Optimizing Turfgrass Fungicide Management Programs on Golf Course Turf in the Northeast

Dr. Bruce B. Clarke
Rutgers University
The Best Turf Disease Management Programs:

● Optimize Cultural Management Practices to reduce plant stress and limit disease development

● Augment traditional disease control strategies with improved methods of Biological Control

● Utilize Cultivars with Improved Genetic Resistance / Tolerance
  ◆ Classical breeding
  ◆ Use of biotechnology

● Maximize Chemical Control Strategies by utilizing -
  ◆ Improved application strategies
  ◆ Enhanced disease forecasting models
  ◆ Benefits of tank-mixes and premixes in improving efficacy
  ◆ Best management practices to reduce fungicide inputs (single and multiple factor interactions)
Maximize Chemical Control Strategies by utilizing:

- Improved application strategies
Increasing Fungicide Performance with Improved application strategies

- Water Volume / Dew Removal
- Timing of Applications
- Nozzle Selection
- Wash-Off / Water pH
Increasing Fungicide Performance with Improved application strategies

Water Volume / Dew Removal
Influence of Water Volume on Fungicide Efficacy: Low Dollar Spot Severity

- Chlorothalonil (Daconil Ultrex @1.8 oz) – Applied after dew removal.
- In general, the contact fungicide provided better dollar spot control when applied at 1.2 gal/1,000 sq ft under low to moderate disease severity.
- 21 days after last treatment.
How much water volume is needed under High Dollar Spot Pressure?
Effects of Water Volume on Dollar Spot Under Very High Disease Pressure – Bent Green

- Untreated
- DU 1.6 oz 1.0 gal
- DU 3.2 oz 1 gal

Number of Lesions

Rutgers University - 2002
Effects of Water Volume on Dollar Spot Very Under High Disease Pressure – Bent Green

Rutgers University - 2002
Optimizing Summer Patch Chemical Control

- Apply in 2 - 4 gal water / 1000 ft$^2$ or Irrigate immediately after spraying
Summer Patch Control

% Disease

- Banner
- Fungo 50
- Tersan 1991
- Cleary 3336
- Control

2 Gal Water
10 Gal Water
Impact of Dew Removal on Fungicide Efficacy

Image courtesy Keith Happ USGA
Effect of Dew Removal on Fungicide Effectiveness for control of Dollar Spot

- Contact fungicide (e.g., Daconil Ultrex @1.8 oz) provided better dollar spot control when dew was removed in the morning.
- Dew prevents contact fungicides from spreading over the leaf to provide complete protection. (McDonald and Dernoeden, 2007)
Effect of Dew Removal on Fungicide Effectiveness for Control of Dollar Spot

- Propiconazole (Banner MAXX @ 0.5 fl oz)
- Dew had **no effect on the efficacy of this penetrant fungicide**
- 21 days after last treatment.
Recommendations

• For contacts, use 1.0 – 2.0 gallons water per 1,000 sq ft was optimum for dollar spot control.

• Under very severe dollar spot pressure, use maximum rates and 2.0 gallons water / 1,000 sq ft.

• Remove dew to improve the performance of contact fungicides (e.g., chlorothalonil), but not DMI fungicides (e.g., propiconazole).

• The tank mixture of contact (chlorothalonil) and penetrant (propiconazole) provided better disease control than either applied alone under high disease severity
Increasing Fungicide Performance with Optimum Application Strategies

Nozzle Selection
Nozzle Types

XR and XRC TeeJet

TwinJet

Turbo TeeJet

TurfJet

AI TeeJet (Air Induction)

TwinJet

Turbo TwinJet

Raindrop

Flat Fan” Spray Pattern

Hollow Cone” Spray Pattern
Spray Coverage

Excellent

XR Nozzle
Fine to Medium

Turbo TeeJet
Medium to Coarse

Air-induction
Course to Very Coarse

TurfJet
Extremely Coarse

Poor

Raindrop
Extremely Coarse
Nozzle Coverage

Water sensitive paper – turns blue when it makes contact with water

50 GPA = 1.15 gallons per 1000 sq. ft.
Drift Control

Excellent

- Raindrop
- TurfJet
- Air-induction
- Turbo TeeJet
- XR nozzle

Poor
Air-induction

Spray Solution

Air

Spray Solution
The Impact of Water Volume and Nozzle Type on Fungicide Efficacy
Impact of Water Volume and Nozzle Type on Dollar Spot Control - 2005

0.5 gal/1000 ft² (chlorothalonil - Daconil Ultex @ 1.8 oz/ M)

Number of lesion Centers

Nozzle Type

Nozzle Type: Al, Turbo, XR, Del., Untr.

