

Turf Grass TRENDS



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Snow molds and cold weather diseases

by Christopher Sann

For turfgrass managers, the coming of the cooler weather of fall and early winter signals a time when they can unwind. The

eliminate disease pressure. During cool to cold weather periods of the year, with temperatures of from -5 C. to 16 C. (23 - 60 F.), there are no less

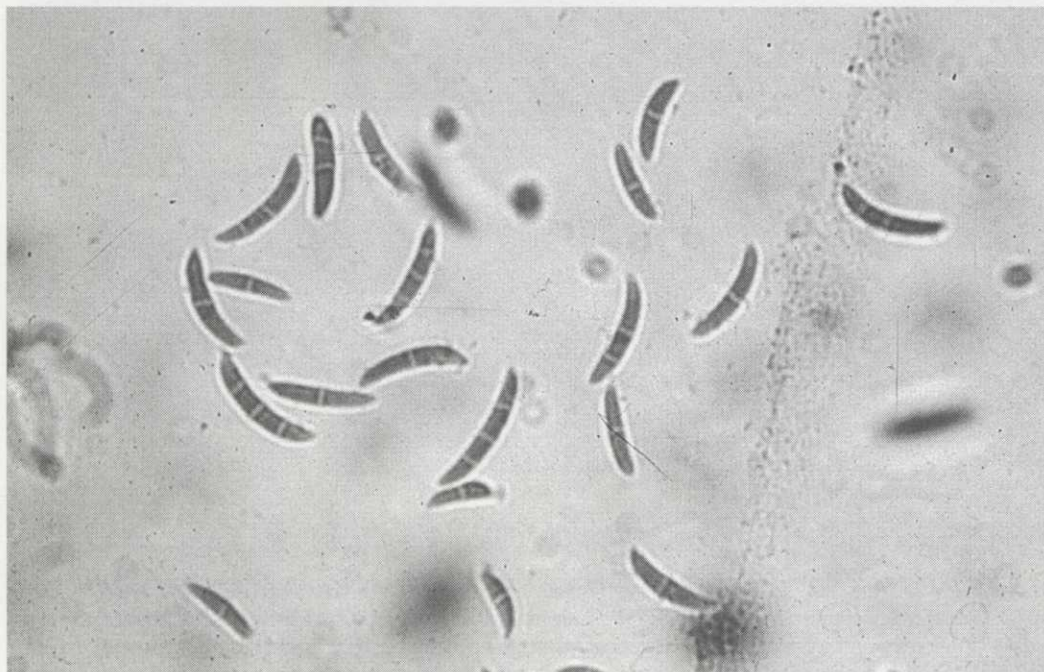


Photo provided by Dr. Eric B. Nelson, Cornell University

Conidia of *Microdochium nivale*. These characteristic 2-celled spores are diagnostic for pink snow mold.

fall is a period when they can decompress from the constant state of angst that typifies the turfgrass managers' states of mind during the warm weather months, and forget diseases, weeds and insects until next year. Often managers will spend this time coasting on auto-pilot, sometimes to their regret.

Disease potential at cooler temperatures

The coming of cooler weather does dramatically reduce weed germination and causes the cessation of most insect activity, but it does not

than 12 well-known diseases or disease groups and 17 lesser-known diseases that can damage turfgrasses.

The well-known cool weather (8 - 16 C.) diseases and disease groups are: *Anthrachnose*, *Dreschlara* diseases, *Necrotic ring spot*, *Powdery mildew*, *Pythium root rot*, *Red thread/pink patch*, *Rust diseases*, *Rhizoctonia diseases*, *Smut diseases*, and *Take-all patch*. The well-known cold season diseases are *Typhula blight* and *Microdochium patch*. The table (see Table 1 on page 2) lists all of the well-known diseases that affect turfgrass at temperatures below 17 C. (62

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F.), the causative pathogens, and the pathogens' growth range.

The tendency to ignore this rogue's gallery of turfgrass diseases accelerates as temperatures decline. Once daytime temperatures drop to the forties many turfgrass managers develop a greater interest in warming up, rather than finding, treating, and preventing disease activity. Luckily, with respect to many of the diseases listed in Table 1, their activity is also reduced as temperatures fall. The two exceptions are the cold weather diseases of Typhula blight (Gray snow mold) and Microdochium patch (Fusarium Blight).

span 22 C. (40 F.) and 28 C. (50 C.) respectively. Depending on the region of the country, these temperature ranges can result in periods of activity up to four months long. These extended periods of activity combined with the slow growth or dormancy of host grasses can lead to extensive blighting over large areas of turfgrass.

