DISEASES OF TURFGRASS
Contents

Causal Agents ........................................... 1  
Principles of Turfgrass Disease Control .......... 2  
Use of Fungicides ....................................... 2  
Disease Resistance ..................................... 3  
General References ................................... 3  

MAJOR DISEASES
Red Thread and Pink Patch ............................ 4  
Entyloma Blister Smut ................................ 5  
Fairy Rings ............................................. 6  
Fusarium Patch (Pink Snow Mold) .................. 7  
Drechslera Diseases (Helminthosporium) Leaf Spots 9  
Puccinia Ruts .......................................... 10  
Necrotic Ringspot ..................................... 11  
Take-all Patch ........................................ 12  
Typhula Snow Mold (Gray Snow Mold) ............ 14  
Ustilago Stripe Smut .................................. 15  

MINOR DISEASES
Air Pollution ........................................... 17  
Colletotrichum—Anthracnose ....................... 17  
Curvularia Blight (Fading Out) .................... 18  
Damping Off and Seed Decay ....................... 18  
Erysiphe Powdery Mildew ............................ 19  
Fusarium Blight ....................................... 19  
Gloeocercospora Copper Spot ..................... 20  
Nematodes (Eelworms) ............................... 21  
Pythium Blight (Grease Spot or Cottony Blight) 21  

Rhizoctonia Brown Patch ............................ 22  
Sclerotinia Dollar Spot ............................... 23  
Septoria Leaf Spot (Tip Blight) .................... 24  
Slime Molds ........................................... 24  
Virus Diseases ......................................... 25  

PHYSIOLOGICAL AND OTHER MISCELLANEOUS PROBLEMS
Algae .................................................. 26  
Buried Debris ......................................... 26  
Chemical Burn ........................................ 26  
Dog Injury ............................................. 26  
Frost Injury ........................................... 26  
Moss .................................................... 26  
Mowing Injury ......................................... 26  
Nutrient Deficiencies ................................ 26  
Soil Problems ......................................... 26  
Thatch Accumulation ................................ 27  
Watering Problems ................................... 27  
Winter Injury ......................................... 27  

DISEASE RESISTANCE AND QUALITY RATING TABLES
Bluegrass .............................................. 28  
Fescues ............................................... 29  
Bentgrasses .......................................... 30  
Ryegrass .............................................. 30  
Chart—Prevalence of Major Turfgrass Diseases During Year ................. 31  
Key to Selected Turfgrass Diseases ............... 32
Turfgrass maintenance in the Pacific Northwest adds at least $250 million a year to the economy, and the replacement value would exceed $1 billion. Part of these maintenance costs are for labor and materials to treat diseases.

Fortunately, many diseases can be reasonably well controlled with proper cultural procedures. However, it is necessary first to identify the problem before undertaking a cure. This publication describes the most common diseases and several of the less common ones. Weather and cultural factors that influence disease development as well as control measures are also discussed.

If your turf disease condition does not fit any of the symptoms, take samples to your local county Extension agent. If necessary, the agent will refer the problem to a specialist.

Turfgrass diseases, as defined in this publication, include any abnormal condition not caused by insects or animals. Many are caused by fungi and only a few by nematodes, bacteria, and viruses. However, many abnormal conditions are caused by too much or too little water, nutrient imbalances, heating, freezing, shade, or other factors. These problems are generally termed physiological or nonparasitic. They will be discussed briefly, since we consider proper management to be an important factor in disease control.

We often hear that turfgrass diseases are increasing. This may be true. As the acreage of a particular crop is increased, there is more opportunity for development and spread of parasites. Turfgrass stands are usually dense, grown under highly artificial conditions, and subjected to more intensive use and closer mowing. Therefore, they are more subject to problems than are native grasses.

However, better diagnosis may contribute to the apparent increase in turfgrass diseases. Many problems that were formerly attributed to winter kill, drought injury, heat injury, etc. are caused by pathogens. It is imperative to pin down the cause of each turfgrass problem. This is important since a control for one disease may actually stimulate another. For example, high nitrogen helps control red thread but stimulates Fusarium patch. Descriptions in this publication are directed toward helping you identify the problem. The disease situation can be complicated because more than one pathogen may be present.

Over 400 different fungi have been reported pathogenic to grasses. Most of them are spread by spores or by fragments of diseased leaves carried on mowers, aerifiers, golf carts, and shoes.

These parasitic fungi compete with millions of bacteria and thousands of other fungi in the soil. Some fungi even secrete compounds that kill or retard the pathogens. It is fortunate that about 99% of soil microorganisms are beneficial, otherwise we could not grow good turf. An example is the frequent and disastrous invasion by *Gaeumannomyces (Ophiobolus)* into soils that have been fumigated with methyl bromide where, presumably, all other organisms have been killed. The *Gaeumannomyces (Ophiobolus)* spreads rapidly at first, then gradually slows down as the other organisms build up. We need to find which are the beneficial organisms and how we can stimulate their development. By doing this it may be possible to reduce our reliance on fungicides.

**Causal Agents**

**Fungus Diseases.** A majority of parasitic turf diseases are caused by fungi. Fungi are small and rather simple plants unable to produce their own food because they do not have the green coloring matter (chlorophyll). Rather than manufacture their own food, they must instead feed on living or dead plants and animals. These minute plants produce microscopic seed-like bodies called spores. Spores can be spread by wind, splashing water, or equipment or even golf carts and shoes. Diseased leaves from infected areas can also be moved about by similar means and can be responsible for spread of disease.

Fungi survive from one season to the next in several ways. Commonly the thread-like growths within a diseased plant can survive through the winter. Other fungi produce special thick-walled spores that can survive for extended periods in the soil. Larger resting structures (sclerotia) are formed from masses of fungal tissue. These hard and usually rounded bodies are visible without using a microscope and remain alive in the soil for several years.

**Bacterial Diseases.** Bacteria are simple, microscopic, usually single-celled plants which must depend upon other plant or animal sources for their food. Few turfgrass diseases are caused by bacteria.

**Virus Diseases.** Virus particles are so small that they cannot be seen with an ordinary light microscope. When they gain access to a plant, they usually penetrate into every part except the seed. So far as we know now, the only serious virus diseases in turf are in the southern United States.

**Nematode Diseases.** Nematodes are very small thread-like worms. Many commonly live in the soil without doing any harm, while others attack various...
adaptability, which should be considered when plant-available resistance to all the major pathogens.

Here is how various grasses rank on several factors:

- **Light required:**
  - Bluegrass (most) — Bent — Rye-grass — Fescue

- **Moisture required:**
  - Bent (most) — Rye-grass — Blue-grass — Fescue

- **Nitrogen required:**
  - Rye-grass (most) — Blue-grass — Bent — Fescue

- **Cold tolerant:**
  - Fescue (most) — Blue-grass — Bent — Rye-grass

- **Heat tolerant:**
  - Rye-grass (most) — Blue-grass — Bent — Fescue

**Mowing.** Mowing height can influence disease development. Close mowing stresses turfgrass, rendering it more susceptible to many pathogens, while high mowing provides an ideal “moist chamber” for fungal development in coastal areas.

For best results with fine-leaved fescues, set the mower at 1 1/4 inches. Closer mowing will seriously weaken fescue turf. Cut bluegrasses from 1 to 1 1/2 inches high. The 1 1/2 inch height is recommended for bluegrasses in western Washington, and 1 inch for improved bluegrasses in eastern Washington. Cut bent-grasses from 3/8 to 1/2 inch high. If lawn planting mixtures contain bentgrasses, mow at 3/4 inch height. For rye-grass, mow at 1 inch.

**Compaction.** Soil compaction increases stress because of poor root growth, insufficient oxygen, and slow water infiltration. These stresses increase the probability for disease. Periodic aeration and use of sand for topdressing are highly desirable.

**Thatch.** The thicker the thatch, the more chance there is for disease to occur. The thatch layer causes the grass to grow under a stressed condition and also provides a suitable environment for many fungi.

**Disease Watch.** Examine your turf often so you will discover disease outbreaks before they become serious.

**Use of Fungicides.**

Fungicides are available for use against most common diseases. However, this publication does not recommend specific ones because new fungicides are constantly being developed and old ones deleted. Therefore, these recommendations are issued in separate publications which Washington State University revises as often as necessary. They are EB 0938, *Disease Control in Home Lawns*, and EB 1133, *Disease Control in Home Turf*, available from your local county Extension agent.

Most fungicides have been applied as sprays in the past but dry (granular) formulations are becoming more popular; usually the finer they are, the better they work.

**Use the correct fungicide.** After determining what disease or diseases are present, select the proper fungicide. The fungicide label should specify the type of grass, the disease, and directions for proper use.

**Do not use the same fungicide repeatedly.** Alternate fungicides, preferably every other application, with an entirely different recommended type. This may
help prevent the development of strains of pathogens resistant to the fungicides and also will retard the accumulation of possible toxic levels of fungicides.

Adopt a year-round preventative treatment program. Treat golf greens regularly during spring and fall and at least once a month during winter and summer to retard buildup of Fusarium patch in western Washington. In eastern Washington, treat at least once during September for *Fusarium* control. Then, before snowfall apply a mixture of two fungicides, one effective against *Fusarium* and the other effective against *Typhula*. If the early treatment for *Fusarium* is omitted, this disease can weaken the grass and make it more susceptible to subsequent attacks under the snow by both *Fusarium* and *Typhula*.

Homeowners seldom need apply fungicides to lawns more than twice a year. One application in the spring and another in the fall in western Washington and one in September and another before snowfall in eastern Washington should be adequate.

Use the correct dosage. Make a careful calculation following label directions, then post the figure on a card near your fungicide shelf. Be sure to recalculate rates if you change from one formulation to another.

Use only clean water. When making up a spray solution avoid lake, pond, or river water, which may contain organic matter, clay, and other materials that could decrease fungicide effectiveness.

Only mix with other materials as directed on label. Addition of other pesticides, iron sulfate, or fertilizers may inactivate the fungicide and/or cause damage to the turf.

Use clean equipment. Be certain that the sprayer, hose, and boom are free of rust and residues of herbicides and fertilizers.

Don't dilute the spray. Sweep or drag greens to remove dew or rain before spraying.

Don't guess at the areas of turf involved. Measure them carefully. Then record the figures on a card posted near the pesticide shelf.

Be sure to get good coverage. Apply half the spray while moving in one direction and the remainder at right angles to the first.

Follow manufacturer's directions carefully. Reread them frequently, particularly when a new supply is purchased. Manufacturers are constantly improving their formulations and updating their recommendations.

Do not use more often nor at higher rates than is recommended. Adverse effects on the turf or on beneficial soil organisms could result.

### Disease Resistance

Culturally desirable disease resistant grasses, if available, are the best solution to most disease problems. Some desirable types are available (see tables) but, unfortunately, none are resistant to all common pathogens. Therefore, it is advisable to use mixtures of varieties.

Disease ratings of turfgrass varieties are given on pages 28–30 for bluegrasses, fescues, and ryegrasses in western Washington and for bentgrasses tested in both western and eastern Washington. The tables include ratings for diseases from our own plots and ratings from available literature.

Particularly impressive was the variation in varietal reactions reported from different areas. This could reflect mistaken diagnoses, but more often it is probably due to different climatic conditions and/or strains of the fungus. Because of this variability it is important to rely upon recommendations from tests in your local area rather than those from entirely different areas.

We urge anyone who reports varietal-resistance results to specify the causal organism. Instead of reporting leaf spot or snow mold, specify *Drechslera poae* (*Helminthosporium vagans*) leaf spot and *Typhula incarnata* snow mold, or, if it is a mixture, provide an estimate of each organism involved.

### General References

Two general references are available and recommended for additional information. Couch’s book is the most comprehensive while the English book by Smith and Jackson may be more applicable to the Pacific Northwest.


### Technical Names for Grasses Listed

<table>
<thead>
<tr>
<th>Bentgrasses</th>
<th><em>Agrostis tenuis</em> (colonial); <em>palustris</em> and <em>stolonifera</em> (creeping); <em>canina</em> (velvet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegrasses</td>
<td><em>Poa pratensis</em> (Kentucky) or <em>Poa annua</em> (annual)</td>
</tr>
<tr>
<td>Fescues</td>
<td>*Festuca (rubra mostly)</td>
</tr>
<tr>
<td>Ryegrasses</td>
<td><em>Lolium perenne</em> L.; <em>multiflorum</em> Lam.</td>
</tr>
</tbody>
</table>
Major Diseases

Red Thread and Pink Patch

Several fungi have now been shown to be responsible for the disease historically known as Corticium Red Thread. Two of these diseases, red thread and pink patch, will be covered in this section, with particular attention paid to their unique aspects.