Fidanza: Research Conducted for Rutgers Field Day - 2005
Impact of Water Volume and Nozzle Type on Dollar Spot Control - 2005

1 gal/1000 ft² (chlorothalonil – Daconil @ 1.8 oz/ M)

Number of lesion Centers

Nozzle Type

AI Turbo XR Del. Untr.

Research Conducted for Rutgers Field Day
Impact of Water Volume and Nozzle Type on Dollar Spot Control - 2005

Number of lesion Centers

Nozzle Type

AI | Turbo | XR | Del. | Untr.

2 gal/1000 ft² (chlorothalonil - Daconil @ 1.8 oz/ M)

Fidanza: Research Conducted for Rutgers Field Day - 2005
Increasing Fungicide Performance with Optimum Application Strategies
Impact of Simulated Rainfall Dollar Spot Control: Rutgers

• Five Fungicide Treatments
  – Daconil Ultrex (1.8)
  – Chipco 26GT (3.0)
  – Trinity (1.0)
  – Renown (mixture of chlorothalonil and azoxystrobin)
  – Disarm (0.18)

• Half inch rainfall treatments were applied
  – Immediately following application (within 5 minutes)
  – Four hours after application
  – 24 hours after application
  – None
EFFECT OF SIMULATED RAINFALL ON DOLLAR SPOT CONTROL WITH Chipco 26GT 3 fl oz/1,000 sq ft

NO WATER immediately following
EFFECT OF SIMULATED RAINFALL ON DOLLAR SPOT CONTROL WITH Chipco 26GT 3 fl oz/1,000 sq ft
Summary

• All fungicide treatments reduced dollar spot when compared to untreated

• All fungicides were impacted by simulated rainfall.

• Chlorothalonil (contact fungicide) was most affected by rainfall immediately following application
What Impact of Water pH on Fungicide Efficacy?
What is the Impact of pH on the Control of $-Spot$?

- Most pesticides stable at pH 4 to 6
- Some fungicides “decompose” pH > 7.
  - alkaline hydrolysis
  - loss of pesticide efficacy
  - examples:
    - Polyoxin D (Endorse) fungicide
    - Thiophanate methyl (Cleary’s 3336)

- Refer to product MSDS sheet for pH stability information
Impact of Water pH on Dollar Spot Control with Cleary 3336 50W @ 2 oz/M - 2007

Dollar Spot (# Infection Centers) vs. Water Carrier pH

Rutgers, bentgrass green, July 19, 2007.
Impact of Water pH on Dollar Spot Control with Daconil Ultrex (1.8 oz/M) - 2006

Dollar Spot (# Infection Centers)

Water Carrier pH

Bellewood GC, bentgrass fairway, July 11, 2006  Fidanza (PSU)
Impact of Water pH on Dollar Spot Control with Banner MAXX @ 0.5 fl oz/M - 2006

Dollar Spot (# Infection Centers) vs. Water Carrier pH

Bellewood GC, bentgrass fairway, July 11, 2006  Fidanza (PSU)
Increasing Fungicide Performance with Optimum Application Strategies

- Water Volume / Dew Removal
- Timing of Applications
- Nozzle Selection
- Wash-Off / Water pH
Timing of Fungicide Applications can Affect Efficacy

- Timing based on a temp. threshold (degree days, soil temps, other environmental parameters)
Summer Patch Chemical Control

- Timing – Soil temp. 65° F @ 2” depth for 5 to 7 consecutive days
Banner applied at 4 fl oz/ 1,000 ft sq on a 28 day interval.
Early Season Dollar Spot Applications

