a	3-5	3 ef	8 cde	13 c-g		
Untreated	-	17 a	27 a	43 a		
Untreated	-	9 bcd	13 bc	23 bc		
Untreated	-	10 bc	15 b	22 c		
Untreated	-	14 ab	22 a	33 ab		

Table 1. Percent crabgrass of dimension combined with Acclaim Extra for postemergent crabgrass control, 2008.

<sup>2</sup> Treatments were applied as follows: 1-3 tiller treatments applied on 1 Jul and 3-5 tiller treatments applied on 11 Jul.
<sup>y</sup> Percent of the plot area infested by crabgrass was visually rated on a 0 to 100 percent scale where 0 = no crabgrass present or 100 = entire plot covered with crabgrass.

<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.	Turfgrass	quality	of dimension	combined with	Acclaim Ex	xtra for F	Postemergent	Crabgrass	Control.
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	App timina <sup>z</sup>		Quality <sup>y</sup>					
Treatment and rate in ai/a	Tillers	11 Jul	20 Jul	1 Aug	15 Aug			
Dimension 2EW 0.18 lb	1-3	8.0 a <sup>x</sup>	7.0 a	6.8 a	6.8 a			
Dimension 2EW 0.25 lb	1-3	6.8 a	6.5 a	6.3 a	6.5 a			
Acclaim Extra 28 fl oz/a	1-3	7.0 a	7.3 a	7.0 a	7.3 a			
Drive 75DF 1.0 lb/a + MSO 1.5 pt/a	1-3	7.0 a	7.0 a	5.3 a	6.0 a			
Dimension 2EW 0.125 lb + Acclaim Extra 14 fl oz	1-3	6.3 a	6.8 a	5.8 a	6.5 a			
Dimension 2EW 0.125 + Acclaim Extra 20 fl oz	1-3	6.3 a	6.5 a	5.8 a	6.3 a			
Dimension 2EW 0.125 lb + Drive 75DF 0.5 lb MSO 1.5 pt/a	1-3	7.5 a	7.0 a	6.3 a	6.3 a			
Dimension 2EW 0.125 lb + Drive 75DF 0.75 lb/a MSO 1.5 pt/a	1-3	6.8 a	6.5 a	5.0 a	5.8 a			
Dimension 2EW 0.18 lb	3-5	7.5 a	7.0 a	6.0 a	6.0 a			
Dimension 2EW 0.25 lb	3-5	7.8 a	7.3 a	6.3 a	6.8 a			
Acclaim Extra 28 fl oz/a	3-5	7.3 a	6.8 a	5.8 a	6.5 a			
Drive 75DF 1.0 lb/a + MSO 1.5 pt/a	3-5	7.8 a	7.0 a	5.8 a	6.3 a			
Dimension 2EW 0.125 lb + Acclaim Extra 14 fl oz	3-5	7.3 a	6.8 a	6.5 a	6.8 a			
Dimension 2EW 0.125 lb +Acclaim Extra 20 fl oz	3-5	7.8 a	7.8 a	6.5 a	7.3 a			
Dimension 2EW 0.125 lb + Drive 75DF 0.5 lb/a MSO 1.5 pt/a	3-5	6.8 a	7.0 a	5.3 a	6.0 a			
Dimension 2EW 0.125 lb + Drive 75DF 0.75 lb/a MSO 1.5 pt/a	3-5	7.5 a	7.0 a	5.5 a	6.3 a			
Untreated	-	7.5 a	7.5 a	6.8 a	7.0 a			
Untreated	-	6.5 a	7.0 a	6.5 a	6.3 a			
Untreated	-	7.0 a	7.3 a	6.3 a	7.0 a			
Untreated	-	7.3 a	7.5 a	6.5 a	7.3 a			

<sup>2</sup> Treatments were applied as follows: 1-3 tiller treatments applied on 1 Jul and 3-5 tiller treatments applied on 11 Jul.
<sup>9</sup> Quality was rated visually on 0-9 scale where 0 = entire plot brown or dead, 6 = minimul acceptable quality for a fine leaf fescue lawn, and 9 = optimum greenness and density.
<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.

	App. timing <sup>z</sup>	Inju	iry <sup>y</sup>	P	Percent Clover <sup>x</sup>		
Treatment and rate in ai/a	Tillers	11 Jul	20 Jul	1 Aug	15 Aug	8 Sep	
Dimension 2EW 0.18 lb	1-3	0.5 a <sup>w</sup>	1.0 a	28 a	28 a	36 a	
Dimension 2EW 0.25 lb	1-3	1.3 a	1.5 a	12 a	12 a	15 abc	
Acclaim Extra 28 fl oz/a	1-3	1.0 a	0.3 a	31 a	31 a	37 a	
Drive 75DF 1.0 lb/a + MSO 1.5 pt/a	1-3	1.3 a	1.5 a	0 a	0 a	0 c	
Dimension 2EW 0.125 lb + Acclaim Extra 14 fl oz	1-3	1.8 a	1.3 a	11 a	11 a	15 abc	
Dimension 2EW 0.125 + Acclaim Extra 20 fl oz	1-3	1.8 a	1.8 a	10 a	10 a	21 abc	
Dimension 2EW 0.125 lb + Drive 75DF 0.5 lb	1-3						
MSO 1.5 pt/a		0.5 a	1.0 a	0 a	0 a	1 bc	
Dimension 2EW 0.125 lb + Drive 75DF 0.75 lb/a	1-3						
MSO 1.5 pt/a		1.3 a	1.8 a	<1 a	<1 a	2 bc	
Dimension 2EW 0.18 lb	3-5	0.8 a	1.3 a	2 a	2 a	4 bc	
Dimension 2EW 0.25 lb	3-5	0.3 a	0.8 a	17 a	17 a	14 abc	
Acclaim Extra 28 fl oz/a	3-5	0.5 a	1.3 a	8 a	8 a	10 bc	
Drive 75DF 1.0 lb/a + MSO 1.5 pt/a	3-5	0.5 a	1.3 a	0 a	0 a	0 c	
Dimension 2EW 0.125 lb + Acclaim Extra 14 fl oz	3-5	1.3 a	1.3 a	7 a	7 a	8 bc	
Dimension 2EW 0.125 lb +Acclaim Extra 20 fl oz	3-5	0.5 a	0.5 a	33 a	33 a	38 a	
Dimension 2EW 0.125 lb + Drive 75DF 0.5 lb/a							
MSO 1.5 pt/a	3-5	1.0 a	1.3 a	2 a	2 a	1 bc	
Dimension 2EW 0.125 lb + Drive 75DF 0.75 lb/a							
MSO 1.5 pt/a	3-5	0.5 a	1.0 a	2 a	2 a	0 c	
Untreated	-	0.8 a	0.5 a	22 a	22 a	15 abc	
Untreated	-	1.5 a	1.0 a	13 a	13 a	18 abc	
Untreated	-	0.8 a	0.8 a	19 a	19 a	26 ab	
Untreated	-	0.8 a	0.5 a	20 a	20 a	15 abc	

Table 3. Turfgrass injury and percent clover of dimension combined with Acclaim Extra for postemergent crabgrass control, 2008.

<sup>2</sup> Treatments were applied as follows: 1-3 tiller treatments applied on 1 Jul and 3-5 tiller treatments applied on 11 Jul.

<sup>y</sup> Turfgrass injury was rated on a 0 to 5 scale where 0 = no injury visible and 5 = entire plot brown or dead.

\* Percent of the plot area infested by white clover was visually rated on a 0 to 100 percent scale where 0 = no clover present or 100 = entire plot covered with clover.

<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.

### INFLUENCE OF VARIOUS HERBICIDES ON THE PHYTOTOXICITY TO CREEPING BENTGRASS FAIRWAY

### JULY-AUGUST

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### INTRODUCTION

Creeping bentgrass (*Agrostis stolonifera*) is a common fairway turf for golf courses in the Northeastern United States. Several herbicides are labeled for the control of various weed species found on golf course fairways, but some products often illicit an undesirable yellowing or other phytotoxic response from the bentgrass plants. The objective of this study was to evaluate the safety of various herbicides when applied to a creeping bentgrass fairway during the summer and also to assess their ability to provide postemergent crabgrass control.

### MATERIALS & METHODS

This study was conducted on a monostand of 'L-93' creeping bentgrass with a severe infestation of crabgrass. The area was maintained as a golf course fairway and mowed approximately 4 times per week to a height of 0.5 inches. Besides the treatments listed, no other pesticide applications were made to the study area. Initial application of all treatments was 8 Jul. All treatments are listed in the treatment table. Plots measured 3 ft x 6 ft and were arranged in a randomized complete block with 4 replications. All treatments were applied with a  $CO_2$  pressurized (40 psi) backpack sprayer equipped with a flat fan nozzle and calibrated to deliver 44 gal of water per acre.

The primary purpose of the study was to assess injury to the creeping bentgrass following application of various herbicides and therefore the site was rated visually for injury. Injury was rated on a 0 to 5 scale in which 0 = no injury present, 2.5 = minimum acceptable injury for a creeping bentgrass fairway, and 5.0 = entire plot area brown or dead. In addition to injury, control of a natural infestation of crabgrass was rated during the study. Crabgrass populations were rated on a percent scale in which 0 = no crabgrass present and 100 = entire plot area covered with crabgrass.

### **RESULTS DISCUSSION**

Bentgrass Injury. Within 3 days of the initial application, unacceptable injury ( $\geq$ 2.5) to the creeping bentgrass was observed in plots receiving applications of Dismiss (0.188 lb) and Speedzone (1.8 fl oz) (Table 1). However, there were no differences on 11 Jul among the treatment with the greatest injury and those plots treated with Dismiss (0.125 lb), Drive (0.5 lb), Surge, Speedzone (1.1 fl oz), and Trimec bentgrass (1.5 fl oz). On 20 Jul, few treatments had unacceptable injury to the creeping bentgrass. However, plots treated with 7.0 fl oz of Acclaim EXTRA or the high rate of Speedzone continued to illicit objectionable disocoloration. On the final rating date (15 Aug), excessive creeping bentgrass injury was observed within plots treated with multiple applications of Acclaim (both rates) and the high rates of Speedzone or Surge. Although Velocity caused some slight discoloration to the bentgrass during the study, only plots receiving weekly applications of Velocity exhibited objectionable injury and this level of injury did not manifest until shortly after the fourth and final application. Various levels of injury were caused by the other treatments in this study, but aside from those mentioned; no treatments caused injury that would be considered unacceptable for a golf course fairway.

Crabgrass control. As expected in this study, crabgrass populations were only reduced in plots received applications of Drive or Acclaim. Although no differences in rate were exhibited in the study, data trended towards and greater reduction of crabgrass as rates of either Drive or Acclaim increased. Regardless of treatment, neither product provided complete postemergent control of crabgrass with 2 applications on the 21-d interval.

### DISCUSSION

In this study, the initial application of Dismiss, Drive, Surge, Speedzone, and Trimec bentgrass resulted in moderate to unacceptable injury to the creeping bentgrass. Although delayed by 1 week, the 7.0 oz rate of Acclaim also resulted in significant injury. Within 3 week of the initial application, injury had generally subsided. Sequential applications of various

herbicides, however, caused a resurgence of objectionable discoloration within 2 to 3 weeks after application. The sequential application of Dismiss did not result in unacceptable discoloration and the reduction in rate for the second application did not appear to positively or negatively influence the phytotoxic response. Regardless of herbicide or number of applications, bentgrass within all plots had recovered and no long term discoloration or thinning of turf was observed in the study. Depending on the targeted weed species, various herbicides are available for their selective control in a creeping bentgrass fairway. Caution, however, should be taken when selecting an appropriate rate as the higher rates of several herbicides evaluated in this study resulted in unacceptable discoloration to the bentgrass. This warning may also be more warranted in a situation where mixed stands of Poa annua and creeping bentgrass are being managed as the influence of these herbicides on annual bluegrass was not evaluated in this study.

### Table 1. Bentgrass injury on creeping bentgrass, 2008.

	Application <sup>z</sup>	Bent injury <sup>y</sup>				
Treatment and rate in ai/a	timing	11 Jul	20 Jul	1 Aug	15 Aug	
Dismiss 4F 0.125 lb	A	2.0 a-d <sup>×</sup>	0.0 g	0.3 de	0.3 h	
Dismiss 4F 0.188 lb	А	3.0 a	0.5 efg	0.3 de	0.0 h	
Dismiss 4F 0.125 lb + Dismiss 4F 0.0625 lb	A + E	1.8 b-e	1.0 def	0.8 cd	1.8 de	
Dismiss 4F 0.125 lb	AE	1.8 b-e	0.8 d-g	0.3 de	1.5 def	
Sedgehammer 0.046 lb	А	1.0 d-g	0.5 efg	0.3 de	0.5 gh	
Sedgehammer 0.062 lb	AE	0.3 fg	0.5 efg	0.3 de	0.3 h	
Drive 0.33 lb + MSO 1.5 pt/a	AD	1.8 b-e	1.0 def	0.8 cd	1.3 efg	
Drive 0.5 lb + MSO 1.5 pt/a	AD	2.3 abc	1.5 cd	1.3 bc	2.3 cd	
Acclaim Extra 3.5 fl oz	AD	0.5 fg	0.8 d-g	0.0 e	3.0 abc	
Acclaim Extra 7.0 fl oz	AD	1.0 d-g	3.0 a	1.5 b	3.8 a	
Surge 1.2 fl oz	AE	2.3 abc	1.0 def	0.3 de	1.8 de	
Surge 1.5 fl oz	AE	2.3 abc	1.5 cd	0.5 de	2.8 bc	
SpeedZone 1.1 fl oz	AE	2.0 a-d	1.3 cde	0.3 de	2.3 cd	
SpeedZone 1.8 fl oz	AE	2.8 ab	2.5 ab	0.8 cd	3.3 ab	
Trimec Bentgrass 1.1 fl oz	AD	1.0 d-g	0.8 d-g	0.3 de	0.8 fgh	
Trimec Bentgrass 1.5 fl oz	AD	2.0 a-d	1.3 cde	0.3 de	1.8 de	
Lontrel 0.20 fl oz	А	0.5 fg	0.3 fg	0.3 de	0.8 fgh	
Lontrel 0.5 fl oz	А	0.5 fg	0.5 efg	0.8 cd	0.5 gh	
Velocity 10 g	ABCD	0.8 efg	2.0 bc	2.5 a	0.5 gh	
Velocity 10 g	AD	1.0 d-g	0.8 d-g	0.3 de	1.3 efg	
Velocity 30 g	AD	1.3 c-f	1.0 def	0.0 e	1.3 efg	
Untreated	-	0.0 g	0.3 fg	0.3 de	0.0 h	
Untreated	-	0.5 fg	0.0 g	0.0 e	0.3 h	
Untreated	-	0.5 fg	0.5 efg	0.0 e	0.5 gh	

<sup>z</sup> Treatments were applied as follows: A = 8 Jul, B = 15 Jul, C = 25 Jul, D= 29 Jul, and E = 5 Aug.

<sup>y</sup> Bentgrass injury was rated on a 0 to 5 scale where 0 = no injury visible; 2.5 = unacceptable injury for a creeping bentgrass fairway; and 5 = entire plot brown or dead.

\* 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. Percent crassgrass of herbicide tolerance on fairway height creeping bentgrass, 2008.

U	Application <sup>z</sup>	Percent crabgrass <sup>y</sup>		
Treatment and rate in ai/a	Timing	20 Jul	1 Aug	
Dismiss 4F 0.125 lb	A	31 abc <sup>x</sup>	24 a-d	
Dismiss 4F 0.188 lb	A	27 abc	27 a-d	
Dismiss 4F 0.125 lb + Dismiss 4F 0.0625 lb	A + E	27 abc	23 bcd	
Dismiss 4F 0.125 lb	AE	31 abc	24 a-d	
Sedgehammer 0.046 lb	A	27 abc	19 de	
Sedgehammer 0.062 lb	AE	31 abc	23 de	
Drive 0.33 lb + MSO 1.5 pt/a	AD	7 d	7 f	
Drive 0.5 lb + MSO 1.5 pt/a	AD	1 d	3 f	
Acclaim Extra 3.5 fl oz	AD	8 d	11 ef	
Acclaim Extra 7.0 fl oz	AD	3 d	7 f	
Surge 1.2 fl oz	AE	31 abc	24 a-d	
Surge 1.5 fl oz	AE	37 a	32 ab	
SpeedZone 1.1 fl oz	AE	31 abc	24 bcd	
SpeedZone 1.8 fl oz	AE	37 a	32 ab	
Trimec Bentgrass 1.1 fl oz	AD	34 ab	34 a	
Trimec Bentgrass 1.5 fl oz	AD	28 abc	25 a-d	
Lontrel 0.20 fl oz	A	26 bc	21 cde	
Lontrel 0.5 fl oz	A	29 abc	24 a-d	
Velocity 10 g	ABCD	35 ab	25 a-d	
Velocity 10 g	AD	27 abc	24 bcd	
Velocity 30 g	AD	23 c	20 de	
Untreated	-	35 ab	31 abc	
Untreated	-	33 abc	27 a-d	
Untreated	-	31 abc	25 a-d	

<sup>2</sup> Treatments were applied as follows: A = 8 Jul, B = 15 Jul, C = 25 Jul, D= 29 Jul, and E = 5 Aug. <sup>y</sup> Percent of the plot area infested by crabgrass was visually rated on a 0 to 100 percent scale where 0 = no crabgrass present or 100 = entire plot covered with crabgrass.

х 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.

### CRABGRASS CONTROL WITH VARIOUS TENACITY AND TENACITY TANK-MIXES, 2008.

### MAY-AUGUST

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### INTRODUCTION

Tenacity (mesotrione) is a relatively new herbicide that was released for use within CT in 2008. Although a primary strength of Tenacity will be the selective removal of creeping bentgrass from desirable turfgrass species such as Kentucky bluegrass, its use will likely expand beyond this. For instance, Tenacity has also shown to have pre- and/or postemergent properties against crabgrass, yellow nutsedge, buckhorn plantain, clover and other weed species. The objectives of this study are to assess the safety of Tenacity and new formulations of mesotrione and prodiamine when applied to a creeping red fescue lawn and to determine the level of pre and early post crabgrass control.

### **MATERIALS & METHODS**

This study was conducted at the University of Connecticut Plant Science Research Facility located in Storrs, CT. Turf consisted of a monostand of 'Jasper' creeping red fescue maintained as a low maintenance home lawn. Mowing was performed approximately once per week to a height of 4.0 in. Plots measured 3 ft x 6 ft, and were arranged in a randomized complete block with four replications. All treatments were applied with a  $CO_2$  pressurized (40 psi) sprayer equipped with a flat-fan nozzle, and calibrated to deliver 1.0 gal water per 1000 ft<sup>2</sup>. All treatments and application dates are listed in the data tables.

Data collected included injury to the desirable fine leaf fescue species, percent crabgrass control and overall turf quality. Percent crabgrass was visually rated on a 0 to 100 scale where 0 = no crabgrass present in the plot and 100 = entire plot area covered with crabgrass. Overall quality of the 'Jasper' creeping red fescue was rated on a 1 to 9 scale where 1 = entire plot area brown or dead; 6.0 = minimum acceptable quality for a low maintenance home lawn; and 9 = optimum density and greenness. Injury to the fine leaf fescue turf was rated on a 0 to 5 scale and as a percent of the plot area exhibiting phytotoxic symptoms (rating methods explained in data tables). Percent clover was also assessed on several rating dates and rating scales were similar to that of crabgrass.

### RESULTS

Percent Crabgrass. Crabgrass pressure was extremely low within the study site until approximately 4 to 5 inches of natural rainfall occurred between 23 and 24 Jul. Prior to this period, limited rainfall may have inhibited the emergence of crabgrass in the study site. When crabgrass was first rated on 1 Aug, all numbered compound-treated plots had less than 1% crabgrass (Table 1). Moderate suppression was provided within plots treated with Dimension. This trend continued until the final rating date on Sep 8 when excellent ( $\leq 1\%$ ) suppression of crabgrass was observed within plots treated with A15879 on either 3 Jun or those receiving sequential applications of mesotrione and or prodiamine. On 8 Sep, moderate but unacceptable suppression of crabgrass was afforded by all Dimension treatments.

Turfgrass Injury. Injury to the fine leaf fescue in this study was highly variable and few differences were observed among treatments. Percent phytotoxicity ratings generally were indicative of discoloration and thinning to the stand and difference were not observed among any treatments until conditions became warm and dry in early Jul (Table 2). It appeared that all treatments receiving any of the numbered compounds applied alone or in combination had the greatest level of injury, but few differences among treatments were observed. When injury was rated on a 0 to 5 scale (indicating the severity of the injury to plants), few differences were observed and no differences were observed when injury ratings were at their highest on 26 May (Table 3).

Quality and Clover. Quality and clover ratings were highly variable and few differences were observed on any rating date. Despite few differences, various treatments resulted in a reduction in turf quality on several rating dates (Table 4). In general, plots received applications of Dimension generally had the highest quality ratings throughout the study. While

most treatments had quality levels that would be considered acceptable for a low maintenance fine leaf fescue lawn ( $\geq$ 6.0), plots treated with A15879 (0.38 lb) + A12738 (0.125 lb) had quality below the acceptable threshold on 4 of 6 rating dates. Percent plot area infested with clover was erratic and no treatments provided acceptable suppression of white clover by the final rating date (Table 5).

### DISCUSSION

Crabgrass pressure in this study was considered low and the populations were slow to develop due to inadequate soil moisture and lack of rainfall until late Jul. Despite this, several treatments involving multiple applications of mesotrione and/or barricade provided excellent control of crabgrass during the study. Although plots receiving A15879 or A12738 + A123333 on 11 May continued to provide adequate suppression of crabgrass on the final rating date, it is likely that an increase in tillering would have resulted in an unacceptable level of crabgrass pressure in a highly maintained lawn. Results from this year's evaluations may represent those of an outlier in that irrigation was limited until late in the season and therefore likely resulted in a late, but large flush of emergence of crabgrass seedlings. Future research may investigate the influence of a wider range of application timings on crabgrass control. Additionally, it may be prudent to evaluate the influence of these products on crabgrass control on a more highly maintained lawn or athletic field under different irrigation practices as well as varying turfgrass species.

Table 1. Percent crabgrass in a fine leaf fescue lawn following the application of various Tenacity and Prodiamine tankmixes, 2008

	Application <sup>z</sup>	Percent crabgras	ss <sup>x</sup>	
Treatment and rate in ai/a	timing	1 Aug	15 Aug	8 Sep
A15879 1.0 lb	A	<1 d	<1 c	2 d
A12738 0.25 lb + A12333 0.75 lb	А	<1 d	1 c	3 d
Dimension 2EW 0.25 lb	А	6 b	8 b	19 b
A15879 1.0 lb + Activator 0.25 % v/v	В	<1 d	<1 c	1 d
Dimension 2EW 0.25 lb + Activator 0.25 % v/v	В	3 c	4 c	10 c
A15879 0.38 lb +	А			
A12738 0.125 lb +Activator 0.25 % v/v	С	<1 d	<1 c	1 d
A12738 0.125 lb + A12333 0.38 lb	AC			
Activator 0.25 % v/v	С	0 d	0 c	<1 d
A15879 0.5 lb +	AC			
Activator 0.25 % v/v	С	<1 d	<1 c	<1 d
Dimension 2EW 0.25 lb +	А			
Acclaim 120EC 20 fl oz + Activator 0.25 % v/v	С	3 c	3 c	10 c
Untreated	-	13 a	21 a	34 a

<sup>z</sup> Treatments were applied as follows: A=11 May, B=3 Jun, and C=25 Jun.

\* Percent of the plot area with Phytotoxicity was visually rated on a 0 to 100 percent scale where 0 = no phyto was present or 100 = entire plot has phyto.

<sup>y</sup> Percent of the plot area infected with crabgrass was visually rated on a 0 to 100 percent scale where 0 = no crabgrass was present or 100 = entire plot was covered in crabgrass.

<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.

