Getting the Most for your Fungicide Dollar: Improving the Control of Dollar Spot with Good Cultural and Chemical Practices

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Dollar Spot

Pathogen: *Sclerotinia homoeocarpa*

*Rutstroemia floccosum or*

(Proposed by J. Powell and J. Vargas, 2001))

*Poculum sp.* (Holst-Jensen et. al., 1997)

Grasses Affected: Annual Bluegrass, Bahiagrass, Bentgrass, Bermudagrass, Centipedegrass, Fine-leaved Fescue, Kentucky Bluegrass, Ryegrasses, Tall Fescue, Zoysiagrass
Dollar Spot
Dollar Spot

Conditions Favoring Disease:

- Overwinters as Sclerotia / Mycelium
- Resumes Growth at 59°F
- Optimum Disease 70 – 84°F
- High RH (> 85% Night)
- Thick Thatch (> 0.5 – 0.75 in.)
- Low Soil Moisture
- Extended Dew
- Low N Fertility
Cultural Management of Dollar Spot

- Maintain balanced N,P,K fertility
- Maintain adequate N when dollar spot is active
- Light, frequent N applications
- Avoid drought stress
- Do not irrigate toward dusk
- Remove dew by mowing, poling, or rolling
- Remove trees to provide good air circulation
- Aerify to reduce compaction and thatch
Dragging fairways
Denotes significant difference b/w DewCure and untreated control DewCure applications made at 14 d intervals
Organic fertilizers and composts can reduce dollar spot but this is due more to increased N availability than to enhanced microbial activity in the soil (Dernoeden, 2003).

Some biocontrol agents have been shown to reduce dollar spot in the field (*Enterobacter cloacae* and *Bacillus subtilis*).

Microbial products containing *Trichoderma harzianum* (Root Shield), *Bacillus licheniformis* (Ecoguard), and *Pseudomonas aureofaciens* strain TX-1 can reduce dollar spot but often not to commercially acceptable levels alone.

Use new improved bentgrass cultivars whenever possible.
# Bentgrass Cultivar Classification of Dollar Spot Resistance*

<table>
<thead>
<tr>
<th>Most Tolerant</th>
<th>Moderate Tolerant</th>
<th>Moderate Susceptible</th>
<th>Highly Susceptible</th>
</tr>
</thead>
<tbody>
<tr>
<td>007 Authority</td>
<td>Alpha Bengal</td>
<td>Backspin</td>
<td>Century</td>
</tr>
<tr>
<td>13M L-93</td>
<td>Bengal Imperial</td>
<td>Grand Prix</td>
<td>Independence</td>
</tr>
<tr>
<td>Benchmk DSR</td>
<td>Penn A-1 Backspin</td>
<td>Mackenzie</td>
<td>18&lt;sup&gt;th&lt;/sup&gt; Green</td>
</tr>
<tr>
<td>Declaration</td>
<td>Penn A-2 Grand Prix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kingpin</td>
<td>Penncross Mackenzie</td>
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<tr>
<td>Pennlinks II</td>
<td>Pennlinks Penn A-4</td>
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<tr>
<td>Memorial</td>
<td>Seaside Seaside II</td>
<td>Pennneagle II Princeville</td>
<td></td>
</tr>
<tr>
<td>SR 1150</td>
<td>Seaside II Penn G</td>
<td>Southshore Providence</td>
<td></td>
</tr>
<tr>
<td>SR 1119</td>
<td>Southshore</td>
<td></td>
<td>*Table developed from data from the 1998 and 2003 NTEP and 2001 - 2004 bentgrass trials at Rutgers University</td>
</tr>
</tbody>
</table>

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Chemical Control of Dollar Spot

I. Benzimidazoles
   n Fungo, Cleary 3336

II. Demethylation Inhibitors (Sterol Inhibitors)
   n Banner, Bayleton, Eagle, Rubigan, Lynx
   Trinity, Tourney

III. Dicarboximides
   n Chipco 26GT
   n Curalan, Touche, Vorlan

IV. Dithiocarbamates
   n Fore, Dithane, Pentathlon, Protect

V. Nitriles
   n Daconil, Echo, ChloroStar

VI. Carboximides
   n Emerald

VII. QoI (strobilurins)
   n Insignia, Disarm
Control Dollar Spot Control on Creeping Bentgrass Fairway – Rutgers 2007

Applied 23 May – 25 July (21 d)
and 23 May - 1 Aug (14 d)

# Lesion center / plot

Rated on 23 August
14 day = 22 DAT
21 day = 29 DAT
Improving Fungicide Performance

- Predictive Models
- Water pH
- Water Volume
- Nozzle Selection

Dollar Spot
Different nozzle depending on products.

