Turf Disease Management:
Are You Using All of the Tools in Your Toolbox?

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 to utilize -
  - Improved efficacy and better application technology
  - Enhanced disease forecasting models
  - Reduced risk of fungicide chemistries and improved fungicide resistance strategies
Cultural Practices that Influence Disease Development

- Fertilization – rate, frequency, source
- Soil and water pH
- Mowing Practices
- Topdressing and Incorporation Method
- Dew removal
- Cultivation Practices
- Soil Moisture / Irrigation Practices
- Plant Growth Regulators
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8 of 13 essential elements have influence on one or more turfgrass diseases:

- Nitrogen (N)
- Phosphorous (P)
- Potassium (K)
- Calcium (Ca)
- Iron (Fe)
- Sulfur (S)
- Manganese (Mn)
- Zinc (Zn)
- Silicon (Si)
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Effect of Nitrogen Rate and Source on Turf Disease Resistance

A. Increase Susceptibility to:
- Gray Leaf Spot
- Heat Stress
- Melting-Out
- Brown Patch
- Summer Patch
- Spring Dead Spot
- Microdochium Patch
- Leaf Spot
- Pythium Blight
- Red Leaf Spot

B. Decrease Susceptibility to:
- Anthracnose
- Dollar Spot
- Red thread
- Rust
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Brown Patch of Cool-season Turfgrasses Management

- Balanced fertility
- Improve air movement
- Decrease leaf wetness
- Correct subsurface drainage problems
- Reduce thatch
- Avoid high N fertility during periods of heat stress
- Improved cultivars for better disease and heat stress
- Proper mowing Ht.
- Use of fungicides
Effect of Nitrogen Rate and Source on Turf Disease Resistance

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- Rust
Nitrogen deficiency can intensify diseases such as Anthracnose.
Effect of Soluble N on Anthracnose Severity
(Poa annua turf during 2004)

28-d  (N at 0.1 lb 1000-ft\(^{-2}\) [4.9 kg ha\(^{-1}\) month\(^{-1}\)])

7-d  (N at 0.1 lb 1000-ft\(^{-2}\) week\(^{-1}\))
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The Source of Nitrogen can Influence the Incidence and Severity of Turfgrass Diseases

- Anthracnose
- Gray leaf spot
- Microdochium patch
- Leaf Spot and Melting-Out
- Summer patch
- Take-all patch
The Source of Nitrogen can Influence the Incidence and Severity of Turfgrass Diseases

- Anthracnose
- Gray leaf spot
- Microdochium patch
- Leaf Spot and Melting-Out
- Summer patch
- Take-all patch
4 lb N/M Ca NO$_3$
4 lb N/M
AS

Thompson et. al, 1998
Suppression of summer patch symptoms with Ammonium Sulfate - Rutgers University

Baron Kentucky Bluegrass – 1.5 inch height

Disease severity Index (dia. x intensity)

- Untreated
- Ammonium sulfate 0.2 lb N at onset of symptoms

* = Means are significantly different according to the Waller-Duncan k-ratio t-test (k=100).
Acidification of the Rhizosphere by Nitrogen Source (4 lb N/1000 sq. ft / yr)
Leaf Spot on Kentucky bluegrass
LEAF SPOT: CULTURAL CONTROL

• Increase Cutting Height
• Avoid Over fertilization with Quick-Release / Water Soluble N Sources
• Decrease Thatch
• Resistant Cultivars / Variety
8 of 13 essential elements have influence on one or more turfgrass diseases:

- Nitrogen (N)
- Phosphorous (P)
- Potassium (K)
- Calcium (Ca)
- Iron (Fe)
- Sulfur (S)
- Manganese (Mn)
- Zinc (Zn)
Influence of Mn and Cu on Take-all Patch on a Bentgrass Fairway

% Disease Incidence

Lb / A  Heckman et al., 2003
Management Practices can have a Dramatic impact on the Incidence and Severity of Turfgrass Diseases

- Nutrition – fertility levels and sources
- Mowing height and frequency
  - patch diseases (summer patch and take-all)
  - gray leaf spot
  - anthracnose
  - leaf spot and melting out
Mowing Height Effect on Anthracnose of an Annual Bluegrass Green—Rutgers University