	Application <sup>z</sup>		Percent pl	nytotoxicity <sup>y</sup>	
Treatment and rate in ai/a	timing	26 May	9 Jun	20 Jun	3 Jul
A15879 1.0 lb	А	26 a <sup>w</sup>	20 a	29 a	26 ab
A12738 0.25 lb + A12333 0.75 lb	А	29 a	19 a	26 a	25 ab
Dimension 2EW 0.25 lb	А	30 a	14 a	16 a	13 bcd
A15879 1.0 lb + Activator 0.25 % v/v	В	23 a	9 a	21 a	15 a-d
Dimension 2EW 0.25 lb + Activator 0.25 % v/v	В	26 a	6 a	15 a	13 bcd
A15879 0.38 lb +	А				
A12738 0.125 lb +Activator 0.25 % v/v	С	38 a	25 a	34 a	30 a
A12738 0.125 lb + A12333 0.38 lb	AC				
Activator 0.25 % v/v	С	29 a	19 a	26 a	20 abc
A15879 0.5 lb +	AC				
Activator 0.25 % v/v	С	21 a	8 a	19 a	18 a-d
Dimension 2EW 0.25 lb +	А				
Acclaim 120EC 20 fl oz + Activator 0.25 % v/v	С	17 a	3 a	10 a	5 cd
Untreated	-	25 a	9 a	9 a	4 d

Table 2. Percent phytotoxicity of a fine leaf fescue lawn following treatment with various Tenacity and Prodiamine tankmixes, 2008.

<sup>z</sup> Treatments were applied as follows: A=11 May, B = 3 Jun, and C= 25 Jun.

\* Percent of the plot area with Phytotoxicity was visually rated on a 0 to 100 percent scale where 0 = no phytotoxicity present or 100 = entire plot exhibiting phytotoxic symptoms.

<sup>y</sup> Percent of the plot area infected with crabgrass was visually rated on a 0 to 100 percent scale where 0 = no crabgrass was present or 100 = entire plot was covered in crabgrass.

<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.

	Application <sup>z</sup>	Injury <sup>y</sup>				
Treatment and rate in ai/a	timing	26 May	9 Jun	20 Jun	3 Jul	
A15879 1.0 lb	А	1.8 a <sup>x</sup>	1.5 a	0.3 bc	0.8 bc	
A12738 0.25 lb + A12333 0.75 lb	А	2.0 a	1.3 a	0.3 bc	0.8 bc	
Dimension 2EW 0.25 lb	А	1.8 a	0.8 a	0.0 c	0.0 c	
A15879 1.0 lb + Activator 0.25 % v/v	В	2.0 a	0.5 a	1.0 a	0.0 c	
Dimension 2EW 0.25 lb + Activator 0.25 % v/v	В	1.8 a	0.5 a	0.0 c	0.0 c	
A15879 0.38 lb +	А					
A12738 0.125 lb +Activator 0.25 % v/v	С	2.8 a	2.3 a	1.0 a	1.8 a	
A12738 0.125 lb + A12333 0.38 lb	AC					
Activator 0.25 % v/v	С	2.3 a	0.8 a	0.5 abc	0.8 bc	
A15879 0.5 lb +	AC					
Activator 0.25 % v/v	С	2.0 a	5.0 a	0.8 ab	1.5 ab	
Dimension 2EW 0.25 lb +	А					
Acclaim 120EC 20 fl oz + Activator 0.25 % v/v	С	0.8 a	0.0 a	0.0 c	0.0 c	
Untreated	-	1.8 a	0.5 a	0.0 c	0.0 c	
A12738 0.25 lb + A12333 0.75 lb Dimension 2EW 0.25 lb A15879 1.0 lb + Activator 0.25 % v/v Dimension 2EW 0.25 lb + Activator 0.25 % v/v A15879 0.38 lb + A12738 0.125 lb + Activator 0.25 % v/v A12738 0.125 lb + A12333 0.38 lb Activator 0.25 % v/v A15879 0.5 lb + Activator 0.25 % v/v Dimension 2EW 0.25 lb + Acclaim 120EC 20 fl oz + Activator 0.25 % v/v Untreated.	A A B B A C AC C AC C AC C AC C A C	2.0 a 1.8 a 2.0 a 1.8 a 2.8 a 2.3 a 2.0 a 0.8 a 1.8 a	1.3 a 0.8 a 0.5 a 0.5 a 2.3 a 0.8 a 5.0 a 0.0 a 0.5 a	0.3 bc 0.3 bc 0.0 c 1.0 a 0.0 c 1.0 a 0.5 abc 0.8 ab 0.0 c 0.0 c	0.8 bc 0.8 bc 0.0 c 0.0 c 1.8 a 0.8 bc 1.5 ab 0.0 c 0.0 c	

Table 3. Injury to a fine leaf fescue lawn following the application of various Tenacity and Prodiamine tank-mixes, 2008.

<sup>2</sup> Treatments were applied as follows: A=11 May, B = 3 Jun, and C= 25 Jun. <sup>y</sup> Turfgrass injury was rated on a 0 to 5 scale where 0 = no injury visible and 5 = entire plot brown or dead.

<sup>\*</sup> Means in a column followed by the same letter are not significantly different at  $P \le 0.05$  level according to the Fisher's

protected least significant difference t-test.

	Application <sup>z</sup>			Qua	ality <sup>y</sup>		
Treatment and rate in ai/a	timing	9 Jun	20 Jun	3 Jul	20 Jul	1 Aug	15 Aug
A15879 1.0 lb	A	6.8 a <sup>x</sup>	5.0 a	6.0 cd	7.0 a	6.0 b	6.8 a
A12738 0.25 lb + A12333 0.75 lb	А	6.5 a	5.0 a	6.3 bcd	6.5 a	6.0 b	6.8 a
Dimension 2EW 0.25 lb	А	7.0 a	6.0 a	7.5 ab	7.0 a	7.3 a	7.0 a
A15879 1.0 lb + Activator 0.25 % v/v	В	7.0 a	5.3 a	7.3 abc	7.0 a	6.8 ab	7.0 a
Dimension 2EW 0.25 lb + Activator 0.25 % v/v	В	7.5 a	6.0 a	7.5 ab	6.8 a	7.3 a	7.0 a
A15879 0.38 lb +	А						
A12738 0.125 lb +Activator 0.25 % v/v	С	5.8 a	4.0 a	5.0 d	6.5 a	5.8 b	6.3 a
A12738 0.125 lb + A12333 0.38 lb	AC						
Activator 0.25 % v/v	С	6.3 a	5.0 a	6.0 cd	6.0 a	5.8 b	6.0 a
A15879 0.5 lb +	AC						
Activator 0.25 % v/v	С	7.3 a	5.5 a	6.5 abc	7.3 a	6.3 ab	7.3 a
Dimension 2EW 0.25 lb +	А						
Acclaim 120EC 20 fl oz + Activator 0.25 % v/v	С	7.8 a	7.0 a	7.5 ab	7.5 a	7.3 a	7.5 a
Untreated	-	6.8 a	7.0 a	7.8 a	7.8 a	7.3 a	7.5 a

Table 4. Quality of a fine leaf fescue lawn following the treatment of various Tenacity and Prodiamine tank-mixes, 2008.

<sup>z</sup> Treatments were applied as follows: A=11 May, B = 3 Jun, and C= 25 Jun.

<sup>y</sup> Quality was rated visually on 0-9 scale where 0 = entire plot brown or dead; 6 = minimum acceptable quality for a fine leaf fescue lawn; and 9 = optimum color and density.

<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 5. Percent white clover in a fine leaf fescue lawn following the application of various Tenacity and Prodiamine tankmixes, 2008.

	Application <sup>z</sup>		P	ercent clov	/er <sup>x</sup>	
Treatment and rate in ai/a	timing	20 Jun	20 Jul	1 Aug	15 Aug	8 Sep
A15879 1.0 lb	Α	3 e	4 d	6 d	5 a	7 a
A12738 0.25 lb + A12333 0.75 lb	А	5 de	12 bcd	12 bcd	15 a	18 a
Dimension 2EW 0.25 lb	А	22 abc	34 ab	34 ab	26 a	23 a
A15879 1.0 lb + Activator 0.25 % v/v	В	12 b-e	25 a-d	28 abc	30 a	31 a
Dimension 2EW 0.25 lb + Activator 0.25 % v/v	В	19 a-d	31 abc	35 a	35 a	39 a
A15879 0.38 lb +	A	6 de	7 cd	8 cd	7 a	9 a
A12738 0.125 lb +Activator 0.25 % v/v	С					
A12738 0.125 lb + A12333 0.38 lb	AC	9 cde	11 bcd	13 bcd	12 a	14 a
Activator 0.25 % v/v	С					
A15879 0.5 lb +	AC	10 b-e	8 cd	10 cd	10 a	12 a
Activator 0.25 % v/v	С					
Dimension 2EW 0.25 lb +	А	30 a	42 a	45 a	28 a	28 a
Acclaim 120EC 20 fl oz + Activator 0.25 % v/v	С					
Untreated	-	24 ab	48 a	42 a	33 a	31 a

<sup>z</sup> Treatments were applied as follows: A=11 May, B = 3 Jun, and C= 25 Jun.

<sup>y</sup> Percent of the plot area infected with crabgrass was visually rated on a 0 to 100 percent scale where 0 = no crabgrass was present or 100 = entire plot was covered in crabgrass.

<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.

# Seedhead Suppression of Annual Bluegrass on a Simulated Fairway J. A. Borger, M. B. Naedel, and M. T. Elmore<sup>1</sup>

# Introduction

This study was conducted on a stand of annual bluegrass (*Poa annua*) at the Valentine Turfgrass Research Center, University Park, PA. The objective of the study was to evaluate plant growth regulators, with and without fertilizers, for the seedhead suppression of annual bluegrass.

# **Methods and Materials**

This study was a randomized complete block design with four replications, and a plot size of 30 ft<sup>2</sup>. Treatments were applied on April 17 (BT), and May 7, 2008 (3 WAT), respectively, using a three-foot  $CO_2$  powered boom sprayer calibrated to deliver 87.12 gpa using one 11008E even tip/flat fan nozzle at 40 psi.

Boot stage of the annual bluegrass was observed April 20, 2008. Non treated test areas within the test site revealed approximately 95% coverage of annual bluegrass seedheads at peak emergence.

The site was maintained using cultural practices for irrigation, mowing, and fertilization that would be typical for a highly maintained golf course fairway. The test area was mowed three times per week with a Toro fairway unit, bench set to 0.500".

### **Results and Discussion**

Turfgrass phytotoxicity was rated three times during the study (Table 1). Only turfgrass treated with Embark T&O alone or with ECO-N reveled phytotoxicity below the 7.0 acceptable level on the May  $6^{th}$  rating date. No other unacceptable phytotoxicity was observed.

Turfgrass color was rated on April 30, 2008 (Table 2). All turfgrass had acceptable color.

Annual bluegrass seedhead suppression was rated three times during the study (Table 3). The amount of suppression was variable during this study. In the final rating date, May 28, 2008, only turfgrass treated with Embark T&O alone or combined with ECO-N had significantly more seedhead suppression than non treated turfgrass.

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Treatment		Form	Rate	Timing	(	-Phytotoxicit	ty)
			oz/M	_	4/30	5/6	5/21
EMBARK T&O		0.2SL	48 oz/A	BT	10.0	6.0	10.0
EMBARK T&O		0.2SL	48 oz/A	BT	10.0	9.0	10.0
FERROMEC		L	5	BT			
EMBARK T&O		0.2SL	48 oz/A	BT	10.0	6.0	10.0
ECO-N (24-0-0)		2.2L	0.037 lb N/M	BT			
EMBARK T&O		0.2SL	48 oz/A	BT	10.0	8.3	10.0
ULTRAPLEX		L	9	BT			
EMBARK T&O		0.2SL	48 oz/A	BT	10.0	7.0	10.0
ULTRAPLEX		L	7	BT			
AMINOPLEX		L	3	BT			
CHECK					10.0	10.0	10.0
EMBARK T&O		0.2SL	48 oz/A	BT	10.0	10.0	10.0
MICROBURST		L	6	BT			
EMBARK T&O		0.2SL	48 oz/A	BT	10.0	9.3	10.0
ULTRAPLEX		L	9	BT			
MICROBURST		L	6	BT			
PRIMO MAXX		1MEC	0.25	BT/3 WAT	10.0	10.0	10.0
PROXY		2SL	5	BT/3 WAT			
PRIMO MAXX		1MEC	0.25	BT/3 WAT	10.0	9.7	10.0
PROXY		2SL	5	BT/3 WAT			
ULTRAPLEX		L	9	BT/3 WAT			
PROXY		2SL	5	BT	10.0	10.0	10.0
ULTRAPLEX		L	7	BT			
AMINOPLEX		L	3	BT			
ECO-N (24-0-0)		2.2L	0.037 lb N/M	BT	10.0	10.0	10.0
PRIMO MAXX		1MEC	0.25	BT/3 WAT	10.0	9.3	10.0
PROXY		2SL	5	BT/3 WAT			
ECO-N (24-0-0)	2.2	L	0.037 lb N/M	BT/3 WAT			
PRIMO MAXX		1MEC	0.25	BT/3 WAT	10.0	10.0	10.0
PROXY		2SL	5	BT/3 WAT			
ECO-N (24-0-0)	2.2	L	0.25 lb N/M	BT/3 WAT			

<u>**Table 1.**</u> Ratings of phytotoxicity of a simulated annual bluegrass fairway on a scale of 0 to 10 where 0 = dead turf, 7 = acceptable, and 10 = no phytotoxicity in 2008.

Treatment	Form	Rate	Timing	()
		oz/M	_	4/30
EMBARK T&O	0.2SL	48 oz/A	BT	7.7
EMBARK T&O	0.2SL	48 oz/A	BT	9.3
FERROMEC	L	5	BT	
EMBARK T&O	0.2SL	48 oz/A	BT	7.8
ECO-N (24-0-0)	2.2L	0.037 lb N/M	BT	
EMBARK T&O	0.2SL	48 oz/A	BT	8.5
ULTRAPLEX	L	9	BT	
EMBARK T&O	0.2SL	48 oz/A	BT	8.3
ULTRAPLEX	L	7	BT	
AMINOPLEX	L	3	BT	
CHECK				10.0
EMBARK T&O	0.2SL	48 oz/A	BT	10.0
MICROBURST	L	6	BT	
EMBARK T&O	0.2SL	48 oz/A	BT	9.5
ULTRAPLEX	L	9	BT	
MICROBURST	L	6	BT	
PRIMO MAXX	1MEC	0.25	BT/3 WAT	9.2
PROXY	2SL	5	BT/3 WAT	
PRIMO MAXX	1MEC	0.25	BT/3 WAT	9.7
PROXY	2SL	5	BT/3 WAT	
ULTRAPLEX	L	9	BT/3 WAT	
PROXY	2SL	5	BT	9.0
ULTRAPLEX	L	7	BT	
AMINOPLEX	L	3	BT	
ECO-N (24-0-0)	2.2L	0.037 lb N/M	BT	9.2
PRIMO MAXX	1MEC	0.25	BT/3 WAT	8.7
PROXY	2SL	5	BT/3 WAT	
ECO-N (24-0-0) 2.2	L	0.037 lb N/M	BT/3 WAT	
PRIMO MAXX	1MEC	0.25	BT/3 WAT	9.8
PROXY	2SL	5	BT/3 WAT	
ECO-N (24-0-0) 2.2	L	0.25 lb N/M	BT/3 WAT	

<u>**Table 2.**</u> Ratings of color of a simulated annual bluegrass fairway on a scale of 0 to 10 where 0 = brown turf, 7 = acceptable, and 10 = dark green color in 2008.

Treatment		Form	Rate	Timing	(%	Suppression	n <sup>1, 2</sup> )
			oz/M		4/30	5/6	5/28
EMBARK T&O		0.2SL	48 oz/A	BT	79.6a	82.6a	52.9a
EMBARK T&O		0.2SL	48 oz/A	BT	22.2c-f	14.7bc	13.8bc
FERROMEC		L	5	BT			
EMBARK T&O		0.2SL	48 oz/A	BT	75.9a	70.6a	63.5a
ECO-N (24-0-0)		2.2L	0.037 lb N/M	BT			
EMBARK T&O		0.2SL	48 oz/A	BT	25.9cd	8.3cd	3.7bc
ULTRAPLEX		L	9	BT			
EMBARK T&O		0.2SL	48 oz/A	BT	50.0b	31.6b	22.2b
ULTRAPLEX		L	7	BT			
AMINOPLEX		L	3	BT			
CHECK					0.0f	0.0cd	0.0bc
EMBARK T&O		0.2SL	48 oz/A	BT	1.9ef	-9.5d	-5.8c
MICROBURST		L	6	BT			
EMBARK T&O		0.2SL	48 oz/A	BT	3.7def	15.3bc	18.5bc
ULTRAPLEX		L	9	BT			
MICROBURST		L	6	BT			
PRIMO MAXX		1MEC	0.25	BT/3 WAT	22.2c-f	-10.0d	-2.1bc
PROXY		2SL	5	BT/3 WAT			
PRIMO MAXX		1MEC	0.25	BT/3 WAT	24.1cde	2.5cd	1.6bc
PROXY		2SL	5	BT/3 WAT			
ULTRAPLEX		L	9	BT/3 WAT			
PROXY		2SL	5	BT	7.4def	2.6cd	18.5bc
ULTRAPLEX		L	7	BT			
AMINOPLEX		L	3	BT			
ECO-N (24-0-0)		2.2L	0.037 lb N/M	BT	1.9ef	3.1cd	10.1bc
PRIMO MAXX		1MEC	0.25	BT/3 WAT	44.4bc	-2.1cd	9.0bc
PROXY		2SL	5	BT/3 WAT			
ECO-N (24-0-0)	2.2	L	0.037 lb N/M	BT/3 WAT			
PRIMO MAXX		1MEC	0.25	BT/3 WAT	16.7def	-13.7d	-2.1bc
PROXY		2SL	5	BT/3 WAT			
$FCO_N(24_0)$	22	T	0.25 lb N/M	BT/3 WAT			

Table 3. Ratings of the percent seedhead suppression of a simulated annual bluegrass fairway in 2008.

ECO-N (24-0-0)2.2L0.25 lb N/MBT/3 WAT1 - Means followed by same letter do not significantly differ (P = 0.05 Duncan's New MRT)

2 – Negative numbers indicate an increase in seedhead presence from the untreated check plots.

# **Evaluation of PGR Materials Applied to Fairway Height** Creeping Bentgrass and Annual Bluegrass

# J. A. Borger, M. B. Naedel, and M. T. Elmore<sup>1</sup>

# Introduction

This study was conducted on a mature stand of fairway height 'Penneagle' creeping bentgrass (*Agrostis stolonifera*) at the Valentine Turfgrass Research Center, Penn State University, University Park, Pa. The objective of the study was to determine the efficacy of Legacy plant growth regulator and Primo Maxx using discoloration, color, and quality ratings, measurements of plant height, and fresh weight foliar yields.

### **Methods and Materials**

This study was a randomized complete block design with three replications. Treatments were applied on May 29 (MAY), June 25 (4 WAT), and July 25, 2008 (8 WAT) using a three foot CO<sub>2</sub> powered boom sprayer calibrated to deliver 80gpa using one, flat fan, 11008E nozzle at 40 psi.

The test site was maintained similar to that of a golf course fairway with respect to irrigation, fertilization and mowing. Turfgrass height was measured using a Turfcheck 1 prism. Clipping weights were taken once a week with an eleven bladed John Deere reel mower bench set to a height of 0.500" and modified to collect clippings.

# **Results and Discussion**

Turfgrass discoloration and color were each rated eleven times during the study (Tables 1 and 2 respectively). There were some significant differences among treated and non-treated turfgrass over the time of the study. There was no time when any treated or non-treated turfgrass fell below a level of acceptable for discoloration or color during the study.

Turfgrass quality, Table 3, was rated eleven times. No treated or non-treated turfgrass fell below a level of 8.0 for quality, still well above the level of acceptability.

Turfgrass heights were rated eleven times and recorded in Table 4. Following a review of the data one can see significant differences from all treated turf on several rating dates. It is also apparent when there were no height differences between treated and non treated turfgrass, hence, the need for reapplications of materials. The time interval for material reapplication appears correct from these data.

Finally, data was collected eleven times to reveal any possible differences in fresh clipping weights (Table 5). On the June 5<sup>th</sup> and 12<sup>th</sup> rating dates all treated turfgrass significantly reduced the fresh clipping weights compare to non treated turfgrass. On the June 19<sup>th</sup> rating date, only the high rate of Legacy had significantly less clippings than non treated. On the July 9<sup>th</sup> rating date, all treated turfgrass, except the low rate of Legacy, significantly reduced clippings compared to non-treated. The last significant difference in fresh clipping weights was observed on the July 29<sup>th</sup> rating date, four days after an application of materials, when treated with Primo MAXX was compared to non-treated.

In general, these PGRs work extremely well and can be a part of almost any turfgrass management regime.

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Treatment	Form	Rate	Timing	(Discoloration <sup>1</sup> )					
		oz/A	5	6/5	6/12	6/19	6/25	7/2	7/9
LEGACY	1.52MEC	8	MAY/4/8 WAT	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
LEGACY	1.52MEC	14	MAY/4/8 WAT	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
CHECK				8.5b	10.0a	10.0a	10.0a	10.0a	10.0a
LEGACY	1.52MEC	20	MAY/4/8 WAT	8.2b	8.2b	7.3b	10.0a	10.0a	10.0a
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	9.5a	10.0a	10.0a	10.0a	10.0a	10.0a

<u>**Table 1.**</u> Turfgrass discoloration ratings on a scale of 0-10 where 0 = brown turf, 7 = acceptable, and 10 = no discoloration, taken in 2008.

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

<u>**Table 1** (continued)</u>. Turfgrass discoloration ratings on a scale of 0-10 where 0 = brown turf, 7 = acceptable, and 10 = no discoloration, taken in 2008.

Treatment	Form	Rate	Timing	(Discoloration <sup>1</sup>				
		oz/A		7/16	7/23	7/29	8/13	8/20
LEGACY	1.52MEC	8	MAY/4/8 WAT	10.0a	10.0a	10.0a	10.0a	10.0a
LEGACY	1.52MEC	14	MAY/4/8 WAT	10.0a	10.0a	10.0a	10.0a	10.0a
CHECK				10.0a	10.0a	10.0a	10.0a	10.0a
LEGACY	1.52MEC	20	MAY/4/8 WAT	10.0a	10.0a	10.0a	10.0a	10.0a
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	10.0a	10.0a	10.0a	10.0a	10.0a

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 2.	Turfgrass color ratings on	a scale of 0-9 where $0 = p$	boor color, 6= accep	table, and $9 = \text{dark green}$	color, taken in 2008.
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Treatment	Form	Rate	Timing	(		(	Color <sup>1</sup>		)
		oz/A	0	6/5	6/12	6/19	6/25	7/2	7/9
LEGACY	1.52MEC	8	MAY/4/8 WAT	8.5a	8.8ab	9.0a	8.7a	9.0a	8.5b
LEGACY	1.52MEC	14	MAY/4/8 WAT	8.5a	8.8ab	9.0a	9.0a	9.0a	9.0a
CHECK				8.3a	8.5b	8.8a	8.7a	8.3b	8.2c
LEGACY	1.52MEC	20	MAY/4/8 WAT	8.0b	9.0a	9.0a	9.0a	9.0a	9.0a
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	8.3a	8.7ab	8.7a	8.8a	9.0a	9.0a

**Table 2 (continued).** Turfgrass color ratings on a scale of 0-9 where 0 = poor color, 6 = acceptable, and 9 = dark green color, taken in 2008.

Treatment	Form	Rate	Timing	(Color <sup>1</sup>					
		oz/A	_	7/16	7/23	7/29	8/13	8/20	
LEGACY	1.52MEC	8	MAY/4/8 WAT	8.7b	8.5bc	8.8a	9.0a	8.8a	
LEGACY	1.52MEC	14	MAY/4/8 WAT	9.0a	8.5bc	9.0a	9.0a	9.0a	
CHECK				8.2c	8.3c	8.5b	8.5b	8.5b	
LEGACY	1.52MEC	20	MAY/4/8 WAT	9.0a	9.0a	9.0a	9.0a	9.0a	
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	9.0a	8.8ab	9.0a	9.0a	9.0a	

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Treatment	Form	Rate	Timing	(	-	Quality <sup>1</sup>				
		oz/A	0	6/5	6/12	6/19	6/25	7/2	7/9	
LEGACY	1.52MEC	8	MAY/4/8 WAT	8.5a	8.5a	8.8a	8.5ab	9.0a	8.5a	
LEGACY	1.52MEC	14	MAY/4/8 WAT	8.3a	8.7a	8.8a	8.5ab	8.8a	8.8a	
CHECK				8.3a	8.3a	8.3ab	8.3b	8.2b	8.0b	
LEGACY	1.52MEC	20	MAY/4/8 WAT	8.2a	8.0b	8.0b	8.8a	8.7a	8.7a	
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	8.3a	8.5a	8.2b	8.7ab	9.0a	8.8a	

<u>**Table 3.**</u> Turfgrass quality ratings on a scale of 0-9 where 0 = poor quality, 6 = acceptable, and 9 = excellent quality, taken in 2008.