Typhula blight

Typhula blight, formerly known as gray snow mold, is caused by the pathogen *Typhula incarnata*. This disease was reported in scientific literature as early as 1926 and is probably the best known of the cold weather diseases.

Table 1

<u>Disease</u>	<u>Pathogen</u>	<u>Growth range</u>
<i>Anthraxnose</i>	<i>Colletotrichum graminicola</i>	10 - 33 C. (50 - 91 F.)
Dreschlera diseases	<i>Dreschlera spp.</i>	3 - 27 C. (37 - 80 F.)
Necrotic ring spot	<i>Leptosphaeria korrae</i>	10 - 30 C. (50 - 86 F.)
Microdochium patch	<i>Microdochium nivale</i>	-6 - 16 C. (21 - 61 F.)
Powdery mildew	<i>Erysiphe graminis</i>	15 - 22 C. (59 - 72 F.)
Pythium root rot	<i>Pythium spp.</i>	0 - 34 C. (32 - 94 F.)
Red thread	<i>Laetisaria fuciformis</i>	0 - 30 C. (32 - 86 F.)
Rust diseases	<i>Puccinia spp.</i>	10 - 30 C. (50 - 86 F.)
	<i>Uromyces spp.</i>	
Rhizoctonia diseases	<i>Rhizoctonia spp.</i>	8 - 40 C. (46 - 104 F.)
Smut diseases	<i>Ustilago spp.</i>	10 - 20 C. (50 - 68 F.)
	<i>Urocystis spp.</i>	
Take-all patch	<i>Gaeumannomyces graminis</i>	N.A.
Typhula blight	<i>Typhula incarnata</i>	-10 - 18 C. (14 - 64 F.)

Cold weather diseases can cause extensive damage

Compared to many of the turfgrass diseases that are very active in the warm to hot weather periods of spring and summer, above 16 C. (61 F.), both Typhula blight and Microdochium patch are slow movers. Extensive damage does occur, however, because the cold weather tolerance of both pathogens allows the diseases to spread while host grasses are in dormancy.

Lab tests of Microdochium patch have found that the pathogen shows signs of respiratory activity at temperatures of -30 C. (-22 F.) with some isolates of the pathogen having established the low end of the growth range with minimal growth activity at -6 C. (21 F.). The high end of the growth range is 16 C. (61 F.). Isolates of Typhula blight have established the low end of their growth range with activity at -10 C. (14 F.) and high end with activity at 18 C. (64 F.). This gives the pathogens' growth ranges that

Life cycle

During warm weather, when temperatures are above 18 C. (65 F.), Typhula blight survives as light pink to red-brown colored sclerotia of from 0.2 mm - 5 mm (1/100 - 1/5 inch) in diameter that develop on the crowns and litter of previously diseased turf. These sclerotia germinate when temperatures fall into the 10 C. - 18 C. (50 F. - 64 F.) range, there is abundant water present, and the site is exposed to light high in the ultraviolet part of the spectrum. Depending on the infestation site's light levels, the germinating sclerotia will produce either mycelia or an intermediate growth stage called sporocarps. At sites with either strong direct light or where the sclerotia are buried in thatch or soil, the germinating sclerotia will produce mycelial growth. In areas that are shaded or get diffuse light, they will produce sporocarps. The intermediate growth stage sporocarps will produce basidiospores that in turn will germinate and produce mycelia. If conditions are favorable at the time of sclerotial germination, i.e. extended cool, wet periods, the

mycelia that are produced can infect plant shoots causing apparent disease symptoms. More often than not, the conditions needed for extensive disease development are not present when sclerotia germinate, and the mycelia and sporocarps that are produced remain dormant awaiting the proper environmental conditions. Tests of the relative

diameter. If, on the other hand, the snow cover melts or temperatures fluctuate substantially, the growing mycelium will develop sclerotia to survive these short periods of unfavorable conditions. If subsequently the area does not have extended periods of snow cover and air temperatures stay cold, then the further damage that can occur will

be insignificant. If snow cover returns for periods of four to six weeks and a new air space develops with a temperature range of 2 C. - 13 C. (35 F. - 55 F.), then the newly developed sclerotia will germinate and cause extensive blighting. Sites that have substantially frozen soil prior to snow cover developing or do not have prolonged periods of snow cover will not develop severe symptoms.

