Developing Best Management Practices for the Control of Anthracnose on Annual Bluegrass

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http://www.turf.rutgers.edu/
Over the Past Decade - Increase in the Prevalence of Anthracnose Disease on Putting Green Turf

- *Anthracnose* is now one of the most destructive diseases on golf course greens in the North America.

- Within the last 10 yrs we have seen an increase in anthracnose basal rot; it has been suggested that changes in *Management Practices* have contributed to this phenomenon by increasing abiotic stress and thus, predisposing turf to anthracnose.
So, we embarked on a major Anthracnose Research Project at Rutgers in 2002 to:

- Determine which management practices influence the incidence and severity of anthracnose, and to

- Formulate a comprehensive set of best management practices for control of this disease on annual bluegrass putting greens.
Anthracnose Disease of Turfgrass

Causal Agent: *Colletotrichum cereale*  
(Formerly known as *Colletotrichum graminicola*)

Symptoms:  
Poa - yellow, irregular patches (1 to 2 in)  
Bent - red to bronze patches (size varies)

Appearance:  
Usually on greens  
Spring through late-summer (variable)
Foliar blighting and thinning of *Poa annua* caused by *Colletotrichum cereale* (formerly *Colletotrichum graminicola*)

Photo: W. Uddin
Acervuli structures and setae on *Poa annua* leaf from *C. cereale* (formerly *C. graminicola*), the causal agent of anthracnose disease (photo from Univ. of Guelph)
Anthracnose Symptomology

Chlorotic Leaves

Acervuli on Infected *Poa annua* Tillers

Photo: Landschoot, APS Press
Nitrogen Fertilization

- Major nutrient controlling plant vigor
- Frequently applied at very low levels
- Influences many turfgrass diseases:
  
  Dollar spot (Markland et al., 1969)
  Anthracnose (Danneberger et al., 1983)
  Red thread (Cahill et al., 1983)
  Brown Patch (Burpee, 1995; Fidanza et al., 1996)
Summer N Fertilization Affects Anthracnose

N sprayed every ...
  28-days
  or
  7-days
  at
  4.9 kg ha⁻¹ (0.1 lb 1000-ft⁻²)
  May through August

(ammonium nitrate)
N Effect on Anthracnose Severity
*(Poa annua turf during 2004)*

- **28-d** (N at 0.1 lb 1000-ft⁻² month⁻¹)
- **7-d** (N at 0.4 lb 1000-ft⁻² month⁻¹)

Disease percentage over time from 11-Jun to 30-Aug.
Recently, Superintendents have asked the following Questions:

What is the potential role, if any, of Fall and Spring Granular-N Fertilization in anthracnose management?

Should I be increasing the use of Liquid (Foliar) Fertilization and reduce or possibly eliminate Granular-N Fertilization?

To answer these questions, we initiated the following 3-yr study:
Study Objectives: Rutgers (2008-10)

1. Identify the optimum frequency for low rate soluble-N fertilization.

2. Evaluate effect of late-fall or early-spring granular-N fertilization rate on anthracnose.

3. Determine whether late- or early-season granular-N fertilization alters (interacts with) the effect of frequent low rate soluble-N fertilization during the summer.
Objective 1: Identify optimum frequency for low rate soluble-N fertilization

<table>
<thead>
<tr>
<th>Rate</th>
<th>Frequency</th>
<th>Date</th>
<th>Seasonal N</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb 1,000-ft&lt;sup&gt;-2&lt;/sup&gt;</td>
<td>weeks</td>
<td></td>
<td>lb 1,000-ft&lt;sup&gt;-2&lt;/sup&gt;</td>
</tr>
<tr>
<td>0.1</td>
<td>1</td>
<td>15-May</td>
<td>1.2</td>
</tr>
<tr>
<td>0.1</td>
<td>2</td>
<td>15-May</td>
<td>0.6</td>
</tr>
<tr>
<td>0.1</td>
<td>4</td>
<td>15-May</td>
<td>0.4</td>
</tr>
<tr>
<td>0.1</td>
<td>8</td>
<td>15-May</td>
<td>0.2</td>
</tr>
<tr>
<td>0.2</td>
<td>2</td>
<td>15-May</td>
<td>1.2</td>
</tr>
<tr>
<td>0.2</td>
<td>4</td>
<td>15-May</td>
<td>0.6</td>
</tr>
</tbody>
</table>
### Objective 1: Opt. Low rate soluble N Fertilization