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

**Table 3** (continued). Turfgrass quality ratings on a scale of 0-9 where 0 = poor quality, 6= acceptable, and 9 = excellent quality, taken in 2008.

Treatment	Form	Rate	Timing	(Quality <sup>1</sup>					(Quality <sup>1</sup> )		)
		oz/A	-	7/16	7/23	7/29	8/13	8/20			
LEGACY	1.52MEC	8	MAY/4/8 WAT	8.5a	8.3ab	8.5a	8.5a	8.5ab			
LEGACY	1.52MEC	14	MAY/4/8 WAT	8.7a	8.5a	8.8a	8.5a	8.8a			
CHECK				8.0b	8.0b	8.5a	8.5a	8.2b			
LEGACY	1.52MEC	20	MAY/4/8 WAT	8.8a	8.7a	8.8a	8.5a	8.8a			
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	8.8a	8.3ab	8.5a	8.5a	8.7a			

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Table 4.	Height ratings	(in inches) of fairy	way height creeping	g bentgrass and annual	bluegrass, taken in 2008.
	000				U ,

Treatment	Form	Rate	Timing	(		ŀ	Ieight <sup>1</sup>	)		
		oz/A	5	6/5	6/12	6/19	6/25	7/2	7/9	
LEGACY	1.52MEC	8	MAY/4/8 WAT	0.37b	0.37bc	0.39a	0.44a	0.44b	0.41a	
LEGACY	1.52MEC	14	MAY/4/8 WAT	0.36b	0.38bc	0.37a	0.43a	0.44b	0.38ab	
CHECK				0.44a	0.46a	0.38a	0.46a	0.52a	0.38ab	
LEGACY	1.52MEC	20	MAY/4/8 WAT	0.37b	0.32c	0.36a	0.44a	0.44b	0.37b	
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	0.38b	0.39b	0.39a	0.44a	0.43b	0.41ab	

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

**<u>Table 4.</u>** Height ratings (in inches) of fairway height creeping bentgrass and annual bluegrass, taken in 2008.

Treatment	Form	Rate	Timing	(	l 	)		
		oz/A	5	7/16	7/23	7/29	8/13	8/20
LEGACY	1.52MEC	8	MAY/4/8 WAT	0.48a	0.46ab	0.42b	0.42ab	0.46a
LEGACY	1.52MEC	14	MAY/4/8 WAT	0.48a	0.47ab	0.44ab	0.44a	0.50a
CHECK				0.51a	0.49a	0.46a	0.46a	0.47a
LEGACY	1.52MEC	20	MAY/4/8 WAT	0.46a	0.49a	0.44ab	0.39b	0.50a
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	0.44a	0.44b	0.42ab	0.42ab	0.48a

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

Treatment	Form	Rate	Timing	(		We	ights <sup>1</sup>	)	)
		oz/A	0	6/5	6/12	6/19	6/25	7/2	7/9
LEGACY	1.52MEC	8	MAY/4/8 WAT	2.2b	3.8b	5.1ab	18.6a	64.6a	22.4ab
LEGACY	1.52MEC	14	MAY/4/8 WAT	2.5b	3.4bc	5.8ab	15.2a	50.8a	15.6b
CHECK				5.2a	8.5a	8.0a	14.2a	45.8a	29.3a
LEGACY	1.52MEC	20	MAY/4/8 WAT	1.7b	1.3d	2.7b	10.2a	62.1a	16.7b
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	2.3b	1.9cd	5.6ab	15.4a	51.3a	15.7b

<u>**Table 5.**</u> Fresh clipping weight (grams) of creeping bentgrass and annual bluegrass, taken in 2008.

 $\overline{1}$  - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

**<u>Table 5.</u>** Fresh clipping weight (grams) of creeping bentgrass and annual bluegrass, taken in 2008.

Treatment	Form	Rate	Timing	Weights <sup>1</sup>				
		oz/A	0	7/16	7/23	7/29	8/13	8/20
LEGACY	1.52MEC	8	MAY/4/8 WAT	94.7a	14.2a	5.9ab	6.2a	13.6a
LEGACY	1.52MEC	14	MAY/4/8 WAT	74.2a	15.1a	6.5ab	9.7a	16.2a
CHECK				102.6a	13.3a	7.9a	10.2a	15.6a
LEGACY	1.52MEC	20	MAY/4/8 WAT	119.1a	17.2a	6.1ab	6.8a	18.1a
PRIMO MAXX	1MEC	11	MAY/4/8 WAT	89.3a	11.7a	4.9b	8.1a	15.4a
		_						

1 - Means followed by same letter do not significantly differ (P= 0.05 Duncan's New MRT)

### EFFICACY OF LEGACY AS A GROWTH REGULATOR IN A CREEPING BENTGRASS FAIRWAY

### JUNE-AUGUST

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### INTRODUCTION

Legacy is a relatively new premix combination of two commonly used plant growth regulators (trinexapac-ethyl and flurprimidol). Trinexapac-ethyl is commonly used to suppress growth, improve shade tolerance of turf, and improve overall quality of golf course fairways and putting greens. This PGR is commonly used in monostands of creeping bentgrass or mixed stands of turf that include annual bluegrass. Also a gibberelic acid inhibitor, flurprimidol can be used to effectively reduce populations of annual bluegrass when found in mixed stands with creeping bentgrass. Increasing in popularity is the tank-mixing of these two products in hopes of achieving the benefits of both PGRs. The interaction between these two PGRs and any antagonistic or synergistic effects of the combination is relatively unknown. The objectives of this study were to assess the growth suppression capability and safety of Legacy when applied to a creeping bentgrass fairway.

### MATERIALS AND METHODS

This study was initiated at the University of Connecticut Plant Science Research Facility located in Storrs, CT. In October 2006, a monostand of 'Putter' creeping bentgrass was seeded at a rate of 1.0 lb/1000ft2. Prior to seeding, the area was treated with glyphosate and tilled. The area was irrigated as needed to promote rapid seed germination. In 2007, the area was maintained as a typical golf course fairway. In 2008, the area received no fertilizer prior to the study initiation, but was treated with 0.5 lb N/1000 ft<sup>2</sup> on 26 Jul.

Plots measured 3 ft x 8 ft and were arranged in a randomized complete block with 4 replications. All treatments were applied with a  $CO_2$  pressurized (40 psi) backpack sprayer equipped with a flat-fan nozzle and calibrated to deliver 1.0 gal water per 1000 ft<sup>2</sup>. Treatments included 3 progressive rates of Legacy applied on 1 Jun and 11 Jul. Plots were visually rated for quality of and injury to the creeping bentgrass. Finally, clippings were collected from the study approximately once per week by making a single pass through the center of each plot. Clippings from each plot were placed in paper bags and immediately placed in a drying oven ( $60^{\circ}C$ ). Clippings were allowed to dry for at least 3 days prior to weighing. Descriptions of all evaluations are outlined in the footnotes of each data table.

### **RESULTS AND DISCUSSION**

Quality and Injury. No differences in turfgrass quality were observed among treatments when plots were first evaluated on 20 Jun. With one exception, turfgrass quality was equal to or greater in plots treated with Legacy when compared to the untreated control plots (Table 1). On 20 Jul (9 days after the second application), however, turfgrass quality was reduced in plots treated with  $\geq$ 15 fl oz of Legacy when compared to the untreated control plots. This reduction in quality correlates to the increased turfgrass injury observed following the second application of Legacy. Although minor levels of injury were observed on a few rating dates, few differences were observed among treatments or the untreated control. Only after the initial application did injury to the creeping bentgrass reach unacceptable levels ( $\geq$  2.5) (Table 2). Injury ratings after the second application were generally greater than the untreated control, but were still considered acceptable.

Clipping Yields. Clippings were collected at various times throughout the study. Although attempts to collect clippings were made weekly, several rain events precluded the ability to collect. When clippings were first collected on 19 Jun, all treatments provided a reduction in clipping yields (46 to 49%) when compared to the untreated control plots (Table 3). Clipping reductions reduced when plots were rated on 3 Jul and no differences in clipping yields were observed on 10 Jul (5 weeks after treatment; WAT). Following the second application on 11 Jul, clippings were reduced between 29% and 53% for 2 weeks when compared to untreated plots. No differences in clipping weights were observed on 1 and 7 Aug,

but a post-inhibition growth stimulation was observed within plots treated with 20 fl oz of Legacy on 14 Aug (~5 WAT). No differences in the growth of creeping bentgrass as measured by clipping yields were observed on the final rating date.

Based on the results of this one year study, it appears that although multiple applications of Legacy may result in short term discoloration of creeping bentgrass, an increase in quality due to improved density and texture can result from these applications. In terms of bentgrass growth regulation, Legacy reduced clipping weights within the first 2 weeks of the initial application and this reduction in growth ended approximately 3 to 4 weeks after application. Post-inhibition growth stimulation was observed when treatments ceased. The impact of continued application on the growth of bentgrass (rather than only two applications), may be necessary to determine an application interval resulting in continued regulation. Future research may also seek to evaluate Legacy on mixed stands of annual bluegrass and creeping bentgrass to determine the relative growth regulation of the two species and the ability of the combination product to reduce annual bluegrass populations.

### Table 1. Overall Quality of Legacy as a growth regulator in creeping bentgrass fairways.

	Application			Quality <sup>y</sup>			Color <sup>x</sup>
Treatment and rate per 1000 sq ft	timing <sup>z</sup>	20 Jun	3 Jul	20 Jul	1 Aug	15 Aug	20 Jun
Legacy 10 fl oz	AB	5.8 a	6.8 ab	7.0 ab	7.8 a	7.5 a	5.5 a
Legacy 15 fl oz	AB	6.5 a	7.5 a	6.3 b	8.0 a	7.8 a	6.0 a
Legacy 20 fl oz	AB	5.8 a	7.0 ab	6.3 b	8.0 a	7.8 a	5.5 a
Untreated	-	6.8 a	6.3 b	7.3 a	7.5 b	6.5 b	7.3 a

<sup>z</sup> Treatments were applied as follows: A = 1 Jun, B = 11 Jul.

<sup>y</sup> Quality was rated visually on 0 to 9 scale in which 0 = entire plot area brown or dead; 7 = minimum acceptable quality for a golf course fairway; and 9 = optimum density and texture.

<sup>x</sup> Color was rated visually on a 0 to 9 scale in which 0 = entire plot area brown or dead; 7 = minimum acceptable color for a golf course fairway; and 9 = dark green.

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

Table 2. Injury to creeping bentgrass fairways with Legacy as a growth regulator.

	Application			Injury <sup>y</sup>		
Treatment and rate per 1000 sq ft	timing <sup>z</sup>	20 Jun	3 Jul	20 Jul	1 Aug	15 Aug
Legacy 10 fl oz	AB	2.5 a <sup>x</sup>	0.3 a	1.3 ab	0.3 a	0.3 b
Legacy 15 fl oz	AB	2.5 a	0.8 a	1.8 a	0.0 a	0.0 b
Legacy 20 fl oz	AB	2.8 a	0.5 a	1.8 a	0.0 a	0.0 b
Untreated	-	0.8 b	0.0 a	0.5 b	0.5 a	1.8 a

<sup>z</sup> Treatments were applied as follows: A = 1 Jun, B = 11 Jul.

<sup>y</sup> Turfgrass injury was rated on a 0 to 5 scale where 0 = no injury visible; 2.5 = unacceptable injury for a golf course fairway; and 5 = entire plot brown or dead.

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

### Table 3. Impact of Legacy on clipping yield of a creeping bentgrass fairway.

	Application	Clipping weight (grams) <sup>y</sup>			
Treatment and rate per 1000 sq ft	timing <sup>z</sup>	19 Jun	3 Jul	10 Jul	17 Jul
Legacy 10 fl oz	AB	3.1 b	3.3 bc	3.4 a	1.5 b
Legacy 15 fl oz	AB	3.3 b	3.0 c	3.4 a	1.2 b
Legacy 20.0 fl oz	AB	3.1 b	3.5 ab	3.5 a	1.3 b
Untreated	-	6.1 a	3.9 a	3.6 a	2.1 a

<sup>z</sup> Treatments were applied as follows: A = 1 Jun, B = 11 Jul

<sup>y</sup> Clipping weights were collected by mowing a single pass through each 3' x 8' plot with a walk-mower. Following collection from each plot, clippings were placed into paper bags and immediately placed in a drying oven for ≥72 hours.
<sup>x</sup> Means in a column followed by the same letter are not significantly different at *P* ≤ 0.05 according to Fisher's protected least significant difference test.

### Table 3. Impact of Legacy on clipping yield of a creeping bentgrass fairway.

	Application	Clipping weight (grams) <sup>y</sup>					
Treatment and rate per 1000 sq ft	timing <sup>z</sup>	25 Jul	1 Aug	7 Aug	14 Aug	21 Aug	
Legacy 10 fl oz	AB	5.1 b	8.3 a	5.7 a	3.8 ab	1.7 a	
Legacy 15 fl oz	AB	4.0 c	7.5 a	5.2 a	3.6 b	1.6 a	
Legacy 20.0 fl oz	AB	3.3 c	7.6 a	5.9 a	4.2 a	2.0 a	
Untreated	-	7.0 a	7.3 a	5.1 a	3.3 b	1.7 a	

<sup>z</sup> Treatments were applied as follows: A = 1 Jun, B = 11 Jul

<sup>y</sup> Clipping weights were collected by mowing a single pass through each 3' x 8' plot with a walk-mower. Following

collection from each plot, clippings were placed into paper bags and immediately placed in a drying oven for ≥72 hours.
<sup>x</sup> Means in a column followed by the same letter are not significantly different at *P* ≤ 0.05 according to Fisher's protected least significant difference test.

# PHYTOTOXICITY TO POA ANNUA FOLLOWING REPEATED APPLICATION OF TRINITY, BANNER MAXX AND EXPERIMENTAL FUNGICIDES

#### JUNE-AUGUST

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### INTRODUCTION

Various products are applied to golf course putting greens to improve the overall quality and playability of the turf. These may include fungicides for the control of common and chronic turfgrass diseases and also plant growth regulators (PGRs) to suppress turf growth, improve turf quality, and reduce clipping yields. While PGRs are applied to reduce canopy growth, some fungicides such as those within the DMI chemical class may provide additional suppression of turf growth when applied repeatedly. While the tank-mixing of these products is often done to reduce the need to make multiple applications, the impact on turfgrass quality is unclear. The purpose of this study was to assess the potential for phytotoxicity to an annual bluegrass putting green when the relatively new fungicide Trinity (triticonazole) is applied repeatedly alone or in a tank-mix with the PGR Primo MAXX (trinexapac ethyl). Also included for comparison is the commonly applied fungicide Banner MAXX (propiconazole) and two experimental fungicides (A7402 and A6780).

### **MATERIALS & METHODS**

This study was conducted on mixed stand of creeping bentgrass and annual bluegrass maintained as a putting green. The area was established from core cultivation plugs obtained from various golf courses in Connecticut between 2005 and 2006. The site is mowed 5 days per week to a height of between 0.125 to 0.156 inches. Treatments included Primo MAXX, Trinity, and Banner MAXX applied alone or in combination with each other and are listed in the treatment table. All treatments are applied with a  $CO_2$  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>. Additional experimental fungicides have also been included in this study.

### RESULTS

Treatments were initiated on 1 Jun and subsequent applications were made on the dates listed in Table 1. Within one week of the initial application (WAIT), minor injury was observed within plots treated with various products, but no differences were observed among any treatments. Additionally, minor injury was also observed within the untreated control plots indicating that decreased quality was not necessarily the result of the treatments applied. Between 20 Jun and 3 Jul, moderate injury ( $\geq$ 2.0) was observed within plots treated with Primo alternated with Trinity (2.0 fl oz), Banner MAXX (2.0 fl oz), Trinity (1.0 fl oz, with weekly Primo applications), or A6780 (1.0 fl oz). A severe decline in the study site occurred during the month of Jul. Although minor injury was observed within the untreated plots in early Jul (0.5 to 0.8), injury to the annual bluegrass was severe (4.0 to 4.3) by 1 Aug. When plots were rated on 1 Aug, a shift in injury was noted among treatments. In general, plots treated with Primo alone (weekly) or with Trinity or Banner MAXX at the 1.0 fl oz rate had unacceptable injury ( $\geq$ 2.5) on 1 Aug. On the final rating date of 15 Aug (approximately 4 weeks after the last fungicide and 3 weeks after the last Primo application), the only plots that had acceptable or near acceptable injury levels (<2.5) were plots treated with 2.0 fl oz of either Banner MAXX or Trinity and alternated with Primo.

#### DISCUSSION

Injury to the annual bluegrass putting green was observed early in the study, but differences in injury during the later ratings made interpretation of the results difficult. Although not entirely clear, it appeared that those treatments in which higher rates (2.0 fl oz) of Trinity or Banner MAXX were applied four times in an alternate fashion with Primo resulted in the least injury to the annual bluegrass putting green. On the other hand, plots receiving either Trinity or Primo alone appeared to decline quickly following their respective final application. While injury was higher earlier in the season when application of Banner or Trinity (2.0 fl oz) were alternated with Primo, these treatments appeared to provide the greatest quality later in the season when decline of the annual bluegrass became most apparent.

Field reports of phytotoxicity or annual bluegrass decline following the application of Trinity have been reported since its introduction. While results of this study indicate that the application of DMI's such as Trinity and Banner MAXX can result in an increase in annual bluegrass injury, especially when Primo is also being applied, the direct relationship between this injury and the fungicide applications remains unclear. Future research should focus on the impact of alternating fungicides to prevent the additional growth regulation effect, but also should take a closer look at the impact of stopping applications of the fungicides. Although some moderate injury was observed following the initial applications in this study, it appeared that subsequent applications actually reduced the injury to annual bluegrass. On the other hand, fungicides applied alone or on a 28-d interval (application timing AE) were met with a dramatic decline in quality and increased injury after the final application on 2 Jul. This reduction was delayed when fungicides were applied on a 14-d interval and last applied on 15 Jul. In the study site, while it was apparent that anthracnose was causing a portion of the decline it appeared that much of the decline was the result of unknown abiotic or environmental conditions. Based on results of this study and tendencies of golf course superintendents, stopping the application of DMI's after the initial signs of injury may actually result in an increase in biotic and abiotic stresses that continue to cause turf decline.

Table 1. Injury to an annual bluegrass putting green following the application of Trinity, Banner MAXX and two experimental fungicides applied alone or alternated with Primo MAXX.

	Application <sup>z</sup>			Injury <sup>y</sup>		
Treatment and rate per 1000 sq ft	timing	9 Jun	20 Jun	3 Jul	1 Aug	15 Aug
Trinity 1.0 fl oz	ACEG	1.8 a <sup>x</sup>	1.3 a-d	1.0 bc	2.8 bc	2.8 cde
Trinity 1.0 fl oz	AE	0.8 a	0.3 d	0.5 c	3.3 ab	3.8 abc
Primo 0.125 fl oz	ABCDEFG	0.8 a	1.0 bcd	1.0 bc	2.8 bc	3.3 a-d
Trinity 1.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	0.3 a	1.3 a-d	1.5 abc	1.8 cd	3.0 bcd
Trinity 2.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	1.3 a	2.0 ab	2.5 a	1.8 cd	1.8 e
Banner MAXX 2.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	1.3 a	2.3 a	2.0 ab	1.8 cd	2.5 de
Trinity 1.0 fl oz alternated w/	AE					
Primo MAXX 0.125 fl oz	BCDFGH	0.5 a	2.0 ab	2.5 a	2.8 bc	3.0 bcd
A7402 0.625 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	1.0 a	1.0 bcd	1.3 bc	1.5 d	3.0 bcd
A6780 1.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	0.5 a	2.3 a	2.0 ab	1.8 cd	2.8 cde
Banner MAXX 1.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	0.5 a	1.5 abc	1.5 abc	2.8 bc	3.8 abc
Untreated	-	0.5 a	0.3 d	0.5 c	4.3 a	4.0 ab
Untreated	-	1.0 a	0.5 cd	0.8 c	4.0 a	4.3 a

<sup>z</sup> Treatments were applied as follows: A = 1 Jun, B=11 Jun, C=18 Jun, D=24 Jun, E=2 Jul, F=7 Jul, G= 15 Jul, H= 25 Jul. <sup>y</sup> Turfgrass injury was rated on a 0 to 5 scale where 0 = no injury visible; 2.5 = unacceptable injury to an annual bluegrass

putting green; and 5 = entire stand of annual bluegrass brown or dead.

\* 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 El adality failing of priviological annual fonoming repeated failgiblate application
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	Application <sup>z</sup>			Quality <sup>y</sup>		
Treatment and rate per 1000 sq ft	timing	9 Jun	20 Jun	3 Jul	1 Aug	15 Aug
Trinity 1.0 fl oz	ACEG	6.0 a <sup>x</sup>	6.8 a	6.5 ab	7.0 ab	5.8 a
Trinity 1.0 fl oz	AE	6.3 a	6.5 a	7.0 a	6.3 bc	6.0 a
Primo 0.125 fl oz	ABCDEFG	6.5 a	6.8 a	6.8 a	7.0 ab	7.5 a
Trinity 1.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	6.8 a	5.3 a	6.3 abc	7.3 a	7.0 a
Trinity 2.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	6.5 a	6.5 a	5.5 c	7.8 a	8.0 a
Banner MAXX 2.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	6.3 a	6.0 a	5.8 bc	7.8 a	8.0 a
Trinity 1.0 fl oz alternated w/	AE					
Primo MAXX 0.125 fl oz	BCDFGH	6.8 a	5.8 a	5.8 bc	7.0 ab	7.0 a
A7402 0.625 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	6.3 a	6.5 a	6.3 abc	7.3 a	6.8 a
A6780 1.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	7.0 a	6.3 a	6.5 ab	7.5 a	7.5 a
Banner MAXX 1.0 fl oz alternated w/	ACEG					
Primo MAXX 0.125 fl oz	BDFH	6.5 a	5.8 a	6.5 ab	7.0 ab	7.3 a
Untreated	-	7.0 a	6.8 a	7.0 a	6.0 c	6.8 a
Untreated	-	6.5 a	6.8 a	6.8 a	5.8 c	6.8 a

<sup>z</sup> Treatments were applied as follows: A = 1 Jun, B=11 Jun, C=18 Jun, D=24 Jun, E=2 Jul, F=7 Jul, G= 15 Jul, H= 25 Jul

<sup>9</sup> Quality of an annual bluegrass and creeping bentgrass putting green was rated visually on 0 to 9 scale where 0 = entire plot area brown or dead; 7 = minimum acceptable quality for a golf course putting green; and 9 = optimum density and green color. Ratings were made on turf that was living and dead turf was not included in the evaluation as a means of determining the impact of the treatments on surviving plants.

\* 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.

### PREVENTIVE CONTROL OF BROWN PATCH WITH VARIOUS FUNGICIDES

### JUNE-AUGUST

J.E. Kaminski

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### INTRODUCTION

Brown patch (*Rhizoctonia solani*) is a common disease of turfgrasses in the Mid-Atlantic and southern regions of New England. The purpose of the study was to evaluate the efficacy of various fungicides for controlling brown patch when applied prior to the development of symptoms.

### **MATERIALS & METHODS**

The study was conducted at the University of Connecticut Plant Science Research and Education Facility located in Storrs, CT. The area used for the study was a mature stand of colonial bentgrass (*Agrostis capillaris*) that was established in 2006. The area was maintained as a golf course fairway and was mowed approximately 3 times per week to a height of 0.5 inches and clippings were removed.

Plots measured 3 x 6' and were arranged as a randomized complete block design with four replications. Fungicides were applied with a  $CO_2$  pressurized (40 psi) sprayer equipped with a flat-fan nozzle and calibrated to deliver 2.0 gal water per 1000 ft<sup>2</sup>. Granular products (GR) were applied by hand using a shaker jar. Treatments were applied on the dates footnoted in the data tables.