Symptoms

Generally these fungus diseases appear as masses of scorched leaf tips in patches varying in size from 2-24 inches or more. The small patches are circular, but larger ones may be irregular. The disease first appears as small patches of water-soaked plants which become bleached and eventually may be pink to red. Leaf tips are usually the first plant parts infected. Very fine fungal threads are associated with infected leaves. These threads are cream-colored when formed in low light, and pink to bright red in bright light.

The fungal threads of red thread disease extend beyond the leaf tips commonly forming anther-like growths. These extensions do not occur with pink patch disease. Under prolonged cool, humid conditions these fungi may also kill lower parts of the plants, and under extreme conditions the plant dies.

Causal Organism

RED THREAD. Laetisaria fuciformis (McAlp.) Burdsall is now the name of the fungus causing red thread disease. It was formerly referred to as Corticium fuciforme (McAlp.) Wakef. The most distinctive features of this fungus are the pale to bright red gelatinous strands of mycelium which not only grow over affected leaves but extend from them up to 1/2 inch (usually 1/4 to 1/2 inch). These extensions may be branched or unbranched. These hyphae do not exhibit clamp connections. Arthroconidia are hyaline (transparent), ellipsoid to cylindrical, and measure 5-17 x 10-47 μm. Tiny basidiocarps (growths) may be present on dead infected tissue.

PINK PATCH. Limonomyces roseipellis Stalpers and Loerakker forms pink to reddish threads on leaves, but differs from L. fuciformis (red thread) by lacking extensions beyond the leaf tips, arthroconidia, cottony growth, and having clamp connections. Tiny basidiocarps may be present on dead infected tissue.

Disease Cycle

Infection occurs from fragments of the diseased leaves or fungal threads. These are spread by rain, wind, and probably most often by mowers and other equipment. Adequate moisture is needed to stimulate the fungus to germinate. Leaves are infected through stomates and, within two days, exhibit a watersoak-

Importance

Since pink patch has only recently been distinguished as a component of red thread, little information exists concerning its distribution and importance. Red thread is probably distributed throughout the world. Generally it is more important in cool, humid areas of Europe and North America and particularly
common and serious in England and west of the Cascade Mountains in the Pacific Northwest. Apparently it is not a problem in the warm southern states. In the coastal areas of the Northwest we consider it our second or third most important disease. All grasses are apparently susceptible, but in general fescues are most susceptible and, in descending order, ryegrasses, bents (especially velvets), and bluegrasses. Pink patch apparently is only a problem on ryegrasses and fescues. Some varieties are more resistant to red thread than others, although probably none are immune. The disease is most troublesome in spring or fall when grass is growing slowly, but can trouble during summer and winter if climatic conditions are favorable. Golf greens are seldom affected in western Washington except during winter when the grass is growing slowly.

Control

**Nutritional.** Maintain an adequate fertilizer program. Use a 6-1-4 ratio in western Washington and apply one-fourth of the annual total amount in April, June, September, and December or January. Be certain that the calcium level is not deficient.

**Other Cultural.** Mow regularly, removing clippings. Aerify and follow recommended procedures. Do not let the turf become dry.

**Resistant Varieties.** See tables on pages 28-30 for the various grasses.

**Fungicidal.** A good nutritional program is usually sufficient during spring to fall when grass is growing rapidly. However, trouble may develop after grass growth slows, particularly on bentgrass greens. Fungicides become necessary at this point. One or two applications in the fall and another one or two in the spring should be adequate since these fungi grow rapidly. In laboratory tests, *L. fuciformis* was sensitive to benomyl while *L. roseipellis* was not. Both were sensitive to iprodione and triadimefon. See EB 0938, *Disease Control in Home Lawns,* and EB 1133, *Disease Control for Commercial Turf.*

References


---

**Entyloma Blister Smut**

**Symptoms**

Individual spots appear first on the lower leaf surfaces as green, water-soaked areas which later develop into rather definite raised black blisters with fringed margins. The irregularly circular to oval blisters measure 1/16 inch or less, and are usually present in islands of green tissue surrounded by yellow halos. The diseased areas are often grouped, leaving intervening green sections. The tissue around the spot eventually turns yellowish or whitish leaving the raised black blisters showing prominently. Heavily diseased turf appears as a dirty brownish-black.

**Causal Organism**

*Entyloma dactylidis* (Pass.) Cif. *E. irregularare* Joh.) Sori develop in the leaves and sheaths as described above. The spores are subglobose, oblong, polyhedral to irregular, and tend to adhere in irregular groups that are difficult to separate. The exospore is smooth and without a sheath.

**Disease Cycle**

There is very little information available on the life cycle of this fungus. Presumably most infection is from spread of sporidia by splashing of raindrops or by transmission on equipment. Sporidia are small spores that develop from the germination of the dark spores described earlier. Mature spores have been found during most of the cool months, so presumably infection could occur whenever temperature and moisture are favorable.

**Factors Affecting**

Cool conditions and relatively semidormant grass apparently favor the fungus since it is much more prevalent during the winter than the summer. The winters of 1975-76 and 1976-77 in western Washington were unusually mild, which may have contributed to its development.

**Importance**

Blister smut is widespread in the United States, but is apparently only serious in the cool, moist climate of Washington and British Columbia west of the Cascades. Although blister smut has been reported on many different grasses, including *Poa annua,* it is a problem only on certain varieties and selections of bluegrass (*Poa pratensis*). Susceptible varieties include Banff, Baron, Parade, and Victa. Resistant varieties are listed on page 28.

Blister smut was first observed in our plots in the fall of 1975 and reoccurred during 1976-77. Bluegrass varieties at Agassiz, British Columbia, were severely infected during the winter of 1976-77. In the United States, the only other severe outbreak reported was from eastern Washington in 1951. It was also found in
Holland in 1961. Because of its abundance in 1975 and 1976, we suspect that the fungus had been present previously but was overlooked because of the chronic abundance of *Drechslera poae* (*Helminthosporium vagans*) leaf spot.

**Control**

Maintain grass in good, but not lush, growing condition using a balanced fertilizer and proper watering schedule. The most practical solution is to use resistant varieties.

**References**


**Fairy Rings**

Fairy rings are caused by various mushroom or puffball type fungi. Three different ring-like symptoms can occur: (1) mushrooms appear in circles but have no effect on the grass; (2) stimulation of grass growth occurs in addition to appearance of mushrooms; and (3) circular patterns of dead grass appear in addition to growth stimulation and mushrooms. Those in groups 1 and 2 may be temporarily nuisances in the spring and fall, but those in group 3 are the most serious. In Washington these rings are caused almost entirely by the *Marasmius* mushroom to which the following discussion pertains.

**Symptoms**

Fairy rings appear first as circular patches of dark green, fast growing grass, enlarging into small circles or circular areas during spring and early summer. Eventually, under stress of warm temperatures and/or inadequate moisture and nutrition, a ring of dead grass develops along the inside of the green zone. Small tan mushrooms often appear near the junction of the dead and outer zone in the spring and/or fall if conditions are favorable. The dead zones are larger when grass is suffering from inadequate water and nutrition. Another green ring often appears inside the dead zone. The various zones of darker green and dead grass range from an inch to a foot or more wide. During the year the diameter of the circle may increase from 3 to 24 inches as the fungus spreads outward. In contrast, in eastern Washington only a single green ring usually develops, without the dead zones and mushrooms. The white waxy mycelium of the fungus infiltrates the soil to a depth of 6 to 12 inches, plugging the pores and making it very difficult to wet. It also often appears as a mat around the base of plants in the outer stimulated zone. This mycelial growth accelerates death of the grass. The fungus decomposes organic matter and thereby releases nitrogen which stimulates grass growth. The inner zone is stimulated by nitrogen resulting from decomposition of the dying fungus. Huge rings (up to ½ mile in diameter and over 400 years old) have occurred in range country but most of them in lawns in Washington are from 3 to 5 feet in diameter. The mushroom seldom reinvades a previously diseased area. Rings may be broken, resulting from an obstruction or for other reasons. Rings may suddenly disappear.

**Causal Organism**

*Marasmius oreades* (Bolt ex. Fr.) Fr. The mushroom (or toadstool) is 1 to 2½ inches wide, smooth, pale tan to light brown when dry, reddish-tan when wet, slightly convex, rather thin, and tough. The stem is smooth, 1½ to 4 inches long, pale buff, tough and rigid, and attached centrally. The gills are pale or whitish and produce spores measuring 10.5 to 9.5 × 6.0 to 5.5 μ. The mushrooms are tough, they do not readily decay, and, after drying, can be revived by moist weather. Many other mushrooms and puffballs occur in Washington lawns, including some deadly types. Most of these do not cause rings and remain visible for only a few days.

**Disease Cycle**

It has not been proven whether these mushrooms become established from a bit of diseased grass tissue or from a spore. The conditions for successful germination and establishment must be very precise.

**Factors Affecting**

**Nutrition.** Most damage is seen on undernourished turf, probably because it is already under stress. For this reason damage often occurs on light sandy or gravelly soils. Rings also occur on golf course fairways but rarely on golf greens, which receive better care. Adequate fertilizer practices help the grass to recover.

**Moisture and Temperature.** The *Marasmius* thrives under mild, moist conditions, hence its destructiveness in western Washington and England. Dry and cold weather retard its activity.

**Miscellaneous.** We have seen more *Marasmius* where heavy amounts of chicken manure were applied. Also some fungicides (such as benomyl and the thiophanates) used for the control of other diseases have stimulated the development of small fairy ring-like spots.

**Importance**

Fairy ring is widespread and, although a curiosity in some regions, is serious in England, western Washington, and similar areas.
Control

**Masking the Disease**

1. For situations which do not warrant the inconvenience or expense of eradication, masking the symptoms by providing turf with adequate deep watering and fertilizer may be sufficient.

2. Rake over diseased areas to loosen them up and then punch holes in and around the rings (pitchfork, etc.). Water with a grass-type wetting agent to re-wet the soil. Reseed and keep adequately watered and fertilized.

3. Research in southern Alberta has shown that punching holes and watering heavily every day for a month will give adequate control during the summer. Their conditions are, however, quite different from those in western Washington where soil is usually wet from October through April.

**Eradication of Disease**

1. Remove sod, or less desirable, kill it by using a nonresidual herbicide such as glyphosate. Repeatedly cultivate the area in different directions with a heavy-duty rototiller. A thorough mixing is essential for control. Water adequately to encourage good microbial activity for a period of time. The area can then be reseeded. Sod may also be used to reestablish the turf, but it is less desirable because the fairy ring fungus may be reintroduced with the sod. Good management, particularly deep and infrequent irrigation, will reduce the possibility of new reinfections.

2. The extreme practice of carefully removing all infested soil (look for the white mold and crumbly soil) has been effective, but is usually expensive. It is necessary to remove an extra foot around and six inches deeper than where the infested soil is found. Refill the area with new soil and reseed.

3. Larger areas can be covered with a tarp, fumigated (0.5-2"), round watersoaked spots, which rapidly turn pink in strong sunlight. During late spring, summer, and early fall, symptoms are often masked by a slow growth of the pathogen and rapid recovery of the grass. Symptoms are most noticeable during colder months because recovery of the grass is slow. Diseased areas under snow are often larger; the spots appear bleached and covered with a white mat of mold that turns pink after exposure to sunlight. The name, pink snow mold, depicts this form.

**Tall Grass (1'').** In tall grasses the disease appears as more or less circular spots. Usually they are some shade of brown, with or without the watersoaked margin and mold described above. Such spots may be large (4-12" or more) and ordinarily are indefinite since some scattered green grass is usually present in the diseased area. Under snow, however, the spots can be as distinct as those on short grass. Stems are occasionally infected. Normally the roots and crowns are not attacked, though after leaves are under repeated or prolonged attacks, the roots and crowns are apparently weakened and die. The dead areas usually are invaded by *Poa annua.*

**Causal Organism**

*Fusarium nivale* (Fr.) Ces. (*Micronectriella nivalis*) (Shafn) Booth [*Gerlachia nivalis* (Ces. ex Sacc.) W. Gams and E. Muller]. Conidia are mostly aseptate (10-20x2.5-5μ) but up to three-septate (19-30x3.5-5μ) occasionally; curved, broadly falcate with a pointed apex and a flattened, wedge-shaped base. Sporodochia develop best at cool temperatures. (See Booth, 1971).

