Getting to the Root of the Problem: Biology and Management of Patch Diseases

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Summer Patch

Causal Organism:

*Magnaporthe poae*

Susceptible Hosts:

- Annual Bluegrass: *Poa annua*
- Kentucky Bluegrass: *Poa pretensis*
- Fine Fescue: *Festuca spp.*
- Bentgrass: *Agrostis spp.*
ROOT DISEASES

Caused by Ectotrophic Root-Infecting (ETRI) Fungi
PATCH DISEASES / ROOT PATHOGENS

Bermudagrass Decline
Kikuyugrass Decline
Necrotic Ring Spot
Spring Dead Spot
Summer Patch
Take-All Patch
IDENTIFICATION AND BIOLOGY OF THE FUNGUS
Conditions Favoring Summer Patch

- Hot, Humid Weather
- Excessive Soil Moisture
- Low Mowing Height
- Soil Compaction / Poor Drainage
Impact of Cultural Practices on Summer Patch Development

- Compaction
- Nitrogen fertility
- Soil and rhizosphere pH
COMPACTION
## Effect of Compaction/Aerification on Summer Patch Severity

<table>
<thead>
<tr>
<th>Aerification</th>
<th>Compaction</th>
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<tr>
<td></td>
<td>HVY (4X)</td>
<td>HVY (2X)</td>
<td>MOD (4X)</td>
<td>MOD (2X)</td>
<td>Non Comp</td>
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<tr>
<td>Dp: S</td>
<td>3.5</td>
<td>4.3</td>
<td>3.8</td>
<td>3.5</td>
<td>2.0</td>
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<tr>
<td>Dp: S &amp; F</td>
<td>4.8</td>
<td>4.3</td>
<td>3.5</td>
<td>3.5</td>
<td>2.8</td>
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<tr>
<td>Dp: F</td>
<td>5.0</td>
<td>5.5</td>
<td>4.5</td>
<td>4.8</td>
<td>3.3</td>
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<tr>
<td>Sh: S</td>
<td>7.3</td>
<td>5.5</td>
<td>6.0</td>
<td>3.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Sh: S &amp; F</td>
<td>6.3</td>
<td>5.8</td>
<td>5.8</td>
<td>3.8</td>
<td>3.3</td>
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<tr>
<td>Sh: F</td>
<td>9.4</td>
<td>10.4</td>
<td>9.5</td>
<td>6.8</td>
<td>4.3</td>
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<tr>
<td>None</td>
<td>17.5</td>
<td>15.0</td>
<td>13.7</td>
<td>10.7</td>
<td>7.1</td>
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</tbody>
</table>

Mean Significant Difference = 3 inches
Sources of Nitrogen

- Urea
- Sulfur-Coated Urea
- Ammonium Sulfate
- Ammonium Chloride

Calcium Nitrate
Potassium Nitrate
Nutralene
Nitroform
4 lb N/M
Ca NO₃
4 lb N/M
AS

Thompson et al., 1998
Acidification of Soil by Nitrogen Source
4 lb N/1000 sq. ft / year

- Pot. Nitrate
- Ca. Nitrate
- No Nitrogen
- Urea
- Nutralene
- Nitroform
- SCU
- Amm. Chloride
- Amm. Sulfate
Nitrogen Form Affects Soil pH

Soil: \( \text{NH}_4^+ \) → Hydrogen release balances charge and reduces rhizosphere pH

Root: \( \text{NO}_3^- \) → Hydroxyl release balances charge and increases rhizosphere pH
Suppression of summer patch symptoms with Ammonium Sulfate – (KBG) Rutgers University

* = Means are significantly different according to the Waller-Duncan k-ratio t-test (k=100).
Summer Patch Management

- Aerify and Improve Drainage
- Raise Mowing Height during Heat Stress
- Overseed with Perennial Ryegrass, Tall Fescue, or Bentgrass
- Fertilize with Ammonium Sources, SCU; Avoid using Nitrate Source
- Maintain pH at or Below 6.0
- Apply Penetrant Fungicides (4 gal water)
Evaluation of Fungicides for the Control of Summer Patch
Control of Summer Patch

I  DMIs :
   - Banner, Bayleton, Eagle, Rubigan, Trinity

II  Benzimidazoles :
   - Cleary 3336

III Strobilurins :
   - Compass, Disarm, Heritage (now available in sprayable and granular formulations), Insignia
   - Headway and Armada
Control of Summer Patch on Kentucky Bluegrass

Rating Date

% Disease

- Banner 2.0 fl oz 14d
- Heritage 0.2 oz 14d
- Heritage 0.4 oz 28d
- Insignia 0.5 oz 28d
- Ammonium Sulfate 0.2 lb N once
- Daconil Ultrex 3.2 oz 14d
- Untreated Check

Rutgers 2002
Impact of Primo on Summer Patch Severity on KBG
Rutgers University

**Baron Kentucky Bluegrass – Fairway height**

Inoculated on June 2.