Should You Rethink the Timing of Your Fungicide Program for the Control of Dollar Spot on Fairways?
#5 Fairway– No early spring applications

Photo July 7, 2004

Dr. Mike Boehm,
Ohio State Univ
#5 Fairway – with one early spring application

Photo July 7, 2004
Dr. Mike Boehm, Ohio State Univ

<table>
<thead>
<tr>
<th>Treatment and rate / 1000 sq ft</th>
<th>6 June</th>
<th>20 June</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curalan 50EG 1.0 oz</td>
<td>1 a</td>
<td>10 a</td>
</tr>
<tr>
<td>Banner MAXX 1.3ME 1.0 fl oz</td>
<td>6 ab</td>
<td>14 a</td>
</tr>
<tr>
<td>Emerald 70 WG 0.13 oz</td>
<td>9 a-c</td>
<td>19 a</td>
</tr>
<tr>
<td>Bayleton 2SC 1.0 fl oz</td>
<td>11 a-c</td>
<td>19 a</td>
</tr>
<tr>
<td>Chipco 26GT 2SC 2.0 fl oz</td>
<td>18 b-d</td>
<td>30 ab</td>
</tr>
<tr>
<td>Daconil Ultrex 82.5WDG 1.8 oz</td>
<td>33 c-e</td>
<td>54 b</td>
</tr>
<tr>
<td>Insignia 20WG 0.5 oz</td>
<td>46 de</td>
<td>56 b</td>
</tr>
<tr>
<td>Untreated Check</td>
<td>89 f</td>
<td>87 c</td>
</tr>
</tbody>
</table>

1 Treatments were applied on 13 April, 2006. (6 June = 7.7 WAT; 20 June = 9.7 WAT)
Delaying the Initial Outbreak and Severity of Dollar Spot on Fairways with an Early Spring Application of Fungicides?

- **One Early Spring Application** - with an effective dollar spot fungicide or a tank mixture of two good dollar spot fungicides after the “Second True Mowing” of the season
Maximize Chemical Control Strategies by utilizing:

- Improved application strategies
- Enhanced disease forecasting models
Some examples of disease prediction models:

- Brown patch (on creeping bents)
- Pythium blight
- Dollar spot
Brown Patch

air temperature
precipitation + irrigation
relative humidity
dew period
soil temperature
Brown Patch (Bentgrass)

1. Low soil temp > 64 F

2. Low air temp > 59 F
   (Warning canceled if below 59 F in next 48 hours)

3. RH > 95% for at least 10 hours

4. Rainfall/irrigation of at least 0.1 inches

Schumann, Clarke and Burpee, 2001
Maximize Chemical Control Strategies by utilizing:

- Improved application strategies
- Enhanced disease forecasting models
- Benefits of tank-mixes and premixes in improving fungicide efficacy
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

Preventive Control of Anthracnose on an Annual Bluegrass Green (Test-1) : Rutgers, 2011*

* Fungicides applied from 17 May to 23 August
Suppression of Summer Patch by the Biological Control Product Companion on Kentucky Bluegrass Turf

Companion microbial inoculant contains *Bacillus subtilis* GB03 (> 1.5 x 10^{10} CFU/L); Heritage 50WG (azoxystrobin) @ 0.4 oz / 1,000 sq ft every 14 days; 3.9 cm cutting height.
## New Turfgrass Fungicide Mixtures