**Disease Cycle**

The fungus may be spread by spores (50,000 were once found on a ¼” blade of grass) but probably more often by diseased leaf fragments being carried on shoes, carts, mowers, and other mechanical equipment. The mycelium infects leaves through the stomata and grows rather slowly at first. Two to three weeks usually elapse before infection is noticed. Lower leaves are infected first and then the fungus spreads to adjacent leaves and plants. Initial infections can be easily overlooked when weather conditions do not favor rapid spread of the fungus. However, when favorable weather occurs, the spots enlarge rapidly. The fungus survives unfavorable conditions as dark brown masses of mycelium in dead leaves. Dry spores have survived for several weeks in laboratory experiments. There is also evidence that the fungus can be transmitted in or on the seed.

---

**Fusarium Patch**

*(Pink Snow Mold)*

**Symptoms**

*Short Grass (¼’’).* The disease begins as small (0.5-2’’), round watersoaked spots, which rapidly change from brownish-black to brown, tan, and eventually light gray. The spots will enlarge up to 6 inches or more under favorable conditions. These large spots may appear ring-like if grass begins to regrow in the center. Rapidly enlarging spots usually have a watersoaked greenish-black margin. Under favorable conditions they may also show a thin to dense mass of mold (mycelium), which is initially white but turns pink after exposure to sunlight. The fungus may also show a thin to dense mass of mold (mycelium), which is initially white but turns pink after exposure to sunlight. The fungus can be transmitted in or on the seed.
Factors Affecting

TEMPERATURE. Different optimum temperatures for disease attack have been reported ranging from near freezing to 69°F. In general, infection can occur from near 32°F (particularly under snow) to around 86–88°F. Most disease in western Washington occurs between 50–60°F. Severe disease often follows repeated frosts because of injury to the grass, slow grass growth, and the ability of the fungus to remain active at low temperatures. It can survive as mycelium at -4°F. Strains adapted to different temperatures have been found in other regions, and it is probable that the strains of *F. nivale* in eastern Washington are different from those in western Washington.

MOISTURE. Moist conditions and high relative humidity favor activity of this fungal pathogen. Most disease occurs in western Washington when moisture remains on the grass for extended periods during foggy weather or light drizzling rain. Heavy rains seem to be detrimental to disease development.

LIGHT. Some light is necessary to stimulate production of spores and also results in development of the pink color. Strong sunlight usually retards infection, probably as a result of drying.

NUTRITION. Nitrogen, sulfur, and potash rank usually in that order on their effect on Fusarium patch in Washington. The higher the nitrogen level, the more severe the disease, particularly if a heavy amount is applied late in the fall. The type of nitrogen applied is important. Much less disease has occurred where ammonium sulfate and sewage sludge were used compared with urea, urea-formaldehyde, and nitrate types. Potash induces some resistance but phosphorus has little effect as long as it is not deficient. Interactions have occurred between N, P, K, and S (see Goss et al.) Sulfur applications have dramatically reduced Fusarium development. Apply no more than is needed for healthy lawn growth.

In western Washington, a balanced fertilizer program includes three elements—nitrogen, phosphorus, and potassium. At each application, use 1 to 1 ½ pounds available nitrogen, ½ pound available phosphorus, and 1 pound available potash per 1,000 square feet.

These amounts can be supplied by 9–12 pounds of a 12–4–8 fertilizer or 7–16 pounds of a 9–3–5 mixture. Apply four times a year—November–December, April, June, and September. Between these dates, one or two additional applications of nitrogen alone at 1 pound per 1,000 square feet may be made for maximum beauty.

In eastern Washington, use 4 pounds of available nitrogen 1,000 square feet each season. Divide this into four equal applications (1 pound each) in April, June, August, and November. Improved Kentucky bluegrasses require more nitrogen. They should receive 6 pounds of available nitrogen per 1,000 square feet each season.

Divide this amount into four or five equal applications. Have your soil tested to determine phosphorus and potassium needs. An application of 2–3 pounds of sulfur per 1,000 square feet per year will improve turf quality and help suppress disease. Elemental sulfur or the use of ammonium sulfate as the nitrogen source will supply this amount of sulfur.

CULTURAL. Promote good air circulation by removing problem trees, shrubs, etc. Provide good soil drainage. Aerify, power rake, verticut, and follow other recommended practices to keep thatch to a minimum. Whip or drag putting greens in the morning to remove moisture from leaf blades. Mow frequently to keep grass at a recommended height and to prevent a "moist chamber" effect. Remove grass clippings.

RESISTANT VARIETIES. Tests are still in progress but some varieties appear promising at this time, with good Fusarium patch resistance plus good cultural characteristics. See tables on variety resistance.

FUNGICIDAL. These recommendations can be found in EB 0938, *Disease Control in Home Lawns*, and EB 1133, *Disease Control for Commercial Turf*. On golf greens, apply fungicides every two weeks dur-
ing “Fusarium-type” weather and once a month otherwise to prevent buildup of the organism in western Washington. In eastern Washington apply fungicides as needed in the fall and spring but with at least one application in early fall and another before snowfall. Alternate types of fungicide or use in mixtures to reduce the chance for development of fungicide-resistant strains of Fusarium (which has occurred with benomyl). Fungicides are not ordinarily applied on home lawns because of the needed frequency of application. It is usually best to rely upon cultural methods, including the use of grass mixtures and the use of sulfur or ammonium sulfate fertilizer.

References

Drechslera Diseases (Helminthosporium) Leaf Spots

There are many related diseases caused by various species of Drechslera. Formerly they were grouped under the name Helminthosporium. These diseases are referred to as melting-out, going-out, leaf spots, zonate eye-spots, brown blight, leaf blotch, and crown and root rots and are discussed at length in Diseases of Turfgrass (Couch 1962). Leaf spot on Kentucky bluegrass appears to be the major disease in this group in Washington. The following discussion is restricted to this disease. As the use of Kentucky bluegrasses expands in this area, other Drechslera (Helminthosporium) diseases may become serious.

Symptoms

The initial spots on leaves are very small, circular, and water-soaked. They turn dark purplish-red and enlarge to the leaf edges and elongate to ½ inch or longer. As they enlarge, the center of the lesion turns brown and eventually pale tan or dull white. Leaf areas above the spot eventually turn yellow. The leaf sheaths may be severely attacked with lesions that girdle the leaf and cause it to collapse. The fungus may also rot the crown, stolons, and roots. The resulting “melting-out” may occur slowly or very rapidly, depending upon environmental conditions. The crowns and roots of such plants are brown and rotten. Leaf lesions are the most common symptom seen in Washington.

Causal Organism

Drechslera poae (Baudys) Shoen., formerly named Helminthosporium vagans Drech. Conidia are formed in the dead areas of lesions and measure 24–150 x 17–23μ. The mature, dark-olivaceous conidia are cylindrical or slightly tapering toward their hemispherical ends, with 1–10 (usually 5–8) septate.

Disease Cycle

The fungus survives hot and cold periods as dormant mycelia in infected plants and plant debris. Spores are produced on surfaces of these tissues and are moved by splashing water, by air, or are carried on equipment, etc. When conditions are favorable, infection may occur within a few hours. Older leaves appear to be more susceptible than younger ones. Leaf infections are most common during the spring and fall months. The dying-out phase from crown and root rots more often occur during the summer months. The fungus may also be transmitted in or on the seed.

Factors Affecting

The minimum temperatures for growth in culture are below 38° F, optimum 77° F, and maximum 86–95° F. Inoculation tests have shown that temperatures between 57° and 89° F did not influence pathogenicity. The fungus sporulates best below 70° F but infection increases above that temperature. The disease is most common during the fall, winter, and spring in Washington. Prolonged periods of cool air temperatures, high relative humidity, overcast skies, and slow grass growth favor disease development. Free moisture on leaf surfaces is required for infection.

Other factors favoring the fungus are high nitrogen fertilization; alternate wetting and drying of thatch, which stimulates sporulation; excessive watering; shading; and short mowing, which increases the root rot stage.

Importance

This widespread disease is found in Europe and North America. It is particularly important on many grasses grown in the northeastern and northwestern United States. It is most common in Washington on bluegrasses. We suspect it may be one of the main factors responsible for the short life expectancy of some Kentucky bluegrasses in western Washington and perhaps even a factor in the dying out of Poa annua in the summer. Fescues, ryegrasses, and bentgrasses are
more often attacked by species of Drechslera (Helminthosporium) other than D. poae.

Control
1. Fertilize with a balanced fertilizer to provide good plant health, but avoid rates that cause excessive growth. Avoid heavy applications of soluble nitrogen fertilizers in hot weather.
2. Water thoroughly (6-8" depth) and infrequently rather than lightly and frequently. Water in the morning so the leaf surfaces will dry before night.
3. Mow at recommended height. Avoid close clipping since it causes stress and renders plants more susceptible to leaf spot and rust. Remove the clippings.
4. Remove excess thatch in early spring and aerify if needed.
5. Open up shaded areas to provide ample light and good air movement.
6. Buy top quality seed to plant new areas and use a mixture of varieties including those resistant to the major diseases. For varieties resistant to Drechslera (Helminthosporium) leaf spot see variety resistance tables.
7. If the problem persists, effective fungicides are available. See EB 0938, Disease Control in Home Lawns.

References

Puccinia Rusts
All of our common turfgrasses are susceptible to one or more rusts. Bluegrasses are most commonly infected in Washington but rust is also found on the ryegrasses. Limited studies indicate that Puccinia brachytodii (poae-sudeticae) is most common on bluegrasses; P. graminis and P. striiformis have also been identified. Detailed surveys would very probably reveal more species. Since the rust diseases are similar in many respects, a general description follows.

Symptoms
The disease starts on the leaves as small light-yellow flecks, which enlarge to form pustules. Powdery masses of spores are produced in these pustules and, depending upon the type of rust, the spores will vary from various shades of yellow through orange to dark reddish-brown. The individual pustules are round, oval, or elongated. As the pustules age they often turn brown to black from development of a teliospore stage. Heavily infected turf becomes thin with an overall yellow-orange to reddish-brown color. Infected plants or leaves turn yellow, wither, and die. Since rusted turf is weakened, it is more susceptible to winterkill, drought, weed invasion, and damage from other diseases.

Causal Organism
Some of the more common rusts are:

Puccinia coronata Corda. Uredia are brownish-yellow, globose to broadly ellipsoid, 16-20 x 18-24 μ; finely echinulate, and occasionally with paraphyses. Teliospores are clavate to oblong, 13-19 x 30-67 μ. It is found mostly during cool weather on Agrostis and Lolium.

Puccinia graminis Pers. Uredia are reddish-brown. Urediospores are oblong or ellipsoid, 13-24 x 21-42 μ; and strongly echinulate. Teliospores are blackish-brown, ellipsoid-clavate, and 16-23 x 35-58 μ. It is a warm but late season rust found throughout Washington on Agrostis, Lolium, and Poa pratensis.

Puccinia brachytodii Otth. var. poae-nemoralis (Otth.) Cumm and Greene (P. poae-sudeticae). Uredia are orange-yellow with numerous peripheral paraphyses. Urediospores are globose or ellipsoid, 18-24 x 21-29 μ, and finely echinulate. Teliospores are chestnut brown and 18-24 x 39-55 μ. It is a warm-season rust found throughout Washington on Poa annua, P. pratensis, and other grasses.

Puccinia recondita Rob. (P. rubigo-vera) Wint. f. sp. agropyri Erikss. Uredia are cinnamon-brown with few or no paraphyses. Urediospores are globose or broadly ellipsoid, 13-24 x 16-32 μ, and finely echinulate. Teliospores are chestnut brown and 13-24 x 32-65 μ. It has a wide host range including Poa and Festuca.

Puccinia striiformis West. Uredia are elongated (0.3 x 0.3-10 mm), and lemon yellow. Urediospores are globose to broadly ellipsoidal, 18-25 x 15-20 μ, and echinulate. Telia are dark brown or black and teliospores are clavate, smooth, and 30-49 x 12-22 μ. It is cool season rust found on many grasses including Poa pratensis and is particularly severe west of the Cascade Mountains.