<table>
<thead>
<tr>
<th>Rate (lb 1,000-ft(^{-2}))</th>
<th>Frequency (weeks)</th>
<th>Date</th>
<th>Seasonal N (lb 1,000-ft(^{-2}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>1</td>
<td>15-May</td>
<td>1.2</td>
</tr>
<tr>
<td>0.1</td>
<td>2</td>
<td>15-May</td>
<td>0.6</td>
</tr>
<tr>
<td>0.1</td>
<td>4</td>
<td>15-May</td>
<td>0.4</td>
</tr>
<tr>
<td>0.1</td>
<td>8</td>
<td>15-May</td>
<td>0.2</td>
</tr>
<tr>
<td>0.2</td>
<td>2</td>
<td>15-May</td>
<td>1.2</td>
</tr>
<tr>
<td>0.2</td>
<td>4</td>
<td>15-May</td>
<td>0.6</td>
</tr>
<tr>
<td>0.1</td>
<td>1</td>
<td>18-June</td>
<td>0.6</td>
</tr>
<tr>
<td>0.1</td>
<td>2</td>
<td>18-June</td>
<td>0.3</td>
</tr>
<tr>
<td>0.1</td>
<td>4</td>
<td>18-June</td>
<td>0.2</td>
</tr>
<tr>
<td>0.1</td>
<td>8</td>
<td>18-June</td>
<td>0.1</td>
</tr>
<tr>
<td>0.2</td>
<td>2</td>
<td>18-June</td>
<td>0.6</td>
</tr>
<tr>
<td>0.2</td>
<td>4</td>
<td>18-June</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Total N = 0.1, 0.2, 0.3, 0.4, 0.6, and 1.2 lb 1,000-ft\(^{-2}\)
Anthracnose severity response to total N applied to annual bluegrass in 2008

\[ y = -3.9736x + 13.12578 \]
\[ p < 0.0001 \]
\[ R^2 = 0.8443 \]

Treatments initiated on 15 May and 18 June 2009
Summary: Low Rate Soluble-N Results

1. Anthracnose severity decreases (linearly) as the cumulative rate of low rate soluble-N fertilization increased up to 19.5 kg ha$^{-1}$ or 0.4 lbs 1000-ft$^{-2}$ per month ((0.1 lb / 1,000 sq ft every wk or 0.2 lb / 1,000 sq ft every 2 wks))

2. Initiate low rate soluble-N program at least one month BEFORE disease becomes severe

Initiated trial in 2009 to assess maximum rate N that will suppress disease severity.
Annual N Fertility Programming

Objective 2: Effect of timing (spring vs. autumn) and N rate of granular fertilization

Objective 3: Does granular-N fertilization alter the effect of frequent low rate soluble-N fertilization during the summer
Annual N Programming Trial Description

2 x 3 x 4 factorial arranged in RCBD

First factor - Timing of granular fertilization:
1. Autumn
2. Spring

Second factor - N rate granular fertilization (IBDU):
1. 73 kg ha\(^{-1}\) (1.5 lb 1000-ft\(^{-2}\))
2. 146 kg ha\(^{-1}\) (3.0 lb 1000-ft\(^{-2}\)) 2/3 Fall or Spring
3. 220 kg ha\(^{-1}\) (4.5 lb 1000-ft\(^{-2}\))

Non-granular fertilization trt included for comparison
Table 2. Summary of treatment combinations (1\textsuperscript{st} and 2\textsuperscript{nd} factors) for granular-N fertilization to be used during Trial II. Same treatments combinations will be used for autumn 2009 and spring 2010 (second year of trial). All treatments listed below will be combined all levels of the summer soluble-N fertilization factor (not shown).