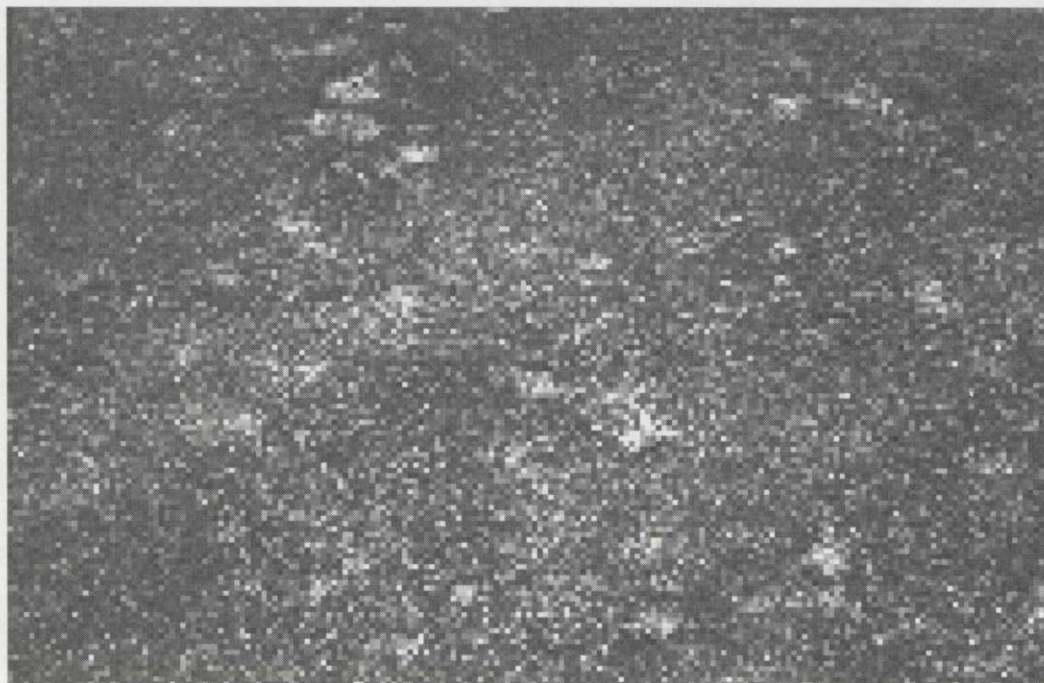


Photo provided by Dr. Eric B. Nelson, Cornell University

Pink snow mold patches may take on an orange to pink appearance on close cut turf.

pathogenicity of mycelia produced directly from germinating sclerotia and that formed by germinating basidiospores, have found that the mycelium produced from sclerotia are more potent.

What conditions are good for Typhula blight?

Typhula blight can cause extensive damage at sites when a prolonged period of snow cover develops on soils that were not frozen at the time of the snow fall or were lightly frozen and warm due to retained heat in the soil mass. Under these conditions, a small air space develops at the soil/snow interface as the retained heat of the soils melts the snow from the bottom up. In this space, the air temperature ranges from 0 C - 5 C. (32 F. - 41 F.) and the relative humidity can reach more than 95%. Optimum mycelial growth for Typhula blight occurs when air temperatures range from 2 C. - 10 C. (35 F. - 50 F.) and when the relative humidity is consistently above 70%. Additionally, tall or uncut turf tends to become matted or overlapped from the initial weight of the snow fall, and the close proximity of one leaf to another facilitates the spread of this slowly growing mycelium.

If the air space environment below the snow cover stays relatively stable for prolonged periods then extensive mycelial masses can develop blighting areas several feet in

What are Typhula blight symptoms?

Because of *Typhula incarnata*'s dependence on snow cover to develop visual symptoms, it is usually first noted at snow melt. Circular areas of light yellow, straw, or grayish brown colored turf become apparent. Under ordinary conditions, these areas can range from three inches in diameter to over six feet under severe circumstances. The leaves in the blighted areas are matted down and are frequently covered with a gray-white mycelial growth, that ranges from sparse to dense in its coverage of the leaves. As the leaf blades dry, they turn light tan to silvery-white in color and the mycelial mat that covers the leaves becomes dry and brittle. Where extensive blighting has occurred under prolonged snow cover, large areas of plants will be killed. When conditions have been less favorable, usually only the leaves are killed and the crowns and roots survive to regenerate new top growth. It is not uncommon for Typhula blight to develop in low areas at sites with higher areas untouched.

As the snow cover melts copious numbers of white to light brown colored, immature sclerotia will often develop on the blighted leaves. The presence of these sclerotia is one of the characteristics that distinguishes Typhula blight from other diseases with similar appearances such as snow scald, with black sclerotia, or Pythium snow blight, with no sclerotia.