Disease Cycle
The rust fungi generally overwinter as mycelia in infected plants or as teliospores. Most infection in grasses probably comes from the mycelium, which becomes activated when the weather is warm. Newly infected leaves form pustules resulting in production of unrediospores. These spores are normally airborne.
but may also be carried on shoes, equipment, etc. They are abundant—with as many as 350,000 in a single pustule. Rusts are obligate parasites—they need a living host. If weather conditions are suitable, the urediospores repeat the cycle every few days until the teliospores are formed. The teliospores germinate and produce another type of spore which infects an entirely different type of plant (alternate host). Spores develop on the alternate host and can infect grasses.

Factors Affecting

Temperature and Moisture. Most rusts are favored by moderately warm, humid weather. The spores germinate quickly.

Stress. Grasses subject to stress conditions, such as lack of water or imbalance of nutrients, are usually more susceptible to rust. For example, leaf rust was much more severe in our bluegrass plots which were cut at \( \frac{1}{8} \) inch as compared to those cut at \( \frac{1}{2} \) inches. Overfertilization with nitrogen increased the severity of rust.

Importance

Rusts are found throughout the world on most types of grasses. Different species of the rust fungi are locally important. Bluegrasses, and particularly the variety Merion, have had more serious rust problems than most other grasses in Washington.

Control

Nutrition. Fertilize to promote good, but not excessive growth.

Water. Infrequent but thorough watering is suggested in order to moisten the soil to a depth of 6-8 inches. Avoid frequent and light irrigation. Water in morning rather than at night.

Promote good light penetration and air movement for rapid drying.

Mow frequently. Frequent mowing will aid control by removing diseased leaf tips.

Fertility. Adequate, but not excessive, nitrogen stimulates leaf growth and may allow removal of infected leaves before they appear unsightly.

Avoid pure stands. Use grass mixtures with at least one variety being resistant to the most serious rust(s). The most rust-resistant bluegrass varieties in our plots at Puyallup are listed on page 28.

Fungicidal. The above measures will normally be sufficient for practical control but, if the disease is still a problem, fungicides are registered for use and are listed in the general references.

Reference


Necrotic Ringspot

Symptoms

Affected areas first appear as small spots or patches of dead turf during late spring-early summer or late summer-early fall. These patches can expand to form rings, arcs, and larger patches up to several feet in diameter. Weeds and sometimes unaffected grasses invade the centers of these rings. During the spring and fall when the fungus is active, the margins of the necrotic areas can have a maroon-brown coloration. Diseased plants can be easily lifted from the soil. Microscopic examination of the surface of lower stems and roots reveals the presence of dark hyphae which are similar in appearance to the runner hyphae of Gaeumannomyces (Ophiobolus). Short-necked, black pseudothecia sometimes appear on infected crowns and roots.

Causal Organism

Necrotic ringspot is caused by the ascomycete fungus *Leptosphaeria korrae*, Walker and Smith. This fungus produces brown ectotrophic mycelium on roots and crowns of diseased plants. Black, short-necked pseudothecia occasionally appear on roots and crowns. Asci are bitunicate, and mature ascospores are filamentous and yellow-brown in color. Ascospores from isolates in Washington measure 135 (100-188) by 4-5 \( \mu \) with 7 (5-11) septa.

Disease Cycle

Little is known at this time concerning the life cycle of this organism. Pseudothecia of the pathogen are seen infrequently, but pseudothecia with mature ascospores appear in Washington during the fall. Their importance in disease development is unknown. In both eastern and western Washington, the disease is most active in the spring and early fall. Frequently, the disease is inactive during mid-summer, and the turf appears to recover, but the same ringspots usually reappear in the fall.

Factors Affecting

Because of the relatively recent appearance of this disease in the Pacific Northwest, little information exists regarding disease development. Field observations indicate that the disease is more common on overfertilized and overwatered turf. The disease has been observed on turf having soils with pH ranging from 5-8. The disease is most commonly seen on three- to five-year-old turf established from sod, but can also occur in seeded lawns.

Importance

Necrotic ringspot is now considered to be one of
the most important diseases on bluegrass turf in Washington. Recent studies in other states, including Wisconsin and New York, have implicated *Leptosphaeria korrae* as one of the pathogens involved with the disease complex historically known as Fusarium blight. This fungus also has been described in Australia and California as the cause of spring dead spot on Bermuda grass.

**Control**

**Cultural.** Avoid overfertilization and overirrigation. However, proper maintenance and fertilization are needed to help the turf recover during periods when the disease is inactive. See EB 0482, *Home Lawns*, for current maintenance and fertilization recommendations.

**Fungicidal.** Rubigan is the only registered turf fungicide which has given control of this disease in experimental tests; however, work is still in progress to determine timing of applications for best disease control. See EB 1133, *Disease Control for Commercial Turf*, for current fungicide recommendations.

**References**


**Take-all Patch**

*(Ophiobolus Patch)*

**Symptoms**

New outbreaks of Take-all patch (Ophiobolus patch) usually appear in the late spring as small, bright brown, dead areas of grass. At this stage the brown areas often resemble Fusarium patch, but unlike the latter, Take-all patch continues to spread from the roots of one plant to those of adjacent plants, rotting both roots and crowns. Also, the Take-all patch is at first rather bright brown while Fusarium patch spots are a dull brown. Take-all infected plants are easily pulled in contrast to Fusarium-infected plants.

A circular, doughnut-like dead spot usually occurs in pure bentgrass stands. The center of the doughnut is eventually invaded by annual bluegrass, fescues, bluegrasses, and other weeds. If the attack occurs in mixed turf, the bent is killed and a thinned spot of fescue and/or bluegrass remains. Occasionally, an indefinite circular area of thinned yellow bent may also appear instead of the definite or more noticeable brown spot.

The symptoms become most conspicuous after stress from hot, dry weather even though moist, cool conditions favor fungal growth. Following the stress, arcs, spots, and rings may appear suddenly—almost overnight. The color of the grass may range from bronze to a bright reddish brown, eventually becoming dull. During the winter it is usually gray.

The affected areas may enlarge as much as 6 inches or more per year and eventually reach a diameter of 3 feet or larger. They may continue to enlarge for several years or suddenly cease to spread.

Dead or dying roots may be covered within thin, dark brown strands of mold (runner-hyphae). Microscopic examination of the strands can help determine the cause of the disease. However, other fungi can also produce similar strands. Accurate diagnosis is based upon the development of tiny characteristic black fruiting bodies of *Gaeumannomyces* (*Ophiobolus*) in the crowns of the dead plants. These do not appear until late October in Washington, so earlier diagnosis and control recommendations must be based tentatively upon symptoms alone. Experience helps in these situations.

The disease is most serious on bentgrass planted in recently fumigated soils, recently cleared forested areas, or other soils of low organic matter and poor nutrition, and in new putting greens built up of sand and sawdust. The beneficial microorganisms competitive with or antagonistic to *Gaeumannomyces* (*Ophiobolus*) are probably either killed by the fumigation or are not present in these other areas.

**Causal Organism**

*Gaeumannomyces graminis* (Sacc.) Arx. and Oliv. var. *avenae* (E.M. Turner) Dennis, formerly named *Ophiobolus graminis* (Sacc.) Sacc. var. *avenae* E.M. Turner. The fungus forms dark brown to black, smooth, flask-shaped, beaked, ostiolate perithecia (up to 500 μ in diameter) with curved necks protruding from lower leaf sheaths. Ascospores are 75–140 (mostly 80–125) μ. Dark brown runner hyphae may be present on roots, crowns, and stolons. Mature ascospores germinate readily. Dr. Roderick Sprague, who confirmed our original diagnosis, indicated our collection more closely resembled the oat rather than the wheat strain. However, he suggested there were enough differences to justify further testing to determine if it might be a new variety or species. This has yet to be done.

**Disease Cycle**

Infection can occur through the root, stolon, and stem. Since the fungus needs a high relative humidity to grow, we assume that most spread and infection occurs during the wet winter months but the grass doesn't show symptoms until warm, sunny weather occurs. The mycelium permeates the roots and crown. Fruit- ing bodies containing spores are formed in the crowns
from late October until early spring in the Pacific Northwest. Based upon the occurrence of the disease we assume that spread may occur in several ways. Infected plant parts can be carried on shoes, equipment, etc., resulting in the rapid invasion of new turf areas. Spores disseminated by wind and water may be responsible for massive infection along drainage slopes. Runner hyphae are responsible for the spread from diseased to adjacent healthy plants. The fungus does not survive long without its hosts.

**Factors Affecting**

**Temperature.** Apparently no one has thoroughly studied the effect of temperature on infection and symptom development on turf. In culture, optimum growth occurs between 68° and 73° F. We placed naturally diseased turf in growth chambers under fluorescent lights. The fungus spread, as determined by symptoms, developed at a rate of 4 inches a month at 51° F as compared with 18 inches a month at 77° F. In general, the symptoms outdoors in western Washington become more evident when temperatures average over 60° F.

**Moisture.** Take-all patch is known as a cool, wet-weather disease. It is favored by a higher soil moisture than many other turf pathogens. Therefore, the disease is most serious during wet years, along drainage slopes, in low or poorly drained areas, or where irrigation has been excessive. This partially explains why it is so much more serious in western than in eastern Washington. The high soil moisture enables the fungus to grow along roots and infect adjacent plants. It spreads less rapidly in dry years.

**Nutrition.** Take-all patch is most serious in soils that are light-textured; low in organic matter; low or unbalanced in nitrogen, potassium, or phosphorus; and usually where lime has been applied. In our tests, generally a balanced (6-1-4 ratio) fertilizer with a moderate rate of nitrogen gave best results. The form of the nitrogen fertilizer is important. Nitrate and urea sources stimulate the fungus whereas ammonium sulfate retards it. We have switched the fungus “off and on” over a period of months by alternating between urea and then ammonium sulfate. Sulfur also suppresses *Gaeumannomyces (Ophiobolus)* but not as rapidly as ammonium sulfate. Lime promotes the disease although it may not be evident for 1-3 years. The more rapid the rise in pH, the greater the chance for increased disease development. Thus, fine lime may increase infection faster than coarse lime. These effects are a result of the pH change around the roots. Soils having a pH above 5, and particularly above 5.5, are apt to be troubled with Take-all (*Ophiobolus*) patch.

**Miscellaneous.** The fungus is suppressed by high levels of carbon dioxide, which may explain the reported benefit from applications of organic materials. The use of sewage sludge in this regard is being tested in Washington. Sludge may be beneficial in favoring the soil microorganisms that apparently inhibit the activity of *Gaeumannomyces (Ophiobolus).*

**Importance**

Take-all patch is a serious disease in climatic areas such as England and the coastal areas of the Pacific Northwest. It is also reported from other temperate areas but apparently is not such a serious problem. Bluegrasses, annual bluegrass, and fescues are resistant and usually invade the areas where the susceptible bent has been killed. These patches of fescue or bluegrass in a bentgrass turf often indicate the presence of Take-all.

**Control**

The most practical remedy on a golf green is to remove the diseased areas and to resod when only small areas are involved. On aprons, collars, lawns, and similar locations, rake and reseed diseased spots. The following measures will help reduce or prevent further attack.

**Nutrition.** Take-all patch cannot be controlled with currently available turf fungicides. The best control at present is the use of ammonium sulfate fertilizer as a source of nitrogen, applied in a balanced nutritional program with phosphorus and potassium. Apply ammonium sulfate fertilizer four times a year: in late March, in June, in early September, and again in late October or November where conditions permit. Use 5 pounds of the product as it comes from the bag per 1,000 square feet for each application. Turfgrasses less than six months old should receive one-half this amount. The fertilizer must be thoroughly watered in to avoid burning.

In addition to the ammonium sulfate, apply elemental sulfur as either a wettable powder or in a granular formulation at the rate of 1 pound actual sulfur per 1,000 square feet in March, and an additional 1 pound per 1,000 square feet in May of each year. Putting greens should receive 3 pounds sulfur per 1,000 square feet per year in 6-8 applications.