Patch Diameter (inches)

<table>
<thead>
<tr>
<th>Date</th>
<th>Untreated</th>
<th>Primo 0.5 fl</th>
<th>Banner MAXX 4 fl oz</th>
<th>Banner MAXX + Primo 4 fl oz + 0.5 fl</th>
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<tbody>
<tr>
<td>Aug. 2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Aug. 18</td>
<td></td>
<td></td>
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<tr>
<td>Sep. 1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sep. 19</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

prefix: All products applied on a 28 day interval.
Summer Patch Gallonage Study

- 2 gallons water / 1000 sq ft
- 5 gallons water / 1000 sq ft
- 10 gallons water / 1000 sq ft

Fairway Study – 3 yrs
Summer Patch Control

% Disease

- 2 Gal Water
- 10 Gal Water

- Banner
- Fungo 50
- Tersan 1991
- Cleary 3336
- Control
Impact of Irrigation on Fungicide Effectiveness
# Impact of Water Volume and Post-treatment Irrigation on Summer Patch in Kentucky Bluegrass

<table>
<thead>
<tr>
<th>Fungicide</th>
<th>Amount of Water Carrier</th>
<th>Amount of Irrigation</th>
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<tbody>
<tr>
<td>Bayleton</td>
<td>2 gal/1000</td>
<td>0</td>
</tr>
<tr>
<td>Banner</td>
<td>5 gal/1000</td>
<td>¼ inch</td>
</tr>
<tr>
<td>Sentinel</td>
<td>10 gal/1000</td>
<td>½ inch</td>
</tr>
<tr>
<td>Rubigan</td>
<td></td>
<td>1 inch</td>
</tr>
</tbody>
</table>

B. Clarke & D. Thompson Rutgers University
IMPACT OF POST-TREATMENT IRRIGATION ON SUMMER PATCH DEVELOPMENT IN KENTUCKY BLUEGRASS

![Bar chart showing the impact of post-treatment irrigation on patch development in Kentucky Bluegrass.](chart.png)

- **Check**: 25.2 IN.
- **Banner 1.1E**
- **Sentinel 40WG**

**Patch Diameter (Inches)**

- **0.0 in.**
- **0.25 in.**
- **0.5 in.**
- **1.0 in.**

**Post-Treatment Irrigation**
Timing Fungicide Applications for Maximum Effectiveness
Baron Kentucky Bluegrass – Fairway height

Inoculated on June 2.

 Pest count: 1995

Aug. 2 Aug. 18 Sep. 2 Sep. 19

Patch Diameter (inches)

- Untreated
- J/J/A
- J/J
- J/A

† Banner applied at 127 ml/m² on a 28 day interval.
Summer Patch Chemical Control

- DMIs, Benzimidazoles, Strobilurins
- Use full label rates – 28 day intervals / 3 times / season in areas with a history of summer patch
- Apply in 2 to 4 gal water / 1000 ft² or Irrigate immediately after spraying
- Timing – Soil temp. 65° F @ 2” depth for 5 to 7 consecutive days
Putting it All Together: Combining Proper Fertilization and Fungicide Practices

Question:

Can acidifying nitrogen fertilizers reduce fungicide rate?

Answer:

Yes. It may, however, can take two to three years to occur.
Summer Patch Severity: Reduced Fungicide Rates and N Form

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.
TAKE-ALL PATCH

Causal Agent: *Gaeumannomyces graminis* var. *avenae*

Hosts: *Agrostis stolonifera* (creeping bentgrass)
A. *tenuis* (colonial bentgrass)
A. *canina* (velvet bentgrass)
IDENTIFICATION
AND
BIOLOGY OF THE FUNGUS
Factors Believed to Enhance Take-All Patch

- Cool Temperatures (40 - 60°F)
- Ample Soil Moisture
- High Soil or Rhizosphere pH (>6.5)
- Sandy, Light-Textured Soils
- Fumigated or Recently Cleared Land
Take-all Decline of Bentgrass

- Generally, Take-All Decline (TAD) starts within 3-5 Years after the disease first appears

