Turfgrass Diseases: Take-all Patch (Causal fungus: Gaeumannomyces graminis var. avenae)

Take-all patch is a root and crown disease of bentgrass putting greens, tees, and fairways.

Caused by the fungus Gaeumannomyces graminis var. avenae, this disease is most often observed on relatively young (1 to 5-year-old) bentgrass turf but can occasionally damage older stands. Because take-all patch is a root and crown disease, infected plants are usually killed, and turf is slow to recover. Patches of dead turf are frequently colonized by resistant plant species, such as annual bluegrass, fine fescues, and broadleaf weeds.
Symptoms and signs

Take-all patch usually appears during late spring or summer as reddish-brown, yellow, or tan areas of dead bentgrass. Disease symptoms appear as rings, crescents, or large spots, with centers often colonized by annual bluegrass, fine fescues, or weeds. Patches range from a few inches to over 3 feet in diameter and older patches are often slightly sunken relative to surrounding turf. In stands of mixed species affected by take-all patch, bentgrass is killed or injured while other grasses remain unaffected. Symptoms are most conspicuous after turf has been stressed during periods of hot, dry weather. Roots and crowns of affected plants are generally brown or black.

When examining dead or dying roots, crowns, and stem bases with a microscope, trained diagnosticians frequently observe dark brown hyphal strands (ectotrophic runner hyphae) and mats of fungal mycelium on the surface of take-all patch-affected tissues. Infected roots often show dark brown coloration of the vascular cylinder, whereas cortical tissues remain clear and intact. In rare instances, spore-producing structures called perithecia may be observed on infected crowns and leaf sheaths.

Figure 2. Take-all patch symptoms on a creeping bentgrass tee. Photo: Peter Landschoot, Penn State

Figure 3. Circular patch of dead bentgrass with the center colonized by Chewings fescue and annual bluegrass. Photo: Peter Landschoot, Penn State
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Figure 4. Dark brown rotting root tissues (left) and ectotrophic runner hyphae of G. graminis on root surface (right) of take-all patch infected creeping bentgrass. Photos: Peter Landschoot, Penn State

Disease cycle
Dark brown runner hyphae of G. graminis begin to grow on the surface of roots soon after bentgrass turf is established. Little is known about the spread of the pathogen into new bentgrass stands, but hyphal strands may be introduced via infected plant debris on excavation equipment, in soil transported from other sites, or on the shoes of golfers. Spread of the pathogen through spore dissemination is thought to be extremely rare. Runner hyphae colonize and infect root systems under cool, moist conditions in fall and spring. Bentgrass plants are often able to withstand some root infection during cool weather, but plants wilt and die due to pathogen-induced root impairment during heat and drought conditions in early to mid-summer. Mycelium of G. graminis remains quiescent over winter months in northern climates but can resume growth and disease activities the following spring and summer.

Disease development
Take-all patch is most frequently observed from June to October on new bentgrass stands established in sandy soils, recently fumigated soils, and/or on new golf courses built in previously forested or wetland areas. In these situations, the beneficial microorganisms that compete with or antagonize the take-all patch pathogen are present in low populations and thus, do not suppress disease activity. In most cases, peak disease activity will decline over a period of 4 or 5 years, a phenomenon thought to be associated with the build-up of naturally occurring disease-suppressive microorganisms which inhibit growth of the causal fungus. Other factors that favor take-all patch development include liming to achieve soil pH values > 6.5, use of high pH topdressing materials on greens, and deficiencies of phosphorus and manganese.

Cultural control
Since pathogen growth on roots occurs prior to patch symptom development in turf, control measures should be implemented well before patches become visible. In high pH soils (>6.5), an effective cultural control measure involves using an acidifying fertilizer such as ammonium sulfate to lower the soil pH to between 5.5 and 6.0. High rates of ammonium sulfate can cause foliar burn of turfgrass in hot (>80°F) weather; thus, low rates should be applied and watered-into turf during spring and fall. Depending on the type of soil, the soil pH, and application frequency/rate of ammonium sulfate, this practice may take several months to a year or more to suppress take-all patch.

In persistent cases of take-all patch where soil tests reveal low levels of manganese, applications of 2 lb soluble manganese per acre as manganese sulfate have shown reductions in disease severity. Applications should be made in spring to avoid the potential for foliar burn injury, and manganese sulfate should be applied with sufficient water to allow penetration into the rootzone.