### **RESULTS & DISCUSSION**

No disease was present at the time when applications were first applied on 27 Jun. Shortly after the first application disease symptoms began to develop and moderate to severe symptoms were noted in the untreated plots and surround areas on 11 Jul. Excellent suppression of brown patch (<1%) on all rating dates was observed by Heritage, Insignia, Disarm (both rates), Headway, and both rates of the experimental fungicides DPX-LEM 17-50-80 (Table 1). Good control ( $\leq 5.0\%$ ) was achieved on all rating dates for the following treatments: Compass, Tourney, Endorse, EXC4084, Heritage GR, and Tartan. In general, long term suppression was provided by fungicides in the QoI chemical class, but the DMI fungicides provided 2 to 3 weeks control before breaking down. Turfgrass quality generally followed closely with the level of brown patch within plots and poor quality was observed within plots treated with Rhapsody, A7402T (0.625 fl oz) and in the untreated control plots.

Previous research conducted at the University of Connecticut has shown that various fungicides have effectively provided acceptable control of brown patch. Excellent control generally is achieved with many different fungicides, but application interval and rate often vary for the different products. Granular products evaluated in past studies have generally performed well when applied to short cut turf such as a golf course fairway. The ability of granular products to suppress brown patch on higher cut turf such as a tall fescue lawn has not been investigated. It should be pointed out that the two granular products evaluated in this study (Heritage GR and EXC4084) will move in an acropetal fashion (upward) within the plant and therefore may still offer acceptable control when applied to higher cut turf.

Table 1 Percent brown patch of preventive control of brown patch with various fundicides

	Application <sup>z</sup>		Percent brown patc	h <sup>y</sup>
Treatment and rate per 1000 sq ft	timing	11 Jul	4 Aug	18 Aug
Rhapsody 5.0 fl oz	ACE	26 aw	52 a	48 a
Rhapsody 5.0 fl oz + Heritage 1.0 fl oz	ACE	<1 c	2 d	0
Heritage 2.0 fl oz	AD	<1 c	0 e	<1 g
Insignia 0.9 oz	AE	<1 c	0 e	0 g
Disarm 0.36 fl oz	AE	0 c	0 e	0 g
Disarm 0.18 fl oz	AD	<1 c	0 e	0 g
Compass 0.2 fl oz	AD	1 c	0 e	4 fg
Tourney 0.28 fl oz	AD	<1 c	2 e	2 fg
A7402T 0.31 fl oz	AD	13 b	19 c	8 efg
A7402T 0.625 fl oz	AD	7 bc	16 cd	14 b-g
Triton 1.0 fl oz	AD	0 c	4 e	9 d-g
Trinity 1.0 oz	AD	6 bc	3 e	9 d-g
Bayleton 1.0 fl oz	AE	13 c	6 de	4 fg
Banner MAXX 2.0 fl oz	AD	8 bc	6 de	16 b-f
Banner MAXX 1.0 fl oz + Daconil Ultrex 3.2 oz	AD	1 c	2 e	12 c-g
Chipco 26GT 2.0 oz	AD	2 c	5 e	23 bcd
26/36 4.0 fl oz	AD	2 c	1 e	7 efg
Endorse 4.0 oz	AD	<1 c	2 e	1 g
EXC4084 64 oz	AE	3 c	4 e	2 fg
Heritage GR 64 oz	AE	3 c	<1 e	0 g
Headway 2.25 fl oz	AE	0 c	<1 e	0 g
Tartan 2.0 fl oz	AE	<1 c	3 e	2 fg
Vitalonil 5.5 fl oz	ACE	8 bc	3 e	27 b
DPX-LEM 17-50-80 0.3 oz	ACE	<1 c	<1 e	<1 g
DPX-LEM 17-50-80 0.5 oz	ACE	0 c	0 e	0 g
Quali-Pro Iprodione 4.0 fl oz	ACE	2 c	2 e	14 b-g
Quali-Pro Chlorothalonil 3.24 oz	ACE	2 c	<1 e	12 c-g
Quali-Pro Thiophanate Methyl 1.33 oz	ACE	2 c	2 e	20 b-e
Quali-Pro Propiconazole 2.0 fl oz	AD	6 bc	7 de	19 b-e
Untreated	-	24 a	37 b	26 bc

<sup>z</sup> Treatments were applied as follows: A = 27 Jun, C = 11 Jul, D = 17 Jul, and E = 25 Jul.

<sup>y</sup> Percent of the plot area infested by brown patch was visually rated on a 0 to 100 percent scale where 0 = no brown patch present and 100 = entire plot exhibiting brown patch symptoms. Means in a column followed by the same letter are not significantly different at  $P \le 0.05$  level according to the Fisher's

w protected least significant difference t-test.

Table 2.	Percent brown	patch and o	uality of	preventive	control of brown	patch with	various fungicides
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	Application <sup>z</sup>	Quality <sup>y</sup>	
Treatment and rate per 1000 sq ft	timing	3 Jul	
Rhapsody 5.0 fl oz.	ACE	5.5 f <sup>x</sup>	
Rhapsody 5.0 fl oz + Heritage 1.0 fl oz	ACE	8.0 ab	
Heritage 2.0 fl oz	AD	7.8 abc	
Insignia 0.9 oz	AE	8.3 a	
Disarm 0.36 fl oz	AE	8.0 ab	
Disarm 0.18 fl oz	AD	8.0 ab	
Compass 0.2 fl oz	AD	7.8 abc	
Tourney 0.28 fl oz	AD	8.0 ab	
A7402T 0.31 fl oz	AD	6.5 def	
A7402T 0.625 fl oz	AD	7.3 a-d	
Triton 1.0 fl oz	AD	8.0 ab	
Trinity 1.0 oz	AD	7.3 a-d	
Bayleton 1.0 fl oz	AE	7.0 bcd	
Banner MAXX 2.0 fl oz	AD	7.0 bcd	
Banner MAXX 1.0 fl oz + Daconil Ultrex 3.2 oz	AD	8.3 a	
Chipco 26GT 2.0 oz	AD	8.0 ab	
26/36 4.0 fl oz	AD	7.8 abc	
Endorse 4.0 oz	AD	8.3 a	
EXC4084 64 oz	AE	8.3 a	
Heritage GR 64 oz	AE	7.8 abc	
Headway 2.25 fl oz	AE	8.3 a	
Tartan 2.0 fl oz	AE	8.3 a	
Vitalonil 5.5 fl oz	ACE	6.8 cde	
DPX-LEM 17-50-80 0.3 oz	ACE	8.3 a	
DPX-LEM 17-50-80 0.5 oz	ACE	8.3 a	
Quali-Pro Iprodione 4.0 fl oz	ACE	7.8 abc	
Quali-Pro Chlorothalonil 3.24 oz	ACE	7.8 abc	
Quali-Pro Thiophanate Methyl 1.33 oz	ACE	8.0 ab	
Quali-Pro Propiconazole 2.0 fl oz	AD	7.3 a-d	
Untreated	-	5.8 ef	

<sup>2</sup> Treatments were applied as follows: A = 27 Jun, C = 11 Jul, E = 25 Jul, G = 08 Aug. <sup>y</sup> Quality was rated visually on 0-9 scale <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.

### PREVENTIVE CONTROL OF ANTHRACNOSE BASAL ROT ON A RESEARCH PUTTING GREEN

### JUNE-AUGUST

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### INTRODUCTION

Anthracnose (*Colletotrichum cereale*; previously *C. graminicola*) is emerging as a major pest problem on annual bluegrass putting greens in the Northeastern United States. In many cases, curative control of anthracnose is difficult or near impossible and various fungicides often are used in succession to arrest disease development. The purpose of this study was to assess the ability of various fungicides to provide acceptable control of the disease when applied prior to symptoms becoming present.

### **MATERIALS & METHODS**

The study was initiated on a newly constructed annual bluegrass putting green at the Plant Science Research and Education Facility located in Storrs, CT. The putting green was constructed from core cultivation plugs collected from various golf courses through Connecticut between 2005 and 2006. Annual bluegrass plugs were spread over native soil. Between 2005 and 2006, the area was subjected to routine topdressing and slowly lowered to a height of 0.140".

Prior to initiation of the study, the area was treated with 0.5 lb N/1000 ft<sup>2</sup> from urea to increase density from winter injury. All treatments were applied on a 14-d interval with initial treatments applied on 5 Jun. All treatments were applied with a  $CO_2$  pressurized (40 psi) sprayer equipped with an air induced flat-fan nozzle, and calibrated to deliver 2.0 gal water per 1000 ft<sup>2</sup>. Plots measured 3'x6' and were arranged as a randomized complete block with 4 replications. All treatments and application dates are listed in the data tables. Data collected included percent plot area affected by anthracnose, anthracnose severity and quality. Data ratings are described in the footnotes of data tables.

### RESULTS

No anthracnose was present when treatments were first applied on 5 Jun and only trace amount were visible until early to mid Jul (Table 1). When plots were rated on 3 Jul, no differences in percent plot area affected by anthracnose was observed among treatments and all plots had  $\leq 4\%$  anthracnose. Based on quality (Table 2), anthracnose severity increased in mid to late-Jul and the untreated control plots had an average of 31% disease by 1 Aug. On this date, plots treated with Daconil Ultrex + Chipco Signature had the least amount of anthracnose (<1%) and good control ( $\leq 5\%$ ) was afforded within plots treated with Tartan + Chipco Signature, Syngenta Program, Daconil Ultrex + Medallion, Concert, LBG-31 + Dovetail, and Spectro + Alude. Although considered unacceptable (>5%), plots treated with Instrata, DPX-LEM17-50-80, Endorse + Alude, and Disarm C had statistically similar levels of anthracnose as all previously mentioned treatments. On the final rating date (15 Aug, ~ 1 month after last application), acceptable suppression of anthracnose was observed within plots treated with Instrata and LBG-31 + Dovetail when compared to the untreated control. No other treatments provided a reduction in percent plot area affected by anthracnose when compared to the untreated control. No

### DISCUSSION

Anthracnose was considered severe in this study and most treatments did not provide adequate suppression once disease activity increased in late Jul. No single active ingredient provided acceptable anthracnose control during the study. When applied as a tank-mix or a pre-mix, disease suppression was generally better. Treatments containing chlorothalonil generally improved disease suppression during the study and only treatments containing this active ingredient provided acceptable control on the final rating date. Results of this study reinforce the theory that tank-mixing multiple active ingredients and liberal use of chlorothalonil will generally result in improved suppression of anthracnose.
While previous research has shown that the QoI fungicides are effective against Colletotrichum, results from this study indicate that resistance at the Storrs study site may have developed.

	Application <sup>z</sup>			Anthi	acnose <sup>y</sup>	
Treatment and rate per 1000 sq ft	Timing	20 Jun	3 Jul	1 Aug	15 Aug	15 Aug
				%		Severity (0-5)
Daconil Ultrex 3.2 oz + Chipco Signature 4.0 oz	ACEG	<1 a <sup>×</sup>	<1 a	<1 g	2 j	1.0
Tartan 1.5 fl oz + Chipco Signature 4.0 oz	ACEG	<1 a	<1 a	4 fg	18 c-h	3.5 efg
Insignia 0.9 oz	ACEG	<1 a	<1 a	22 a-d	21 а-е	5.0 a
Trinity 1.0 fl oz + Insignia 0.7 oz	ACEG	2 a	2 a	29 ab	27 abc	4.8 ab
Trinity 1.0 fl oz	ACEG	<1 a	2 a	27 ab	19 b-g	4.3 bcd
SP2059 1.0 oz	ACEG	1 a	3 a	30 ab	31 ab	5.0 a
SP2059 2.0 oz	ACEG	<1 a	<1 a	25 abc	25 a-d	5.0 a
Syngenta program <sup>w</sup>	ACEG	0 a	0 a	2 g	8 f-j	2.5 hi
Daconil Ultrex 2.4 oz + Medallion 0.25 oz	ACEG	<1 a	<1 a	4 fg	7 g-j	1.8 jk
Concert 4.0 fl oz	ACEG	2 a	2 a	3 fg	5 hij	2.3 ij
Instrata 4.25 fl oz	ACEG	<1 a	<1 a	7 efg	13 d-j	2.5 hi
DPX-LEM17-50-80 0.2 oz	ACEG	<1 a	<1 a	23 abc	20 b-g	4.8 ab
DPX-LEM17-50-80 0.3 oz	ACEG	<1 a	1 a	17 b-f	20 a-f	3.8 def
DPX- LEM17-50-80 0.4 oz	ACEG	<1 a	<1 a	22 а-е	24 a-d	4.0 cde
DPX- LEM17-50-80 0.5 oz	ACEG	1 a	2 a	11 c-g	19 b-d	3.8 def
LBG-31 5.5 fl oz + Dovetail 2.0 fl oz	ACEG	1 a	2 a	4 fg	9 e-j	2.3 ij
Endorse 4.0 oz + Alude 6.0 fl oz	ACEG	<1 a	1 a	10 c-g	17 c-i	3.0 gh
Spectro 3.5 oz + Alude 6.0 fl oz	ACEG	<1 a	<1 a	2 g	4 ij	1.3 kl
Disarm 0.27 fl oz	ACEG	<1 a	<1 a	29 ab	23 a-d	4.3 bcd
Disarm C 4.32 fl oz	ACEG	1 a	3 a	7 d-g	22 a-d	3.3 fg
Disarm 0.27 fl oz + ARY-0438-002 0.44 oz	ACEG	2 a	4 a	29 ab	33 a	4.5 abc
ARY-0438-002 0.44 oz	ACEG	<1 a	2 a	29 ab	31 ab	5.0 a
Untreated	-	<1 a	1 a	32 a	29 abc	5.0 a
Untreated	-	<1 a	1 a	30 ab	27 abc	5.0 a

Table 2. Percent Anthracnose of preventive control of anthracnose basal rot on a research putting green

<sup>z</sup> Treatments were applied as follows: A=05 Jun, C = 19 Jun, E= 07 Jul, and G = 18 Jul.

\* Percent of the plot area with Anthracnose was visually rated on a 0 to 100 percent scale where 0 = no anthracnose was present or 100 = entire plot area affected by anthracnose. Anthracnose severity was rated on a 0 to 5 scale where 0 = no visible anthracnose symptoms present and 5.0 = all annual bluegrass within plot dead.

<sup>y</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

<sup>w</sup> Full details of Syngenta program listed in table 3.

Table 2. Turfgrass quality of preventive control of anthracnose basal rot on a research putting green

	Application <sup>z</sup>	•	Quality	
Treatment and rate per 1000 sq ft	Timing	20 Jun	3 Jul	20 Jul
Daconil Ultrex 3.2 oz + Chipco Signature 4.0 oz	ACEG	8.0 a <sup>x</sup>	8.3 ab	7.5 ab
Tartan 1.5 fl oz + Chipco Signature 4.0 oz	ACEG	8.0 a	8.0 abc	7.3 abc
Insignia 0.9 oz	ACEG	7.3 a-d	7.5 a-e	4.3 h-k
Trinity 1.0 fl oz + Insignia 0.7 oz	ACEG	6.8 c-f	6.8 de	3.8 ijk
Trinity 1.0 fl oz	ACEG	7.0 b-e	6.8 de	4.3 h-k
SP2059 1.0 oz	ACEG	7.5 abc	6.8 de	4.3 h-k
SP2059 2.0 oz	ACEG	6.8 c-f	7.0 cde	4.8 f-i
Syngenta program <sup>w</sup>	ACEG	6.5 def	7.8 a-d	8.0 a
Daconil Ultrex 2.4 oz + Medallion 0.25 oz	ACEG	6.3 ef	7.3 b-e	7.5 a
Concert 4.0 fl oz	ACEG	6.8 c-f	7.0 cde	7.0 abc
Instrata 4.25 fl oz	ACEG	7.8 ab	8.5 a	7.3 abc
DPX-LEM17-50-80 0.2 oz	ACEG	6.8 c-f	7.3 b-e	5.0 fgh
DPX-LEM17-50-80 0.3 oz	ACEG	7.0 b-e	6.5 e	5.5 efg
DPX- LEM17-50-80 0.4 oz	ACEG	7.0 b-e	7.5 a-e	5.8 def
DPX- LEM17-50-80 0.5 oz	ACEG	7.0 b-e	7.5 a-e	6.3 cde
LBG-31 5.5 fl oz + Dovetail 2.0 fl oz	ACEG	6.0 f	7.0 cde	7.3 abc
Endorse 4.0 oz + Alude 6.0 fl oz	ACEG	7.3 a-d	7.3 b-e	6.3 cde
Spectro 3.5 oz + Alude 6.0 fl oz	ACEG	7.0 b-e	7.3 b-e	7.0 abc
Disarm 0.27 fl oz	ACEG	7.8 ab	6.8 de	5.0 fgh
Disarm C 4.32 fl oz	ACEG	7.3 a-d	7.3 b-e	6.8 bcd
Disarm 0.27 fl oz + ARY-0438-002 0.44 oz	ACEG	6.5 def	6.5 e	4.0 h-k
ARY-0438-002 0.44 oz	ACEG	7.0 b-e	6.8 de	4.5 g-j
Untreated	-	7.0 b-e	6.5 e	3.5 jk
Untreated	-	7.0 b-e	7.0 cde	3.3 k

<sup>z</sup> Treatments were applied as follows: A=05 Jun, C = 19 Jun, E= 07 Jul, and G = 18 Jul. <sup>y</sup> Quality was rated visually on 0-9 scale

<sup>×</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.
<sup>w</sup> Full details of Syngenta program listed in table 3.

Table 3.	Syngenta program	consisted of the followin	g treatments sequenti	ally applied on a	14-d interval.
			g		

Product	Rate
Primo MAXX + Instrata followed by	0.15 fl. oz. + 4.25 fl. oz.
Primo MAXX + Daconil Ultrex followed by	0.15 fl. oz. + 3.2 oz.
Primo MAXX + Concert + Medallion followed by	0.15 fl. oz. + 4.0 fl. oz. + 0.25 oz.
Primo MAXX + Daconil Ultrex + Heritage followed by	0.15 fl. oz. + 3.2 oz. + 2.0 fl. oz.
Primo MAXX + Concert + Medallion +	0.15 fl. oz. + 4.0 fl. oz. + 0.25 oz. +
Subdue MAXX followed by	0.5 fl. oz.
Primo MAXX + Daconil Ultrex + Heritage	0.15 fl. oz. + 3.2 oz. + 3.0 fl. oz.

Preventive control of dollar spot on a creeping bentgrass fairway with various fungicides

## JUNE-SEPTEMBER

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## INTRODUCTION

Fungicides are commonly used for preventive and curative control of dollar spot (*Sclerotinia homoeocarpa*). As new fungicides are developed, their efficacy must be evaluated in both laboratory and field situations. In addition, field evaluation of these fungicides in various parts of the country is important. The objective of this study was to evaluate the relative efficacy and turf safety of commercially available and confidential fungicides against dollar spot.

## **MATERIALS & METHODS**

This study was initiated at the University of Connecticut Plant Science Research and Education Facility located in Storrs, CT. Soil was a loam with a pH of 5.9 and 7.2% OM. Turfgrass used for the fungicide evaluation is a 1.5 year old stand of 'Crenshaw' creeping bentgrass (*Agrostis stolonifera*). The area was maintained as a bentgrass fairway and mowed three times per week to a height of 0.5 in. All treatments were applied with a  $CO_2$  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>. Initial treatments were applied on 2 Jun and individual treatments were reapplied according to the schedule listed in the treatment table.

Plots measured 3 ft x 6 ft and were arranged in a randomized complete block with four replications. Dollar spot severity was assessed every 2 weeks throughout the study. Initial dollar spot severity was rated by counting the number of *S*. *homoeocarpa* infection centers per plot. As disease severity increased, percent plot area affected by *Sclerotinia homoeocarpa* was visually rated on a 0 to 100 scale where 0 = entire plot void of dollar spot and 100 = entire plot area covered with dollar spot symptoms. Other observations included quality, injury and color.

## RESULTS

Dollar spot. Dollar spot symptoms first appeared within the study site 1 week after the initial application (10 Jun). In early to mid-Jul, dollar spot severity was low. Towards the end of Jul, percent dollar spot began to increase and the greatest amount of dollar spot was found within plots treated with SP2059 and the untreated control. Except for these plots, little to no dollar spot was present within all fungicide-treated plots until after the last treatments were applied on 4 or 12 Aug. Dollar spot activity increased in Sep. Dollar spot started to break through within 2 to 3 weeks after the final application in most fungicide treatments applied on a 14-d or 28-d interval. Several treatments, including Emerald (alone or tank-mixed), Trinity + Iprodione (3.0 fl oz), Curalan, A16422A (3.6 fl oz), Headway, Tartan, and Concert continued to show excellent disease suppression (<1%) for up to five weeks after the final application. Among 21-d interval treatments, dollar spot levels were low (<1.0%) within plots treated with Trinity (1.5 fl oz), A15925A, and 26/36 for 3 to 4 weeks after the final applications, but acceptable suppression for these treatements did not last for 5 weeks.

Plots treated with Emerald generally provided complete control during the application timing and approximately 4 to 5 weeks of continued suppression following the last application regardless of tank-mix combination. Trinity also provided excellent control for approximately 3 to 4 weeks, regardless of whether applied alone or in combination with Iprodione Pro. Curalan provided complete or near complete control of dollar spot for up to 4 to 5 weeks following application. The contact fungicide Daconil Weather Stik controlled the disease during application, but began to breakdown within 2 to 4 weeks after the final application and was rate dependent. Bayleton was the only fungicide applied on a 28-d interval in this study and provided complete or near complete control when applications were being made and for approximately 4 to 5 weeks after the final application.

Injury. Injury to the creeping bentgrass from a few of the treatments was observed after multiple applications. Although no treatments reached an unacceptable threshold (≥2.5) on any rating date, several treatments had slight to moderate

injury that was visibly noticeable (Table 2). Injury to the creeping bentgrass was moderate (2.0) when plots were rated aabout 2 weeks after the second or fifth application of Bayleton or Heritage, respectively. Injury within plots treated with Bayleton peaked on 6 Aug (2 days after the third and final application), but injury within these plots was among the highest on all rating dates after 23 Jul. Among all rating dates, treatments that had the highest injury ratings on one ore more days included Headway, Tartan, Bayleton, Trinity (1.5 fl oz), and Tourney (0.28 oz).

# DISCUSSION

Except for SP2059, all treatments provided excellent control of dollar spot when treatments were routinely applied. Due to the reduced activity of dollar spot during the season, few differences were observed among treatments. Once disease pressure increased and treatments ceased, most fungicides provided between 2 to 5 weeks of additional control before dollar spot became unacceptable. Although differences in dollar spot severity was observed later in the season when fungicides started to become less efficacious, most performed at or above labeled expectations of 14 to 28 days of control. When selecting fungicides for the suppression of dollar spot, caution should be used so as not to repeat applications of a single active ingredient or chemical class to prevent the development of resistance. Additionally, the repeated use of fungicides that can have growth regulation effects during the summer months (e.g., DMI) may cause an increase in injury to the turf and rotation of these producs is recommended. Extended periods of control observed by select treatments in this study, however, may be viewed an indicator of proper fungicide selection later in the season to carry dollar spot control until the period when the disease is likely to become inactive.

Table 1. Percent dollar spot following application of various confidential fungicides, Storrs, 2008.

				5113, 2000.	.V	
	Application		Per	cent dollar sp	pot'	
Treatment and rate per 1000 sq ft	Timing	<u>16 Jun</u>	23 Jun	30 Jun	7 Jul	14 Jul
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	0.0 a^	0.0 a	0.0 b	0.0 c	0.0 c
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Curalan 1.0 oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
SP2059 1.0 oz	14-d	0.0 a	0.0 a	0.1 a	0.1 b	0.2 a
SP2059 2.0 oz	14-d	0.0 a	0.0 a	0.1 a	0.1 a	0.2 a
Emerald 0.13 oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Trinity 1.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Trinity 1.5 fl oz	21-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Daconil Weather Stik 2.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Daconil Weather Stik 3.6 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
A16422A 2.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
A16422A 3.6 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
A16422B 2.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
A16422B 3.6 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Daconil Ultrex 1.8 oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 bc
Daconil Ultrex 3.2 oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
A15935A 2.5 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 bc
A15935A 4.5 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
A15935A 2.5 fl oz	21-d	0.0 a	0.0 a	0.0 b	0.0 c	0.1 b
A15935A 4.5 fl oz	21-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Daconil Weather Stik 2.0 fl oz + Heritage						
TL 0.2 oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Headway 1.5 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Tartan 1.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Concert 3.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Bavleton 1.0 oz	28-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Tourney 0.18 oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Tourney 0.28 oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
DPZ-LEM17-50-80 0.3 oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
DPZ-LEM17-50-80 0.5 oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
26/36 4.0 fl oz	21-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Quali-Pro Chlorothalonil 3.24oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Quali-Pro Iprodione 4.0 fl oz	14-d	0.0 a	0.0 a	0.0 b	0.0 c	0.0 c
Check	-	0.0 a	0.0 a	0.1 a	0.1 a	0.2 a

<sup>y</sup> Percent of the plot area with dollar spot was visually rated on a 0 to 100 percent scale where 0 = no dollar spot was present or 100 = entire plot has dollar spot.

