Diseases induced by Pythium -
Diseases of Bentgrass Caused by *Pythium*

- Damping-off of seedlings
- Pythium blight of foliage
- Pythium root rot, dysfunction
Hyphae, sporangia and oospores of *P. ultimum*
Seedling Diseases / Damping-Off

F Causal Agent(s): Pythium spp., Bipolaris sorokiniana, Rhizoctonia species, Drechslera spp., Fusarium spp.

F Hosts/ Occurrence: All grasses may be affected in the seedling stage or may be affected by seed rot. Seed of poor quality or vigor is especially prone to problems. Poor seedbed preparation and seed that is planted too deep or is planted in soils that are too cold or too wet are prone to problems. Excessive nitrogen in the seed bed and excessive seeding rates also increase disease potential.
Seedling Diseases / Damping-Off

- **Symptoms/ Signs:** No emergence of seedlings, or a sparse stand. Seedlings may emerge, but turn yellow, reddish brown, wilt and collapse.

- **Control:** Plant Apron treated seed (mefanoxam) or seed treated with ethazole (Terrazole). Follow label directions for treating seed with ethazole. After seedlings emerge and the “stand” has been achieved, spray with mefenoxam, or propamocarb at the low label rate in 1 to 2 gallons per 1000 sq.ft.
Pythium Blight

**Causal Agent(s):** *Pythium aphanidermatum* (Edson) Fitzpatrick and other *Pythium* species such as *P. myriotylum* Drechs., *P. graminicola* Subrum., *P. arrhenomanes* Drechs., and *P. ultimum*

**Hosts / Occurrence:** All turfgrasses are susceptible with the cool-season grasses - creeping bentgrass, annual bluegrass and Kentucky bluegrass - being the most.

We are seeing Pythium blight on bermudagrass more and it can be an important disease of cool-season turfgrasses used for overseeding bermudagrass putting greens.

It is most likely to occur when day and night temperatures exceed 85 F and 68 F, respectively, and when the relative humidity is high. Pythium blight can be a highly destructive disease.
Pythium Diseases - Symptoms on Leaves

- small (2.5-10 cm), purplish water-soaked patches, with slippery or slimy feeling when rubbed between the fingers
- white-gray “cobwebby” mycelium may be present with humidity is high
- leaves become light brown, dry and shriveled
- symptoms may occur in streaks, sometimes with water draining channels
Pythium and Brown Patch together -
time to purchase sod
Pythium blight in *Poa trivialis* overseeding
Pythium Blight epidemic in overseeding
Pythium Blight in Bermudagrass
Pythium Blight in Bermudagrass
(not overseeded)
Pythium Blight

Most likely to occur when day and night temperatures exceed 85 F and 68 F, respectively, and when the relative humidity is high.

Typically occurs between June and September.
**Pythium Blight**

**150 Rule:**

Historically, *Pythium* blight was predicted when Min. air temp + Max. relative humidity > 150 (over predicts)
Pythium Blight

Hall et al - 1985 (over predicts)

- Based on air temp during 24 hr period only
- Min temp $> 70^\circ$ F $< 18$ hr = No risk
- Min temp $> 68^\circ$ F $> 18$ hr $< 24$ hr = Mod risk
- Min temp $> 68^\circ$ F $> 24$ hr = Severe risk
Conditions Favoring Pythium Blight

1. **High soil salinity** favors increased susceptibility.

2. **High fertility generally** favors increased disease.

3. **Low soil moisture** preceding abundant rainfall and high temperatures favor disease outbreaks.
Pythium Blight Cultural Control

- Maintain adequate soil moisture
- Reduce seed rates (spring and summer)
- Soil pH in a more acid range
- Balanced fertility
- Leach salts if they accumulate to high levels
- Reduce leaf wetness
Chemical Control of Pythium Blight

I Aromatic Hydrocarbons:
   Koban, Terraneb, Terrazole

II Dithiocarbamates:
   Banol, Mancozeb,

III Phenylamides:
   Quell, Subdue Maxx, Apron (seed treatment)

IV Phosphonates:
   Signature, Prodigy and the phosphites

V Strobilurins (QoI):
   Heritage, Insignia, Disarm

VI QII
   cyazofamid: Segway

VII Premixture: Stellar (Valent/fluopicolide +propamocarb)
## Control of Pythium Blight on PRG: Rutgers 2005