68%: Same nozzle for everything.

32%

n= 42

Different water volume depending on products.

- 59%
- 41%

Same water volume for everything.

How Does Water Volume and Dew Removal Affect Fungicide Efficacy?
Influence of Water Volume on Fungicide Efficacy: Dollar Spot

- 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.
**Influence of Dew Removal on Fungicide Efficacy: Dollar Spot**

- **Daconil Ultrex (1.8 oz)** – 1.2 gal/1,000 sq ft water carrier
- This contact fungicide provided **better dollar spot control** when **dew was first removed** in the AM
- Dew prevents contact fungicides from spreading over the leaf to provide complete protection.
- 21 days after last treatment.
Influence of Dew Removal on Fungicide Efficacy: Dollar Spot

- Banner MAXX (0.5 fl oz) – 1.2 gal/1,000 sq ft water carrier
- Dew had no effect on the efficacy of this penetrant fungicide
- 21 days after last treatment.

AM/ dew

AM/ no dew
Effects of Water Volume on Dollar Spot Under Very High Disease Pressure – Bent Green

![Bar graph showing the number of lesions with different water volumes.](chart.png)

- Untreated
- DU 1.6 oz 1.0 gal
- DU 3.2 oz 0.5 gal

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

- Untreated DU 1.6 oz 2.0 gal
- DU 3.2 oz 2 gal

Rutgers University - 2002
Recommendations

- For contacts, use 1.0 – 2.0 gallons per 1,000 sq ft of water carrier for optimum disease control.
- Remove dew to improve the performance of contact fungicides (e.g., chlorothalonil), but not Sterol-inhibiting fungicides (e.g., propiconazole).
- The tank mixture of chlorothalonil and propiconazole generally provided better disease control than either applied alone.
- Under very severe dollar spot pressure, use maximum rates and 2.0 gallons water / 1,000 sq ft.
What Impact does Nozzle Selection have on Fungicide Efficacy?
Nozzle Types

XR and XRC TeeJet
TwinJet
Turbo TeeJet
TurfJet
AI TeeJet (Air Induction)
Turbo TwinJet
Raindrop

Flat Fan” Spray Pattern
Hollow Cone” Spray Pattern
Flat Fan Spray Application and Droplet Size

XR Flat-fan
Medium to coarse droplets

Air-induction Flat-fan
Coarse to very coarse droplets

TurfJet Flat-fan Extremely Coarse droplets
Example: XR and XRC TeeJet

~ Effect of Pressure on Droplet Size

<table>
<thead>
<tr>
<th>XR TeeJet</th>
<th>psi</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>15</td>
</tr>
<tr>
<td>XR8001</td>
<td>M</td>
</tr>
<tr>
<td>XR80015</td>
<td>M</td>
</tr>
<tr>
<td>XR8002</td>
<td>M</td>
</tr>
<tr>
<td>XR8003</td>
<td>M</td>
</tr>
<tr>
<td>XR8004</td>
<td>C</td>
</tr>
<tr>
<td>XR8005</td>
<td>C</td>
</tr>
<tr>
<td>XR8006</td>
<td>C</td>
</tr>
<tr>
<td>XR8008</td>
<td>VC</td>
</tr>
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<td>XR11001</td>
<td>F</td>
</tr>
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<td>XR110015</td>
<td>F</td>
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<td>M</td>
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<td>M</td>
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<td>M</td>
</tr>
<tr>
<td>XR11005</td>
<td>M</td>
</tr>
<tr>
<td>XR11006</td>
<td>C</td>
</tr>
<tr>
<td>XR11008</td>
<td>C</td>
</tr>
</tbody>
</table>

*Colors in the left column refer to the VisiFlo color coding guide for spray tips

Fidanza
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

Raindrop  | TurfJet
--- | ---
XR nozzle | Air-induction

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

Excellent

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

Poor
AI/AIC TeeJet Nozzles

• Advantages
  – Good coverage
  – Uses Venturi-air technology
  – Drift control
    • Even at very high pressure
  – Works best at >40psi
  – Canopy penetration

• Disadvantages
  – Not useable at low pressures (<30 psi)
  – Wear tolerance
Air-induction

Spray Solution

Air

Spray Solution
What Impact does Water Volume and Nozzle Type have on Fungicide Efficacy?
Impact of Water Volume and Nozzle Type on Dollar Spot Control - 2005

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

Number of lesion Centers

Nozzle Type

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

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

Number of lesion Centers

Nozzle Type

Al  Turbo  XR  Del.  Untr.