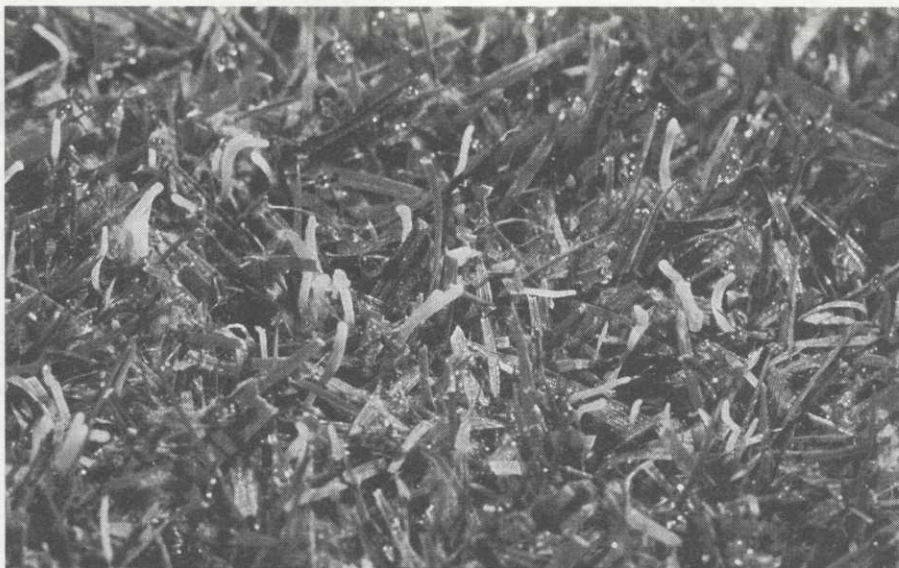


Photo provided by Dr. Eric B. Nelson, Cornell University

Basidiocarps of *Typhula incarnita*. These are the sexual reproduction structures of the fungus that give rise to basidiospores.

Controlling Typhula blight

Since Typhula blight is so weather dependent, control measures can seem somewhat problematical. If the site is in a region of the country that rarely gets prolonged periods of snow cover, then understanding a site's potential for the development of symptoms followed by appropriate cultural practices should prove successful at mitigating most problems with this disease. At sites where snow cover can consistently occur, site analysis and cultural practices should be combined with properly timed preventative fungicide applications to reduce the potential for extensive damage.

First analyze site characteristics

Before either cultural practices are initiated or fungicide applications are made it is important to fully analyze a site for its potential to develop Typhula blight. Identifying hosts, site grades, soil permeability, and light exposures can help to determine whether a site will be vulnerable to damage.

Hosts

All though Typhula blight can occur on all of the common cool season turfgrass species, it is a particular problem on bentgrasses and tall fescue varieties. Within the

group of closely cut bentgrass species, the older bentgrasses (particularly the creeping varieties) are the most vulnerable, while the red and brown top varieties are the most resistant. In the tall-cut species, tall fescue varieties seem to be the most vulnerable. [Note: Tall fescue varieties may be more vulnerable because they are consistently mowed at higher levels.] Some varieties of bluegrass, ryegrasses, and fine fescues have shown varying levels of resistance.

Grade

A site that is consistently flat or concave may be vulnerable. If the site has varying topography, then low areas, where water normally flows or sits, may be more vulnerable than higher locations. Areas where snow tends to accumulate will be more vulnerable than areas where snow fall is removed by



Photo provided by Dr. Eric B. Nelson, Cornell University

Clamp connections on the hyphae of *Typhula incarnita*. These structures are characteristic of Basidiomycetes, the group of fungi with which the Typhula species are classified.

winds or melts rapidly. Additionally, the disease can develop under mulches or covers that have been designed to reduce winter desiccation.

Soils

Soils that are tight, compacted, or have poor structure with reduced pore spaces are vulnerable. Well-drained areas with loose or sandy soils will be less vulnerable to damage.



Close up of a pink snow mold patches. The periphery of the patch usually takes on a pinkish appearance, particularly in the morning. This is due to the pink-colored mycelium of *Microdochium nivale*.
Photo provided by Dr. Eric B. Nelson, Cornell University

ing the turf to become dormant early will improve winter hardiness and thereby reduce vulnerability. If maintaining color is a priority for the site, then the use of slow-release fertilizers or supplemental iron applications should reduce site vulnerability.

Where snow accumulates or is placed, blowing drifting snow piles, periodic removal of piles, or strategic placement of snow fences can be effective at reducing snow cover periods and thereby reduce damage.

Light

Well drained sites that have a consistent light exposure are probably more vulnerable to damage than are other locations which are well drained and shaded or get transient shade. This occurs because the full light areas are more prone to have the more virulent sclerotia developed mycelium than shaded areas that are more likely to have the less virulent basidiospore generated mycelium.