<table>
<thead>
<tr>
<th>Primary Season of Fertilization</th>
<th>N Fertilizer Rate by Month</th>
<th>Annual N</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spring</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Autumn</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Spring</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Autumn</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Spring</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Autumn</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>
### Third factor - Rate of soluble-N fertilization during summer:

<table>
<thead>
<tr>
<th>Monthly</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>kg ha⁻¹</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>4.6</td>
</tr>
<tr>
<td>3.</td>
<td>9.1</td>
</tr>
<tr>
<td>4.</td>
<td>18.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Monthly</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb 1000-ft⁻²</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>0.0933</td>
</tr>
<tr>
<td>3.</td>
<td>0.187</td>
</tr>
<tr>
<td>4.</td>
<td>0.375</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 0</td>
<td>0</td>
</tr>
<tr>
<td>2. 0.375</td>
<td>0.375</td>
</tr>
<tr>
<td>3. 0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>4. 1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Objectives 2 & 3

Preliminary Results: 2009

- Early season, Spring granular fertilization reduced disease, Autumn did not

- ... and the 146 kg ha\(^{-1}\) (3.0 lb 1000-ft\(^{-2}\)) rate spring program was necessary to reduce disease severity

- Interactions indicate Summer soluble-N fertilization very effective at reducing disease, POSSIBLY more effective than granular N

- Will continue in 2010
Impact of Mowing Practices on Anthracnose Severity

- **Mowing Height**
  - 0.110 in.
  - 0.125 in.
  - 0.141 in.

- **Mowing Frequency**
  - Single cut each day (7x / wk)
  - Double cut each day (14x / wk)
Mowing Height Effect on Anthracnose – Rutgers University

![Graph showing the effect of mowing height on Anthracnose](image)

- **0.110-inch**
- **0.125-inch**
- **0.141-inch**

<table>
<thead>
<tr>
<th>Date</th>
<th>Disease %</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-Jul</td>
<td></td>
</tr>
<tr>
<td>13-Aug</td>
<td></td>
</tr>
<tr>
<td>27-Aug</td>
<td></td>
</tr>
<tr>
<td>10-Sep</td>
<td></td>
</tr>
<tr>
<td>24-Sep</td>
<td></td>
</tr>
<tr>
<td>8-Oct</td>
<td></td>
</tr>
</tbody>
</table>

2004
Lightweight Rolling Practices Effecting Anthracnose

Rolled every other day

No rolling

TRUE-SURFACE™ vibratory rollers
Lightweight Vibratory Rolling Effect on Anthracnose Severity

% Disease

30-Jul 13-Aug 27-Aug 10-Sep 24-Sep 8-Oct

Roll No Roll
Materials & Methods

Strip-Plot Design
3 x 2 factorial with 8 reps

Roller Type
– Vibratory Roller
– Sidewinder Roller
– No Rolling

Location
– Center
– Periphery
Anthracnose disease response to lightweight rolling practices in 2007

- Rolling initiated on 10 May 2007
The Take-Home message is ... 

... you can significantly reduce anthracnose and maintain green speed (ball roll distance) by:

(1) increasing heights of cut AND either

(2) increasing mowing frequency, and/or

(3) initiating frequent lightweight rolling
Sand Topdressing

Routine light sand topdressing:

- Dilutes organic matter
- Improves infiltration rate
- Smoothes putting surface

However, does it enhance infection through wounding?
## Impact of Topdressing Rate and Frequency on Anthracnose: 2006-2007

<table>
<thead>
<tr>
<th>Interval (days)</th>
<th>Rate (ft³ 1000-ft⁻²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>No sand</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>28</td>
<td>2</td>
</tr>
</tbody>
</table>

All plots brushed uniformly

![Grass field with topdressing differences]
Effect of Topdressing Rate on Anthracnose of Annual Bluegrass - 2006

sand ft$^3$/1,000ft$^2$
No Sand

Sand

$1\text{ ft}^3/1000\text{-ft}^2$
Impact of Topdressing Frequency on Anthracnose of Annual Bluegrass - 2006
Topdressing improves surface characteristics

Firmer surface raises effective height of cut

Deeper crowns reduces stress
What About Sand Type and Incorporation Method?

**Incorporation**
- None
- Vibratory roller
- Soft-bristled broom
- Stiff-bristled broom

**Sand Type**
- Round
- Sub-angular
Brushing Method
Incorporation Method Influence on Anthracnose Severity – 2007

![Graph showing the influence of incorporation method on anthracnose severity from June to September 2007. The x-axis represents dates from 17th June to 25th September, and the y-axis represents disease severity (%). The graph compares four methods: None (blue), Roll (red), Soft (green), and Stiff (purple). The disease severity increases from June to August and then decreases in September.]
Sand Particle Shape Effect on Anthracnose Severity – 2007

Graph showing the disease severity (%) from 17-Jun to 25-Sep, with disease severity increasing from late July to mid-August and decreasing thereafter. Three shapes are compared: None, Round, and Sub-angular.
What about foot traffic?