Table 1. Percent dollar spot following application of various confidential fungicides, Storrs, 2008.

	Application <sup>z</sup>		Per	cent dollar s	pot <sup>y</sup>	
Treatment and rate per 1000 sq ft	Timing	21 Jul	28 Jul	4 Aug	11 Aug	18 Aug
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	0.0 c <sup>×</sup>	0.0 c	0.0 c	0.0 c	0.0 c
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Curalan 1.0 oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
SP2059 1.0 oz	14-d	0.3 a	0.8 a	1.6 a	3.9 a	4.0 a
SP2059 2.0 oz	14-d	0.2 b	0.5 b	1.1 b	2.1 b	2.6 b
Emerald 0.13 oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Trinity 1.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Trinity 1.5 fl oz	21-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Daconil Weather Stik 2.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.1 c	0.1 c
Daconil Weather Stik 3.6 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
A16422A 2.0 fl oz	14-d	0.0 c	0.1 c	0.0 c	0.2 c	0.1 c
A16422A 3.6 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
A16422B 2.0 fl oz	14-d	0.0 c	0.2 c	0.1 c	0.2 c	0.2 c c
A16422B 3.6 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Daconil Ultrex 1.8 oz	14-d	0.0 c	0.1 c	0.0 c	0.1 c	0.1 c
Daconil Ultrex 3.2 oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
A15935A 2.5 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.1 c
A15935A 4.5 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
A15935A 2.5 fl oz	21-d	0.1 c	0.1 c	0.2 c	0.1 c	0.0 c
A15935A 4.5 fl oz	21-d	0.0 c	0.0 c	0.1 c	0.0 c	0.0 c
Daconil Weather Stik 2.0 fl oz + Heritage						
TL 0.2 oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Headway 1.5 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Tartan 1.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Concert 3.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Bayleton 1.0 oz	28-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Tourney 0.18 oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Tourney 0.28 oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
DPZ-LEM17-50-80 0.3 oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
DPZ-LEM17-50-80 0.5 oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
26/36 4.0 fl oz	21-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Quali-Pro Chlorothalonil 3.24oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Quali-Pro Iprodione 4.0 fl oz	14-d	0.0 c	0.0 c	0.0 c	0.0 c	0.0 c
Check	-	0.2 b	0.4 b	0.9 b	2.5 b	2.7 b

Percent of the plot area with dollar spot was visually rated on a 0 to 100 percent scale where 0 = no dollar spot was present or 100 = entire plot has dollar spot.

Table 1. Percent dollar	spot following ap	oplication of various	confidential fungicides,	Storrs, 2008
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	Application <sup>z</sup>	oonnachtian	Dorcont	dollar cnat <sup>y</sup>	
Treatment and rate per 1000 cg ft	Timing	25 \ua		15 Son	22 Son
Emorph 0.12 oz L T Mothyl 4.5L 2.0 fl.oz	14 d	23 Aug		10 Sep	22.3ep
Emerald 0.13 oz $+$ T-Methyl 4.5L 3.0 fl oz	14-u 14 d	0 0 0	0 e	<1 g	<1 ij
Efficiency $0.13 \text{ oz} + 1$ -intensity $0.75 \text{ float}$	14-0 14-0	00	<1 e	<1 g	<1 ij
Emerald 0.13 oz + Trinity 0.75 ii 02	14-0 14-0	00	<1 e	<19	< 1 mj
Emerald 0.13 02 + Thinky 1.0 II 02	14-0 14-0	00	<1 e	<1 g	<1 IJ
Emerald 0.13 02 + Iprodione Pro 3.0 II 02	14-0	<10	<re< td=""><td>&lt;1 g</td><td>&lt;1 IJ</td></re<>	<1 g	<1 IJ
Emeraid 0.13 oz + Iprodione Pro 4.0 fl oz	14-0	U C	0 e	<1 g	<11
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-0	<1 C	<1 e	<1 g	∠ ī-j
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	0 C	<1 e	<1 g	<1 nij
I rinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	0 C	<1 e	<1 g	4 e-j
Curalan 1.0 oz	14-d	0 c	0 e	<1 g	<1 j
SP2059 1.0 oz	14-d	4 a	12 a	25 a	29 a
SP2059 2.0 oz	14-d	3 b	9 c	18 b	22 b
Emerald 0.13 oz	14-d	0 c	<1 e	<1 g	<1 ij
Trinity 1.0 fl oz	14-d	0 c	<1 e	<1 fg	3 e-j
Trinity 1.5 fl oz	21-d	<1 c	<1 e	2 efg	5 d-g
Daconil Weather Stik 2.0 fl oz	14-d	<1 c	<1 e	2 fg	4 e-j
Daconil Weather Stik 3.6 fl oz	14-d	<1 c	<1 e	<1 g	1 g-j
A16422A 2.0 fl oz	14-d	<1 c	<1 e	2 fg	3 e-j
A16422A 3.6 fl oz	14-d	0 c	<1 e	<1 g	<1 hij
A16422B 2.0 fl oz	14-d	<1 c	<1 e	2 fg	4 e-i
A16422B 3.6 fl oz	14-d	0 c	<1 e	<1 g	2 f-j
Daconil Ultrex 1.8 oz	14-d	<1 c	<1 e	2 fg	5 d-g
Daconil Ultrex 3.2 oz	14-d	0 c	<1 e	2 fg	4 e-j
A15935A 2.5 fl oz	14-d	<1 c	<1 e	2 fg	4 e-h
A15935A 4.5 fl oz	14-d	0 c	<1 e	<1 g	2 f-j
A15935A 2.5 fl oz	21-d	<1 c	3 e	7 c	10 c
A15935A 4.5 fl oz	21-d	<1 c	<1 e	5 cde	8 cd
Daconil Weather Stik 2.0 fl oz + Heritage					
TL 0.2 oz	14-d	<1 c	<1 e	1 fg	4 e-i
Headway 1.5 fl oz	14-d	0 c	0 e	<1 a	<1 hii
Tartan 1.0 fl oz	14-d	0 c	<1 e	<1 a	<1 hii
Concert 3.0 fl oz	14-d	0 0	0 e	<1 a	<1 hii
Bayleton 1 0 oz	28-d	0 0	<1 e	1 fa	3 f-i
Tourney 0 18 oz	14-d	0 0	<1 e	2 fa	5 d-a
	14-d	0 0	<1 e	1 fa	2 a-i
DP7-LEM17-50-80.0.3 oz	14-d	<1 c		3 def	Zgj Zcde
DPZ-LEM17-50-80 0.5 oz	14 d			$\sim 1 \text{ fr}$	7 cuc 3 f_i
26/36 4 0 fl oz	74-d	~1 c	24	6 cd	10 c
Quali-Pro Chlorothalonil 3 2407	∠ i-u 14_d	~1 c	2 u ~1 o	2 fa	5 def
Quali-Fio Onioronalonii 5.2402	14-u 17 d			∠ iy 1 fa	
	14-U	26	<u> くし ひ</u> 11 k	1 I <u>y</u> 22 o	1 y-j
	-	30	an	22 a	zoia

<sup>2</sup> Treatments were applied as follows: 14-d interval treatments were applied on 2, 18 and 30 Jun; 15 and 18 Jul; and 12 Aug: 21-d interval treatments were applied on 2 and 24 Jun; 15 Jul; and 4 Aug: 28-d interval treatments were applied on 2 Jun; 28 Jul; and 4 Aug. SP2059 treatments were applied on 2, 19, and 30 Jun; 15 and 28 Jul; and 12 Aug.
<sup>y</sup> Percent of the plot area with dollar spot was visually rated on a 0 to 100 percent scale where 0 = no dollar spot was

<sup>y</sup> Percent of the plot area with dollar spot was visually rated on a 0 to 100 percent scale where 0 = no dollar spot was present or 100 = entire plot has dollar spot.

Table 2 Creeping bentgrass injury following repeated applications of various fungicides for the control of dollar	spot, 2008.
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	Application <sup>z</sup>			Injury <sup>y</sup>		
Treatment and rate per 1000 sq ft	Timing	7 Jul	14 Jul	21 Jul	23 Jul	30 Jul
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	0.0 e <sup>x</sup>	0.3 def	0.0 de	0.1 de	0.3 efg
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	0.6 cd	0.5 b-e	0.1 cde	0.1 de	0.4 d-g
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	0.5 cde	0.5 b-e	0.3 b-e	0.1 de	0.4 d-g
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	0.0 e	0.3 def	0.0 de	0.0 e	0.1 fg
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz.	14-d	0.3 de	0.3 def	0.0 de	0.0 e	0.1 fg
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz.	14-d	0.3 de	0.0 f	0.0 de	0.0 e	0.0 g
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	0.5 cde	0.4 c-f	0.4 bcd	0.3 cde	0.8 bcd
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	0.5 cde	0.4 c-f	0.1 cde	0.3 cde	0.9 bc
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	0.1 de	0.4 c-f	0.5 abc	0.4 bcd	0.8 bcd
Curalan 1.0 oz	14-d	0.0 e	0.3 def	0.0 de	0.0 e	0.1 fg
SP2059 1.0 oz	14-d	0.0 e	0.1 ef	0.3 b-e	0.1 de	0.1 fg
SP2059 2.0 oz	14-d	0.1 de	0.1 ef	0.0 de	0.0 e	0.1 fg
Emerald 0.13 oz	14-d	0.0 e	0.1 ef	0.0 de	0.0 e	0.0 g
Trinity 1.0 fl oz	14-d	0.9 bc	0.4 c-f	0.3 b-e	0.1 de	0.3 efg
Trinity 1.5 fl oz	21-d	0.5 cde	0.4 c-f	0.4 bcd	0.0 e	0.6 cde
Daconil Weather Stik 2.0 fl oz	14-d	0.1 de	0.0 f	0.0 de	0.0 e	0.0 g
Daconil Weather Stik 3.6 fl oz	14-d	0.0 e	0.0 f	0.0 de	0.0 e	0.0 g
A16422A 2.0 fl oz	14-d	0.1 de	0.0 f	0.0 de	0.0 e	0.1 fg
A16422A 3.6 fl oz	14-d	0.1 de	0.0 f	0.0 de	0.0 e	0.0 g
A16422B 2.0 fl oz	14-d	0.0 e	0.0 f	0.0 de	0.0 e	0.0 g
A16422B 3.6 fl oz	14-d	0.0 e	0.0 f	0.0 de	0.0 e	0.0 g
Daconil Ultrex 1.8 oz	14-d	0.0 e	0.1 ef	0.0 de	0.0 e	0.0 g
Daconil Ultrex 3.2 oz	14-d	0.0 e	0.0 f	0.0 de	0.0 e	0.0 g
A15935A 2.5 fl oz	14-d	0.1 de	0.0 f	0.0 de	0.0 e	0.3 efg
A15935A 4.5 fl oz	14-d	0.0 e	0.0 f	0.0 de	0.0 e	0.1 fg
A15935A 2.5 fl oz	21-d	0.1 de	0.1 ef	0.0 de	0.0 e	0.0 g
A15935A 4.5 fl oz	21-d	0.0 e	0.0 f	0.0 de	0.0 e	0.0 g
Daconil Weather Stik 2.0 fl oz + Heritage						
TL 0.2 oz	14-d	0.1 de	0.2 def	0.0 e	0.0 e	0.2 efg
Headway 1.5 fl oz	14-d	1.8 a	0.9 ab	0.9 a	0.5 abc	2.0 a
Tartan 1.0 fl oz	14-d	0.4 cde	1.1 a	0.4 bcd	0.6 ab	1.1 b
Concert 3.0 fl oz	14-d	0.5 cde	0.4 c-f	0.3 b-e	0.3 cde	0.9 bc
Bayleton 1.0 oz	28-d	1.3 ab	0.8 abc	0.5 abc	0.8 a	2.0 a
Tourney 0.18 oz	14-d	0.0 e	0.5 b-e	0.1 cde	0.1 de	0.3 efg
Tourney 0.28 oz	14-d	0.1 de	0.5 b-e	0.6 ab	0.4 bcd	0.8 bcd
DPZ-LEM17-50-80 0.3 oz	14-d	0.5 cde	0.3 def	0.0 de	0.3 cde	0.3 efg
DPZ-LEM17-50-80 0.5 oz	14-d	0.5 cde	0.3 def	0.0 de	0.0 e	0.3 efg
26/36 4.0 fl oz	21-d	0.0 e	0.0 f	0.0 de	0.0 e	0.0 g
Quali-Pro Chlorothalonil 3.24oz	14-d	0.0 e	0.0 f	0.0 de	0.0 e	0.0 g
Quali-Pro Iprodione 4.0 fl oz	14-d	0.3 de	0.6 bcd	0.1 cde	0.1 de	0.5 c-f
Check	-	0.5 cde	0.5 b-e	0.0 de	0.1 de	0.3 efg

<sup>y</sup> Crabgrass injury was rated on a 0 to 5 scale where 0 = no injury visible and 5 = ontire plot brown or dead.

Table 2 (continued).	Creeping bentgrass	injury following	repeated a	applications of	various fungicio	des for the	control of
dollar spot, 2008.					-		

·	Application <sup>z</sup>			Injury <sup>y</sup>		
Treatment and rate per 1000 sq ft	Timing	4 Aug	6 Aug	11 Aug	18 Aug	25 Aug
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	0.1 efx	0.3 efg	0.3 def	0.3 ef	0.1 d
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	0.0 f	0.0 g	0.0 f	0.3 ef	0.0 d
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	0.3 def	0.3 efg	0.6 cde	0.5 c-f	0.5 bcd
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	0.3 def	0.0 g	0.3 def	0.0 f	0.1 d
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz.	14-d	0.3 def	0.0 g	0.0 f	0.0 f	0.0 d
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz.	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	0.4 c-f	0.6 def	0.6 cde	0.6 c-f	0.4 cd
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	0.9 bcd	0.9 cd	0.9 bc	0.8 b-e	0.4 cd
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	0.5 c-f	0.8 de	0.6 cde	0.5 c-f	0.6 bcd
Curalan 1.0 oz	14-d	0.3 def	0.0 g	0.0 f	0.0 f	0.0 d
SP2059 1.0 oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
SP2059 2.0 oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
Emerald 0.13 oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
Trinity 1.0 fl oz	14-d	0.5 c-f	0.1 fg	0.5 c-f	0.4 def	0.3 d
Trinity 1.5 fl oz	21-d	0.5 c-f	0.9 cd	0.8 cd	0.8 b-e	1.0 abc
Daconil Weather Stik 2.0 fl oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
Daconil Weather Stik 3.6 fl oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
A16422A 2.0 fl oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
A16422A 3.6 fl oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
A16422B 2.0 fl oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
A16422B 3.6 fl oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
Daconil Ultrex 1.8 oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
Daconil Ultrex 3.2 oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
A15935A 2.5 fl oz	14-d	0.3 def	0.0 g	0.0 f	0.1 ef	0.0 d
A15935A 4.5 fl oz	14-d	0.0 f	0.0 g	0.0 f	0.3 ef	0.0 d
A15935A 2.5 fl oz	21-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
A15935A 4.5 fl oz	21-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
Daconil Weather Stik 2.0 fl oz + Heritage					0.0 f	0.0 d
TL 0.2 oz	14-d	0.2 def	0.1 fg	0.1 ef		
Headway 1.5 fl oz	14-d	1.8 a	1.4 bc	1.4 b	1.4 ab	1.0 abc
Tartan 1.0 fl oz	14-d	0.9 bcd	1.5 b	2.3 a	1.0 a-d	1.1 ab
Concert 3.0 fl oz	14-d	0.5 c-f	0.5 d-g	0.9 bc	0.6 c-f	0.0 d
Bayleton 1.0 oz	28-d	1.3 ab	2.3 a	2.0 a	1.5 a	1.1 ab
Tourney 0.18 oz	14-d	0.3 def	0.0 g	0.0 f	0.0 f	0.0 d
Tourney 0.28 oz	14-d	1.0 bc	0.5 d-g	0.8 cd	1.1 abc	1.4 a
DPZ-LEM17-50-80 0.3 oz	14-d	0.8 b-e	0.3 efg	0.3 def	0.1 ef	0.0 d
DPZ-LEM17-50-80 0.5 oz	14-d	0.3 def	0.0 g	0.0 f	0.0 f	0.0 d
26/36 4.0 fl oz	21-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
Quali-Pro Chlorothalonil 3.24oz	14-d	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d
Quali-Pro Iprodione 4.0 fl oz	14-d	0.4 c-f	0.0 g	0.1 ef	0.6 c-f	0.1 d
Check	-	0.0 f	0.0 g	0.0 f	0.0 f	0.0 d

<sup>y</sup> Crabgrass injury was rated on a 0 to 5 scale where 0 = no injury visible and 5 = entire plot brown or dead.

Table 3. Number of dollar spot infection centers and percent dollar spot per plot following application of various formulations of confidential,2008

,	Application <sup>z</sup> Dollar spot Infection cent					
Treatment and rate per 1000 sq ft	Timing	16 Jun	23 Jun	30 Jun	7 Jul	14Jul
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	<1 a <sup>×</sup>	0 a	0 a	0 c	0 b
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	<1 a	0 a	0 a	0 c	0 b
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Curalan 1.0 oz	14-d	0 a	0 a	0 a	0 c	0 b
SP2059 1.0 oz	14-d	0 a	<1 a	1 a	2 b	5 a
SP2059 2.0 oz	14-d	0 a	<1 a	1 a	3 a	4 a
Emerald 0.13 oz	14-d	0 a	0 a	0 a	0 c	0 b
Trinity 1.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Trinity 1.5 fl oz	21-d	0 a	0 a	0 a	0 c	0 b
Daconil Weather Stik 2.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Daconil Weather Stik 3.6 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
A16422A 2.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
A16422A 3.6 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
A16422B 2.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
A16422B 3.6 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Daconil Ultrex 1.8 oz	14-d	0 a	0 a	0 a	0 c	<1 b
Daconil Ultrex 3.2 oz	14-d	0 a	0 a	0 a	0 c	0 b
A15935A 2.5 fl oz	14-d	0 a	0 a	0 a	0 c	<1 b
A15935A 4.5 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
A15935A 2.5 fl oz	21-d	0 a	0 a	0 a	0 c	1 b
A15935A 4.5 fl oz	21-d	0 a	0 a	0 a	0 c	0 b
Daconil Weather Stik 2.0 fl oz + Heritage						
TL 0.2 oz	14-d	0 a	0 a	0 a	0 c	0 b
Headway 1.5 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Tartan 1.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Concert 3.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Bayleton 1.0 oz	28-d	0 a	0 a	0 a	0 c	0 b
Tourney 0.18 oz	14-d	0 a	0 a	0 a	0 c	0 b
Tourney 0.28 oz	14-d	0 a	0 a	0 a	0 c	0 b
DPZ-LÉM17-50-80 0.3 oz	14-d	0 a	0 a	0 a	0 c	0 b
DPZ-LEM17-50-80 0.5 oz	14-d	0 a	0 a	0 a	0 c	0 b
26/36 4.0 fl oz	21-d	0 a	0 a	0 a	0 c	0 b
Quali-Pro Chlorothalonil 3.24oz	14-d	0 a	0 a	0 a	0 c	0 b
Quali-Pro Iprodione 4.0 fl oz	14-d	0 a	0 a	0 a	0 c	0 b
Check	-	0 a	<1 a	<1 a	2 b	5 a

<sup>y</sup> Dollar spot was rated by counting the total number of infection centers or percent plot area covered with dollar spot per 18 sq ft plot.

Table 3 Number of dollar spot infection centers and percent dollar spot per plot following application of various formulations of confidential, 2008.

	Application <sup>z</sup>		Dollar sp	Dollar spot Infection center <sup>y</sup>			
Treatment and rate per 1000 sq ft	Timing	21 Jul	28 Jul	4 Aug	11 Aug	18 Aug	
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	0 c <sup>x</sup>	0 d	0 e	0 d	0 c	
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz	14-d	0 c	<1 d	0 e	<1 d	<1 c	
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	0 c	0 d	0 e	<1 d	<1 c	
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Curalan 1.0 oz	14-d	0 c	0 d	0 e	0 d	0 c	
SP2059 1.0 oz	14-d	9 a	18 a	32 a	42 a	49 a	
SP2059 2.0 oz	14-d	4 b	10 b	23 b	34 b	43 b	
Emerald 0.13 oz	14-d	0 c	0 d	0 e	0 d	0 c	
Trinity 1.0 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Trinity 1.5 fl oz	21-d	0 c	0 d	0 e	<1 d	<1 c	
Daconil Weather Stik 2.0 fl oz	14-d	0 c	0 d	<1 e	2 cd	2 c	
Daconil Weather Stik 3.6 fl oz	14-d	0 c	0 d	0 e	<1 d	<1 c	
A16422A 2.0 fl oz	14-d	0 c	1 d	1 e	3 cd	4 c	
A16422A 3.6 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
A16422B 2.0 fl oz	14-d	0 c	5 c	2 de	5 c	5 c	
A16422B 3.6 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Daconil Ultrex 1.8 oz	14-d	<1 c	<1 d	<1 e	1 cd	1 c	
Daconil Ultrex 3.2 oz	14-d	0 c	0 d	0 e	0 d	<1 c	
A15935A 2.5 fl oz	14-d	0 c	<1 d	0 e	<1 d	2 c	
A15935A 4.5 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
A15935A 2.5 fl oz	21-d	1 c	1 d	5 d	2 cd	5 c	
A15935A 4.5 fl oz	21-d	0 c	0 d	1 e	<1 d	<1 c	
Daconil Weather Stik 2.0 fl oz + Heritage							
TL 0.2 oz	14-d	0 c	<1 d	<1 e	<1 d	<1 c	
Headway 1.5 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Tartan 1.0 fl oz	14-d	0 c	0 d	1.0 e	0 d	0 c	
Concert 3.0 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Bayleton 1.0 oz	28-d	0 c	0 d	0 e	0 d	0 c	
Tourney 0.18 oz	14-d	0 c	0 d	0 e	0 d	0 c	
Tourney 0.28 oz	14-d	0 c	0 d	0 e	0 d	0 c	
DPZ-LÉM17-50-80 0.3 oz	14-d	0 c	0 d	0 e	1 cd	<1 c	
DPZ-LEM17-50-80 0.5 oz	14-d	0 c	0 d	0 e	0 d	0 c	
26/36 4.0 fl oz	21-d	0 c	0 d	<1 e	0 d	<1 c	
Quali-Pro Chlorothalonil 3.24oz	14-d	0 c	0 d	0 e	<1 d	<1 c	
Quali-Pro Iprodione 4.0 fl oz	14-d	0 c	0 d	0 e	0 d	0 c	
Check	-	5.0 b	11.0 b	19 c	33 b	44 ab	

<sup>2</sup> Treatments were applied as follows: 14-d interval treatments were applied on 2, 18 and 30 Jun; 15 and 18 Jul; and 12 Aug: 21-d interval treatments were applied on 2 and 24 Jun; 15 Jul; and 4 Aug: 28-d interval treatments were applied on 2 Jun; 28 Jul; and 4 Aug. SP2059 treatments were applied on 2, 19, and 30 Jun; 15 and 28 Jul; and 12 Aug.

<sup>y</sup> Dollar spot was rated by counting the total number of infection centers or percent plot area covered with dollar spot per 18 sq ft plot.

Table 3 Number of dollar spot infection centers and percent dollar spot per plot following application of various formulations of confidential, 2008.