In general, a site that has vulnerable hosts, bentgrasses or tall fescues, is flat or concave, is compacted or has limited soil pore spaces, and is located in full sun areas will tend to have more numerous and more extensive blighting, than a site that is well drained, shaded, of varying grades, and has the less vulnerable bluegrass and fine fescues as the predominant plant populations.

Cultural practices

Once a site has been determined to be vulnerable, those cultural practices that have been identified to ameliorate Typhula blight infestations should be put into place.

Host species that have been identified as showing resistance should be introduced by overseeding at those sites where infestations are only an occasional problem. In areas where extensive damage has previously occurred wholesale renovation with resistant varieties may become necessary. Keep in mind that new stands of all species are more vulnerable than older stands.

Actions to alleviate compaction, change water flow, fill low areas, or correct poor soil chemistry should help vulnerable areas. Additionally, reducing fall fertilization and allow-

How and when should fungicides be used?

Traditionally, applications of fungicides to control Typhula blight have been based on turfgrass managers' best guesses as to when cold temperature plant dormancy will occur, when the first snow fall would occur, or whether the snow that did fall would persist for long periods of time. These methods have their obvious flaws, not the least of which is developing consistent and efficient control.

Where Typhula blight is more than an occasional problem, applications based on weather records and dates have produced better, but still somewhat mixed, results.

The type of fungicide selected and recent site history should determine application timing. If there has been a recent infestation of Typhula blight and the fungicide that has been selected is has a systemic action, then applications of the fungicide should begin as soon as air temperatures are in the 10 C. - 18 C. (50 F. - 64 F.) range. So long as the temperatures are in this range, and depending on the fungicide applied, multiple applications of systemic materials may be necessary.

This approach of protecting the turf during the period of optimum sclerotial germination should prove effective at reducing the pathogen population to the point where appropriately applied cultural practices will substantially lower the potential for extensive damage. In subsequent years, single timely applications of systemic fungicides, or rigorous application of appropriate cultural practices, should make Typhula blight

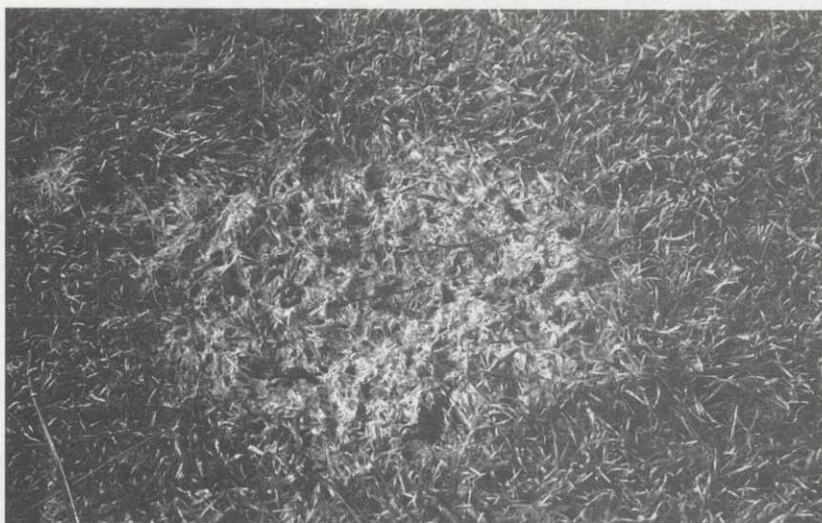
outbreaks few and far between.

If a contact type fungicide is chosen, then the application should be made after the turf has gone into dormancy, but before the first snow fall. In areas with consistent snow cover this application should be delayed until the last possible moment and the rate of active ingredient should be the highest listed on the label. If snow cover is anticipated for short periods and the sites are at times without snow cover, then re-application of contact fungicides should be made to extend the periods of protection.

A strategy that combines rigorous application of cultural practices, site enhancement where practical, and early applications of a systemic fungicide followed by periodic applications of contact type fungicides should provide the turfgrass manager with his best possible defense, even in areas where extensive damage from *Typhula* blight is common.

Microdochium patch

Microdochium patch or Pink snow mold as it is more commonly known was formerly known as Fusarium patch disease. Neither of the previous names -- Pink snow mold or Fusarium patch -- are satisfactory descriptive names



Close-up view of a pink snow mold patch.

because the infected turf does not always have a pink color, snow cover is not required for the disease to be present, and identity of the causative pathogen, *Microdochium nivale*, has been changed three times. Despite the fact that the causative pathogen is not a member of the *Fusarium* species, that name is still used in some locations to describe the symptoms associated with snow melt. The disease was first described in scientific literature in 1933.