<table>
<thead>
<tr>
<th>Trt and rate / 1000 ft²</th>
<th>Sch.</th>
<th>13 Jun</th>
<th>30 Jun</th>
<th>25 Jul</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subdue MAXX 2MC 0.5 fl oz</td>
<td>14 day</td>
<td>7.3 a</td>
<td>3.0 a</td>
<td>0.0 a</td>
</tr>
<tr>
<td>Banol 6SC 1.0 fl oz</td>
<td>14 day</td>
<td>0.0 a</td>
<td>1.0 a</td>
<td>0.0 a</td>
</tr>
<tr>
<td>Chipco Signature 80WG 4.0 oz</td>
<td>14 day</td>
<td>0.8 a</td>
<td>0.0 a</td>
<td>3.8 ab</td>
</tr>
<tr>
<td>Alude 46L 5.5 fl oz</td>
<td>14 day</td>
<td>0.3 a</td>
<td>0.7 a</td>
<td>7.0 b-d</td>
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<tr>
<td>Insignia 20WG 0.9 oz</td>
<td>14 day</td>
<td>0.0 a</td>
<td>0.0 a</td>
<td>0.0 a</td>
</tr>
<tr>
<td>Heritage 50WG 0.2 oz</td>
<td>14 day</td>
<td>0.0 a</td>
<td>0.0 a</td>
<td>0.3 a</td>
</tr>
<tr>
<td>Heritage 50WG 0.4 oz</td>
<td>21 day</td>
<td>0.0 a</td>
<td>1.3 a</td>
<td>11.3 d</td>
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<tr>
<td>Heritage TL 0.8ME 2.0 fl oz</td>
<td>21 day</td>
<td>0.0 a</td>
<td>10.0 b</td>
<td>4.5 a-c</td>
</tr>
<tr>
<td>Untreated check</td>
<td>-</td>
<td>7.8 b</td>
<td>32.7 c</td>
<td>24.3 e</td>
</tr>
</tbody>
</table>

### INT, DAT

<table>
<thead>
<tr>
<th>INT</th>
<th>DAT</th>
<th>DAT</th>
<th>DAT</th>
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<tr>
<td>14</td>
<td>7</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>21</td>
<td>7</td>
<td>21</td>
<td>7</td>
</tr>
</tbody>
</table>
Creeping bentgrass 'PennTrio' (~fairway, 0.450 inch height), Bellewood Golf Course, North Coventry, PA.
Treatments applied on July 20 and Aug. 3, 2007 (14-day int.), in 1 gal water per 1000 sq ft.
Treatments arranged as a randomized complete block design, 4 reps, plot size was 2.5 x 2.5 ft.
Plots inoculated with *Pythium aphanadermatum* infested rye grain (20 g per plot) on Aug. 13, 2007.
Fisher’s Protected Least Significant Different Test at $P < 0.10$.  

---

Mike Fidanza
Pythium Root Disease/Dysfunction

**F** Pathogen: *Pythium aristosporum*, *P. arrhenomanes*, *P. graminicola*, *P. volutum*; others

**F** Grasses affected: All turfgrasses, but primarily creeping bentgrass and annual bluegrass
Two Root Diseases Caused by Pythium species

**F Pythium Root Rot**
- Caused by an large number of Pythium species
- Occurs in poorly drained greens or during wet weather
- May develop at any time of year
- Symptoms usually in irregular patterns, sometimes in spots or patches
- Responds well to standard Pythium fungicides (ethazole, mefanoxam)

**F Pythium Root Dysfunction**
- *P. volutum, P. arrhenomanes, or P. aristosporum*
- Most severe in well-drained greens
- Disease development occurs in fall and spring, symptoms appear in summer
- Symptoms appear in distinct circular patches
- Standard Pythium fungicides not highly effective
- QoI and Qii fungicides most effective
Pythium Root Disease/Dysfunction

Symptoms and Signs: Nonspecific; sometimes yellow patches or reddish-brown discolored turf, thinning in irregular areas. *No foliar mycelium*. Discolored sometimes water-soaked roots and crown tissues. Oospores, mycelium and/or sporangia may be readily evident in root/crown tissues.