Does foot traffic alter the response of anthracnose to topdressing?

Surprisingly, traffic did not increase anthracnose in the presence of sand topdressing!
Materials and Methods

Traffic

i) none

ii) 5 days wk$^{-1}$ at rate of 200 rounds day$^{-1}$

Topdressing

i) none

ii) weekly at 1 ft$^3$ per 1000-ft$^2$
Effect of Foot Traffic on Anthracnose

Foot traffic initiated on 14 June 2007
Irrigation

First reported observations on the influence of cultural practices on anthracnose were related to poor irrigation and soil conditions (Sprague and Evaul, 1928)

So we decided to:
evaluate the effects of irrigation quantity on anthracnose
Effects of Irrigation Quantity

100% replacement of ET₀
   Excessive Irrigation

80% replacement of ET₀
   Moderate Irrigation

60% replacement of ET₀
   Stress, plus syringing

40% replacement of ET₀
   Severe Stress, extensive syringing
Irrigation Quantity Effects on Anthracnose Severity - 2007

Disease (%)
Irrigation Quantity Effects on Anthracnose Severity - 2008

Treatments initiated 30 May 2008
Findings

• Both extremes in irrigation increased anthracnose

• Frequent wilt stress increased anthracnose severity more than wet conditions
Studies with Plant Growth Regulators

Mefluidide (Embark 2L)
- None
- 3 fl oz 1000 ft$^{-2}$ applied twice
  late-March to early-April

Trinexapac-ethyl (Primo MAXX)
- None
- 0.125 fl oz. 1000 ft$^{-2}$ every 14-d
  late-April to August

Mefluidide and Trinexapac-ethyl
- also Ethephon (Proxy)+ TE
Mefluidide Effect on Anthracnose in Absence of Trinexapac-ethyl

% Disease

- ME  + ME

11-Jun  7-Jul  5-Aug  30-Aug  2004
Trinexapac-ethyl Effect on Anthracnose in Absence of Mefluidide
Mefluidide and Trinexapac-ethyl Interaction on Anthracnose Severity

% Disease

11-Jun 7-Jul 5-Aug 30-Aug 2004

+ME +TE ME*TE

% Disease

11-Jun 7-Jul 5-Aug 30-Aug 2004
Growth Regulation Recommendations

Continue to use these PGRs to produce a quality playing surface …

1) Embark or Proxy at label rates during Mar/Apr

2) Follow-up with subsequent apps of Primo
   - every 7 to 14 days @ 0.1 to 0.125 fl oz / 1000 ft²

This will not increase anthracnose …

… and may actually reduce it, particularly when using seedhead suppressants and Primo together with weekly nitrogen fertility
Anthracnose in Creeping Bentgrass

*Colletotrichum cereale*

- Typically a problem on annual bluegrass
- In some areas it is also a problem on creeping bentgrass
- Natural infection occurred in 2007 and 2008 on putting green trial — Bonos et al., 2009
## Anthracnose Ratings of Bentgrass Cultivars in 2004
 Putting Green Trial – 2007 and 2008 data

### Top Performing Entries

<table>
<thead>
<tr>
<th>Cultivar or Selection</th>
<th>Species</th>
<th>Anthracnose Rating</th>
<th>Cultivar or Selection</th>
<th>Species</th>
<th>Anthracnose Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. VE3 Comp</td>
<td>Velvet</td>
<td>8.7</td>
<td>14. Penn A-2</td>
<td>Creep</td>
<td>6.8</td>
</tr>
<tr>
<td>2. Shark</td>
<td>Creep</td>
<td>8.3</td>
<td>16. DMC Comp</td>
<td>Creep</td>
<td>6.8</td>
</tr>
<tr>
<td>3. SRX 1WM3</td>
<td>Creep</td>
<td>7.5</td>
<td>17. FDS2 Comp</td>
<td>Creep</td>
<td>6.8</td>
</tr>
<tr>
<td>5. Runner</td>
<td>Creep</td>
<td>7.3</td>
<td>19. SRX 1WM</td>
<td>Creep</td>
<td>6.7</td>
</tr>
<tr>
<td>6. SRX 1G32</td>
<td>Creep</td>
<td>7.3</td>
<td>20. Villa</td>
<td>Velvet</td>
<td>6.7</td>
</tr>
<tr>
<td>9. Tyee</td>
<td>Creep</td>
<td>7.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Authority</td>
<td>Creep</td>
<td>7.2</td>
<td>LSD</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>13. EPC Comp</td>
<td>Creep</td>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Anthracnose in Creeping Bentgrass