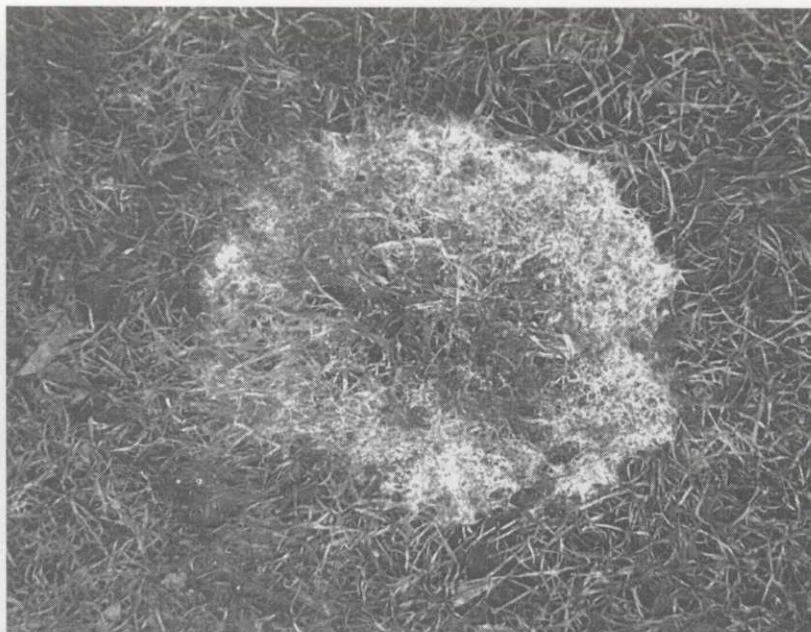


Photo provided by Dr. Eric B. Nelson, Cornell University
Pink snow mold on higher cut perennial ryegrass.

Lifecycle

Although the causal pathogen, *Microdochium nivale*, has an optimum growth range of 18 C. - 22 C. (65 F. - 71 F.), this relatively noncompetitive fungus can withstand temperatures as low as -20 C. (-2 F.) and still remained viable. Some isolates of this fungus have shown growth activity at -6 C. (20 F.) on the low end and others have been active at 32 C. (89 F.). Despite this fungus' primary association with periods of cold weather and snow, its active growth temperature spans 38 C. (69 F.). Nevertheless, even though the pathogen is active over a very wide range of temperatures, the symptoms of this disease are most often seen in cool wet weather when grasses are dormant. Since this pathogen favors extended periods of leaf wetness when humidity levels drop and leaf wetness decreases the fungus can become inactive.

During periods when conditions do not favor the growth of this pathogen, it can survive for extended periods as a saprophyte feeding on organic matter in thatch or soil. As more favorable periods of low temperatures and prolonged leaf wetness begin, new mycelial growth is generated from old mycelium or conidia spores in leaf litter. This infection can be spread conidia by wind, the splashing action of rainfall, or through the mechanical movement of conidia or mycelium by equipment, people, or animals.

Conditions that favor the growth of Microdochium patch

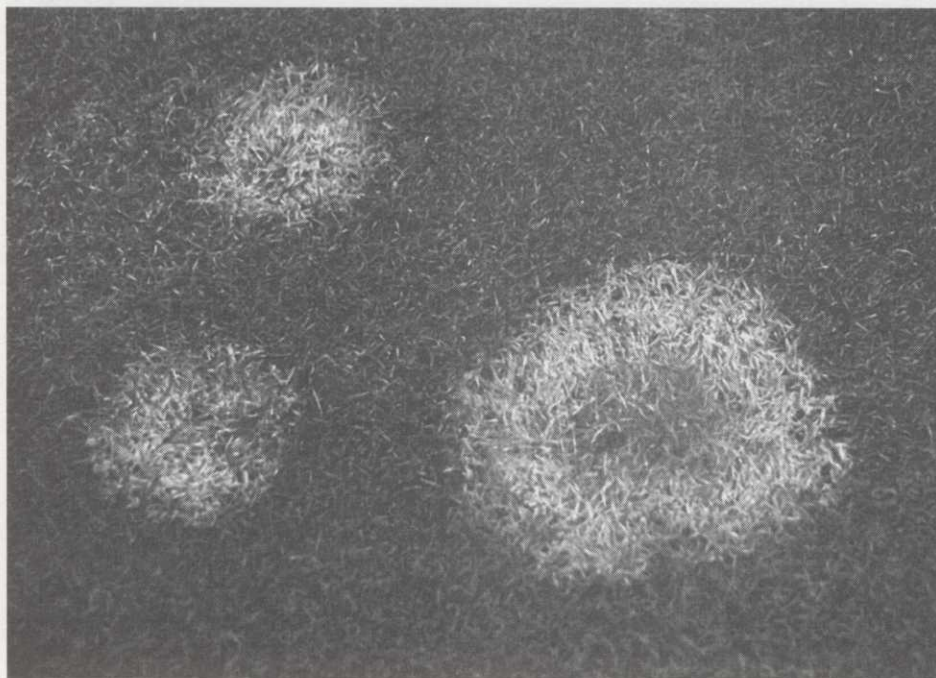
Although *Microdochium* patch can often be found in association with *Typhula* blight, unlike *Typhula*, prolonged periods of snow cover are not required for this disease to be present. Optimum growth occurs at 0 C. - 8 C. (32 F. - 46 F.) under periods of prolonged leaf wetness where the soil is not frozen.