- In wheat, TAD has been linked to a buildup of producing fluorescent *Pseudomonas* spp. and other Bacteria

- Root colonizing bacteria inhibit growth of the pathogen on root surfaces (i.e. antagonism) and eventually brings about TAD

Dernoeden (Univ. MD)
Take-All Patch Control

Question: What is the impact of soil pH and nitrogen source on disease severity?
**Effect of N-Sources on Take-all Patch in Colonial Bentgrass**

<table>
<thead>
<tr>
<th>N-Source*</th>
<th>Rate</th>
<th>% Diseased Area</th>
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<tbody>
<tr>
<td></td>
<td>Ib/M</td>
<td>kg/ha</td>
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<tr>
<td>Ammonium Phos.</td>
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<tr>
<td>Ammonium Sulfate</td>
<td>0.7</td>
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<tr>
<td>Untreated</td>
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</table>

*Applied 12 July and 8 August

SMITH, 1956
Roles of Mn in Take-all

Manganese

• *G. graminis* oxidizes $\text{Mn}^{2+}$ to $\text{Mn}^{3+}$ or $\text{Mn}^{4+}$, rendering it unavailable to the plant
• Results in a localized deficiency of Mn
• Weakens plant’s resistance
• Mn applications reduces take-all severity
Influence of Mn and Cu on Take-all Patch on a Bentgrass Fairway

% Disease Incidence

0 Mn 0 Cu 0 Mn 0.7 Cu 1 Mn 0 Cu 1 Mn 0.7 Cu 2 Mn 0 Cu 2 Mn 0.7 Cu

Ib / A Heckman et. al., 2003, 2004

Year 1 Year 2
Reducing Plant Stress
COMPACTION
Integrated Management of Take-all Patch

Resistant Species / Cultivars

- Fescues, bluegrasses, and ryegrasses are not affected by take-all patch
- Little known about relative susceptibility of bentgrass species and cultivars
## Susceptibility of Bentgrass Cultivars to Take-all Patch

**Madison, WI, 2001 (Fairway Ht)**

*Note: NTEP Trials, where 9 = least disease*  

<table>
<thead>
<tr>
<th><strong>CULTIVAR</strong></th>
<th><strong>MEANS (1-9 RATING)</strong></th>
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<tbody>
<tr>
<td>Backspin</td>
<td>6.2a</td>
</tr>
<tr>
<td>Princeville</td>
<td>6.0ab</td>
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<tr>
<td>Penn G-6</td>
<td>5.7ab</td>
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<tr>
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<td>Century</td>
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</tr>
<tr>
<td>SR 7100</td>
<td>4.7ab</td>
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<td>4.3ab</td>
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<td>L93</td>
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<td>Seaside II</td>
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<tr>
<td>Providence</td>
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Question: Which fungicides are most effective?
Control of Take-All Patch

P Banner
P Rubigan
P Bayleton
P Heritage
P Insignia
P Disarm
<table>
<thead>
<tr>
<th>Fungicide</th>
<th>AN</th>
<th>BP</th>
<th>DS</th>
<th>GL</th>
<th>LS</th>
<th>NR</th>
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<th>SM</th>
<th>SP</th>
<th>TA</th>
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<td>Compass</td>
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<td>3”</td>
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</table>

AN=Anthracnose, BP=Brown patch, DS=Dollar spot, GL=Gray leaf spot, LS=Leaf spot, NR=Necrotic ring spot, PB=Pythium blight, SM=Snow mold (pink), SP=Summer patch, TA=Take-all patch, YP=Yellow patch, YT=Yellow tuft; Effectiveness 1-4”, where 4”=excellent, 3”=good to excellent, 2”=fair to good, 1”=inconsistent control and L=limited data.

B.B. Clarke, Rutgers University, www.turf.rutgers.edu
Subsurface Injection vs. Surface Application

***Rubigan 1AS applied at 4 oz/1000 ft² in Sept., Oct., Apr., and May

B.B. Clarke, unpublished data
Management of Take-All Patch with Fungicides

- Fungicides reduce TA but do not eliminate it

- Preventive Treatments are best

- Products*
  - azoxystrobin (Heritage)
  - pyraclostrobin (Insignia)
  - fluoxastrobin (Disarm)
  - propiconazole (Banner MAXX)
  - fenarimol (Rubigan)
  - triadimefon (Bayleton)

  *Apply in 4 GPA with flat fan nozzles and high pressure
This Presentation is on the Rutgers Turf Web Site
www.turf.rutgers.edu