% Disease

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

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

2004
31 August 2005

0.141-inch

0.110-inch
Cultural Practices that Influence Disease Development

- Fertilization – rate, frequency, source
- Soil and water pH
- Mowing Practices
- **Topdressing and Incorporation Method**
- Dew removal
- Cultivation Practices
- Soil Moisture / Irrigation Practices
- Plant Growth Regulators
No Sand

Sand
1 ft³/1000-ft²
<table>
<thead>
<tr>
<th>Sand Rate (ft³/1,000 ft²)</th>
<th>Anthracnose Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>c</td>
</tr>
</tbody>
</table>

Note: Different letters indicate significant differences between treatments.
Cultural Practices that Influence Disease Development

- Fertilization – rate, frequency, source
- Soil and water pH
- Mowing Practices
- Topdressing and Incorporation Method
- Dew removal
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- Plant Growth Regulators
Dragging fairways

Image courtesy Keith Happ USGA
Dollar Spot Creeping Bentgrass Putting Green
Clarke, et. al. - Rutgers University - 2005

Denotes significant difference b/w DewCure and untreated control
DewCure applications made at 14 d intervals
Cultural Practices that Influence Disease Development

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- Plant Growth Regulators
Diseases Enhanced by Compaction

- Anthracnose basal rot
- Necrotic ring spot
- Pythium root rot
- Summer patch
- Take-all patch
Diseases Enhanced by Compaction

- Anthracnose basal rot
- Necrotic ring spot
- Pythium root rot
- Summer patch
- Take-all patch
Conditions Favoring Summer Patch

- Hot, Humid Weather
- Excessive Soil Moisture
- Low Mowing Height
- Soil Compaction / Poor Drainage
### Effect of Compaction/Aerification on Summer Patch Severity of an Annual Bluegrass Fairway

<table>
<thead>
<tr>
<th>Aerification</th>
<th>Compaction</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>HVY (4X)</td>
</tr>
<tr>
<td>Dp: S</td>
<td>3.5</td>
</tr>
<tr>
<td>Dp: S &amp; F</td>
<td>4.8</td>
</tr>
<tr>
<td>Dp: F</td>
<td>5.0</td>
</tr>
<tr>
<td>Sh: S</td>
<td>7.3</td>
</tr>
<tr>
<td>Sh: S &amp; F</td>
<td>6.3</td>
</tr>
<tr>
<td>Sh: F</td>
<td>9.4</td>
</tr>
<tr>
<td>None</td>
<td>17.5</td>
</tr>
</tbody>
</table>

Mean Significant Difference = 1.2 inch; Clarke, Rutgers University, 1993
Cultural Practices that Influence Disease Development

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- Plant Growth Regulators
Enhanced by leaf wetness:

- Pythium blight
- brown patch
- dollar spot
- gray leaf spot
- *Drechslera* leaf spots
<table>
<thead>
<tr>
<th>Leaf Wetness Period / Soil Moisture and Disease</th>
</tr>
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Enhanced by leaf wetness:

- **Pythium blight**
- **brown patch**
- **dollar spot**
- **gray leaf spot**
- **Drechslera leaf spots**
DO NOT IRRIGATE

Dew and Guttation Water

6 AM

LEAVES DRY

12 AM

12 PM

DO NOT IRRIGATE

6 PM
Leaf Wetness Period / Soil Moisture and Disease

Enhanced by leaf wetness:
- Pythium blight
- brown patch
- dollar spot
- gray leaf spot
- *Drechslera* leaf spots

Enhanced by high soil moisture:
- patch diseases
- Pythium blight
- Pythium rot root
- brown patch

Enhanced by low soil moisture:
- red thread
- dollar spot
- gray leaf spot
- anthracnose
Irrigation Practices Influence on Anthracnose of an Annual Bluegrass Green -2007

Disease (%)
The Best Turf Disease Management Programs:

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# Biological Controls for Turfgrass Diseases