Conditions: late spring to early winter, particularly during or following prolonged wet, overcast weather. Drought or other stresses can initiate visible symptoms.
**Pythium Species from roots and crowns of bentgrass**

<table>
<thead>
<tr>
<th>Highly aggressive</th>
<th>Mod. Aggressive</th>
<th>Low Aggressive</th>
<th>Not Aggressive</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. arrhenomanes</td>
<td>P. distoccum</td>
<td>P. oligandrum</td>
<td>P. perillum</td>
</tr>
<tr>
<td>P. aristosporum</td>
<td>P. irregulare</td>
<td>P. multisporum</td>
<td>P. catenulatum**</td>
</tr>
<tr>
<td>P. aphanidermatum</td>
<td>P. multisporum</td>
<td>P. rostratum</td>
<td>P. torulosum**</td>
</tr>
<tr>
<td>P. graminicola</td>
<td>P. paroecandrum</td>
<td>P. zinglberis</td>
<td>P. intermedium</td>
</tr>
<tr>
<td>P. myriotylum</td>
<td>P. splendens</td>
<td>P. violae</td>
<td>P. plurisporium</td>
</tr>
<tr>
<td>P. tardiocrescens</td>
<td>P. sylvaticum</td>
<td>P. afertile</td>
<td>P. carolinianum</td>
</tr>
<tr>
<td>P. vanderpoolii</td>
<td>P. ultimum var. spongiferum</td>
<td>P. pulchrum</td>
<td>P. dissimile</td>
</tr>
<tr>
<td>P. volutum</td>
<td>P. violae</td>
<td>P. iwayamai</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P. sylvaticum</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P. pyrilobum</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P. polycarpum</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P. disstocum</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P. salpingophorum</td>
<td></td>
</tr>
</tbody>
</table>

**most frequently isolated

* cause cottony blight

A Summer Root and Stolon Rot of Bentgrass caused by Pythium volutum
Pythium Crown and Root Rot
Pythium Crown and Root Rot

Martin, 1996
Pythium Crown and Root Rot
Oospores in crown and roots of bentgrass
Preventative Control of PRD - 2004

Treatments applied 4/21, 5/6, 5/20, and 6/2
Data collected 7/15
Error bars indicate MSD according to Waller-Duncan

Tredway, NC State Univ.
Curative Control of Unknown Bentgrass Disease

Disease Severity

Subude Maxx (1 fl oz)  Terrazole (3.5 oz)  Sheffield Program  Terrazole-Subdue Program  Heritage (0.4 oz)  Insignia (0.9 oz)  Untreated

Treatments applied 7/20 and 8/3
Data collected 8/5
Error bars indicate MSD according to Waller-Duncan

Tredway, 2004
Pythium Root Rot 2005
Sprays applied May 27, June 17, and July 8
Aug. 26 rating

- Check
- Heritage TL
- Heritage 50WG
- Insignia
- Chipco Signature
- Sig+Daconil
- Koban/Subdue
- Terraneb
- Terr alt. Subdue
- Cyazofamid

Sprays applied May 27, June 17, and July 8
Aug. 26 rating

Martin, 2005
2005 Pythium Root Rot Trial

Check
Insignia
Heritage TL
Signature
Cyazofamid
New Products for Turfgrass Disease Control

Segway

cyazofamid

QiI, new class of chemistry to the turf market

developed by ISK, but marketed by FMC

0.45 to 0.9 fl oz per 1000 ft² application rate

released in spring 2007
Segway™
Fungicide

EPA Reg. No. 71512-13-279  EPA Est. No. 279-NY-1

Active Ingredient:
Cyazofamid* ........................................... 34.5%
Other Ingredients: .................................... 85.5%

*4-ethyl-2-cyano-N,N-dimethyl-5-(4-methylphenyl)-1H-indolizine-1-carboxamide (IUPAC)
Contains 3.33 pounds Cyazofamid Per Gallon (460 grams per litre)

KEEP OUT OF REACH OF CHILDREN
CAUTION

See side panel for additional precautionary statements.
Read entire label carefully and use only as directed.
MANUFACTURED IN FRANCE.

FIRST AID

If on skin
• Take off contaminated clothing.
• Rinse skin immediately with plenty of soap and water for 15-20 minutes.
• Call a poison control center or doctor for treatment advice.

If in eyes
• Hold eye open and rinse slowly and gently with water for 15-20 minutes.
• Remove contact lenses, if present, after the first 5 minutes, then continue rinsing.
• Call a poison control center or doctor for treatment advice.

If swallowed
• Call a poison control center or doctor immediately for treatment advice.
• Have person sip a glass of water if able to swallow.
• Do not induce vomiting unless told to do so by the poison control center or doctor.
• Do not give anything by mouth to an unconscious person.

If inhaled
• Move person to fresh air.
• If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible.
• Call a poison control center or doctor for further treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

HOTLINE NUMBER

For 24-Hour Medical Emergency Assistance (Human or Animal)
Call 1-800-331-3146.
For Chemical Emergency, Spill, Leak, Fire or Accident,
Call 1-800-331-3146.