To balance the ammonium sulfate nutrition with phosphorus and potassium, apply 0-20-20 fertilizer in early spring and again in early fall at the rate of 5 pounds of the product as it comes from the bag per 1,000 square feet for each application. After the disease has disappeared, apply lawn fertilizers with 3-1-2 ratio (formulas such as 12-4-8, 15-5-10, 21-7-14, etc.) and alternating with ammonium sulfate as described above. If lime applications must be made, use slowly dissolving types (perhaps 100 mesh or coarser) so that the pH does not change rapidly. Apply lime uniformly and not more than the rate recommended on the basis of soil analysis. If the soil test indicates that 1 ton or more should be used per acre, apply the total in two equal applications, perhaps six months apart. After liming, apply an acid-type fer-
Fertilizer, such as ammonium sulfate, in the spring.

**Organic Matter.** The use of sewage sludge and other mixtures high in organic matter may help control the disease.

**Moisture.** Provide good drainage and do not overwater.

**Resistance.** There have been some differences in natural invasion by *Gaeumannomyces (Ophiobolus)* into our bentgrass variety plots, but we do not yet have enough data to make recommendations.

**Fungicidal.** Nothing has been found that works better than ammonium sulfate or sulfur. Prolonged use of the dithiocarbamate fungicides would probably be beneficial because of their high sulfur content.

**References**


**Typhula Snow Mold**

**(Gray Snow Mold)**

**Symptoms**

This disease usually, but not invariably, develops under snow. It may occur in late fall under cool, moist conditions as small, roughly circular watersoaked spots, turning yellow or yellow-brown and measuring 3–6 inches in diameter. Some grass may survive in these spots so they are less distinct than those under snow. Under prolonged snow the spots are often larger, up to 2 feet, and frequently coalesce. They are white or grayish-white, with leaves matted together and covered with a fluffy white to gray mass of mold, which may appear as a silver crust after drying. Under conditions favorable for disease development, the spots may continue to enlarge with a gray halo of mold on the margin. Usually numerous tan or reddish-brown, hard round-shaped sclerotia (½ to ½ inch) are in the leaves and crown of infected plants.

Fusarium patch and Typhula snow mold may occur in the same area at the same time and are often intermingled. *Typhula* sclerotia and *Fusarium* spores have often been found in the same sample. Sometimes suspicious samples have shown neither, but, when samples were stored in a plastic bag in a refrigerator for two weeks, the *Typhula* sclerotia developed. Leaf symptoms may also help to differentiate these two diseases. *Typhula*-infected leaves are usually whiter and brittle, while those infected by *F. nivale* may be pink or somewhat discolored and tougher.

**Causal Organism**

*Typhula incarnata* Lasch ex Fries. Sclerotia are white, changing to pink and later dark reddish-brown, hard, with an irregular shape. These may produce either mycelium or sporocarps which are slender, rose-pink, clublike, and ½ to 1 inch tall. At high elevations under prolonged snowcover in the Pacific Northwest, snow mold may also be caused occasionally by *T. idahoensis* (black sclerotia and brownish sporocarps), *T. ishikariensis* (black sclerotia and whitish sporocarps), and *Sclerotinia borealis* (larger black sclerotia and apothecia). The as yet unnamed low temperature basidiomycete, which causes so much trouble in much of Canada, has not yet been reported on turf in the United States.

**Disease Cycle**

The sclerotia allow the fungus to survive the hot, dry summer months. In the fall they germinate under cool (50–63°F optimum), moist conditions. If light is optimum (diffuse, with relatively high ultra violet), they form sporocarps. This usually occurs in eastern Washington from late October to mid-December. We have seen them only once in western Washington. Without proper light, the sclerotia germinate to produce new infective mycelia. Although the sporocarps produce thousands of basidiospores, which are capable of causing infection, most natural infection apparently comes from direct attack by mycelia. New sclerotia are formed during the winter in diseased tissues and may be easily spread by equipment.

**Factors Affecting**

**Temperature.** *Typhula* is most active under snow that has fallen on unfrozen ground and under snow as it melts in the spring. It is most parasitic at temperatures slightly above freezing but only limited growth occurs below freezing. Optimum sclerotial formation occurs at mild temperatures (50–63°F), while warm summer temperatures are required to induce dormancy. The optimum for growth in culture is near 50°F; however, infection is greater at lower temperatures because such temperatures adversely affect grass more than they do the pathogen.
MOISTURE. A high relative humidity is essential for germination and infection, but too much water (flooding) can inhibit growth. The “moist-chamber” condition under deep snow on unfrozen ground, straw mulches, etc., is an ideal situation for disease development. The disease is aggravated under compact snow—caused by skis, snowmobiles, walking, etc. Generally the deeper the snow deposit, and the longer its duration on turf, the more severe the disease development.

LIGHT. Germination of sclerotia is inhibited by direct light, but diffuse light of short wave length (UV) is needed for formation of sporocarps. Sclerotia buried below soil or snow receive no light and germinate by producing mycelium.

NUTRITION. Late fall fertilizing with nitrogen apparently increases the turf’s susceptibility by increasing the plant succulence and producing excess foliage. *T. incarnata* is rated as a weak parasite and attacks the older leaves first as they break down under prolonged snow. Turf entering the winter in a weakened or nutrient-deficient condition is also prone to *Typhula* injury.

MISCELLANEOUS. A grass mowed at correct height (see page 2) is often more resistant than high-cut grass. The excess foliage apparently provides an ideal environment for disease development and an abundant food base for the fungus when foliage begins to decompose during winter.

Importance
The fungus is distributed worldwide but is most serious in areas having relatively mild, wet, winter climates, particularly where heavy snow customarily remains on the ground for prolonged periods. The northern United States, southern Canada, and mountain states of the West have such climates. Other snow mold pathogens seem to be more important in northern Canada. *T. incarnata* may be more widely distributed than is normally expected. In England, for example, after a severe winter in 1962–63, severe outbreaks occurred in areas never before attacked. It is common in northeastern Washington but is rare west of the Cascade Mountains. The fungus attacks all types of turfgrasses as well as many cereal crops. The bentgrasses, fescues, and annual bluegrasses are more susceptible as a group than bluegrasses.

Control

NUTRITION. Use a balanced fertilizer. Avoid late fall heavy applications of nitrogen. Do not use over ½ pound nitrogen per 1,000 square feet per application in the fall and do not apply nitrogen after November 1 in eastern Washington. Sewage sludge or ammonium sulfate are recommended sources of nitrogen for fall applications.

CULTURAL. Improve air and soil drainage. Reduce thatch by aerifying, etc., and continue to cut grass until snowfall, removing clippings. Don’t mulch with organic mulchers. Avoid using the area for skiing, snowmobiling, etc. Use snow fences to prevent large drifts, and encourage snow melt in spring by spreading dark materials (as sewage sludge, coal dust, etc.) over surface of drifts.

RESISTANT VARIETIES. Bentgrass resistance apparently varies according to the region. Seeded types have been more resistant to *Typhula* than have stolonized types in our tests at Spokane on 138 varieties and selections (see table on page 30 for ratings). In making a final selection, the resistance to *F. nivale* must also be considered. Dormie, Park, Adorno, and Monopoly bluegrasses are reported as being among the most resistant. (See page 28). Reptans and Boreal fescues have been reported to be more resistant than Galfrood, Duraturf, and Olds.

FUNGICIDAL. Recommendations on fungicidal control of *T. incarnata* are listed in EB 1133, *Disease Control for Commercial Turf*. Since *F. nivale* is also a part of the snow mold complex, it is essential that a fungicide program for both be used. In fact, our experiments indicated that early fall attacks by *Fusarium* weaken the turf, resulting in an increase in later attacks by *Typhula*. Therefore, we recommend one or two early fall fungicide applications to control *Fusarium*, followed by one just before snowfall for both *Fusarium* and *Typhula*, and another application for *Fusarium* in the spring. Use different fungicides for *Fusarium* control for each application to help prevent development of fungicide-resistant strains.

References

Ustilago Stripe Smut

Symptoms
Infected plants are most noticeable during cool weather in the spring and fall when they appear pale green to slightly yellow or brown. Either single plants may be affected or groups may form spots up to a foot or more in diameter. The streaks that appear first on leaves are narrow, short or long, and yellow-green.
They later become dull gray and eventually black as the leaf epidermis ruptures, exposing dusty masses of blackish spores. Smutted leaves turn yellow and become curled and torn along the leaf veins, resulting in a tattered or shredded appearance. Smut infection weakens the plants and makes them more susceptible to damage from heat, drought, and infection by other fungi and usually results in a thinning of the turf. Root and tiller growth are reduced. Stripe smut is not apparent in new lawns since it is difficult to see the widely scattered infected plants. However, these infection centers spread and the disease becomes noticeable after 3–6 years. Smutted plants may be difficult to find during hot, dry weather because leaves curl downward and the plant often dies.

**Causal Organism**

*Ustilago striiformis* (Westend.) Niessl. Spores of this smut fungus are single, round to elliptical, dark olive brown, echinulate, and 9–11 μ in diameter. Physiological races exist. For example, the race on bluegrass does not attack bentgrass and vice versa. The symptoms closely resemble those of flag smut (*Urocystis agropyri* (Preuss) Schrot) and apparently the two have often been confused. Microscopic examination is necessary for positive identification. The flag smut spores are smooth, rounded, and composed of one to four dark reddish-brown cells (teliospores) surrounded by several smaller, empty or sterile cells with the entire “ball” 18–35 x 35–40 μ.

**Disease Cycle**

Infection takes place from spores germinating in the soil and growing into the axillary buds on the crowns and rhizomes or through the coleoptile. Once the smut fungus penetrates, it usually spreads through the entire plant although some tillers may escape. Teliospore formation begins as thick, tangled mats of mycelium within infected leaf tissues. The mycelium then breaks up to form the spore masses that are released as the host tissue ruptures. The teliospores may be spread by wind, rain, mowing and other turf practices, as well as on grass seed. They may germinate immediately or lie dormant for a year or more, enabling the fungus to survive conditions unfavorable for disease development. The fungus also survives as perennial mycelia in the crown and nodes of infected plants.

**Importance**

This disease has a world-wide distribution and is widespread in the United States. It is quite destructive in many areas, particularly on the susceptible bluegrass variety Merion, which is widely planted. In general the more vigorous spreading bluegrass varieties are more resistant than are the tillering types. Various races of this fungus also attack bentgrasses and many other grasses. Stripe smut is also occasionally found on red fescues and perennial ryegrasses.

**Factors Affecting**

**Temperature.** The fungus growth within the plant is more rapid in cool than in warm weather so the disease is most evident in late spring and early fall when temperatures are about 50–60°F. High temperatures inhibit growth of the fungus and hasten death of the already infected plants. The minimum temperature for spore germination is about 45°F, optimum 72°F and maximum 95°F, and for growth in culture about 41°F, 68–77°F, and 95°F, respectively. Smut pustules develop best at temperatures between 60°F and 85°F; cooler or warmer conditions reduce their development.

**Moisture.** High moisture favors spread of the fungus while limited moisture puts stress on infected plants and many of them die.

**Nutrition.** Strong plants tolerate the disease better than weak ones, thus the disease becomes severe on both undernourished and on overfertilized grass. Disease is also worse if soils are acid rather than in the pH range of 6.0 to 7.0.

**Miscellaneous.** The disease is worse where thatch is thick.

**Control**

1. When available plant treated seed or start with disease-free sod.
2. Adopt a fertilization and watering schedule that is on the low side of optimum. Water occasionally and deep rather than light and frequent.
3. Spray with an effective fungicide, either in the late fall or early spring.
4. Use at least one smut-resistant variety in a mixture when seeding. Some of the most resistant bluegrasses reported are: Anheuser Dwarf, Belturf, Bonnieblue, Fylking, and Pennstar. Others with some tolerance include Adelphi, Park, Sodco, Sydspo, and Warrens A-20 and A-34. See table on page 28.

**References**


Minor Diseases

Air Pollution

Air pollutants may injure grass leaves by killing tissues, causing chlorosis, tip blight or banding, or they may adversely affect growth even though no direct burn is evident. It has been suggested that part of the difficulty in keeping Poa annua healthy during hot weather may be due to the weakening effect by smog and other pollutants, thereby making the Poa more subject to stress from heat, drought injury, disease attack, etc.