Chemical control
Certain penetrant fungicides can control take-all patch if applications are timed to inhibit G. graminis growth and infection before visible patch symptoms appear in turf. The timing of fungicide applications will depend on the approximate dates of patch symptom development. If greens, tees, or fairways have a history of symptom development in early to mid-spring, then fall fungicide applications may be required for adequate control. For outbreaks in late spring or summer, an early spring fungicide application followed by repeat applications on 21 to 28-day intervals typically provides the best control.

Because take-all patch is caused by a root and crown-infecting fungus, fungicide applications should be applied with large spray volumes (up to 5 gallons of water per 1000 sq ft) to ensure significant concentrations of active ingredient reach the crown and upper
portion of the root system. An alternative to using large spray volumes is to apply the fungicide in the early morning, then irrigate the treated area immediately with enough water to wash spray droplets off the canopy and into the surface soil where crowns and roots are located.

<table>
<thead>
<tr>
<th>Active ingredient according to class</th>
<th>Fungicide class, FRAC code*, and plant mobility classification**</th>
<th>Product name(s)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demethylation inhibitors (DMI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mefentrifluconazole</td>
<td>DMI, 3, acropetal penetrant</td>
<td>Maxtima</td>
</tr>
<tr>
<td>metconazole</td>
<td>DMI, 3, acropetal penetrant</td>
<td>Tourney</td>
</tr>
<tr>
<td>myclobutanil</td>
<td>DMI, 3, acropetal penetrant</td>
<td>Andersons Golden Eagle DG, Eagle 20EW, Myclobutanil 20EW</td>
</tr>
<tr>
<td>propiconazole</td>
<td>DMI, 3, acropetal penetrant</td>
<td>Andersons Prophesy DG, Banner Maxx II, Dorado, Lesco Spectator, Propiconazole 14.3, Savvi</td>
</tr>
<tr>
<td>prothioconazole</td>
<td>DMI, 3, acropetal penetrant</td>
<td>Andersons Fungicide VII, Bayleton FLO</td>
</tr>
<tr>
<td>tebuconazole</td>
<td>DMI, 3, acropetal penetrant</td>
<td>ArmorTech TEB 360 XL, Mirage Stressgard, Sipcam Clearscape ETQ, Tebuconazole 3.6, Torque</td>
</tr>
<tr>
<td>triadimefon</td>
<td>DMI, 3, acropetal penetrant</td>
<td>Andersons Fungicide VII, Bayleton FLO</td>
</tr>
<tr>
<td>triticonazole</td>
<td>DMI, 3, acropetal penetrant</td>
<td>Trinity</td>
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<tr>
<td>Methyl benzimidazole carbamates (MBC)</td>
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<tr>
<td>thiophanate-methyl</td>
<td>MBC, 1, acropetal penetrant</td>
<td>3336 EG, 3336 DG, Cavalier F, Fungo Flo, Lesco T-Storm, SysTec 1998, TM 4.5, TM 85 WDG, T-Methyl, Transom 4.5F</td>
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<tr>
<td>Quinone outside inhibitors (QoI)</td>
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<td></td>
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<tr>
<td>azoxystrobin</td>
<td>QoI, 11, acropetal penetrant</td>
<td>Heritage, Heritage TL, Strobe 50WG, Strobe 2L, Strobe Pro</td>
</tr>
<tr>
<td>fluoxastrobin</td>
<td>QoI, 11, acropetal penetrant</td>
<td>Disarm G, Disarm 480 SC, Fame Granular, Fame SC</td>
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<tr>
<td>mandestrobin</td>
<td>QoI, 11, acropetal penetrant</td>
<td>Pinpoint</td>
</tr>
<tr>
<td>pyraclostrobin</td>
<td>QoI, 11, local penetrant</td>
<td>Insignia Intrinsic (suppression only)</td>
</tr>
</tbody>
</table>