PRECAUTIONARY STATEMENTS

Hazard to Humans (and Domestic Animals)

CAUTION
Harmful if absorbed through skin. Avoid contact with skin, eyes or clothing. Avoid breathing spray mist. DO NOT take internally.

Personal Protective Equipment (PPE)
Applicators and other handlers must wear long-sleeved shirt and long pants, steel-toed shoes, and chemical resistant gloves made of any waterproof material. Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing. Do not allow contact of contaminated clothing with unprotected skin. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

Engineering Control Statement
When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides (40 CFR 170.240 (d) (4)) the handler PPE requirements may be reduced or modified as specified in the WPS.

Manufactured for:
FMC
FMC Corporation
Agricultural Products Group
Philadelphia PA 19103

Net Contents:
03-09-07
Disarm™ 480 SC

Fungicide

For Turf Uses

Ingredients

<table>
<thead>
<tr>
<th>By wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Ingredient</td>
</tr>
<tr>
<td><strong>Fluoxastrobin</strong></td>
</tr>
<tr>
<td>Inert Ingredients</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

This product contains 4 pounds of Fluoxastrobin per gallon (480 g per liter).

**[(1E)-2-((6-(2-Chlorophenoxy)-5-fluoro-4-pyrimidinyl)oxy)phenyl] 5,6-dihydro-1,4,2-dioxazin-3-yl) methanone-0-methylxime**

KEEP OUT OF REACH OF CHILDREN

CAUTION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.

(If you do not understand the label find someone to explain it to you in detail.)

For PRODUCT USE Information Call 1-866-761-9397

Produced for:

ARYSTA LIFESCIENCE
NORTH AMERICA CORPORATION
15401 Weston Parkway, Suite 150
Cary, NC 27513

EPA Est. No. 62171-MS-001
EPA Registration No. 66330-64
Label Number 20630-B

NET WEIGHT: 16 FLUID OUNCES
STELLAR™ Fungicide

Turf and Ornamental Fungicide
For Control of Pythium and Phytophthora Diseases

Active Ingredient By Wt.
*Fluopicolide ................................................................. 5.54%
**Propamocarb Hydrochloride ........................................... 55.40%
Other Ingredients .......................................................... 39.06%
Total .................................................................................. 100.00%

*2,6-dichloro-N-[3-chloro-5-(trifluoromethyl)-2-pyridinyl]methyl]benzamide
**propyl[3-(dimethylamino)propyl]carbamate hydrochloride

STELLAR™ FUNGICIDE is a suspendable concentrate fungicide containing 0.52 lb fluopicolide per gallon and 5.2 lbs of propamocarb hydrochloride per gallon.

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE NEXT PAGE FOR ADDITIONAL PRECAUTIONARY STATEMENTS.

NET CONTENTS ___
SHAKE WELL BEFORE USING
AGITESE BIEN ANTE USO
Yellow Tuft (Downy Mildew)

Pathogen: *Sclerophthora macrospora*

Grasses affected: Kentucky bluegrass; perennial ryegrass; tall fescue; red fescue; and colonial, creeping and velvet bentgrasses; and St. Augustine grass
Yellow Tuft (Downy Mildew)

**Conditions:** A cool, wet-weather disease. Favored by air temp. in 60's and prolonged rainfall. Grass subject to flooding is particularly vulnerable to this disease.

**Control:** Subduse, Signature, Alude, Insignia
Yellow Spot
Yellow Spot
Unknown Etiology
Yellow Spot
Unknown Etiology
Plot treated with Daconil Ultrex (3.2 oz) every 14 days/ No yellow spot evident
To Optimize Results from Fungicide Applications:

F  Determine diseases of importance and when they are likely to be most active
F  Know how fungicides rank in effectiveness for the different diseases
F  Know effective tank-mix partners for improved disease control
F  Avoid undesirable non-target effects of fungicides
# Clemson Program 5 (developed 1998)