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Common Name</th>
<th>FRAC #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Briskway</td>
<td>azoxystrobin + difenoconazole</td>
<td>11 + 3</td>
</tr>
<tr>
<td>Concert</td>
<td>chlorothalonil + propiconazole</td>
<td>M5 + 3</td>
</tr>
<tr>
<td>Disarm C</td>
<td>fluoxastrobin + chlorothalonil</td>
<td>11 + M5</td>
</tr>
<tr>
<td>Disarm M</td>
<td>fluoxastrobin + myclobutanil</td>
<td>11 + 3</td>
</tr>
<tr>
<td>Honor</td>
<td>boscalid + pyraclostrobin</td>
<td>7 + 11</td>
</tr>
<tr>
<td>Encartis</td>
<td>boscalid + chlorothalonil</td>
<td>7 + M5</td>
</tr>
<tr>
<td>Interface</td>
<td>iprodione + trifloxystrobin</td>
<td>2 + 11</td>
</tr>
<tr>
<td>Lexicon</td>
<td>Insignia + fluxapyroxad</td>
<td>11 + 7</td>
</tr>
<tr>
<td>Pillar</td>
<td>pyraclostrobin + triticonazole</td>
<td>11 + 3</td>
</tr>
<tr>
<td>Renown</td>
<td>chlorothalonil + azoxystrobin</td>
<td>M5 + 11</td>
</tr>
<tr>
<td>Reserve</td>
<td>chlorothalonil + triticonazole</td>
<td>M5 + 3</td>
</tr>
<tr>
<td>Stellar</td>
<td>fluopicolide + propamocarb</td>
<td>28 + 43</td>
</tr>
<tr>
<td>Tartan</td>
<td>trifloxystrobin + triadimefon</td>
<td>11 + 3</td>
</tr>
</tbody>
</table>
A Programmatic Approach to Controlling Anthracnose Basal Rot
Excellent Control of ABR: Programs (Alt/R)

Rutgers Alternation Program for NE and Mid-Atlantic States

- Mid-May – DMI
- Early-June – Nitrile (chlorothalonil)
- Mid-June – Phosphonate (fosetyl-Al) + Nitrile
- Early-July – Dicarboximide (iprodione)
- Mid-July – Phenylpyrrole (fludioxonil) + DMI (reduced rate)
- Early-August – Phosphonate + Nitrile
- Mid-August – Polyoxin-D + DMI (reduced rate)
- Late-August (if weather is still hot) - Nitrile

14 – d interval
Maximize Chemical Control Strategies by utilizing:

- Improved application strategies
- Enhanced disease forecasting models
- Benefits of tank-mixes and premixes in improving fungicide efficacy
- Best management practices to reduce fungicide inputs (single and multiple factor interactions)
Influence of N Rate and Fungicide Type on Red Thread Severity

% Red Thread (N x Fung)

% Red Thread

0 lb N

1 lb N

2 lb N

8 lb N

Bay  Cd/T  Dac  Dyr  CK
Influence of N Form and Fungicide Rate on Summer Patch Severity

Lynx 25DF 1.32/0.66; Banner 1.1E 4/2 fl oz; Sentinel 40WG 0.25/0.12 oz.
Bent/Poa Green, Little Mill, CC, Marlton, NJ.
Best Management Practices can Reduce Fungicide Rates / Extend Intervals Needed to Control Turf Diseases
Putting It All Together

BMPs Effect on Fungicide Efficacy - 2012-13

Objective: To determine BMPs on fungicide efficacy.

Factors:

- **Mowing Height**
  - 0.090 vs. 0.125 inch

- **N Fertility**
  - 2.05 vs. 4.1 lb N per 1000 ft² per yr

- **Fungicide Program**
  - Calendar-based 14-day interval at 100%, 75%, 50% and 25% rates of fungicides (3.2 oz/M Dac Ultrex + 4 oz/M Signature)
  - Threshold schedule at 100% rate of fungicides
**N fertility** had a greater effect on disease severity than mowing height.

**N fertility interacted with fungicide program**, which means the effectiveness of a fungicide program depended on the level of N rate!
Fungicide Efficacy Trial: Results

Nitrogen X Fungicide Rate Interaction*

* Interaction data shown from Sept. 14, 2012 is representative of all rating dates in 2012.
Total # of Fungicide Applications (May-Sept 2012): Comparison of Threshold Applications to Combinations of Nitrogen Programs and Mowing Heights

<table>
<thead>
<tr>
<th>Nitrogen Program</th>
<th>Low Mow (0.090 in)</th>
<th>High Mow (0.125 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low N (2.05 lbs N 1000 ft(^2) yr(^{-1}))</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>High N (4.1 lbs N 1000 ft(^2) yr(^{-1}))</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

80% less fungicide than calendar-based schedule
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- Augment traditional disease control strategies with improved methods of Biological Control
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Rutgers Golf Turf Field Day

July 29, 2013

Hort Farm II, North Brunswick, NJ

www.turf.rutgers.edu