Poa annua is very susceptible to smog, followed in a decreasing order of sensitivity by ryegrasses, Kentucky bluegrasses, red fescues, and bentgrasses the most resistant. Sulfur dioxide affects red fescue and bentgrass more than bluegrass and ryegrass, with Bermuda and zoysia being most resistant. Bermuda and zoysia are also the most resistant to ozone while ryegrass, bluegrass, and red fescue are intermediate. Bentgrasses (Agrostis alba) are the most susceptible to hydrogen fluoride, followed by bluegrasses and red fescues. Merion, Glade, Baron, Pennstar, and Wend-sor bluegrasses are all moderately or highly susceptible to ozone and PAN (peroxyacetyl nitrate), while Newport and Fylking are much more resistant. Newport, Fylking, and Pennstar and Merion are also resistant to sulfur dioxide. Newport and Fylking would appear to be top bluegrass choices for planting in locations with high air pollution.

Ozone toxicity typically appears as a bleaching and necrosis of the leaf blade except on red fescue where some pigmented stippling occurs and on Poa annua where yellow to tan necrotic flecks may also appear. Ozone may also predispose annual bluegrass to increased drought damage under dry soil conditions. Sulfur dioxide toxicity consistently causes a necrosis of the leaf tips. Smog may cause a banding on different parts of the leaf blade of Poa annua.

Different genera, species, and varieties of grasses respond in different ways to different pollutants under different environmental conditions. Therefore, in certain cities and near factories releasing sulfur dioxide, hydrogen fluoride, etc., air pollutants should be considered as possibilities in diagnosing unusual problems.

Lawns exposed to air pollutants require more careful maintenance than ordinary lawns. The damage has been reduced appreciably in some cases by drenching turf with a benzimidazole fungicide.

References


Colletotrichum – Anthracnose

Symptoms

Two distinct symptom types have been observed with this disease. One type is usually seen under stress conditions in the summer as irregular areas of thinned blighted grass ranging from a few inches to several feet in diameter. The overall color at first is reddish brown, later fading to a light yellow tan, and finally to a light gray as the leaves shrivel and die. Individual leaves show round or elongated reddish brown spots in which are later produced very small black fruiting bodies of the fungus. The second symptom and less frequent type appears during the winter on Poa annua as a yellowing of scattered individuals or small groups of plants. The disease develops slowly, first appearing on older leaves and later on central ones. They turn orange and later an orange-red. A black discoloration develops at the base of the leaf sheaths and the central shoot is easily pulled away from the rotted base.

Causal Organism

Colletotrichum graminicola (Ces.) Wils. Acervuli are brown or black, round or elongate, 70–300μ. Setae are few or many, dark brown or black, and thick at the base. Conidia are falcate, spindle or boat-shaped, and 19–29 x 3–5μ.

Disease Cycle

Spores spread from infected debris to healthy plants during moist weather. Rapid spread and development takes place at 80° to 85° F when plants are under stress from lack of water, undernourishment, or other causes. Between 68° and 90° F the blight occurs more rapidly as the temperature increases. The fungus is both air- and seed-borne.

Importance

The disease is commonly reported throughout the world but only is serious on plants under stress. Many different types of grasses can become diseased. Most of our samples have been of fescues. The yellow-Poa annua winter problem did not occur in adjacent bent-grass plots.

Maintain an adequate, balanced nutritional program; water grass thoroughly when needed; remove thatch and aerify compacted areas. A general turf
fungicide that is registered for anthracnose can be used if the problem persists. Some varieties appear to be more susceptible than others.

References

Curvularia Blight (Fading Out)
This disease has been the subject of a great deal of controversy with some pathologists claiming the fungus is only a saprophyte while others have argued that it is a good parasite. Two recent studies (see references) have shown that under some conditions it can cause problems.

Symptoms
General yellowing or fading out of plants occurs in small patches followed by coalescence into large irregular patches. Symptoms vary on individual plants according to the isolate of the fungus. On Kentucky bluegrass and creeping red fescue leaf tips yellow and die back. Gradually the disease progresses down the leaf blade. Affected tissues turn brown, then gray, and ultimately shrivel. In some instances a reddish-brown margin occurs between affected and normal tissue. Die back will vary from ½ to 1 inch or more. The more virulent isolates tend to induce a longer lesion. Symptoms on creeping bentgrass are similar except that the affected areas become tan and shriveled and do not pass through the brown phase observed for bluegrass and fescues. Leafspot and tip die-back lesions are induced by some isolates on both bluegrass and fescue. Leaf spots are tan in the center with red or brown margins. Leaf spots have never been observed on bentgrass. Crown and leaf sheath infection result in dark brown blighted areas without distinct margins. Lesions may be covered with a black mass of spores.

Causal Organism
Curvularia spp. The spores are 3–4 celled, brown, fusiform, typically curved or bent with one or two of the central cells somewhat enlarged and measure 8–16 wide x 19–42μ. Recent studies have demonstrated a great deal of variability in the pathogenicity of isolates to different hosts, at different temperatures, etc.

Disease Cycle
In general, the cycle is similar to that of Helminthosporium. It can survive for extended periods in soil. Spores are air-borne and seed-borne.

Factors Affecting
Curvularia is most destructive under hot, humid conditions, frequently attacking turf weakened by improper fertilizer practices, excessive wear, etc. Recent studies showed no disease developed below 75°F while heavy infection occurred between 75° and 95°F. Infection has been demonstrated even at temperatures above 100°F.

Importance
The disease is apparently widespread on most grasses as well as other hosts. Because of its high temperature requirements it is more common in warm climates. Most, but not all, collections in the Pacific Northwest were on turf that appeared to be under stress.

Control
In general, follow the directions listed under Helminthosporium, including seed treatment and avoidance of stress. If a fungicide seems to be needed, read and follow label directions and precautions.

References

Damping Off and Seed Decay
Symptoms
Seeds rot before sprouting or the young seedlings become water-soaked, turn yellow to brown, wither, and die before or after emergence. After emergence the disease is called damping off and is evident as a collapse of the seedlings at the soil surface. The end result is a bare area or thin turf.

Causal Organism
Many common fungi that inhabit the soil are responsible for seed decay and damping off. Fusarium, Pythium, Rhizoctonia, and Helminthosporium are several of these fungi. They may be either soil-borne or seed-borne.

Disease Cycle
One or more of the causal organisms listed above are usually present in debris or as spores in the soil.
Under cold, wet, shaded conditions which inhibit rapid germination and growth of grass seed, decay and damping off can occur. Fungi such as *Pythium* may also be destructive during warm wet weather.

**Importance**

These fungi are distributed throughout the world and can cause serious damage. All grass types are susceptible but particularly the small-seeded grasses such as bents.

**Control**

Provide good surface and subsurface drainage and aeration, and allow as much light as possible. Use top quality seed which is preferably treated with a fungicide. Plant at the recommended depth during cool, dry weather, and particularly avoid planting too early or too late when the soil is cold or wet or both, which slows grass germination. Avoid overwatering. Apply enough nitrogen to encourage good but not excessive growth. In general the faster the germination and growth, the less chance there is for damping off. Spray with a fungicide (see EB1133, *Disease Control for Commercial Turf*) immediately if the disease appears. The fungicide will not cure already infected plants.

**Reference**


**Erysiphe Powdery Mildew**

**Symptoms**

A white to light gray or gray-brown powdery growth appears on upper surfaces of leaves and leaf sheaths. It spreads rapidly and becomes increasingly dense. The lower leaves may be completely covered. Leaves turn yellow, later tan or light brown, and gradually die. Repeated attacks result in reduced growth of roots and eventual death of the plants. Surviving plants are weakened and more susceptible to winter kill, drought, and other disease attacks. Attacks are rare on short (putting green) turf.

**Causal Organism**


**Disease Cycle**

The fungus survives the winter in infected plants and debris. The powdery appearance is due to masses of spores which are easily dislodged and carried by air currents. They can infect leaves within two hours under favorable conditions and produce a new crop of spores in 3–4 days. Spore production can be continuous for 1–2 weeks, thus under favorable conditions it spreads rapidly and can be difficult to control.

**Factors Affecting**

Both spore production and infection are favored by cool (optimum is 65 ° F), humid, cloudy weather. Spore germination requires a high relative humidity without free water on the leaves. Powdery mildew is more severe in shaded and protected areas (on north and east sides of buildings and under dense trees and shrubs) than in full sun. In the Pacific Northwest it usually attacks in the fall when days are mild and cloudy and the nights are cool and damp, although severe disease situations may occur in the spring as well.

**Importance**

The disease is common throughout the world, attacking over 100 genera of the *Gramineae*, including many cultivated and weed grasses. It is found in the Pacific Northwest, usually in shaded locations on susceptible bluegrass varieties such as Merion, Windsor, and Kenblue but is seldom found on bentgrasses.

**Control**

Reduce shading and improve air circulation as much as possible. For new seedings, use mildew-resistant varieties or red fescues recommended for shade (see page 29). Substitute ground covers (ivy, etc.) for grass in very dense shade. Use a moderate rate of a balanced fertilizer. Water in the morning and mow frequently at the higher recommended height. Apply fungicides if needed (see EB 0938, *Disease Control in Home Lawns*). Some of the better mildew-resistant varieties are listed in on page 28.

**References**


Commonwealth Mycological Institute Descriptions of Pathogenic Fungi and Bacteria No. 153.

**Fusarium Blight**

**Symptoms**

The disease first appears as a dark green leaf lesion which rapidly fades to a dull tan or yellow and rapidly enlarges up and down the leaf. Symptoms usually noticed first are the appearance of scattered 2- to 6-inch light green patches which rapidly turn a dull reddish-brown to tan and finally yellow. They may
be circular, arc-shaped, or in streaks up to 2–3 feet long or in diameter. In large spots some green plants may remain, producing a doughnut appearance much like Take-all. Roots and crowns have a dark brown or black rot and sometimes show a pink mycelial mass of the fungus. Spots coalesce to produce an irregular shape. In the Midwest and East, the first symptom is often the foliage blight stage which is usually, but not always, followed by root and crown rot. In some other instances, and especially in California, only the root and crown rot occur.

Causal Organism

*Fusarium tricinctum* f. *sp. poae* (Pk.) Snyd. and Hans. and species of *F. roseum*-type (emended Snyd. and Hans.). Many species of *Fusarium* are associated with the disease and spore morphologies differ greatly. *Fusarium* species may be identified according to Booth, 1971.

Disease Cycle

The fungi overwinter in debris or in infected plants. Spores germinate under warm, humid conditions and within 12 hours they can infect leaves directly or through the cut leaf tips. Crown infestations also may occur. In hot, humid weather all turf may be lost within 4–7 days. Spores are blown by wind and carried by equipment or shoes and on seed.

Factors Affecting

Spore production and infection are abundant during humid weather when daytime temperatures are 80–95° F and nighttime temperatures are above 70° F. Temperatures below 70° F and dry air limit development. High nitrogen fertility and low calcium levels favor the blight. Grass under stress from any cause, including drought and nematode attack on roots, is more susceptible. Greatest damage occurs when periods of high temperature and high humidity are followed by lack of rain for several weeks. The blight is more common on older (over 4 years) than on younger turf. Acid soil (below pH 6) and thick thatch layers favor the disease.

Importance

Fusarium blight is widespread, being most destructive from the Midwest to the East Coast. It has been found only occasionally in Washington, but is described here because of its potential importance with the expansion of bluegrass plantings west of the Cascade Mountains. It prefers hot, humid climates.

Gloeocercospora Copper Spot

Symptoms

Copper spot appears as scattered, rounded salmon-pink to copper-red patches, 1–3 inches wide. Individual spots on leaves are small and red, later turning darker red. During warm, moist weather the leaves may become covered with pinhead sized gelatinous salmon-pink spore masses. When rubbed with a white cloth, these spores produce a copper coloring.

Causal Organism

*Gloeocercospora sorgii* Bain & Edg. Conidia are hyaline, many septate, elongate to filiform, and measure 20 x 1.4–3.2μ. Sclerotia are black, lenticular to spherical, 0.1 to 0.2 mm in diameter, and are formed in necrotic tissues.

Disease Cycle

The fungus survives the winter as sclerotia. After rainy periods in the spring when air temperatures reach 68–75° F, these germinate by producing hyphae. The hyphae enter grass leaves through stomata, producing visible lesions within 24 hours and masses of spores 1–2 days later. Conidia germinate within 5 hours so the complete cycle can be very rapid.
Factors Affecting

Warm (68–80° F), moist conditions and acid soils favor the fungus.

Importance

This disease is widespread in the United States but is only occasionally severe. Most problems occur in coastal regions but the disease has been rarely found in Washington. Velvet and colonial bents or redtop are most susceptible.