- **Tolerant cultivars**
  - Shark, Penneagle II, Runner, Penn A-1, A-2 Tyee
- **Susceptible cultivars**
  - Viper, Providence, Penncross, Brighton, Seaside II, Pennlinks II and Penn A-4
Controlling Anthracnose Basal Rot with a Sound Fungicide Program
# Chemical Control of Anthracnose

## I. Demethylation Inhibitors
(Sterol Inhibitors)
- Banner,
- Bayleton,
- Eagle, **Trinity**, Tourney, Triton

## II. Strobilurins
- Heritage, Compass
- Insignia, **Disarm**

## III. Benzimidazoles
- Fungo, Cleary
- 3336, Systec 1998

## IV. Nitriles
- Daconil, ChloroStar,
- Echo, Concorde

## V. Combinations
(III + IV)
- ConSyst, Spectro,
- Headway, Tartan
Excellent Control of ABR: Single Products

- Nitrile – chlorothalonil
  - Daconil Ultrex 82.5SDG (3.2 oz)

- DMI - propiconazole
  - Banner MAXX 1.3MC (1.0 fl oz)
- triticonazole
  - Trinity 1.67SC (1.0 fl oz)

- Antibiotic – polyoxin-D
  - Endorse 2.5W (4.0 oz)

14 d interval
Evaluation of Fungicides for the Control of Anthracnose on an Annual Bluegrass Green - PSU

Trinity 1.67SC 1.0 fl oz
Trinity 1.67SC 0.5 fl oz
Banner MAXX 1.24MC 1.7 fl oz
Daconil Ultrex 82.5WG 3.2 oz
Insignia 20WG 1.0 oz
Cleary 3336 50WP 2.0 oz
Heritage 50WG 0.4 oz
Untreated Check

Disease severity (%) / plot

Applied every 14 days from 25 May – 1 Aug.
Endorse Performance 2004 - 2006

Anthracnose severity

- 2004: Endorse 4.0 oz (a), Check (b)
- 2005: Endorse 4.0 oz (a), Check (b)
- 2006: Endorse 4.0 oz (a), Check (b)
Good Control of ABR until Late August

- Phosphonate – fosetyl-Al
  - Chipco Signature 80WG (4.0 oz)
- DMI – myclobutanil
  - Eagle 40W (1.0 oz)
- Dicarboximide – iprodione
  - Chipco 26GT 2SC (4 fl oz)
- Phenylpyrrole - fludioxonil
  - Medallion 50W (0.25 oz)

14 – d interval
Sensitivity to 4 SI-Fungicides: Baseline Population TCGC, n = 102

- Tebuconazole
- Propiconazole
- Myclobutanil
- Triadimefon

Log ED$_{50}$ (ug/mL) fungicide

Frequency (%)
### Rutgers 2002 Anthracnose Data

<table>
<thead>
<tr>
<th>Treatment</th>
<th>% Area Diseased</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18 Jul</td>
</tr>
<tr>
<td>1.0 oz Eagle 40W (1.2 kg/ha myclobutanil)</td>
<td>3.3</td>
</tr>
<tr>
<td>1.0 fl oz Banner MAXX (1.1 kg/ha propiconazole)</td>
<td>0.8</td>
</tr>
<tr>
<td>1.1 oz Lynx 45W (1.5 kg/ha tebuconazole)</td>
<td>0.0</td>
</tr>
<tr>
<td>1.0 oz Bayleton 50DF (1.5 kg/ha triadimefon)</td>
<td>7.3</td>
</tr>
</tbody>
</table>

All treatments applied at 14 day intervals, 2 gal/M
Civitas 98 AS (Mineral Oil)

1. New Product 2009: Isoparaffin

Acropetal penetrant

Mode of action: Induced systemic resistance (activates plant signaling genes/antimicrobial compounds).
Control of Anthracnose on ABG Green with Civitas, Rutgers 2009

Treatments applied on 14-day interval from 15 May – 21 August
Evaluating Tank Mixtures for the Control of Anthracnose
Curative Control of Anthracnose Basal Rot on an Annual Bluegrass Green – Univ. Riverside, CA