<table>
<thead>
<tr>
<th>Product name</th>
<th>Pathogen Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actinovate (<em>Streptomyces lydicus</em>)</td>
<td>Soilborne pathogens</td>
</tr>
<tr>
<td>Companion (<em>Bacillus subtilis</em>)</td>
<td>Brown patch; Summer Patch; Pythium Blight</td>
</tr>
<tr>
<td>DiTera</td>
<td>Nematodes</td>
</tr>
<tr>
<td>EcoGuard (<em>Bacillus licheniformis</em>)</td>
<td>Dollar spot (low and moderate pressure)</td>
</tr>
<tr>
<td>Spot-Less (<em>Pseudomonas aureofaciens</em>Tx-1)</td>
<td>Dollar spot</td>
</tr>
<tr>
<td>Rapsody (<em>Bacillus subtilis</em>)</td>
<td>Anthracnose; brown patch; dollar spot; p. mildew; rust</td>
</tr>
<tr>
<td>RootShield/TurfShield (<em>Trichoderma harzianum</em>)</td>
<td>Brown patch; dollar spot; many soilborne pathogens</td>
</tr>
<tr>
<td>Mycostop Mix (Primastop; <em>Gliocladium catenulatum</em>)</td>
<td>Many</td>
</tr>
</tbody>
</table>
There Have Been Successes!
Suppression of Summer Patch by the Commercial Biological Control Product, Companion

Disease Severity

Majumdar et al., 2000
Efficacy of *Bacillus licheniformis* for the Control of Dollar Spot in Crenshaw Creeping Bentgrass

Clarke et. al., 2002
Green plots were treated with *Typhula phacorrhiza* to control gray snow mold

Hsiang, 2000
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- Utilize Cultivars with Improved Genetic Resistance / Tolerance
  - Classical breeding – Significant improvements in resistance to many diseases including:
    - gray leaf spot (PRG), dollar spot (bents), leaf spot (KBG), brown patch (tall fescue)
18th Green

Declaration (HTE)
Dramatic Improvements in Gray Leaf Spot Resistance over the past 10 Years

‘Ph D’ Blend

‘Paragon GLR’
Dollar spot disease (Sclerotinia homoeocarpa)
**Perennial Ryegrass Cultivars with Improved Resistance to Gray Leaf Spot (FS 1048 turf.rutgers.edu/**

<table>
<thead>
<tr>
<th>1G²</th>
<th>Palmer IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1G2</td>
<td>Palmer V</td>
</tr>
<tr>
<td>All*Star 3</td>
<td>Palmer GLS</td>
</tr>
<tr>
<td>Apple GL</td>
<td>Panther GLS</td>
</tr>
<tr>
<td>Charismatic I GLSR</td>
<td>Paragon GLR</td>
</tr>
<tr>
<td>Dart</td>
<td>Prelude GLS</td>
</tr>
<tr>
<td>Derby Xtreme</td>
<td>Primary</td>
</tr>
<tr>
<td>DP – 1 (Soprano)</td>
<td>Protégé GLR</td>
</tr>
<tr>
<td>Exacta II GLSR*</td>
<td>Regal 5</td>
</tr>
<tr>
<td>Fiesta 4*</td>
<td>Repel GLS</td>
</tr>
<tr>
<td>GL – 2</td>
<td>Revenge GLX</td>
</tr>
<tr>
<td>Harrier</td>
<td>Secretariat II GLSR</td>
</tr>
<tr>
<td>Manhattan 5 GLR</td>
<td>SR 4600</td>
</tr>
<tr>
<td>Palace</td>
<td>Stellar GL</td>
</tr>
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Improvements in Brown Patch Resistance in Perennial Ryegrass
Leaf Spot on Kentucky bluegrass
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    - gray leaf spot (PRG), dollar spot (bents), leaf spot (KBG), brown patch (perennial ryegrass and tall fescue)
  - But there is a need for improved resistance to anthracnose, patch diseases, rusts, stripe smut, and Pythium diseases
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Enhancing Fungicide Performance with Improved Application Technology

- Sprayer Calibration
- Water Volume
- Dollar Spot
- Water pH
- Nozzle Selection
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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
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What are the strategies for combating resistance?

1. Rotate among different fungicide classes.
2. Tank mixing fungicides.
3. Reduced rate tank mixing of fungicides.
4. Combinations of Tank Mixing and Rotation.
5. Limiting number of sprays per season.
6. Proper timing (avoid once disease is active).
7. Use fungicide until you have resistance.
8. Withdrawal of fungicide when detect tolerance.
9. Use proper mgm’t techniques to reduce disease.
Are There any Questions?

Dr. Clarke and his graduate students and field crew

(turf.rutgers.edu)