<table>
<thead>
<tr>
<th>Application No</th>
<th>Product</th>
<th>Rate/1000sqft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Banner Maxx + Daconil Ultrex</td>
<td>1.0 oz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.2 oz</td>
</tr>
<tr>
<td>2</td>
<td>Consyst/Spectro 90</td>
<td>4.0 oz</td>
</tr>
<tr>
<td>3</td>
<td>Daconil Ultrex + Chipco Signature</td>
<td>3.2 oz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 oz</td>
</tr>
<tr>
<td>4</td>
<td>Heritage</td>
<td>0.2 oz</td>
</tr>
<tr>
<td>5</td>
<td>Daconil Ultrex + Chipco Signature</td>
<td>3.2 oz</td>
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<tr>
<td></td>
<td></td>
<td>4.0 oz</td>
</tr>
<tr>
<td>6</td>
<td>Daconil Ultrex</td>
<td>3.2 oz</td>
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<tr>
<td>7</td>
<td>Banner Maxx + Daconil Ultrex</td>
<td>1.0 oz</td>
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<tr>
<td></td>
<td></td>
<td>3.2 oz</td>
</tr>
</tbody>
</table>

Applications 3, 4, and 5 during time of maximum heat stress.
Comparison of Chipco Signature and a Phosphite in a Program Approach - Fungicide Schedule

<table>
<thead>
<tr>
<th>Prog</th>
<th>May 24</th>
<th>June 8</th>
<th>June 22</th>
<th>July 6</th>
<th>July 20</th>
<th>Aug 3</th>
<th>Aug 17</th>
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<tbody>
<tr>
<td>2</td>
<td>Signature + Bayleton</td>
<td>Sig + 26 GT</td>
<td>Sig + Compass</td>
<td>Sig + Daconil</td>
<td>Sig + Daconil</td>
<td>Sig + Compass</td>
<td>26 GT</td>
</tr>
<tr>
<td>4</td>
<td>PHOS + Bayleton</td>
<td>PHOS + 26 GT</td>
<td>PHOS + Compass</td>
<td>PHOS + Daconil</td>
<td>PHOS + Daconil</td>
<td>PHOS + Compass</td>
<td>26 GT</td>
</tr>
</tbody>
</table>

Martin, 2004
Comparison of Chipco Signature and a PHOSPHITE in a Program Approach - Brown Patch

Martin, 2004
Comparison of Chipco Signature and a PHOSPHITE in a Program Approach - Turf Quality

Martin, 2004

Signature program

PHOS program

Percent Disease


Check Program 2 Program 4
Clemson Turf Fungicide Program Trials 2007

August 21, 2007
Pee Dee Research Center, Florence, SC

Untreated Check

Dr. Bruce Martin, Clemson
Turf Fungicide Program Trial
Untreated Check

Incidence/Turf Quality

Days after 1st application

May 28
Sept. 5

UTC Dollar Spot
UTC Brown Patch
UTC Turf Quality

Dr. Bruce Martin, Clemson
Turf Fungicide Program Trial

May 22: Banner Maxx 1.0 fl oz + Daconil Ultrex 3.2 oz

June 5: Chipco 26GT 4.0 oz

June 19: Spectro 90 5.76 fl oz

July 3: Signature 4.0 oz + Daconil Ultrex 3.2 oz

July 17: Heritage 0.2 oz

July 31: Signature 4.0 oz + Daconil Ultrex 3.2 oz

August 14: Chipco 26GT 4.0 oz

August 28: Banner Maxx 1.0 fl oz + Daconil Ultrex 3.2 oz

Martin Program (5) from 1998...

August 21, 2007
Pee Dee Research Center, Florence, SC

Dr. Bruce Martin, Clemson
<table>
<thead>
<tr>
<th>Date</th>
<th>Fungicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 22</td>
<td>Tartan 2.0 fl oz</td>
</tr>
<tr>
<td>June 5</td>
<td>Insignia 0.9 oz</td>
</tr>
<tr>
<td>June 19</td>
<td>Spectro 90 5.76 oz</td>
</tr>
<tr>
<td>July 3</td>
<td>Signature 4.0 oz + Daconil Ultrex 3.2 oz</td>
</tr>
<tr>
<td>July 17</td>
<td>Insignia 0.9 oz</td>
</tr>
<tr>
<td>July 31</td>
<td>Signature 4.0 oz + Daconil Ultrex 3.2 oz</td>
</tr>
<tr>
<td>August 14</td>
<td>Chipco 26GT 4.0 fl oz</td>
</tr>
<tr>
<td>August 28</td>
<td>Tartan 2.0 fl oz</td>
</tr>
</tbody>
</table>

Clemson Program (13)

August 21, 2007
Pee Dee Research Center, Florence, SC

Dr. Bruce Martin, Clemson
Turf Fungicide Program Trial
Program 13 (Martin)

Dr. Bruce Martin, Clemson

Days after 1st application

May 28 Sept. 5

Incidence/Turf Quality

Dollar Spot (Program 13) Brown Patch (Program 13) Turf Quality (Program 13)