Also, unlike *Typhula* blight, *Microdochium* patch is

Annual bluegrass is very susceptible to attacks and is often killed. The bentgrasses species, maintained as golf course turf, range from very susceptible to moderately resistant. The bentgrass variety, Penncross, is considered by many to be the most resistant of all the bentgrass varieties. As a group, fine fescues and ryegrasses are considered to be moderately resistant, while most bluegrasses are believed to fall into the resistant category.

What are *Microdochium* patch symptoms?

Circular patches of infected turf may arise, whenever prolonged cool, wet periods develop. Small water soaked areas less than 2 inches in diameter appear and can rapidly expand into patches 10 - 12 inches in diameter. Initially the patches can have a light to dark brown appearance but this changes to light gray, similar in appearance to *Typhula* blight. Under wet conditions, a fluffy, white mycelium may be present on the matted leaves of the patch. This is often seen at snow melt. When the mycelium is exposed to light, it changes color to pink. Under wet conditions or on close cut turf, the edges of the patch



Sclerotia of *Typhula incarnita* embedded in host tissues.

Photo provided by Dr. Eric B. Nelson, Cornell University

not usually found at low maintenance turf sites. Conversely, highly managed turf sites with heavy thatch layers are prone to the most severe infestations.

Repeated periods of thaw and snow cover, frosts, fog, or drizzle are especially favorable to the leaf to leaf transfer and spread of the mycelium. The disease is active over a wide soil pH range, 4.3 - 7.2, but the higher the pH, the more severe the infestation. Like *Typhula*, the disease favors sites with poorly drained, heavy, or compacted soils.

Applications in the late fall of unbalanced, inorganic high nitrogen fertilizers with little or no phosphorus or potassium predisposes the turf to infection. Low to moderate nitrogen applications improved turf quality better than high or very high levels, which had the opposite effect and increased disease severity. Soils with poor soil chemistry balance, especially low calcium and potassium levels, also showed increased disease activity. Contrary to the application of high nitrogen mineral fertilizers, applications of high potassium and low nitrogen fertilizers, late in the growing season, did not increase disease severity.

Host plant susceptibility varies from species to species.

may appear to have a ring of active fungus similar to the smoke ring of Brown patch.

Turfgrasses that are infected with the cool season form of *Microdochium* patch are often killed if they are in advanced stages of infection. Often, if the patches are extensive, re-seeding of the large areas becomes necessary.

How to control *Microdochium* patch

As with *Typhula* blight, many of the same cultural practices are effective. Cultural practices such as the use of resistant varieties, maintaining good soil chemistry balance, particularly calcium and potassium, improving drainage, and increasing air flow, are the same. Moisture control and pH control differ from *Typhula*, in that excess moisture should be removed from leaf surfaces as soon as possible and the soil surface pH should be kept at or below 6.0. The application of a liquid wetting agent to leaf surfaces may help to reduce leaf wetness periods and light frequent applications of sulfur will discourage the establishment of the disease.

Which fungicides should be used and when should they be applied?

Historically, heavy-metal contact fungicides have been used to control *Microdochium* patch. For overriding environmental reasons none of the heavy metal materials are still in the turfgrass managers' chemical tool boxes. Additionally, several other contact and systemic materials have been withdrawn by their manufacturers and are no longer available.