	Application <sup>z</sup>		Dollar spot In	fection centers <sup>3</sup>	/
Treatment and rate per 1000 sq ft	Timing	25 Aug	8 Sep	15 Sep	22 Sep
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	0 d <sup>x</sup>	0 k	5 mn	14 o-r
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	0 d	<1 jk	5 mn	16 n-r
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	0 d	<1 k	<1 n	6 r
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	0 d	<1 jk	2 n	10 qr
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz	14-d	0 d	1 jk	7 lmn	18 n-r
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz	14-d	0 d	0 k	7 lmn	18 n-r
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	0 d	4 h-k	20 g-n	40 h-r
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	0 d	2 jk	10 k-n	22 m-r
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	0 d	2 jk	26 f-l	72 c-j
Curalan 1.0 oz	14-d	0 d	0 k	<1 n	5 r
SP2059 1.0 oz	14-d	61 a	113 a	143 a	203 a
SP2059 2.0 oz	14-d	58 ab	101 b	123 a	177 a
Emerald 0.13 oz	14-d	0 d	<1 k	5 mn	17 n-r
Trinity 1.0 fl oz	14-d	0 d	9 g-k	31 e-i	59 e-m
Trinity 1.5 fl oz	21-d	<1 d	22 ef	58 bcd	84 c-f
Daconil Weather Stik 2.0 fl oz	14-d	2 cd	10 f-k	39 d-g	65 e-k
Daconil Weather Stik 3.6 fl oz	14-d	<1 d	1 jk	18 i-n	35 j-r
A16422A 2.0 fl oz	14-d	3 cd	12 f-j	30 e-k	59 e-m
A16422A 3.6 fl oz	14-d	0 d	1 jk	11 j-n	32 k-r
A16422B 2.0 fl oz	14-d	2 cd	14 f-i	38 e-h	66 d-k
A16422B 3.6 fl oz	14-d	0 d	<1 jk	20 g-n	52 f-n
Daconil Ultrex 1.8 oz	14-d	<1 d	16 fgh	45 c-f	78 c-h
Daconil Ultrex 3.2 oz	14-d	0 d	8 g-k	32 e-i	60 e-l
A15935A 2.5 fl oz	14-d	<1 d	9 g-k	37 e-i	74 c-i
A15935A 4.5 fl oz	14-d	0 d	<1 k	19 h-n	46 g-q
A15935A 2.5 fl oz	21-d	7 c	55 c	70 b	103 bcd
A15935A 4.5 fl oz	21-d	3 cd	35 d	63 bc	108 bc
Daconil Weather Stik 2.0 fl oz + Heritage TL					
0.2 oz	14-d	<1 cd	8 g-k	32 e-i	73 c-j
Headway 1.5 fl oz	14-d	0 d	0 k	11 j-n	25 l-r
Tartan 1.0 fl oz	14-d	0 d	1.0 jk	8 lmn	20 n-r
Concert 3.0 fl oz	14-d	0 d	0 k	5 mn	14 pqr
Bayleton 1.0 oz	28-d	0 d	4 ijk	30 e-j	52 f-o
Tourney 0.18 oz	14-d	0 d	12 f-k	47 cde	73 c-j
Tourney 0.28 oz	14-d	0 d	6 g-k	20 g-n	38 i-r
DPZ-LEM17-50-80 0.3 oz	14-d	<1 cd	30 de	58 bcd	96 b-e
DPZ-LEM17-50-80 0.5 oz	14-d	0 d	10 g-k	33 e-i	50 f-p
26/36 4.0 fl oz	21-d	<1 d	57 c	77 b	129 b
Quali-Pro Chlorothalonil 3.24oz	14-d	<1 d	17 fg	44 c-f	79 c-g
Quali-Pro Iprodione 4.0 fl oz	14-d	0 d	5 h-k	22 g-m	38 i-r
Check	-	54 b	100 b	133 a	196 a

<sup>2</sup> Treatments were applied as follows: 14-d interval treatments were applied on 2, 18 and 30 Jun; 15 and 18 Jul; and 12 Aug: 21-d interval treatments were applied on 2 and 24 Jun; 15 Jul; and 4 Aug: 28-d interval treatments were applied on 2 Jun; 28 Jul; and 4 Aug. SP2059 treatments were applied on 2, 19, and 30 Jun; 15 and 28 Jul; and 12 Aug.

<sup>y</sup> Dollar spot was rated by counting the total number of infection centers or percent plot area covered with dollar spot per 18 sq ft plot.

Table 4 Turfgrass quality following the application of various fungicides, 2008.

	Application <sup>z</sup>	0		Quality <sup>y</sup>		
Treatment and rate per 1000 sq ft	Timing	16 Jun	23 Jun	30 Jun	7 Jul	14 Jul
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	6.5 a <sup>x</sup>	7.8 a	8.0 a	8.0 c-f	8.3 b-e
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	7.0 a	7.8 a	9.0 a	8.3 cde	8.5 a-d
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	6.5 a	7.3 a	8.3 a	7.5 efg	8.0 cde
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	6.8 a	7.8 a	8.5 a	8.3 cde	8.3 b-e
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz	14-d	7.0 a	8.3 a	9.0 a	8.0 c-f	8.5 a-d
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz	14-d	6.8 a	8.3 a	8.8 a	7.8 d-g	8.8 abc
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	6.8 a	7.5 a	8.8 a	8.0 c-f	8.3 b-e
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	7.0 a	7.8 a	9.3 a	8.0 c-f	8.3 b-e
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	6.8 a	7.8 a	8.8 a	8.3 cde	8.5 a-d
Curalan 1.0 oz	14-d	6.8 a	7.8 a	9.0 a	8.3 cde	9.0 ab
SP2059 1.0 oz	14-d	7.0 a	8.0 a	8.8 a	8.0 c-f	8.0 cde
SP2059 2.0 oz	14-d	6.3 a	7.8 a	7.8 a	8.3 cde	7.5 e
Emerald 0.13 oz	14-d	6.3 a	7.3 a	7.8 a	7.3 fg	8.3 b-e
Trinity 1.0 fl oz	14-d	6.8 a	7.8 a	8.8 a	7.8 d-g	8.3 b-e
Trinity 1.5 fl oz	21-d	6.3 a	6.8 a	8.0 a	7.3 fg	7.8 de
Daconil Weather Stik 2.0 fl oz	14-d	7.0 a	7.8 a	9.0 a	8.8 abc	8.8 abc
Daconil Weather Stik 3.6 fl oz	14-d	6.5 a	7.5 a	8.5 a	8.0 c-f	8.5 a-d
A16422A 2.0 fl oz	14-d	6.8 a	8.0 a	8.8 a	8.0 c-f	8.8 abc
A16422A 3.6 fl oz	14-d	6.5 a	8.0 a	8.8 a	8.3 cde	9.3 a
A16422B 2.0 fl oz	14-d	7.3 a	8.5 a	9.5 a	9.3 ab	9.3 a
A16422B 3.6 fl oz	14-d	6.5 a	7.8 a	8.8 a	8.5 bcd	9.0 ab
Daconil Ultrex 1.8 oz	14-d	6.5 a	8.3 a	8.3 a	8.3 cde	8.5 a-d
Daconil Ultrex 3.2 oz	14-d	6.5 a	8.0 a	8.5 a	8.3 cde	9.0 ab
A15935A 2.5 fl oz	14-d	7.3 a	8.0 a	9.5 a	8.5 bcd	8.8 abc
A15935A 4.5 fl oz	14-d	7.0 a	7.8 a	8.8 a	8.8 abc	9.3 a
A15935A 2.5 fl oz	21-d	6.5 a	8.0 a	8.8 a	8.3 cde	8.5 a-d
A15935A 4.5 fl oz	21-d	6.8 a	8.3 a	8.8 a	8.0 c-f	8.8 abc
Daconil Weather Stik 2.0 fl oz + Heritage	14-d					
TL 0.2 oz		7.0 a	8.5 a	9.3 a	9.6 a	9.0 ab
Headway 1.5 fl oz	14-d	6.8 a	7.0 a	8.3 a	7.0 g	7.8 de
Tartan 1.0 fl oz	14-d	7.0 a	8.0 a	8.5 a	8.0 c-f	7.8 de
Concert 3.0 fl oz	14-d	6.8 a	7.5 a	8.5 a	7.8 d-g	8.0 cde
Bayleton 1.0 oz	28-d	6.5 a	7.5 a	8.5 a	7.3 fg	7.8 de
Tourney 0.18 oz	14-d	6.5 a	8.0 a	8.8 a	8.0 c-f	7.8 de
Tourney 0.28 oz	14-d	6.8 a	7.8 a	8.3 a	7.5 efg	8.3 b-e
DPZ-LEM17-50-80 0.3 oz	14-d	7.3 a	7.8 a	8.3 a	8.0 c-f	8.3 b-e
DPZ-LEM17-50-80 0.5 oz	14-d	6.8 a	7.8 a	8.5 a	8.0 c-f	8.3 b-e
26/36 4.0 fl oz	21-d	6.5 a	7.3 a	8.5 a	8.3 cde	8.3 b-e
Quali-Pro Chlorothalonil 3.24oz	14-d	6.3 a	7.8 a	8.5 a	8.5 bcd	8.8 abc
Quali-Pro Iprodione 4.0 fl oz	14-d	7.0 a	7.8 a	9.0 a	8.3 cde	8.5 a-d
Check	-	6.8 a	7.8 a	8.5 a	7.8 d-g	7.8 de

<sup>9</sup> Quality was rated visually on 0 to 10 scale where 0 = entire plot area brown or dead; 7 = minimum acceptable quality for a home lawn; and 10 = optimum density and dark green color.

Table 4 Turfgrass quality following the application of various fungicides, 2008.

App.     Quality       Treatment and rate per 1000 sq ft     Timing <sup>2</sup> 21 Jul     28 Jul     4 Aug     11 Aug     18 Aug       Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz     14-d     8.5 b-e <sup>x</sup> 8.0 bcd     8.3 cde     8.3 bc     9.3 ab       Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz     14-d     8.8 a-d     7.8 cde     8.5 bcd     8.5 abc     8.8 a-d       Emerald 0.13 oz + Trinity 0.75 fl oz     14-d     8.0 def     7.8 cde     8.3 cde     8.0 bc     8.8 a-d       Emerald 0.13 oz + Trinity 1.0 fl oz     14-d     8.5 b-e     8.3 abc     8.3 cde     8.0 bc     8.8 a-d
Treatment and rate per 1000 sq ft     Timing <sup>2</sup> 21 Jul     28 Jul     4 Aug     11 Aug     18 Aug       Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz     14-d     8.5 b-e <sup>x</sup> 8.0 bcd     8.3 cde     8.3 bc     9.3 ab       Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz     14-d     8.8 a-d     7.8 cde     8.5 bcd     8.5 abc     8.8 a-d       Emerald 0.13 oz + Trinity 0.75 fl oz     14-d     8.0 def     7.8 cde     8.3 cde     8.0 bc     8.8 a-d       Emerald 0.13 oz + Trinity 1.0 fl oz     14-d     8.5 b-e     8.3 abc     8.3 cde     8.0 bc     8.8 a-d
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz   14-d   8.5 b-e <sup>x</sup> 8.0 bcd   8.3 cde   8.3 bc   9.3 ab     Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz   14-d   8.8 a-d   7.8 cde   8.5 bcd   8.5 abc   8.8 a-d     Emerald 0.13 oz + Trinity 0.75 fl oz   14-d   8.0 def   7.8 cde   8.3 cde   8.0 bc   8.8 a-d     Emerald 0.13 oz + Trinity 1.0 fl oz   14-d   8.5 b-e   8.3 abc   8.3 cde   8.0 bc   8.8 a-d     Emerald 0.13 oz + Trinity 1.0 fl oz   14-d   8.5 b-e   8.3 abc   8.3 cde   8.3 bc   9.0 abc
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz   14-d   8.8 a-d   7.8 cde   8.5 bcd   8.5 abc   8.8 a-d     Emerald 0.13 oz + Trinity 0.75 fl oz   14-d   8.0 def   7.8 cde   8.3 cde   8.0 bc   8.8 a-d     Emerald 0.13 oz + Trinity 1.0 fl oz   14-d   8.5 b-e   8.3 abc   8.3 cde   8.3 bc   9.0 abc
Emerald 0.13 oz + Trinity 0.75 fl oz     14-d     8.0 def     7.8 cde     8.3 cde     8.0 bc     8.8 a-d       Emerald 0.13 oz + Trinity 1.0 fl oz     14-d     8.5 b-e     8.3 abc     8.3 cde     8.3 bc     9.0 abc
Emerald 0.13 oz + Trinity 1.0 fl oz     14-d     8.5 b-e     8.3 abc     8.3 cde     8.3 bc     9.0 abc
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz 14-d 9.0 abc 8.0 bcd 8.8 abc 8.5 abc 8.8 a-d
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz     14-d     8.3 cde     8.0 bcd     8.3 cde     8.5 abc     9.0 abc
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz 14-d 8.3 cde 7.5 def 8.0 cde 8.0 bc 8.5 b-e
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz 14-d 8.3 cde 7.5 def 8.0 cde 7.8 bcd 8.3 b-e
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz 14-d 8.0 def 7.5 def 8.8 abc 8.3 bc 8.8 a-d
Curalan 1.0 oz 14-d 8.8 a-d 8.0 bcd 8.3 cde 8.0 bc 8.8 a-d
SP2059 1.0 oz 14-d 7.3 f 6.0 h 6.0 g 6.0 e 6.0 f
SP2059 2.0 oz 14-d 7.8 ef 6.5 gh 6.0 g 6.0 e 6.0 f
Emerald 0.13 oz 14-d 8.5 b-e 8.0 bcd 8.3 cde 8.3 bc 8.8 a-d
Trinity 1.0 fl oz 14-d 8.5 b-e 7.8 cde 8.3 cde 8.3 bc 9.3 ab
Trinity 1.5 fl oz 21-d 8.3 cde 7.3 ef 8.0 cde 8.0 bc 7.8 de
Daconil Weather Stik 2.0 fl oz 14-d 9.0 abc 8.0 bcd 8.8 abc 8.5 abc 8.8 a-d
Daconil Weather Stik 3.6 fl oz 14-d 8.5 b-e 8.3 abc 8.5 bcd 8.5 abc 8.8 a-d
A16422A 2.0 fl oz 14-d 8.8 a-d 8.5 ab 8.5 bcd 8.3 bc 8.3 b-e
A16422A 3.6 fl oz 14-d 9.0 abc 8.3 abc 8.5 bcd 8.5 abc 9.3 ab
A16422B 2.0 fl oz 14-d 9.5 a 8.8 a 9.3 ab 7.5 cd 7.5 e
A16422B 3.6 fl oz
Daconil Ultrex 1.8 oz 14-d 8.3 cde 8.3 abc 8.3 cde 8.5 abc 8.8 a-d
Daconil Ultrex 3.2 oz 14-d 8.8 a-d 8.3 abc 8.5 bcd 8.8 ab 9.0 abc
A15935A 2.5 fl oz 14-d 8.3 cde 8.0 bcd 8.8 abc 8.5 abc 8.5 b-e
A15935A 4.5 fl oz 14-d 8.8 a-d 8.3 abc 8.5 bcd 8.8 ab 8.8 a-d
A15935A 2.5 fl oz 21-d 8.0 def 8.0 bcd 6.8 fg 8.0 bc 8.0 cde
A15935A 4.5 fl oz 21-d 8.5 b-e 8.5 ab 8.3 cde 8.8 ab 9.0 abc
Daconil Weather Stik 2.0 fl oz + Heritage TL 14-d
0.2 fl oz
Headway 1.5 fl oz
Tartan 1.0 fl oz 14-d 8.5 b-e 7.5 def 7.5 ef 6.8 de 8.3 b-e
Concert 3.0 fl oz 14-d 8.3 cde 8.0 bcd 8.3 cde 7.8 bcd 8.5 b-e
Bayleton 1.0 oz
Tourney 0.18 oz
Tourney 0.28 oz
DPZ-LEM17-50-80 0.3 oz
DPZ-LEM17-50-80 0.5 oz
26/36 4.0 fl oz
Quali-Pro Chlorothalonil 3.24oz
Quali-Pro Iprodione 4.0 fl oz
Check 7.3 f 6.5 ah 6.0 a 6.0 e 6.0 f

<sup>y</sup> Quality was rated visually on 0 to 10 scale where 0 = entire plot area brown or dead; 7 = minimum acceptable quality for a home lawn; and 10 = optimum density and dark green color.

Table 4. Turfgrass quality following the application of various fungicides, 2008.

	Application <sup>z</sup>		Qual	ity <sup>y</sup>	
Treatment and rate per 1000 sq ft	Timing	25 Aug	8 Sep	15 Sep	22 Sep
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	8.5 bcd <sup>×</sup>	9.5 abc	8.3 abc	6.0 bcd
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	8.5 bcd	9.8 ab	8.3 abc	6.0 bcd
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	8.5 bcd	9.8 ab	9.3 a	6.5 bc
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	8.8 bcd	9.8 ab	8.8 ab	6.8 ab
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz	14-d	8.8 bcd	9.5 abc	7.5 cd	6.8 ab
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz	14-d	9.0 abc	10.0 a	6.8 de	6.0 bcd
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	8.8 bcd	8.3 cde	6.0 ef	6.0 bcd
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	8.3 b-e	9.3 a-d	6.8 de	6.0 bcd
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	8.8 bcd	9.3 a-d	6.0 ef	6.0 bcd
Curalan 1.0 oz	14-d	9.0 abc	9.8 ab	9.3 a	7.5 a
SP2059 1.0 oz	14-d	6.0 f	5.3 h	5.0 f	4.5 g
SP2059 2.0 oz	14-d	6.0 f	5.8 gh	5.0 f	5.0 efg
Emerald 0.13 oz	14-d	8.5 bcd	9.8 ab	7.5 cd	6.0 bcd
Trinity 1.0 fl oz	14-d	9.0 abc	6.8 fg	6.0 ef	6.0 bcd
Trinity 1.5 fl oz	21-d	8.3 b-e	6.0 gh	6.0 ef	6.0 bcd
Daconil Weather Stik 2.0 fl oz	14-d	8.5 bcd	6.8 fg	6.0 ef	6.0 bcd
Daconil Weather Stik 3.6 fl oz	14-d	8.8 bcd	9.5 abc	6.0 ef	6.0 bcd
A16422A 2.0 fl oz	14-d	8.3 b-e	6.8 fg	6.0 ef	6.0 bcd
A16422A 3.6 fl oz	14-d	9.0 abc	9.5 abc	6.8 de	6.0 bcd
A16422B 2.0 fl oz	14-d	8.5 bcd	6.0 gh	6.0 ef	6.0 bcd
A16422B 3.6 fl oz	14-d	10.0 a	9.5 abc	6.0 ef	6.0 bcd
Daconil Ultrex 1.8 oz	14-d	9.0 abc	6.0 gh	6.0 ef	6.0 bcd
Daconil Ultrex 3.2 oz	14-d	9.0 abc	8.5 b-e	6.0 ef	5.8 cde
A15935A 2.5 fl oz	14-d	9.0 abc	6.8 fg	6.0 ef	6.0 bcd
A15935A 4.5 fl oz	14-d	9.0 abc	9.8 ab	6.0 ef	6.0 bcd
A15935A 2.5 fl oz	21-d	7.3 e	6.0 gh	5.8 ef	5.5 def
A15935A 4.5 fl oz	21-d	8.8 bcd	6.0 gh	6.0 ef	6.0 bcd
Daconil Weather Stik 2.0 fl oz + Heritage	14-d	9.3 ab	6.8 fg	6.0 ef	6.0 bcd
TL 0.2 fl oz					
Headway 1.5 fl oz	14-d	7.8 de	10.0 a	6.8 de	6 bcd
Tartan 1.0 fl oz	14-d	8.0 cde	9.3 a-d	7.8 bcd	6.5 bc
Concert 3.0 fl oz	14-d	8.8 bcd	10.0 a	8.3 abc	6.5 bc
Bayleton 1.0 oz	28-d	7.8 de	8.5 b-e	6.0 ef	6.0 bcd
Tourney 0.18 oz	14-d	8.8 bcd	6.0 gh	6.0 ef	6.0 bcd
Tourney 0.28 oz	14-d	7.3 e	8.3 cde	6.0 ef	6.0 bcd
DPZ-LEM17-50-80 0.3 oz	14-d	8.5 bcd	6.0 gh	6.0 ef	5.8 cde
DPZ-LEM17-50-80 0.5 oz	14-d	9.0 abc	7.5 ef	6.0 ef	6.0 bcd
26/36 4.0 fl oz	21-d	8.8 bcd	6.0 gh	6.0 ef	5.8 cde
Quali-Pro Chlorothalonil 3.24oz	14-d	9.0 abc	6.8 fg	6.0 ef	5.8 cde
Quali-Pro Iprodione 4.0 fl oz	14-d	8.0 cde	8.0 def	6.0 ef	6.0 bcd
Check	-	6.0 f	5.8 gh	5.0 f	4.8 fg

<sup>y</sup> Quality was rated visually on 0 to 10 scale where 0 = entire plot area brown or dead; 7 = minimum acceptable quality for a home lawn; and 10 = optimum density and dark green color.

Table 5. C	Creeping bentgrass c	olor ratings as meas	sured by the NDVI	(Normalized Differen	ce Vegetative	Index) color
meter.						

	Application <sup>z</sup>		NDVI <sup>y</sup>	
Treatment and rate per 1000 sq ft	Timing	16 Jul	29 Jul	11 Aug
Emerald 0.13 oz + T-Methyl 4.5L 3.0 fl oz	14-d	0.702 a-e <sup>x</sup>	0.740 b-e	0.733 a-f
Emerald 0.13 oz + T-Methyl 4.5L 4.0 fl oz	14-d	0.686 efg	0.735 b-g	0.740 a-d
Emerald 0.13 oz + Trinity 0.75 fl oz	14-d	0.694 b-g	0.736 b-g	0.734 a-f
Emerald 0.13 oz + Trinity 1.0 fl oz	14-d	0.708 a-d	0.733 b-g	0.733 a-f
Emerald 0.13 oz + Iprodione Pro 3.0 fl oz	14-d	0.694 b-g	0.735 b-g	0.732 b-f
Emerald 0.13 oz + Iprodione Pro 4.0 fl oz	14-d	0.699 a-g	0.740 b-e	0.734 a-f
Trinity 1.0 fl oz + Iprodione Pro 2.0 fl oz	14-d	0.691 c-g	0.727 c-h	0.731 b-f
Trinity 1.0 fl oz + Iprodione Pro 3.0 fl oz	14-d	0.688 d-g	0.732 b-g	0.725 e-h
Trinity 1.0 fl oz + Iprodione Pro 4.0 fl oz	14-d	0.685 e-h	0.730 b-g	0.732 b-g
Curalan 1.0 oz	14-d	0.705 a-e	0.741 b-e	0.733 a-f
SP2059 1.0 oz	14-d	0.695 b-g	0.736 b-g	0.733 a-f
SP2059 2.0 oz	14-d	0.699 a-f	0.744 abc	0.734 a-f
Emerald 0.13 oz	14-d	0.696 a-g	0.738 b-f	0.730 c-f
Trinity 1.0 fl oz	14-d	0.693 c-g	0.745 abc	0.733 a-f
Trinity 1.5 fl oz	21-d	0.687 efg	0.733 b-g	0.721 f-i
Daconil Weather Stik 2.0 fl oz	14-d	0.700 a-e	0.738 b-f	0.739 a-e
Daconil Weather Stik 3.6 fl oz	14-d	0.698 a-g	0.731 b-g	0.737 a-e
A16422A 2.0 fl oz	14-d	0.700 a-g	0.746 ab	0.746 a
A16422A 3.6 fl oz	14-d	0.708 a-d	0.738 b-f	0.743 abc
A16422B 2.0 fl oz	14-d	0.713 ab	0.759 a	0.741 a-d
A16422B 3.6 fl oz	14-d	0.715 a	0.738 b-f	0.731 b-f
Daconil Ultrex 1.8 oz	14-d	0.695 a-g	0.737 b-f	0.744 ab
Daconil Ultrex 3.2 oz	14-d	0.696 a-g	0.748 ab	0.743 abc
A15935A 2.5 fl oz	14-d	0.690 c-g	0.735 b-g	0.736 a-e
A15935A 4.5 fl oz	14-d	0.697 a-g	0.737 b-f	0.745 ab
A15935A 2.5 fl oz	21-d	0.696 a-g	0.747 ab	0.733 a-f
A15935A 4.5 fl oz	21-d	0.693 b-g	0.748 ab	0.740 a-d
Daconil Weather Stik 2.0 fl oz + Heritage TL 0.2 fl oz	14-d	0.695 a-g	0.738 b-f	0.737 a-e
Headway 1.5 fl oz	14-d	0.680 fgh	0.719 gh	0.713 hi
Tartan 1.0 fl oz	14-d	0.665 h	0.711 h	0.710 i
Concert 3.0 fl oz	14-d	0.687 efg	0.721 fgh	0.731 b-f
Bayleton 1.0 oz	28-d	0.679 gh	0.724 e-h	0.716 b-f
Tourney 0.18 oz	14-d	0.695 b-g	0.737 b-f	0.734 a-f
Tourney 0.28 oz	14-d	0.688 d-g	0.726 d-h	0.721 f-i
DPZ-LEM17-50-80 0.3 oz	14-d	0.687 efg	0.739 b-f	0.738 a-e
DPZ-LEM17-50-80 0.5 oz	14-d	0.701 a-e	0.739 b-e	0.740 a-d
26/36 4.0 fl oz	21-d	0.700 a-e	0.744 a-d	0.740 a-d
Quali-Pro Chlorothalonil 3.24oz	14-d	0.709 abc	0.742 a-e	0.746 a
Quali-Pro Iprodione 4.0 fl oz	14-d	0.686 efg	0.740 b-e	0.728 d-g
Check	-	0.691 c-g	0.740 b-e	0.732 b-f

Color ratings for reeping bentgrass fairway were measured with the NDVI color meter.