Applied every 14 days from 15 Jun – 1 Sept

Rated on 24 July

Signature 4.0 oz + Daconil 3.2 oz
Insignia 20WG 0.7 oz
Banner MAXX 1.3ME 1.0 fl oz
Heritage TL 0.8ME 1.0 fl oz
Endorse 2.5WP 4.0 oz
Medallion 50WP 0.33 oz
Daconil Ultrx 82.5WG 3.2 oz
26GT 2SC 4.0 fl oz
Chipco Signature 80WG 4.0 oz
Untreated check

Disease severity (%) / plot

Signature Tank Mix Performance

Anthracnose severity

2004 2005 2006

Signature 4.0 oz + Daconil Ultrex 3.2 oz
Signature 4.0 oz + Medallion 0.33 oz
Signature 4.0 oz + 26 GT 4.0 fl oz
Signature 4.0 oz
Check
A Programmatic Approach to Controlling Anthracnose Basal Rot
Excellent Control of ABR: Programs (Alt/R)

Rutgers Alternation Program

- Banner MAXX 1 fl oz/ 1000 ft²
- Daconil Ultrex 3.2 oz/ 1000 ft²
- Chipco Signature 4 fl oz + Daconil Ult. 2.4 oz/ 1000 ft²
- Chipco 26GT 4 fl oz/ 1000 ft²
- Medallion 0.18 oz + Banner MAXX 0.75 oz/ 1000 ft²
- Chipco Signature 4 fl oz+ Daconil Ultrex 2.4 oz/1000 ft²
- Endorse 3.0 oz + Banner MAXX 0.75 oz/ 1000 ft²
- Chipco Signature 4 fl oz+ Daconil Ultrex 2.4 oz/1000 ft²

14 – d interval
Summary: Rutgers Anthracnose Fungicide Studies

- Preventive better than Curative Control
- Nitrogen (0.1 -0.25 lb @ 7-14 day intervals) will reduce anthracnose severity & improve fungicide efficacy
- DMI, Nitrile, Polyoxin-D = Excellent Control (Banner) (Daconil) (Endorse); (DMI’s variable)
- Benzimidazole (3336) and QoI’s (Insignia) provide excellent control as long as resistant strains are not present
- Phosphonate, Dicarboximide, Phenylpyrrole = Good (Signature) (Chipco 26GT) (Medallion) Control
- Tank Mixes and Rotation Programs typically provide the Best Control
Development of BMPs

Nitrogen

1. Apply sufficient amounts of N to maintain turf vigor without over-fertilizing

2. Use light-frequent (weekly, if feasible) apps of N during **Summer** up to 0.4 lb 1000-ft$^{-2}$ (19.5 kg ha$^{-1}$) month$^{-1}$

3. Granular fertilization should emphasize **Spring** fertilization

4. Interactions suggest N is more effective if program includes light-frequent apps during **Summer**
Development of BMPs

Mowing and Rolling

- Avoid mowing below 0.125-inch (3.2 mm) (fixed head mower – flex unit probably a lower bench setting)

- Increase mowing frequency and/or lightweight roll for playability
Development of BMPs

Sand Topdressing

- Light-frequent applications to match the rate of turfgrass growth

  1 ft³ 1000 ft⁻² every 7-d
  2 ft³ 1000 ft⁻² every 14-d

Now evaluating spring topdressing effect and initiating sand application at start of disease
Development of BMPs

Irrigation

- Avoid irrigation that induces wilt stress
- Avoid irrigation that increases likelihood of waterlogging & anthracnose infection
- Goal: 80% $\text{ET}_o$ to minimize anthracnose
Development of BMPs

Plant Growth Regulators

Use for better turf and playing quality

Will not increase anthracnose severity; may reduce

1) Proxy or Embark at label rates during March/April for Spring seedhead control

2) Primo throughout the Summer every 7 to 14 days @ 0.1 to 0.2 fl oz per 1000-ft²
Development of BMPs

Fungicide Management

- Avoid repeated sequential use of any fungicide chemistry
- Tank-mix or alternate with different fungicide chemistries to enhance efficacy and reduce potential for resistance
- Develop programs that focus on strengths of fungicide chemistries & major diseases
  - Use as many chemistries as practical
For Additional information - Turf.rutgers.edu