Control

Raise the soil pH to 6 with applications of lime. Use a balanced fertilizer. Apply a general type fungicide if needed, following label recommendations and precautions.

Nematodes (Eelworms)

Symptoms

In general nematode-infested turf lacks vigor, is often yellow or otherwise discolored, and stunted. It may become thinner, wilt, and die in irregular patches. Healthy and diseased individual plants may be intermingled. Roots may be stunted, swollen or knobby, or otherwise abnormal. The general condition resembles stressed turf suffering from fertilizer burn, hard soil, lack of water, nutrient deficiency, or some other factor. If the grass does not respond to fertilizing and watering and fungicide applications, there is the possibility that nematodes are involved. However, definite identification requires laboratory examination. If all other possible causes of trouble can be eliminated, take samples from the edge of the affected area, including soil 6–10 inches deep, and send to a nematologist for examination.

Causal Organism

One or more of at least 14 different types of nematodes (see Thorne for descriptions).

Disease Cycle

Nematodes are very small (1/8 inch long) slender roundworms which live in the soil. Most all soil contains nematodes but the majority are harmless, feeding on dead organic matter or other soil microorganisms. Those that cause disease problems do so by penetrating into roots or sucking sap from the root surface with a spear-like “hypodermic needle.” In addition to the damage they do by feeding, they cause wounds through which parasitic fungi can enter. They overwinter in the soil debris or within living roots as eggs, cysts, or larvae. As the soil warms up they become active and attack grass roots. Most have a life cycle of 20–60 days. Nematodes can move on their own (up to 2–3 feet a year), but are more rapidly spread by movement of soil such as with aerifying and similar equipment. As the surface soil dries they may move downward, so it is essential to take a deep plug for analysis.

Factors Affecting

The optimum temperature for most nematodes is between 60° to 85° F. Adequate moisture is necessary for migration through the soil. The severity of the disease depends upon the number of nematodes and climatic conditions.

Importance

Nematodes are distributed worldwide and the diseases they cause are most common in warm areas, such as the southern United States. However, recent studies indicate that they may be more common in cool climates than previously suspected. Some parasitic types have been found in western Washington but seldom in quantities large enough to be detrimental.

Control

Maintain grass in good growing condition by adequate watering, fertilizing, etc. Aerify turf areas known to contain parasitic nematodes last to help reduce the possibility of spread to other areas. If necessary, apply a nematicide according to directions from your local nematologist.

References


Pythium Blight

(Grease Spot or Cottony Blight)

Symptoms

Pythium blight may appear suddenly during hot,
Pythium low soil moisture, and a pH above 7 favor disease grasses, but susceptibility may vary with the species of the temperature decreases, with little occurring below places where hot, humid conditions occur. It is usually Control 60-68° F. Overwatering, shading, dense grass, high and are severe in the southern United States and other cent reports indicate it may be more prevalent than previously suspected. Apparently it is rare in the Pacific Northwest. These fungi can attack all types of nitrogen, low calcium, poorly drained soils, stress from and the environment is moist, the fungus can spread in just a few hours. When temperatures are high and the environment is moist, the fungus can spread extremely rapidly.

**Causal Organism**

Several species of *Pythium* or water mold fungi are responsible for these diseases. Two are most common: (1) *Pythium ultimum* Trow. Conidia usually are terminal and spherical 12~28µ; oospores are spherical and measure 14.7~18.3µ. (2) *Pythium aphanidermatum* (Edson) Fitz. Sporangia are filamentous and the oospores spherical and measure 12~25µ.

**Disease Cycle**

These fungi usually survive unfavorable conditions in infested plants or debris. The mycelium grows out from them under favorable conditions and infects adjacent plants. They may be spread by movement of diseased tissues, by drainage water, on equipment or shoes, and other means. When temperatures are high and the environment is moist, the fungus can spread in just a few hours.

**Factors Affecting**

*Pythium* thrives during hot and wet weather. Disease becomes severe at 90~95° F and decreases as the temperature decreases, with little occurring below 60~68° F. Overwatering, shading, dense grass, high nitrogen, low calcium, poorly drained soils, stress from low soil moisture, and a pH above 7 favor disease development. Repeated use of benomyl and the thiophanates has also increased susceptibility.

**Importance**

*Pythium* diseases are found throughout the world and are severe in the southern United States and other places where hot, humid conditions occur. It is usually not considered to be a problem in the North, but recent reports indicate it may be more prevalent than previously suspected. Apparently it is rare in the Pacific Northwest. These fungi can attack all types of grasses but susceptibility may vary with the species of *Pythium* and genus of the host.

**Control**

Provide good air and soil aeration and drainage. Water in the morning and as infrequently as possible. Do not overfertilize. Remove thatch. Apply fungicides as recommended in one of the general references.

**References**


**Rhizoctonia Brown Patch**

**Symptoms**

On close-cut grass (¼”) the disease seems to appear almost overnight as more or less circular light-brown patches that vary from a few inches to 3 feet or more in diameter. Often in moist weather these patches have a dark grayish-brown smoke ring, 1~2 inches wide around the edge. A light colored cobwebby mold is associated with this ring. Usually only the leaves are killed and new shoots appear as soon as the weather changes or fungicides are applied. Persistent attacks result in death of crowns and roots. On high-cut grass (1½”) the symptoms are similar but often the affected areas are larger and may lack the smoke ring. Cold-weather type: Identical symptoms have been observed recently in many of the northern states, including Washington, during cool weather. The imperfect stage is a *Rhizoctonia* but the perfect stage is apparently a *Ceratobasidium*.

**Causal Organism**

*Rhizoctonia solani* Kuhn (*Thanatephorus cucumeris* (Frank) Donk). The mycelium is tan to brown and 4~15µ in diameter, with a typical right-angled branching and a constriction at the septum; sclerotia generally dark brown, membranous, and about 2 mm in diameter. Strains of this fungus exist.

**Disease Cycle**

The fungus overwinters either as sclerotia or as mycelia in plant debris or infected plants and can begin growing as soon as conditions become favorable. Spread of the fungus is mostly by diseased fragments being carried on shoes and equipment. However, the fungus is so widespread in nature that it appears the factor limiting the extent of disease is the environment.
Factors Affecting

This is a disease of hot, humid climates. The fungus spreads slowly below 70-75° F. Very rapid infection and spread occurs when the relative humidity is high, and temperatures are over 60° F at night and 80-85° F during the day. Fortunately these combinations rarely occur in Washington. Other factors favoring brown patch are dense, lush, highly fertilized, and overwatered turf with prolonged periods of dew or free moisture on the grass.

Importance

Brown patch occurs throughout the world and is a serious disease in most of the United States. Attacks are usually of short duration (1 week) in the Pacific Northwest because the combination of hot weather and high relative humidity rarely occurs. The fungus has an extremely wide host range, attacking many other hosts as well as grasses. Bentgrasses (especially Colonial types) and annual bluegrass are more susceptible than are the coarser grasses.

Control

When environmental conditions are favorable for the disease, sweep grass in the morning to remove water from the leaf surfaces. Give grass adequate but not excessive fertilizers and water in the morning. Maintain a soil pH between 6 and 7. Provide good soil drainage. Mow regularly during the morning hours and remove clippings. Remove excess thatch and aerify if necessary. Spray with a fungicide (see EB 1133, Disease Control for Commercial Turf) if the disease persists more than a week (which rarely occurs in the Pacific Northwest). Plant resistant varieties.

Sclerotinia Dollar Spot

Symptoms

Although this disease has never been positively identified in Washington, it is included here because of its widespread occurrence elsewhere and the likelihood that it could appear under certain conditions in the state. It resembles the late stages of Fusarium patch. On bentgrass putting greens the disease appears as round, yellow to brown, later gray and somewhat sunken spots about the size of a silver dollar, which may merge producing larger irregular areas. On higher-cut (lawn-type) grass the spots may reach 4-8 inches in diameter. This disease is distinguished from most other leaf diseases by the girdling lesions on leaves. These lesions are first watersoaked and dark, as they dry they turn light tan with a reddish-brown border and can be up to an inch or more long. The lesions girdle fine-leaf grasses but may only affect the leaf margins on coarse-leaf types. Roots and crowns may be decayed under severe attacks. The fungus spreads to adjacent plants by a cobwebby mass of fine, white fungus threads that can be seen at the edges of diseased patches if dew is present.

Causal Organism

Sclerotinia homoeocarpa F.T. Bennett. Conidia and apothecia with ascospores are rarely found in nature. Therefore, most identification is based upon symptoms (especially the "bands" of diseased tissue) and the cobwebby mycelium. In laboratory cultures the mycelium is white to dark gray and small flake-like sclerotia are formed. Strains of the fungus exist.

Disease Cycle

The fungus survives unfavorable conditions as sclerotia in or on the soil and as mycelia in infected plants or debris. Mycelia from these sources penetrate the leaves when moist conditions occur. Infection can occur at 50-60° F but the maximum development takes place between 70° and 80° F. Cool nights which allow dew to form also favor the disease. The fungus is spread primarily by scattering of diseased clippings on equipment and shoes.

Factors Affecting

Most infections occur during 60-80° F humid weather. Minimum temperatures for fungal growth are 40° F, optimum 81° F, and maximum over 90° F. Dollar spot occurs most frequently on poorly maintained turf that is malnourished, underwated, and has excessive thatch. It may be more severe in seasons of low rainfall because of stress.

Importance

Dollar spot is a serious problem throughout the world. It is widespread in the United States except in the Pacific Northwest. There are no verified reports of this disease in Washington. Most types of turfgrasses can be infected, but some varieties and/or species are resistant. In general, creeping bentgrasses are more susceptible than colonial bents. See variety resistance tables.

Control

Maintain a good balanced fertilization program. Activated sewage sludge has reduced the disease more than other common sources of nitrogen. Water in the morning. Remove dew from golf greens early in the morning. Promote good air movement and high light intensity by removing trees or branches if the area is heavily shaded. Remove clippings. Provide good soil drainage. Aerify and dethatch. Use resistant varieties. Apply fungicides if necessary (see one of the general references).

References

Septoria Leaf Spot (Tip Blight)

Symptoms
The spots usually develop near the leaf tips, are gray or gray-green before fading to a pale yellow and eventually whitish gray. They can be an inch or more long. Very small brown or black fruiting bodies of the fungus are scattered in the dead area. The overall final appearance is a mass of burned leaf tips giving a scorched appearance.

Causal Organism
*Septoria tritici* Rob. ex Desm. Several species of *Septoria* may attack grasses but apparently this species is responsible for most of the damage in the Pacific Northwest. Pycnidia are immersed, globose to elliptical, black, and 80-150 μ diameter. Conidia are hyaline, filiform, 2-3 septate, typically curved, and 43-70 x 1.5-2 μ. Strains of the fungus exist.

Disease Cycle
The fungus survives unfavorable weather during winter and summer as mycelia and pycnidia (fruiting bodies) in infected plants and debris. During cool rains the spores in the pycnidia ooze out and are splashed by water or carried on equipment to healthy plants. It may be seed borne.

Factors Affecting
The fungus thrives in cool weather when ample moisture (abundant rain, heavy night dews or prolonged foggy weather) is present. Undernourished turf suffers increased damage. Hot weather retards the disease. It is also more common in unmowed turf.

Importance
Septoria leaf spot occurs worldwide on many cereals and grasses. The major grass hosts in the Pacific Northwest appear to be the bluegrasses. Fortunately, most of the good bluegrass varieties in the plots at Puyallup are resistant.

Control
Follow recommendations given for control of *Helminthosporium*. Plant a blend of bluegrasses and include at least one variety resistant to *Septoria*. Of the more common varieties the most resistant in test plots at Puyallup are listed in the table on page 28.

References

Slime Molds

The slime molds are not parasites but they do disfigure turf at times and cause alarm.

Symptoms
The fungus emerges out of the soil as a white to yellowish translucent, slimy growth of protoplasm which covers the soil and grows up on any nearby erect surfaces, whether they are grass leaves, dandelions, or fence posts. Upon reaching an aerated, lighted location the gelatinous mass rapidly becomes converted into reproductive structures. Depending on the species, these may form large numbers of pinhead-size individual gray to purplish-brown rounded spore masses (*Physarum*) or a large, irregularly rounded sponge spore mass, whitish on the surface and black within (*Mucilago*). Although the leaves are not directly attacked, they may be smothered, turning a dull gray or yellow. The overall affected area is of irregular shape and may vary from a few inches to several feet across. The slime mold usually reappears in the same area year after year, usually for 1-2 weeks.