### Preventive control of dollar spot on a golf course putting green with various fungicides

### JUNE-SEPTEMBER

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#### INTRODUCTION

Fungicides are commonly used for preventive and curative control of dollar spot (*Sclerotinia homoeocarpa*). As new fungicides are developed, their efficacy must be evaluated in both laboratory and field situations. In addition, field evaluation of these fungicides in various parts of the country is important. The objective of this study was to evaluate the relative efficacy and turf safety of commercially available and confidential fungicides against dollar spot on a golf course putting green.

### MATERIALS & METHODS

This study was initiated at the University of Connecticut Plant Science Research and Education Facility located in Storrs, CT. The site consisted of an 'A-4' creeping bentgrass on a native soil putting green that had been topdressed for a period of 1 year. Underlying soil was a loam with a pH of 5.9 and 7.2% OM and topdressing mixture was Holliston's "40 mix". The sand topdressing was within USGA specifications and is routinely used as a topdressing sand for putting greens in the Northeast. The area was maintained as a bentgrass putting green and mowed five times per week to a height of 0.125 to 0.140 in. All treatments were applied with a  $CO_2$  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>. Initial treatments were applied on 2 Jun and individual treatments were reapplied on either a 14- or 21-d interval. All treatments and application dates are listed in the tables.

Plots measured 3 ft x 6 ft and were arranged in a randomized complete block with four replications. Dollar spot severity was assessed every 2 weeks throughout the study. Initial dollar spot severity was rated by counting the number of *S. homoeocarpa* infection centers per plot. As disease severity increased, percent plot area affected by *Sclerotinia homoeocarpa* was visually rated on a 0 to 100 scale where 0 = entire plot void of dollar spot and 100 = entire plot area covered with dollar spot symptoms. Other observations included quality, injury and color.

#### RESULTS

Dollar spot. Dollar spot pressure was low throughout the study. Treatments were initiated on 2 Jun and final treatments were applied on 4 and 12 Aug for 21 and 14-d interval timings, respectively. During the month of Jun, dollar spot incidence was low and all plots had  $\leq$  2 infection centers (Table 1). In early Jul, dollar spot incidence increased and the untreated control plots had an average of 6 to 10 infection centers. Between 7 Jul and 25 Aug, all treatments suppressed dollar spot symptoms and all treatments had <1 infection center per plot. On 8 Sep, approximately 3 to 4 weeks after the last application, dollar spot incidence increased in select plots. Although no significant differences were observed among any fungicide-treated plot, plots treated with Daconil Ultrex (2.4 oz; 14-d interval) and A7402T (both rates; 21-d interval) had unacceptable levels (>5 infection centers per plot) of dollar spot on 8 Sep. On the final rating date (22 Sep), moderate to poor disease suppression was observed within plots treated with Leagacy + Signature alternated with Daconil + Signature, Daconil (2.4 oz; 14-d), and A7402T (0.625 fl oz; 21-d interval). Plots treated with the following fungicides, however, continued to provide complete control of the dollar spot on 22 Sep (6 to 7 weeks after last application): Legacy B (1.1 fl oz; 14-d), Legacy C (5.4 fl oz; 14-d), Daconil + Banner MAXX (14-d), A6780 (1.5 fl oz; 14-d), and A16841 (both rates; 14-d).

Quality and color. Quality and color (visual and NDVI) were assessed throughout the study. Few agronomic differences in quality and color were observed for most the study. In general, quality was lower during Jul and Aug and few treatments had quality ratings that were consistently considered acceptable ( $\geq$ 7.5) (Table 3). Plots treated with A7402T (0.625 fl oz; 14-d) and Legacy C + Signature (14-d) had the greatest number of dates with acceptable quality (8 and 7 dates, respectively) over the entire study period (14 rating dates total).

Take all patch. A natural infestation of take-all patch was observed within the study site in 2008. During this period, few differences in percent plot area affected by take-all were observed and no differences in disease severity occurred. Data presented in this report represents changes in take-all during the 2008 study year. Differences observed among treatments on the final rating date (11 Aug) offer little insight into the efficacy of the products evaluated in this study. Further analyses are required to assess the change in percent take-all patch within each plot when treatments were first initiated until the final rating date. Depending on the recurrence of take-all in 2009, spring data may better represent the level of control that can be excpected from the various treatments.

## DISCUSSION

In this study, dollar spot was considered low to moderate during the period in which fungicides were applied. Despite the low disease pressure, few infection centers are required for the disease severity to be considered unacceptable for a golf course putting green. In this study, numerous treatments provided excellent control during the period of fungicide application. When fungicide treatments ceased, control was provided for between 3 and 7 weeks. During this period, dollar spot activity increased immediately following the final applications, but began to naturally subside approximately about the time that the residual efficacy of the fungicides would naturally decline.

While all treatments provided good to excellent control of dollar spot in this study, the repeated application of the same fungicides or fungicides within the same chemical class is generally not recommended. Future research from the various products evaluated in this study would benefit from the examination of alternated fungicide applications as part of a program approach to managing dollar spot. Additionally, the field studies should be developed that investigate the impact of repeated applications of fungicides with the potential for growth regulation, such as those in the DMI class. The use of PGRs and the tank-mixing of various products are increasing in popularity for a number of reasons and the interaction among all of these products is poorly understood. Field evaluations of these products and common tank-mix partners would help to identify any antagonistic or synergistic effects that may occur.

Table 1.	Dollar spot infection	centers per plot following	the application c	of various fungicides to	o a creeping bentgrass
putting gi	reen, 2008.		••	-	

	Application <sup>z</sup>	Dollar Spot Infection <sup>y</sup>				
Treatment and rate per 1000 sq ft	Timing	16 Jun	23 Jun	30 Jun	7 Jul	14 Jul
Legacy B 0.4 fl oz	ACEG	0 a <sup>x</sup>	0 a	0 a	0 b	0 b
Legacy B 0.55 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
Legacy B 0.75 fl oz	ACEG	0 a	<1 a	0 a	0 b	0 b
Legacy B 1.1 fl oz	ACEG	1 a	0 a	0 a	0 b	0 b
Legacy B 0.4 fl oz + Signature 4.0 oz	AE					
alternated with						
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	0 a	0 a	0 a	0 b	0 b
Legacy C 3.6 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
Legacy C 4.5 fl oz	ACEG	<1 a	0 a	0 a	0 b	0 b
Legacy C 5.4 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
Daconil Ultrex 2.4 oz	ACEG	0 a	0 a	0 a	0 b	0 b
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	0 a	0 a	0 a	0 b	0 b
Concert 5.0 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
Banner MAXX 1.0 fl oz	ACEG	0 a	0 a	0 a	1 b	0 b
Banner MAXX 1.5 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
Banner MAXX 1.0 fl oz	ADG	0 a	0 a	0 a	0 b	0 b
Banner MAXX 1.5 fl oz	ADG	0 a	0 a	0 a	0 b	0 b
A7402T 0.625 fl oz	ACEG	<1 a	0 a	0 a	0 b	0 b
A7402T 0.94 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
A7402T 0.625 fl oz	ADG	0 a	0 a	0 a	0 b	0 b
A7402T 0.94 fl oz	ADG	<1 a	0 a	0 a	0 b	0 b
Trinity 1.0 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
Bayleton 1.0 fl oz	ACEG	<1 a	0 a	0 a	0 b	0 b
A6780 1.0 fl oz	ACEG	<1 a	0 a	<1 a	0 b	0 b
A6780 1.5 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
A16841 0.98 fl oz	ACEG	0 a	0 a	0 a	0 b	0 b
A16841 1.47 fl oz	ACEG	<1 a	0 a	0 a	0 b	0 b
Untreated	ACEG	1 a	1 a	<1 a	10 a	5 a
Untreated	ACEG	2 a	1 a	<1 a	6 a	3 a

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Dollar spot was rated by counting the total number of infection centers or percent plot area covered with dollar spot per plot.

Table 1 (continued). Dollar spot infection centers per plot following the application of various fungicides to a creeping bentgrass putting green, 2008.

	Application <sup>z</sup>					
Treatment and rate per 1000 sq ft	Timing	21 Jul	28 Jul	4 Aug	11 Aug	18 Aug
Legacy B 0.4 fl oz	ACEG	0 b <sup>x</sup>	0 c	0 C	0 b	0 b
Legacy B 0.55 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Legacy B 0.75 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Legacy B 1.1 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Legacy B 0.4 fl oz + Signature 4.0 oz	AE					
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	0 b	0 c	0 c	0 b	0 b
Legacy C 3.6 fl oz.	ACEG	0 b	0 c	0 c	0 b	0 b
Legacy C 4.5 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Legacy C 5.4 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Daconil Ultrex 2.4 oz	ACEG	0 b	0 c	0 c	0 b	<1 b
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	0 b	0 c	0 c	0 b	0 b
Concert 5.0 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Banner MAXX 1.0 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Banner MAXX 1.5 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Banner MAXX 1.0 fl oz	ADG	0 b	0 c	0 c	0 b	0 b
Banner MAXX 1.5 fl oz	ADG	0 b	0 c	0 c	0 b	0 b
A7402T 0.625 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
A7402T 0.94 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
A7402T 0.625 fl oz	ADG	<1 b	0 c	0 c	0 b	0 b
A7402T 0.94 fl oz	ADG	0 b	0 c	0 c	0 b	0 b
Trinity 1.0 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Bayleton 1.0 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
A6780 1.0 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
A6780 1.5 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
A16841 0.98 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
A16841 1.47 fl oz	ACEG	0 b	0 c	0 c	0 b	0 b
Untreated	ACEG	5 a	13 b	25 b	41 a	40 a
Untreated	ACEG	7 a	20 a	39 a	58 a	48 a

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Dollar spot was rated by counting the total number of infection centers or percent plot area covered with dollar spot per plot.

Table 1 (continued). Dollar spot infection centers per plot following the application of various fungicides to a creeping bentgrass putting green, 2008.

	Application <sup>z</sup>	Dollar Spot Infection cente			ter <sup>y</sup>
Treatment and rate per 1000 sq ft	Timing	25 Aug	8 Sep	15 Sep	22 Sep
Legacy B 0.4 fl oz	ACEG	0 c <sup>x</sup>	2 b	0 b	5 c
Legacy B 0.55 fl oz	ACEG	0 c	<1 b	0 b	2 c
Legacy B 0.75 fl oz	ACEG	0 c	<1 b	<1 b	1 c
Legacy B 1.1 fl oz	ACEG	0 c	0 b	0 b	0 c
Legacy B 0.4 fl oz + Signature 4.0 oz	AE				
alternated with					
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	0 c	2 b	12 b	26 b
Legacy C 3.6 fl oz	ACEG	0 c	0 b	<1 b	<1 c
Legacy C 4.5 fl oz	ACEG	0 c	0 b	<1 b	2 c
Legacy C 5.4 fl oz	ACEG	0 c	0 b	0 b	0 c
Daconil Ultrex 2.4 oz	ACEG	1 c	10 b	12 b	18 bc
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	0 c	0 b	<1 b	<1 c
Concert 5.0 fl oz	ACEG	0 c	<1 b	0 b	<1 c
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	0 c	0 b	0 b	0 c
Banner MAXX 1.0 fl oz	ACEG	0 c	<1 b	2 b	4 c
Banner MAXX 1.5 fl oz	ACEG	0 c	0 b	0 b	<1 c
Banner MAXX 1.0 fl oz	ADG	0 c	<1 b	<1 b	1 c
Banner MAXX 1.5 fl oz	ADG	0 c	0 b	2 b	4 c
A7402T 0.625 fl oz	ACEG	0 c	<1 b	0 b	3 c
A7402T 0.94 fl oz	ACEG	0 c	0 b	0 b	2 c
A7402T 0.625 fl oz	ADG	0 c	9 b	7 b	18 bc
A7402T 0.94 fl oz	ADG	0 c	5 b	1 b	5 c
Trinity 1.0 fl oz	ACEG	0 c	0 b	<1 b	2 c
Bayleton 1.0 fl oz	ACEG	0 c	<1 b	0 b	3 c
A6780 1.0 fl oz	ACEG	0 c	0 b	0 b	3 c
A6780 1.5 fl oz	ACEG	0 c	0 b	0 b	0 c
A16841 0.98 fl oz	ACEG	0 c	<1 b	0 b	0 c
A16841 1.47 fl oz	ACEG	0 c	<1 b	0 b	0 a
Untreated	ACEG	40 b	83 a	65 a	80 a
Untreated	ACEG	60 a	91 a	69 a	74 a

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Dollar spot was rated by counting the total number of infection centers or percent plot area covered with dollar spot per plot.

Table 2. Percent dollar spot per plot following the application of various fungicides to a creeping bentgrass putting green,2008.

	Application <sup>z</sup>	Percent Dollar Spot <sup>y</sup>				
Treatment and rate per 1000 sq ft	Timing	16 Jun	23 Jun	30 Jun	7 Jul	14 Jul
Legacy B 0.4 fl oz	ACEG	0.0 a <sup>x</sup>	0.0 a	0.0 a	0.0 b	0.0 b
Legacy B 0.55 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Legacy B 0.75 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Legacy B 1.1 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Legacy B 0.4 fl oz + Signature 4.0 oz	AE					
Daconil Ultrex 3.2 oz + Signature 4.0 oz.	CG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Legacy C 3.6 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Legacy C 4.5 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Legacy C 5.4 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Daconil Ultrex 2.4 oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Concert 5.0 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Banner MAXX 1.0 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Banner MAXX 1.5 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Banner MAXX 1.0 fl oz	ADG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Banner MAXX 1.5 fl oz	ADG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
A7402T 0.625 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
A7402T 0.94 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
A7402T 0.625 fl oz	ADG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
A7402T 0.94 fl oz	ADG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Trinity 1.0 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Bayleton 1.0 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
A6780 1.0 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
A6780 1.5 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
A16841 0.98 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
A16841 1.47 fl oz	ACEG	0.0 a	0.0 a	0.0 a	0.0 b	0.0 b
Untreated	ACEG	0.0 a	0.0 a	0.0 a	0.2 a	0.1 a
Untreated	ACEG	0.0 a	0.0 a	0.0 a	0.1 a	0.1 a

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Dollar spot was rated on a 0 to 100% scale in which 0 = no dollar spot symptoms observed and 100 = entire plot area covered with dollar spot symptoms.

Table 2 (continued). Percent dollar spot per plot following the application of various fungicides to a creeping bentgrass putting green, 2008.

	Application						
	z		Perc	ent Dollar	Spot <sup>y</sup>		
Treatment and rate per 1000 sq ft	Timing	21 Jul	28 Jul	4 Aug	11 Aug	18 Aug	
Legacy B 0.4 fl oz	ACEG	0.0 b <sup>x</sup>	0.0 c	0.0 b	0.0 c	0.0 b	
Legacy B 0.55 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Legacy B 0.75 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Legacy B 1.1 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Legacy B 0.4 fl oz + Signature 4.0 oz	AE						
alternated with							
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Legacy C 3.6 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Legacy C 4.5 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Legacy C 5.4 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Daconil Ultrex 2.4 oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.2 b	
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Concert 5.0 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Banner MAXX 1.0 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Banner MAXX 1.5 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Banner MAXX 1.0 fl oz	ADG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Banner MAXX 1.5 fl oz	ADG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
A7402T 0.625 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
A7402T 0.94 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
A7402T 0.625 fl oz	ADG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
A7402T 0.94 fl oz	ADG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Trinity 1.0 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Bayleton 1.0 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
A6780 1.0 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
A6780 1.5 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
A16841 0.98 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
A16841 1.47 fl oz	ACEG	0.0 b	0.0 c	0.0 b	0.0 c	0.0 b	
Untreated	ACEG	0.1 a	0.2 b	0.3 b	1.0 b	1.3 b	
Untreated	ACEG	0.1 a	0.3 a	0.9 a	2.3 a	2.2 a	

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Dollar spot was rated on a 0 to 100% scale in which 0 = no dollar spot symptoms observed and 100 = entire plot area covered with dollar spot symptoms.

Table 2 (continued). Percent dollar spot per plot following the application of various fungicides to a creeping bentgrass putting green, 2008.

	Application <sup>z</sup>	ation <sup>z</sup> Percent Dollar Spot <sup>y</sup>				
Treatment and rate per 1000 sq ft	Timing	25 Aug	8 Sep	15 Sep	22 Sep	
Legacy B 0.4 fl oz	ACEG	0.0 c <sup>x</sup>	0.1 b	0.0 b	0.1 b	
Legacy B 0.55 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.1 b	
Legacy B 0.75 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.1 b	
Legacy B 1.1 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
Legacy B 0.4 fl oz + Signature 4.0 oz	AE					
alternated with						
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	0.0 c	0.1 b	0.2 b	0.4 b	
Legacy C 3.6 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
Legacy C 4.5 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.1 b	
Legacy C 5.4 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
Daconil Ultrex 2.4 oz	ACEG	0.0 c	0.2 b	0.4 b	0.4 b	
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
Concert 5.0 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
Banner MAXX 1.0 fl oz	ACEG	0.0 c	0.0 b	0.1 b	0.1 b	
Banner MAXX 1.5 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
Banner MAXX 1.0 fl oz	ADG	0.0 c	0.0 b	0.0 b	0.0 b	
Banner MAXX 1.5 fl oz	ADG	0.0 c	0.0 b	0.1 b	0.1 b	
A7402T 0.625 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.1 b	
A7402T 0.94 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.1 b	
A7402T 0.625 fl oz	ADG	0.0 c	0.2 b	0.1 b	0.2 b	
A7402T 0.94 fl oz	ADG	0.0 c	0.1 b	0.1 b	0.1 b	
Trinity 1.0 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.1 b	
Bayleton 1.0 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.1 b	
A6780 1.0 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.1 b	
A6780 1.5 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
A16841 0.98 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
A16841 1.47 fl oz	ACEG	0.0 c	0.0 b	0.0 b	0.0 b	
Untreated	ACEG	1.2 b	3.6 a	5.1 a	6.2 a	
Untreated	ACEG	2.3 a	4.7 a	4.4 a	6.1 a	

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Dollar spot was rated on a 0 to 100% scale in which 0 = no dollar spot symptoms observed and 100 = entire plot area covered with dollar spot symptoms.

	Application <sup>z</sup>	Quality <sup>y</sup>				
Treatment and rate per 1000 sq ft	Timing	16 Jun	23 Jun	30 Jun	7 Jul	
Legacy B 0.4 fl oz	ACEG	7.7 a <sup>x</sup>	6.7 a	7.3 a	7.3 a	
Legacy B 0.55 fl oz	ACEG	7.3 a	6.7 a	7.3 a	7.7 a	
Legacy B 0.75 fl oz	ACEG	5.7 a	6.3 a	7.3 a	7.0 a	
Legacy B 1.1 fl oz	ACEG	6.0 a	6.7 a	7.3 a	7.0 a	
Legacy B 0.4 fl oz + Signature 4.0 oz	AE					
alternated with						
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	6.0 a	7.0 a	7.3 a	7.7 a	
Legacy C 3.6 fl oz	ACEG	6.3 a	6.3 a	7.0 a	7.0 a	
Legacy C 4.5 fl oz	ACEG	7.0 a	7.0 a	7.7 a	8.0 a	
Legacy C 5.4 fl oz	ACEG	6.7 a	6.3 a	7.3 a	7.3 a	
Daconil Ultrex 2.4 oz	ACEG	6.7 a	6.0 a	7.0 a	7.0 a	
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	6.7 a	6.7 a	7.7 a	7.7 a	
Concert 5.0 fl oz	ACEG	7.0 a	6.0 a	7.0 a	7.0 a	
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	7.0 a	6.7 a	7.3 a	7.0 a	
Banner MAXX 1.0 fl oz	ACEG	5.7 a	6.0 a	7.3 a	6.3 a	
Banner MAXX 1.5 fl oz	ACEG	7.3 a	6.3 a	7.0 a	6.7 a	
Banner MAXX 1.0 fl oz	ADG	6.7 a	6.7 a	7.3 a	6.7 a	
Banner MAXX 1.5 fl oz	ADG	6.7 a	6.7 a	7.7 a	7.0 a	
A7402T 0.625 fl oz	ACEG	6.7 a	6.7 a	7.3 a	7.3 a	
A7402T 0.94 fl oz	ACEG	7.0 a	7.0 a	8.0 a	7.3 a	
A7402T 0.625 fl oz	ADG	6.0 a	6.7 a	7.7 a	7.0 a	
A7402T 0.94 fl oz	ADG	6.3 a	6.3 a	7.0 a	7.0 a	
Trinity 1.0 fl oz	ACEG	7.7 a	7.0 a	7.3 a	7.7 a	
Bayleton 1.0 fl oz	ACEG	6.3 a	6.7 a	6.7 a	7.0 a	
A6780 1.0 fl oz	ACEG	5.3 a	6.0 a	6.7 a	6.0 a	
A6780 1.5 fl oz	ACEG	6.7 a	6.7 a	7.0 a	6.7 a	
A16841 0.98 fl oz	ACEG	7.0 a	7.0 a	7.7 a	7.3 a	
A16841 1.47 fl oz	ACEG	6.0 a	6.7 a	7.3 a	6.7 a	
Untreated	ACEG	6.7 a	7.0 a	7.3 a	6.0 a	
Untreated	ACEG	5.7 a	6.3 a	7.0 a	6.0 a	

Table 3. Turfgrass quality following the application of various fungicides to a creeping bentgrass putting green, 2008.

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Turfgrass quality was rated visually on a 0 to 10 scale where 0 = entire plot area brown or dead, 7.5 = minimum acceptable quality for a bentgrass fairway, and 10 = optimum color and density.

	Application <sup>z</sup>			Quality <sup>y</sup>		
Treatment and rate per 1000 sq ft	Timing	14 Jul	21 Jul	28 Jul	4 Aug	11 Aug
Legacy B 0.4 fl oz	ACEG	7.0 a <sup>x</sup>	6.7 bcd	6.7 a	7.0 a	6.7 a
Legacy B 0.55 fl oz	ACEG	7.0 a	7.7 a	7.3 a	7.3 a	7.0 a
Legacy B 0.75 fl oz	ACEG	7.3 a	7.0 abc	7.3 a	7.3 a	7.0 a
Legacy B 1.1 fl oz	ACEG	7.0 a	7.7 a	7.0 a	7.3 a	7.3 a
Legacy B 0.4 fl oz + Signature 4.0 ozalternated with	AE					
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	7.3 a	7.0 abc	7.7 a	7.0 a	7.3 a
Legacy C 3.6 fl oz	ACEG	7.3 a	7.0 abc	7.3 a	6.7 a	7.0 a
Legacy C 4.5 fl oz	ACEG	7.3 a	7.0 abc	7.0 a	7.0 a	7.0 a
Legacy C 5.4 fl oz	ACEG	7.0 a	6.7 bcd	6.3 a	7.0 a	6.7 a
Daconil Ultrex 2.4 oz	ACEG	6.7 a	7.0 abc	6.3 a	6.3 a	6.3 a
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	7.7 a	7.3 ab	7.7 a	7.0 a	7.3 a
Concert 5.0 fl oz	ACEG	6.3 a	6.3 cd	6.3 a	6.3 a	6.0 a
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	6.7 a	6.3 cd	6.3 a	6.3 a	6.3 a
Banner MAXX 1.0 fl oz	ACEG	6.7 a	6.7 bcd	6.7 a	7.0 a	6.3 a
Banner MAXX 1.5 fl oz	ACEG	6.7 a	6.3 cd	6.7 a	7.0 a	7.0 a
Banner MAXX 1.0 fl oz	ADG	7.0 a	7.0 abc	6.7 a	7.0 a	6.7 a
Banner MAXX 1.5 fl oz	ADG	6.7 a	7.0 abc	7.0 a	7.0 a	6.3 a
A7402T 0.625 fl oz	ACEG	7.7 a	7.3 ab	7.7 a	7.7 a	7.7 a
A7402T 0.94 fl oz	ACEG	7.3 a	7.0 abc	7.3 a	7.3 a	7.3 a
A7402T 0.625 fl oz	ADG	7.3 a	7.3 ab	7.7 a	7.3 a	7.7 a
A7402T 0.94 fl oz	ADG	7.0 a	7.0 abc	7.0 a	7.0 a	7.0 a
Trinity 1.0 fl oz	ACEG	7.3 a	6.7 bcd	7.0 a	7.0 a	7.0 a
Bayleton 1.0 fl oz	ACEG	6.7 a	6.7 bcd	6.7 a	7.0 a	6.7 a
A6780 1.0 fl oz	ACEG	6.3 a	6.0 d	6.7 a	6.7 a	6.7 a
A6780 1.5 fl oz	ACEG	7.0 a	6.7 bcd	6.7 a	6.7 a	6.7 a
A16841 0.98 fl oz	ACEG	7.0 a	7.0 abc	7.0 a	6.7 a	7.0 a
A16841 1.47 fl oz	ACEG	7.3 a	7.3 ab	7.3 a	7.3 a	7.3 a
Untreated	ACEG	7.3 a	7.0 abc	6.7 a	6.3 a	6.7 a
Untreated	ACEG	6.3 a	7.0 abc	6.7 a	6.3 a	6.7 a

Table 3 (continued). Turfgrass quality following the application of various fungicides to a creeping bentgrass putting green, 2008.