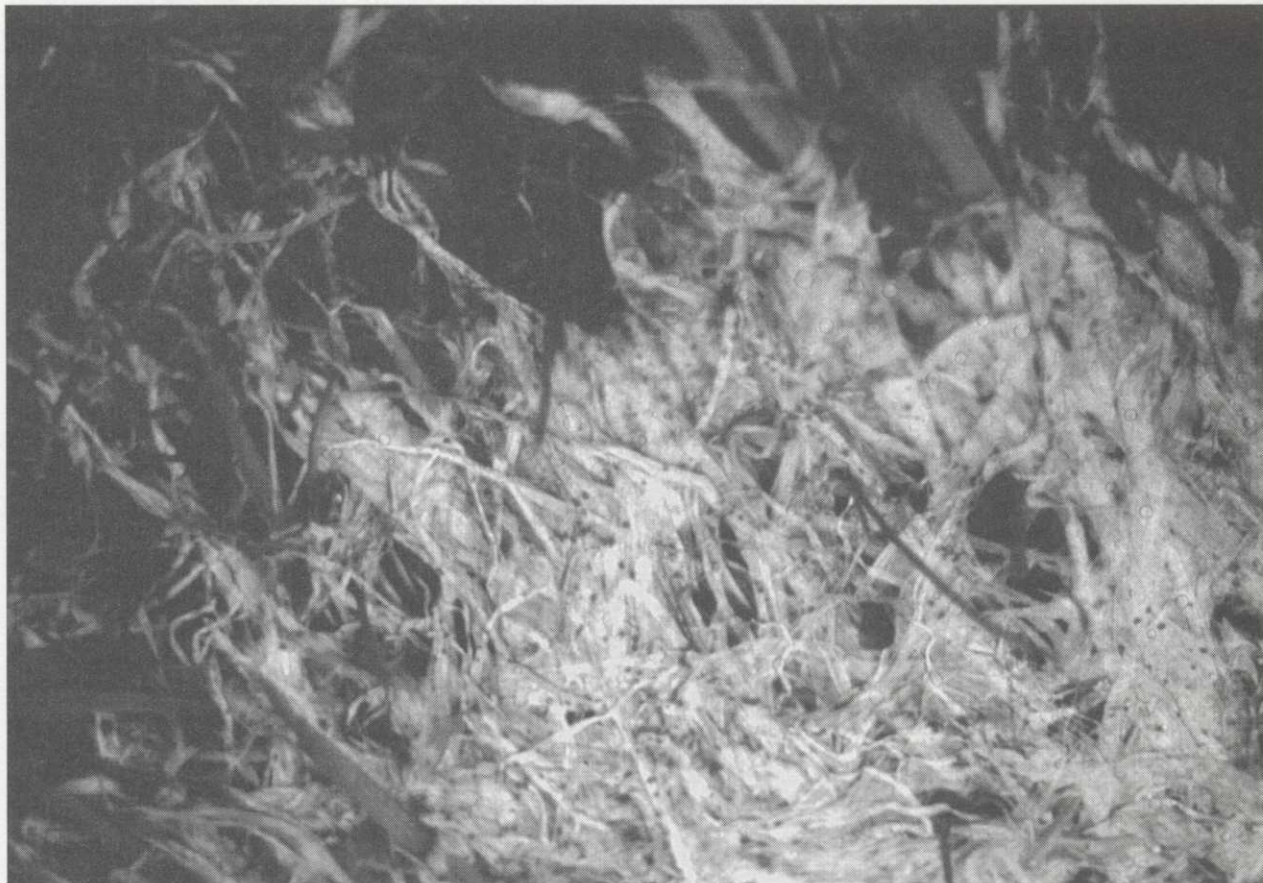


Photo provided by Dr. Eric B. Nelson, Cornell University

Close-up of *Typhula* blight patch. Small brown to reddish-brown sclerotia are visible in the interior of the patch.

The number of fungicides that can be used on turf to control this disease is down to a handful, so turfgrass managers should be careful to check their labels to be sure that the fungicide that they have chosen is still registered for this use. In contacts, PCNB and iprodione can be effective while in systemics the newer sterol inhibitors have proven to be effective.

If a systemic fungicide is chosen, then an application should be made after daytime temperatures fall below 10 C. (50 F.), but at least 15 to 30 days before the onset of cold dormancy or snow fall. If a liquid contact fungicide is chosen, the application should be made to dry leaves after the onset of cold dormancy and as close to snow fall as possible. Additional contact applications can be made during snow free winter periods, if infestation levels war-

rant and daytime air temperatures are high enough for a liquid application. Granular applications can be made at these times, if leaves are wet and the site is stable enough to support equipment travel.

In severe cases of infestation, these two strategies, systemic fungicides early and contact fungicides late, can be combined with rigorous application of cultural practices to produce maximum effectiveness. Whichever strategy is chosen for *Microdochium* patch control, the fungicides that applied should be rotated with each application be-

cause of the limited supply of chemical tools that are available and to avoid the development of resistant pathogen populations.

Start with an inventory

The key to any cold weather disease control strategy is allowing time for a complete turf site inventory by disease potential. Done early enough, this inventory should identify all sites which are predisposed to cold weather diseases while there is still time to implement corrective and preventive actions. Steps might include site changes, introduction of appropriate cultural practices, or developing a plan for chemical application. Following this strategy every year should keep cold weather diseases in permanent check. ■