Fidanza: Research Conducted for Rutgers Field Day - 2005
Summary: Choosing the Right Nozzles; Fidanza and Clarke

- Choose a flat fan spray pattern for uniformity.
- Medium to coarse droplet size the best (e.g., XR, Turbo TeeJet and AI) for foliar diseases.
- Maintain 1 to 2 gal water/ M and a spray pressure of 30 - 60 psi.
- Avoid extremely large droplet sizes.
  - Fungicides are not distributed very well under low water volumes with coarse droplet nozzles.
  - Avoid extremely coarse droplet nozzles such as Raindrop [EC] and Turf Jet nozzles [EC] for foliar diseases.
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)

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

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)

Water Carrier pH

Bellewood GC, bentgrass fairway, July 11, 2006  Fidanza (PSU)
Fungicide Efficacy

• What is the Impact of Spray Adjuvants on the Control of Dollar Spot with Fungicides?
Rutgers 2005 Dollar Spot Trials - Creeping Bentgrass Fairway

Daconil Ultrex (1.8 oz/M) +/- Sync 0.32 fl oz @ 2 spray volumes, 21 d interval
Potential for Phytotoxicity using DMIs during Hot Weather on Poa annua Green –Rutgers 2007

Application date: May 18, June 1  Phyto (1-5); (1=0, 2=sl chlor/necrosis, 3=mod, 4=sv, 5=dead)
Rating date: June 13. 0.125 in cut ht
And Last but not Least,

Should You Rethink the Timing of Your Fungicide Program for the Control of Dollar Spot on Fairways?
Photo July 7, 2004
Dr. Mike Boehm,
Ohio State Univ

#5 Fairway– No early spring applications
#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 Late Fall or Early Spring Applications 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

- **One to Three Late Fall Applications** - with an effective dollar spot fungicide “4 to 6-wks” before the course typically experiences consistently freezing temperatures
Improving Disease Control using Disease Predictive Models

R. Latin
Professor of Plant Pathology
Purdue University
Decisions regarding fungicide application schedules may be based upon...

Calendar

Damage thresholds

Environmental-Based

Disease Predictive models
Weather Data – model building

**Staples**
- Air temperature
- Relative Humidity
- Rainfall/Irrigation
- Soil Temperature

**Others**
- Dewpoint
- Evapotranspiration
- Leaf wetness
- Degree Days base 50
Weather-based spray schedules are based on the principle that…

If we can identify and quantify environmental conditions that promote disease development…

…then we can predict disease outbreaks, and schedule remedial treatments at the most appropriate times.
Weather-based systems collect environmental data and process the data into usable information.
Attributes of a “Successful” Disease Forecasting Model

- Reliable
- Accurate and Available Data
- Rapid, Effective Communications
Weather-based spray schedules …

Advantages

• Potential to limit turf damage with reduced chemical inputs…(only essential sprays are applied)
• Environmental / regulatory benefit

Disadvantages

* Potential to apply fungicides at too short an interval (need to take fungicide longevity into account).
Important environment-based models

(Cool season grasses)

- **Diseases** – Pythium blight, Brown patch, Gray leaf spot, Dollar spot, and Anthracnose

- **Insects** – “white grubs” like Black Turfgrass Ataenius, masked chafers, Japanese Beetles; Also black cutworm

- **Weeds** – Poa annua flowering/seedheads; crabgrass (annual grassy weeds and broadleaf weeds)
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 (Bent)

1. Mean soil temp > 70F
2. Low soil temp > 64 F
3. Mean air temp > 68 F
4. Low air temp > 59 F
   (Warning canceled if below 59 F in next 48 hours)
5. RH > 95% for at least 10 hours
6. Rainfall/irrigation of at least 0.1 inches

Schumann, Clarke and Burpee, 2001
Brown Patch (Bent)

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Schumann, Clarke and Burpee, 2001
Pythium Blight
Pythium blight

Two risk models...

“150” rule

PSU model
According to the “150 Rule”, risk is based on average temperatures and relative humidity.

average daily $T +$ average daily relative humidity

Risk is high when the sum is 150 or greater!
Pythium blight

- Max Temp > 85 F
- Min Temp > 68 F
- Relative Humidity is > 90% for 10-14 hrs in a 24 hr period
- Consecutive hours of leaf wetness could be measured also

*Nutter, et al.*
Comparison of 150 rule and PSU model for Pythium blight risk assessment
Dollar Spot

- **Hall Model - underpredicts**
  - avg temp > 72 F
  - 2 days of measurable precipitation

- **Mills and Rothwell Model - overpredicts**
  - Max T > 77
  - RH > 90% any 3 days in 7
So In Conclusion:

Calendar
Weather-based
Damage threshold

Decision-making improves with experience and an understanding of turfgrass diseases and the efficacy of fungicides.