Some penetrant fungicides labeled for control of take-all patch disease.
<table>
<thead>
<tr>
<th>Active ingredient</th>
<th>Fungicide class, FRAC code*, and plant mobility classification**</th>
<th>Product name(s)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>azoxystrobin + acibenzolar-S-methyl</td>
<td>QoI, 11, acropetal penetrant + Host defense induction, P1, systemic penetrant</td>
<td>Heritage Action</td>
</tr>
<tr>
<td>azoxystrobin + difenoconazole</td>
<td>QoI, 11, acropetal penetrant + DMI, 3, acropetal penetrant</td>
<td>Briskway</td>
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<tr>
<td>azoxystrobin + propiconazole</td>
<td>QoI, 11, acropetal penetrant + DMI, 3, acropetal penetrant</td>
<td>Goliath XP, Headway, Headway G</td>
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<tr>
<td>azoxystrobin + propiconazole + pydiflumetofen</td>
<td>QoI, 11, acropetal penetrant + DMI, 3, acropetal penetrant + SDHI, 7, acropetal penetrant</td>
<td>Posterity XT</td>
</tr>
<tr>
<td>azoxystrobin + tebuconazole</td>
<td>QoI, 11, acropetal penetrant + DMI, 3, acropetal penetrant</td>
<td>ArmorTech Zoxy-T, OXimus</td>
</tr>
<tr>
<td>benzovindiflupyr + difenoconazole</td>
<td>SDHI, 7, acropetal penetrant + DMI, 3, acropetal penetrant</td>
<td>Ascendity</td>
</tr>
<tr>
<td>boscalid + pyraclostrobin</td>
<td>Chlornitriple, M5, contact + DMI, 3, acropetal penetrant</td>
<td>Honor Intrinsic</td>
</tr>
<tr>
<td>chlorothalonil + propiconazole</td>
<td>Chlornitriple, M5, contact + DMI, 3, acropetal penetrant</td>
<td>Concert II</td>
</tr>
<tr>
<td>chlorothalonil + tebuconazole</td>
<td>Chlornitriple, M5, contact + DMI, 3, acropetal penetrant</td>
<td>E-Scape ETQ</td>
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<tr>
<td>fluoxastrobin + chlorothalonil</td>
<td>QoI, 11, acropetal penetrant + Chlornitriple, M5, contact</td>
<td>Disarm C, Fame+C</td>
</tr>
<tr>
<td>fluoxastrobin + myclobutanil</td>
<td>QoI, 11, acropetal penetrant + DMI, 3, acropetal penetrant</td>
<td>Disarm M</td>
</tr>
<tr>
<td>fluoxastrobin + tebuconazole</td>
<td>QoI, 11, acropetal penetrant + DMI, 3, acropetal penetrant</td>
<td>Fame+T</td>
</tr>
<tr>
<td>isofetamid + tebuconazole</td>
<td>SDHI, 7, acropetal penetrant + DMI, 3, acropetal penetrant</td>
<td>Tekken</td>
</tr>
<tr>
<td>mefentrifluconazole + pyraclostrobin</td>
<td>DMI, 3, acropetal penetrant + QoI, 11, local penetrant</td>
<td>Navicon</td>
</tr>
<tr>
<td>PCNB + tebuconazole</td>
<td>Aromatic hydrocarbon, 14, contact + DMI, 3, acropetal penetrant</td>
<td>Premion</td>
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<tr>
<td>pyraclostrobin + fluxapyroxad</td>
<td>QoI, 11, local penetrant + SDHI, 7, acropetal penetrant</td>
<td>Lexicon Intrinsic</td>
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<tr>
<td>pyraclostrobin + triticonazole</td>
<td>QoI, 11, local penetrant + DMI, 3, acropetal penetrant</td>
<td>Pillar G</td>
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<tr>
<td>trifloxystrobin + triadimefon</td>
<td>QoI, 11, acropetal penetrant + DMI, 3, acropetal penetrant</td>
<td>Armada 50WG, Tartan Stressgard</td>
</tr>
</tbody>
</table>

Some combination product fungicides labeled for control of take-all patch disease.

*FRAC is an abbreviation for Fungicide Resistance Action Committee. The FRAC code/resistance group system consists of numbers indicating classes or groups of fungicides based on mode of action, and letters that refer to broad classifications of fungicides (P = host plant defense inducers; M = multi-site fungicides; and U = unknown mode of action and unknown resistance risk). Due to the risk of fungicide resistance, turf managers should avoid excessive use of fungicides within the same FRAC code/resistance group and alternate products among different FRAC codes/resistance groups.

**Plant mobility classification refers to a fungicide’s ability to penetrate plant surfaces or remain on plant leaf or stem surfaces without penetration. Fungicides that penetrate plant surfaces and are translocated mostly upwards through plant xylem tissues are...
called acropetal penetrants (acropetal = toward the apex). Fungicides that enter plant cuticles or move limited distances in internal plant spaces, but do not translocate through vascular tissues (xylem and/or phloem) are called local penetrants. Contact fungicides do not penetrate plant surfaces and only inhibit fungal pathogens residing on leaf and stem surfaces.

“Follow label precautionary statements, restrictions, and directions regarding tolerant turfgrass species, rates, and timing of applications.

References

Buhler, W. Fungicide spraying by the numbers.


Authors

Peter Landschoot, Ph.D.
Professor of Turfgrass Science
pj1@psu.edu
814-863-1017

extension.psu.edu

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