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Turfgrass quality was rated visually on a 0 to 10 scale where 0 = entire plot area brown or dead, 7.5 = minimum acceptable quality for a bentgrass fairway, and 10 = optimum color and density.

	Application <sup>z</sup>			Quality <sup>y</sup>		
Treatment and rate per 1000 sq ft	Timing	18 Aug	25 Aug	8 Sep	15 Sep	22 Sep
Legacy B 0.4 fl oz	ACEG	6.7 cd <sup>x</sup>	7.0 a	8.0 ab	7.3 cde	7.7 abc
Legacy B 0.55 fl oz	ACEG	7.3 a-d	7.3 a	8.7 a	7.7 bcd	8.7 a
Legacy B 0.75 fl oz	ACEG	8.0 ab	7.3 a	8.3 ab	7.7 bcd	8.3 a
Legacy B 1.1 fl oz	ACEG	7.7 abc	7.3 a	8.0 ab	7.0 de	8.3 a
Legacy B 0.4 fl oz + Signature 4.0 oz	AE					
alternated with						
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	7.7 abc	7.7 a	8.7 a	7.0 de	7.0 bc
Legacy C 3.6 fl oz	ACEG	7.3 a-d	7.0 a	8.0 ab	8.7 a	7.7 abc
Legacy C 4.5 fl oz	ACEG	7.0 bcd	7.3 a	8.7 a	8.7 a	8.7 a
Legacy C 5.4 fl oz	ACEG	6.3 d	6.7 a	8.0 ab	8.3 ab	8.0 ab
Daconil Ultrex 2.4 oz	ACEG	6.7 cd	7.0 a	8.0 ab	8 abc	8.0 ab
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	7.0 bcd	7.0 a	8.3 ab	8.7 a	8.3 a
Concert 5.0 fl oz	ACEG	6.3 d	6.7 a	7.7 bc	8.3 ab	8.0 ab
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl	ACEG	6.3 d	6.7 a	8.0 ab	8.7 a	8.3 a
0Z						
Banner MAXX 1.0 fl oz	ACEG	7.0 bcd	7.0 a	7.7 bc	7.0 de	7.7 abc
Banner MAXX 1.5 fl oz	ACEG	6.7 cd	7.0 a	8.0 ab	7.7 bcd	8.3 a
Banner MAXX 1.0 fl oz	ADG	7.3 a-d	7.3 a	8.0 ab	8.0 abc	8.7 a
Banner MAXX 1.5 fl oz	ADG	7.0 bcd	7.0 a	8.3 ab	7.7 bcd	8.0 ab
A7402T 0.625 fl oz	ACEG	8.3 a	7.7 a	8.3 ab	7.3 cde	8.0 ab
A7402T 0.94 fl oz	ACEG	7.3 a-d	7.3 a	8.7 a	7.7 bcd	8.0 ab
A7402T 0.625 fl oz	ADG	8.3 a	7.7 a	7.0 cd	7.3 cde	7.0 bc
A7402T 0.94 fl oz	ADG	7.0 bcd	7.3 a	7.7 bc	7.7 bcd	8.0 ab
Trinity 1.0 fl oz	ACEG	7.3 a-d	7.3 a	8.7 a	7.3 cde	8.3 a
Bayleton 1.0 fl oz	ACEG	6.7 cd	7.0 a	7.7 bc	7.0 de	8.0 ab
A6780 1.0 fl oz	ACEG	6.7 cd	7.0 a	7.7 bc	7.0 de	7.7 abc
A6780 1.5 fl oz	ACEG	6.7 cd	7.0 a	8.0 ab	7.3 cde	8.3 a
A16841 0.98 fl oz	ACEG	7.0 bcd	7.0 a	8.3 ab	8.0 abc	8.3 a
A16841 1.47 fl oz	ACEG	8.0 ab	7.7 a	8.7 a	7.7 bcd	8.0 ab
Untreated	ACEG	6.7 cd	7.0 a	6.3 d	6.7 e	6.7 c
Untreated	ACEG	6.7 cd	7.0 a	6.3 d	7.0 de	7.0 bc

Table 3 (continued). Turfgrass quality following the application of various fungicides to a creeping bentgrass putting green, 2008.

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Turfgrass quality was rated visually on a 0 to 10 scale where 0 = entire plot area brown or dead, 7.5 = minimum acceptable quality for a bentgrass fairway, and 10 = optimum color and density.

Table 4. Severity of take-all patch on a creeping bentgrass putting green following the application of various fungicides for the control of dollar spot, 2008.

	App <sup>z</sup>	Take All severity <sup>y</sup>					
Treatment and rate per 1000 sq ft	Timing	7 Jul	14 Jul	21 Jul	28 Jul	4 Aug	11 Aug
Legacy B 0.4 fl oz	ACEG	2.0 a <sup>x</sup>	2.5 a	3.0 a	3.0 a	3.3 a	3.0 a
Legacy B 0.55 fl oz	ACEG	1.7 a	1.7 a	1.8 a	2.2 a	2.5 a	2.2 a
Legacy B 0.75 fl oz	ACEG	1.3 a	1.0 a	1.0 a	1.7 a	0.8 a	1.0 a
Legacy B 1.1 fl oz	ACEG	1.0 a	0.5 a	0.5 a	0.8 a	0.5 a	0.8 a
Legacy B 0.4 fl oz + Signature 4.0 oz	AE						
alternated with							
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	1.7 a	1.0 a	0.8 a	1.7 a	1.7 a	0.8 a
Legacy C 3.6 fl oz	ACEG	2.0 a	1.3 a	2.0 a	2.0 a	1.7 a	1.7 a
Legacy C 4.5 fl oz	ACEG	1.7 a	1.7 a	1.7 a	2.7 a	2.2 a	1.5 a
Legacy C 5.4 fl oz	ACEG	1.7 a	2.0 a	2.3 a	2.0 a	3.0 a	1.8 a
Daconil Ultrex 2.4 oz	ACEG	1.7 a	2.0 a	2.3 a	2.7 a	2.5 a	1.8 a
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	1.0 a	1.7 a	1.7 a	1.7 a	1.7 a	1.3 a
Concert 5.0 fl oz	ACEG	1.7 a	2.3 a	2.7 a	3.0 a	3.2 a	3.0 a
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	2.3 a	2.7 a	2.7 a	3.3 a	3.3 a	3.0 a
Banner MAXX 1.0 fl oz	ACEG	1.3 a	1.7 a	1.7 a	1.7 a	2.3 a	1.7 a
Banner MAXX 1.5 fl oz	ACEG	2.3 a	2.7 a	2.8 a	2.7 a	3.0 a	2.0 a
Banner MAXX 1.0 fl oz	ADG	1.7 a	2.0 a	2.0 a	2.7 a	2.3 a	2.2 a
Banner MAXX 1.5 fl oz	ADG	2.0 a	2.3 a	2.8 a	2.7 a	3.0 a	2.8 a
A7402T 0.625 fl oz	ACEG	1.3 a	1.2 a	1.2 a	1.2 a	1.7 a	1.2 a
A7402T 0.94 fl oz	ACEG	2.0 a	2.0 a	2.3 a	2.0 a	1.7 a	2.3 a
A7402T 0.625 fl oz	ADG	1.3 a	1.2 a	1.3 a	1.5 a	1.2 a	1.0 a
A7402T 0.94 fl oz	ADG	1.7 a	1.7 a	1.5 a	2.3 a	1.7 a	1.7 a
Trinity 1.0 fl oz	ACEG	1.7 a	2.0 a	3.0 a	2.0 a	2.2 a	2.3 a
Bayleton 1.0 fl oz	ACEG	1.7 a	2.0 a	1.7 a	2.3 a	1.7 a	1.8 a
A6780 1.0 fl oz	ACEG	2.3 a	2.3 a	2.2 a	3.0 a	2.3 a	2.0 a
A6780 1.5 fl oz	ACEG	2.0 a	2.3 a	2.3 a	2.0 a	2.3 a	2.3 a
A16841 0.98 fl oz	ACEG	1.7 a	2.0 a	2.7 a	2.7 a	2.3 a	2.3 a
A16841 1.47 fl oz	ACEG	1.0 a	1.3 a	1.3 a	1.3 a	1.5 a	1.3 a
Untreated	ACEG	2.0 a	2.3 a	2.3 a	3.0 a	3.0 a	2.7 a
Untreated	ACEG	1.7 a	1.7 a	1.8 a	2.2 a	1.7 a	1.3 a

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Take all severity was rated on a 0 to 5 scale where 0 = no injury visible and 5 = entire plot invested with take all.

	App <sup>z</sup>			Percer	nt Take All	/	
Treatment and rate per 1000 sq ft	Timing	7 Jul	14 Jul	21 Jul	28 Jul	4 Aug	11 Aug
Legacy B 0.4 fl oz	ACEG	12 a <sup>×</sup>	17 a	13 a	12 b-g	10 c-i	8 c-g
Legacy B 0.55 fl oz	ACEG	10 a	12 a	9 a	11 c-g	9 c-i	13 а-е
Legacy B 0.75 fl oz	ACEG	8 a	9 a	8 a	9 efg	6 e-i	8 d-g
Legacy B 1.1 fl oz	ACEG	8 a	8 a	6 a	6 g	5 hi	6 efg
Legacy B 0.4 fl oz + Signature 4.0 oz alternated with	AE						
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	9 a	7 a	7 a	8 fg	4 i	6 efg
Legacy C 3.6 fl oz	ACEG	14 a	13 a	12 a	11 c-g	12 b-h	13 а-е
Legacy C 4.5 fl oz	ACEG	8 a	8 a	9 a	8 fg	8 c-i	11 c-g
Legacy C 5.4 fl oz	ACEG	11 a	14 a	15 a	16 b-f	12 b-g	15 a-d
Daconil Ultrex 2.4 oz	ACEG	14 a	19 a	16 a	18 abc	18 ab	19 ab
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	8 a	10 a	12 a	10 d-g	7 d-i	9 c-g
Concert 5.0 fl oz	ACEG	17 a	21 a	22 a	26 a	21 a	21 a
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	15 a	21 a	21 a	20 ab	18 ab	16 abc
Banner MAXX 1.0 fl oz	ACEG	13 a	16 a	14 a	16 b-f	14 a-d	9 c-g
Banner MAXX 1.5 fl oz	ACEG	17 a	19 a	22 a	18 abc	15 abc	11 b-g
Banner MAXX 1.0 fl oz	ADG	15 a	19 a	18 a	17 b-e	13 b-f	10 c-g
Banner MAXX 1.5 fl oz	ADG	13 a	16 a	17 a	13 b-g	11 b-i	9 c-g
A7402T 0.625 fl oz	ACEG	13 a	11 a	10 a	10 d-g	5 ghi	6 efg
A7402T 0.94 fl oz	ACEG	8 a	11 a	11 a	8 fg	6 f-i	5 fg
A7402T 0.625 fl oz	ADG	8 a	12 a	12 a	8 fg	4 i	5 efg
A7402T 0.94 fl oz	ADG	8 a	9 a	11 a	8 fg	6 e-i	6 efg
Trinity 1.0 fl oz	ACEG	13 a	12 a	13 a	12 b-g	11 b-i	9 c-g
Bayleton 1.0 fl oz	ACEG	10 a	9 a	8 a	9 efg	6 f-i	5 efg
A6780 1.0 fl oz	ACEG	17 a	18 a	18 a	16 b-f	12 b-h	9 c-g
A6780 1.5 fl oz	ACEG	15 a	19 a	19 a	18 a-d	15 abc	12 b-f
A16841 0.98 fl oz	ACEG	15 a	16 a	19 a	16 b-f	13 а-е	11 b-g
A16841 1.47 fl oz	ACEG	10 a	11 a	7 a	6 g	6 d-i	3 g
Untreated	ACEG	10 a	14 a	14 a	11 c-g	8 c-i	10 c-g
Untreated	ACEG	9 a	11 a	11 a	8 fa	5 ahi	6 efa

Table 5. Percent plot area affected by take-all patch on a creeping bentgrass putting green following the application of various fungicides for the control of dollar spot, 2008.

<sup>z</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Percent Take All was rated on a 0 to 100% scale in which 0 = no percent take all symptoms observed and 100 = entire plot area covered with Take all symptoms.

Table 6. Color ratings on a creeping bentgrass putting green as measured by the NDVI (Normalized Difference Vegetative Index) color meter

	Application <sup>z</sup>		NDVI <sup>y</sup>	
Treatment and rate per 1000 sq ft	Timing	16 Jul	29 Jul	11 Aug
Legacy B 0.4 fl oz	ACEG	0.684 a <sup>x</sup>	0.737 a-e	0.749 a
Legacy B 0.55 fl oz	ACEG	0.682 a	0.748 a-d	0.743 a
Legacy B 0.75 fl oz	ACEG	0.692 a	0.730 cde	0.742 a
Legacy B 1.1 fl oz	ACEG	0.691 a	0.747 a-d	0.737 a
Legacy B 0.4 fl oz + Signature 4.0 oz	AE			
Daconil Ultrex 3.2 oz + Signature 4.0 oz	CG	0.684 a	0 755 abc	0 746 a
Legacy C 3.6 fl oz	ACEG	0.686 a	0.732 b-e	0.739 a
Legacy C 4.5 fl oz	ACEG	0.687 a	0.733 b-e	0.757 a
Legacy C 5.4 fl oz	ACEG	0.673 a	0.717 e	0.726 a
Daconil Ultrex 2.4 oz	ACEG	0.675 a	0.727 de	0.738 a
Legacy C 3.6 fl oz + Signature 4.0 oz	ACEG	0.691 a	0.750 a-d	0.731 a
Concert 5.0 fl oz	ACEG	0.664 a	0.739 a-e	0.738 a
Daconil Ultrex 3.2 oz + Banner MAXX 1.0 fl oz	ACEG	0.686 a	0.733 b-e	0.743 a
Banner MAXX 1.0 fl oz	ACEG	0.688 a	0.734 b-e	0.744 a
Banner MAXX 1.5 fl oz	ACEG	0.652 a	0.740 a-e	0.744 a
Banner MAXX 1.0 fl oz	ADG	0.679 a	0.714 e	0.743 a
Banner MAXX 1.5 fl oz	ADG	0.685 a	0.746 a-d	0.745 a
A7402T 0.625 fl oz	ACEG	0.688 a	0.753 a-d	0.745 a
A7402T 0.94 fl oz	ACEG	0.694 a	0.751 a-d	0.752 a
A7402T 0.625 fl oz	ADG	0.694 a	0.762 a	0.754 a
A7402T 0.94 fl oz	ADG	0.703 a	0.747 a-d	0.750 a
Trinity 1.0 fl oz	ACEG	0.706 a	0.758 ab	0.751 a
Bayleton 1.0 fl oz	ACEG	0.681 a	0.738 a-e	0.722 a
A6780 1.0 fl oz	ACEG	0.655 a	0.714 e	0.735 a
A6780 1.5 fl oz	ACEG	0.679 a	0.749 a-d	0.745 a
A16841 0.98 fl oz	ACEG	0.676 a	0.756 abc	0.745 a
A16841 1.47 fl oz	ACEG	0.663 a	0.741 a-e	0.746 a
Untreated	ACEG	0.698 a	0.741 a-e	0.748 a
Untreated	ACEG	0.681 a	0.753 a	0.751 a

<sup>2</sup> Treatments were applied as follows: 14-d invertal treatments applied on 2, 18 and 30 Jun; 15 and 28 Jul; and 12 Aug: 21-d interval treatments applied on 2 and 24 Jun; 15 Jul; and 4 Aug.

<sup>y</sup> Color ratings for creeping bentgrass were measured with the NDVI color meter.

## CURATIVE CONTROL OF TAKE-ALL PATCH WITH VARIOUS FUNGICIDES

### JUNE-JULY

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#### INTRODUCTION

Take-all patch (*Gaeumannomyces graminis* var. *avenae*) is a common disease of newly established creeping bentgrass (*Agrostis stolonifera*) fairways and putting greens. Disease symptoms generally appear during the late spring or early summer and may persist for several months. As infected bentgrass declines, unaffected weed species often invade dead patches resulting in a reduction in the overall turf quality.

In situations where turfgrass quality deteriorates or golf course playability is negatively impacted, chemical control strategies are often necessary. Although control is most efficacious when fungicides are applied during the spring and the fall when the pathogen is most active, curative control is often necessary when unexpectedly struck with the disease during the summer months. Due to difficulty to find suitable sites for research on this pathogen, chemical control information is limited. The purpose of this study is to identify effective fungicides for the curative control of take-all patch naturally occurring on a creeping bentgrass putting green.

## **MATERIALS & METHODS**

The study is being conducted at the UConn Plant Science Research and Education Facility. The site consists of an 'A-4' creeping bentgrass putting green established in 2006. Following the establishment of the site, a sever outbreak of take-all patch was observed throughout the season in 2007 and again in the spring of 2008. A curative trial was initiated to assess the efficacy of various fungicides on controlling the disease. All treatments, rates and application timings are listed in the treatment table.

The study area consists of a native soil putting green with approximately 1 inch of topdressing applied between 2006 and 2008. The area was maintained as a creeping bentgrass putting green and mowed 5 times per week to height between 0.125 and 0.156 inches. The area received nitrogen applications in the spring and again in early summer with urea and ammonium sulfate, respectively. Plots measure  $3 \times 6'$  and are arranged as a randomized complete block design with 3 replications. All 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 applied during the summer of 2008 and will again be applied in the spring of 2009.

## RESULTS

Take all patch was considered very severe in this study and treatments were initiated on 1 Jun when symptoms were already present. There were no differences in the percent plot area affected by take-all patch when treatments were initiated and plots had an average of 35% disease (Table 1). Disease symptoms were prominent during the summer months until a period of heavy rains occurred on 23 and 24 Jul. After these rain events, disease symptoms began to naturally subside and no differences were observed among treatments. In early to mid-Aug, disease symptoms once again resurged and differences among treatments were observed on 18 Aug. At this time, plots treated with Headway (2 applications, 3.0 fl oz) had the least amount of take all patch. Of the remaining treatments, only turf treated with Tartan, Heritage and 3336 had reduced the disease when compared to the untreated control plots. Following this rating, disease symptoms subsided in all plots.

## DISCUSSION

Data collected from the first year of this multi-year study confirmed that curative control of take-all patch during the summer is difficult. Despite 2 applications, little suppression in percent disease was observed. When symptoms naturally faded following copius precipitation, however, differences in disease resurgence were observed. Plots treated with

thiophanate methyl or Heritage (alone or as a pre-mix with Banner) reduced disease symptoms when compared to the untreated control plots. It should be pointed out that the application of 3336 was made at an 8 fl oz rate, which is above the legal labeled rate for management of take-all. It is unclear if a rate effect would impact the reduction in disease severity observed in this trial.

Although no fungicides will be applied during the fall 2008, treatments will be initiated again in the spring prior to the onset of symptoms. Results from this study and two other studies seeking to identify the influence of application technology (post application irrigation and application volume), will hopefully improve our understanding of managing take-all patch on golf course putting greens.

Table 1	. Curative	control c	of take-all	patch wit	h various	funaicides

	Application <sup>z</sup>	<sup>z</sup> Percent take all <sup>y</sup>				
Treatment and rate per 1000 sq ft	timing	20 Jun	3 Jul	20 Jul	1 Aug	18 Aug
ProStar 1.5 oz	AE	37 a <sup>x</sup>	37 a	25 a	13 a	19 а-е
Tartan 2.0 fl oz	AE	31 a	19 a	17 a	4 a	9 def
DPX-LEM 17-50-76 0.5 oz	ACEG	29 a	29 a	18 a	9 a	13 b-f
Headway 3.0 fl oz	AE	35 a	35 a	17 a	8 a	5 f
Heritage 2.0 fl oz	AE	36 a	23 a	16 a	9 a	7 ef
Disarm 0.36 fl oz	AE	31 a	25 a	25 a	14 a	17 a-f
Insignia 0.9 oz	AE	35 a	49 a	24 a	13 a	23 a-d
Compass 0.25 oz	AE	39 a	32 a	27 a	12 a	24 ab
Banner MAXX 4.0 fl oz	AE	20 a	22 a	18 a	6 a	11 b-f
Bayleton 2.0 fl oz	AE	47 a	46 a	36 a	7 a	10 c-f
Trinity 1.0 fl oz	AE	39 a	39 a	35 a	11 a	16 a-f
Triton 0.30 fl oz	AE	36 a	43 a	26 a	17 a	29 a
3336 8.0 fl oz	AE	40 a	35 a	13 a	4 a	9 ef
Untreated	-	32 a	34 a	23 a	10 a	23 abc

<sup>z</sup> Treatments were applied as follows: A = 01 Jun, C = 18 Jun, E = 02 Jul, and G = 15 Jul.

<sup>y</sup> Percent of the plot area infested by take all was visually rated on a 0 to 100 percent scale where 0 = no take all or 100 = entire plot covered with take all patch.

<sup>×</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. Curative control of take-all patch with various fungicides

	Application <sup>z</sup>	Take all severity <sup>y</sup>					
Treatment and rate per 1000 sq ft	timing	20 Jun	3 Jul	20 Jul	1 Aug	18 Aug	
ProStar 1.5 oz	AE	3.0 a <sup>x</sup>	3.7 a	3.0 a	3.7 a	3.7 a	
Tartan 2.0 fl oz	AE	2.7 a	2.0 a	1.3 a	1.0 a	1.0 a	
DPX-LEM 17-50-76 0.5 oz	ACEG	3.0 a	3.0 a	2.7 a	2.3 a	2.3 a	
Headway 3.0 fl oz	AE	3.0 a	3.0 a	2.3 a	2.7 a	2.7 a	
Heritage 2.0 fl oz	AE	3.3 a	2.3 a	2.0 a	2.3 a	2.3 a	
Disarm 0.36 fl oz	AE	2.7 a	2.7 a	2.7 a	3.0 a	2.3 a	
Insignia 0.9 oz	AE	3.3 a	3.3 a	2.7 a	3.0 a	2.3 a	
Compass 0.25 oz	AE	3.7 a	3.0 a	2.7 a	3.7 a	3.0 a	
Banner MAXX 4.0 fl oz	AE	2.7 a	2.7 a	2.3 a	1.7 a	2.3 a	
Bayleton 2.0 fl oz	AE	3.3 a	3.3 a	2.7 a	2.3 a	2.7 a	
Trinity 1.0 fl oz	AE	3.0 a	3.7 a	2.7 a	3.0 a	3.7 a	
Triton 0.30 oz	AE	3.0 a	2.7 a	2.7 a	3.0 a	3.0 a	
3336 8.0 fl oz	AE	2.7 a	2.7 a	1.7 a	1.0 a	0.7 a	
Untreated	-	2.7 a	3.0 a	3.0 a	2.3 a	2.3 a	

<sup>z</sup> Treatments were applied as follows: A = 01 Jun, C = 18 Jun, E = 02 Jul, and G = 15 Jul.

<sup>y</sup> Take all severity was rated on a 0 to 5 scale where 0 = no injury visible and 5 = entire plot invested with take all. \* 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.