Causal Organism
*Physarum cinereum* (Botsch) Pers. Sporangia are sessile, closely gregarious, subglobose, elongate or plasmodiocarpous, more or less calcareous, and a lilaceous gray. The spore mass is purplish brown and the spores are warted and measure 7-11 μ. *Mucilago spongiosa* (Leyss.) Morg. The outer spore mass is aethalium white or cream-colored, of variable size and shape, 1-7 cm long and half as broad. The internal spore mass is black; individual spores are exceedingly rough and measure 12-15 μ.

Disease Cycle
Slime molds survive unfavorable conditions as spores. These germinate in cool, humid weather, producing swimming spores which feed on other microorganisms and dead organic matter in the soil. Eventually they fuse and produce a mass of protoplasm (plasmodium) which sporulates under suitable conditions after it has grown to a certain size. This usually occurs in the fall, but may occur in the spring. The spores are spread easily by air currents, water, and on equipment.

Factors Affecting
Cool, humid weather stimulates spore germination and subsequent spore production. Abundant organic matter probably stimulates growth.
Importance

Slime molds are found worldwide, are fairly common, but are only occasionally troublesome. All plants may serve as supports but the fungi are most often reported on turf, perhaps because the mass of decaying leaves and thatch provide an unusually good food source.

Control

If practical, rake the area and rinse with water during dry weather (if the weather is wet, the spores will be spread and start new “infections”). Mow the grass frequently. If the problem is sufficiently disturbing, spray with any general fungicide to prevent reappearance.

Virus Diseases

Viruses are infectious particles too small to be seen with a normal light microscope, but can be viewed under an electron microscope. Although they cause serious diseases on many crop plants, it is only recently that they have been found in turfgrasses. Most of the reports emanate from the South and, as yet, none have been reported on turf in the Pacific Northwest. However, future surveys may reveal their presence. The general symptoms are a mottling or chlorosis. Viruses can be spread by various means. Some are transmitted by aphids or nematodes or just by rubbing infected plants against healthy leaves. Virus diseases reported to date are: St. Augustine decline virus and sugarcane mosaic virus (both on St. Augustine), Poa semi-latent virus (annual ryegrass, Poa and others), barley yellow dwarf virus (fescues, ryegrasses, and bluegrass), western ryegrass mosaic virus (ryegrasses and meadow fescue), oat necrotic mottle virus (bluegrass and ryegrass), bromegrass mosaic virus (bentgrasses, ryegrasses, and bluegrasses), ryegrass mosaic virus (ryegrasses, bentgrasses, bluegrasses, and meadow fescue) and aster yellows (ryegrass).

References

**Physiological and Other Miscellaneous Problems**

**Algae**

The algae on turfgrass are similar to those that produce a green scum in warm lakes toward the end of the summer. The problem is widespread but most common in the coastal areas of the Pacific Northwest. Individual algae are small, primitive, single-cell or filamentous green or bluegreen plants that manufacture their own food. In thin turf they produce a thick, slimy, greenish to blackish scum over the soil surface. The scum dries to form a tough black crust that resists water penetration and later cracks and peels. Algae occur in wet, low, shaded and compacted turfgrass areas. The grass is not killed but its growth is retarded. The best control is to maintain a thick stand of healthy, vigorous turf. Provide good surface and subsurface drainage, adequate light penetration and aeration, and aerify and remove thatch as necessary. Avoid heavy application of organic nitrogen fertilizers and when needed use sulfur (2 lbs/1000 sq. ft. yearly divided into 2 equal applications) or sulfur-containing fungicides.

**Buried Debris**

Bricks, chunks of lumber, stumps, etc., may permit the soil above them to dry out rapidly so grass dies in spots, resembling a disease. Probe and remove.

**Chemical Burn**

Chemical injury from improper use of fertilizers, herbicides, and pesticides appears as spots, streaks, or an overall scorch, usually within a few days after application. Follow directions carefully. Water after applying fertilizers. If the mistake is recognized immediately after application, try spreading activated charcoal over the area at 200 pounds per acre and water thoroughly.

**Dog Injury**

Dog injury appears as brown, rather circular spots a few inches in diameter. Suspected samples, placed in a plastic bag for a few hours, release ammonia which is easily detected by smelling. The nitrogen stimulates grass growth within a few days resulting in a ring of darker green grass around the dead spots. The urine from female dogs is reported to be stronger than that from males. Watering heavily will aid in recovery.

**Frost Injury**

Frost injury appears where people have walked or equipment has been driven over frosted grass. The turf is crushed, turns yellow to brown, and takes some time to recover.

**Moss**

Moss occurs in lawns growing in acid soils having low fertility and poor drainage. Shading, overwatering, compaction, or a combination of these also can lead to moss problems. Moss can be controlled by raking or applying ferrous ammonium sulfate or a high iron-containing fertilizer according to directions on the label. Correct the soil condition aggravating the problem and maintain a good nutritional, watering, and mowing program, see EB 0607, *Lawn Weed Control*.

**Mowing Injury**

Dull Mowers fray the grass, producing shredded yellow or bleached leaf tips. Improper Adjustment results in a clean cut by one side of the mower, and a poor cut by the other side. Scalping produces a general brown, thin, diseased-like turf. It results from lowering the cutting height too rapidly, particularly during the summer. Maintain sharp, properly adjusted mowers.

**Nutrient Deficiencies**

Yellowing. Several nutrient deficiencies can cause turf to develop a chlorotic or yellow color; however, the chief cause is usually nitrogen. Follow published recommendations in EB 0482, *Home Lawns*, and other publications for proper fertilization.

Red Leaf. Fall and early spring planted turf may develop a “red leaf” symptom that can be controlled by adding soluble nitrogen or soluble nitrogen plus phosphorus. These nutrients may be relatively unavailable due to cold soil temperatures.

**Soil Problems**

Compaction from too much traffic produces hard soil and thin turf or bare spots, particularly on
certain soil types when they are waterlogged. Aerify and reroute traffic. Poor drainage reduces root growth due to stress from lack of oxygen, disease attack, etc. Aerify and/or fill in low spots or install drain lines. Too thin soil over sand or gravel can’t hold sufficient water or nutrients, so it often results in stress and thin, yellow grass with many weeds. When in doubt, contact your county Extension agent about soil testing procedures.

**Thatch Accumulation**

Thatch is the layer of brown material formed from stems and roots which accumulates between the soil surface and the area of green grass blades. It prevents adequate wetting of the soil and fertilizer movement and provides an environment for disease organisms to thrive. Use a power rake to remove excess thatch whenever it gets more than ½ inch thick. Dethatching should take place in the early spring to allow ample recovery time. Reseeding of thin areas may be necessary.

**Watering Problems**

Both overwatering and under-watering put grass under stress but the former is probably the most serious since many pathogens thrive in the presence of high moisture. Water infrequently to a depth of 6-8 inches. Water in the morning rather than in evening to lessen danger of disease attack. Frequent light watering results in shallow grass roots, which are easily injured during periods of severe drought. Since water resources are diminishing, the use of grasses tolerant to water stress will become increasingly important.

**Winter Injury**

Winter injury results from desiccation or drying out of grass in exposed areas. Turf subjected to cold, dry winds during the winter or after snow melt is likely to suffer. Ice accumulation can smother turf, resulting in weakened plants exhibiting brown leaf tips or complete killing. Excess water followed by hard freezing can cause serious crown tissue damage. If possible, do not allow traffic on frozen turf.

**PLEASE NOTE:** The following tables list a number of turfgrass varieties with known reaction to various turfgrass diseases. The desirable variety list continues to grow, but often susceptibility to diseases has not been clearly established. It is not practical to attempt to list all varieties, especially newer ones. Varieties can be discontinued without notice, available only in specific geographic areas, or have limited seed supplies. Contact the Cooperative Extension agent in your county or knowledgeable seed company representatives about availability of seed or propagating materials. Note also that Kentucky Bluegrass is not well adapted to western Washington, Oregon and British Columbia, and not recommended as pure plantings (monoculture). Bluegrass is well adapted EAST of the Cascade mountains.
BLUEGRASS (*Poa pratensis*)—Disease Resistance and Overall Quality Rating for Western Washington and Other Areas.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Quality† overall</th>
<th>Corticium fueliforme (Laetisoria)</th>
<th>Enyloma irregular</th>
<th>Erisiphe graminis</th>
<th>Puccinia nivale</th>
<th>Puccinia recondita</th>
<th>Helminthosporium sativum</th>
<th>Helminthosporium vagans (Drechslera)</th>
<th>Low Temp</th>
<th>Basidiomycetes</th>
<th>Puccinia Leaf Ruts</th>
<th>Puccinia graminis</th>
<th>Puccinia striiformis</th>
<th>Sclerotinia homeocarpa</th>
<th>Septoria tritici (?)</th>
<th>Typhula spp.</th>
<th>Ustilago striiformis</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-34 (Bensun)</td>
<td>5 5</td>
<td>5 5</td>
<td>4 5</td>
<td>3 4</td>
<td>2 1</td>
<td>4 3</td>
<td>4 4</td>
<td>4 4</td>
<td>2 1</td>
<td>4</td>
<td>2 1</td>
<td>4 3</td>
<td>3 5</td>
<td>4 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adelphi</td>
<td>4 5</td>
<td>5 5</td>
<td>5 2</td>
<td>4 4</td>
<td>2 2</td>
<td>4 4</td>
<td>4 4</td>
<td>4 4</td>
<td>1 4</td>
<td>5</td>
<td>4 4</td>
<td>4 4</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baron</td>
<td>4 5 3</td>
<td>2 1</td>
<td>3 5</td>
<td>4 4</td>
<td>2 1</td>
<td>3 1</td>
<td>1 2</td>
<td>3 1</td>
<td>1 4</td>
<td>4</td>
<td>3 1</td>
<td>4 4</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birka</td>
<td>5 5</td>
<td>5 5</td>
<td>3 5</td>
<td>4 2</td>
<td>2 1</td>
<td>2 2</td>
<td>4 4</td>
<td>4 4</td>
<td>1 4</td>
<td>4</td>
<td>2 1</td>
<td>4 4</td>
<td>3 5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bonnieblue</td>
<td>4 5</td>
<td>5 2</td>
<td>4 5</td>
<td>4 4</td>
<td>2 2</td>
<td>3 1</td>
<td>4 4</td>
<td>4 4</td>
<td>1 4</td>
<td>4</td>
<td>3 1</td>
<td>4 4</td>
<td>3 5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brunswick</td>
<td>5 3</td>
<td>5 3</td>
<td>3 4</td>
<td>2 2</td>
<td>4 4</td>
<td>4 4</td>
<td>4 4</td>
<td>4 4</td>
<td>1 4</td>
<td>4</td>
<td>3 4</td>
<td>4 4</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheri (Golf)</td>
<td>4 5</td>
<td>5 4</td>
<td>4 3</td>
<td>4 2</td>
<td>4 3</td>
<td>4 1</td>
<td>4 1</td>
<td>4 1</td>
<td>1 4</td>
<td>4</td>
<td>3 4</td>
<td>4 4</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fylking</td>
<td>4 3</td>
<td>3 5</td>
<td>3 5</td>
<td>2 5</td>
<td>3 3</td>
<td>4 3</td>
<td>3 3</td>
<td>3 3</td>
<td>1 4</td>
<td>4</td>
<td>4 3</td>
<td>4 4</td>
<td>5 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glade</td>
<td>4 4</td>
<td>5 4</td>
<td>4 4</td>
<td>5 2</td>
<td>3 3</td>
<td>3 1</td>
<td>3 1</td>
<td>3 1</td>
<td>1 4</td>
<td>5</td>
<td>4 3</td>
<td>4 4</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Majestic</td>
<td>4 4</td>
<td>5 4</td>
<td>5 4</td>
<td>5 3</td>
<td>4 3</td>
<td>5 4</td>
<td>4 4</td>
<td>4 4</td>
<td>1 4</td>
<td>5</td>
<td>4 4</td>
<td>4 4</td>
<td>5 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merion</td>
<td>4 3</td>
<td>4 5</td>
<td>1 5</td>
<td>2 5</td>
<td>5 1</td>
<td>2 1</td>
<td>1 1</td>
<td>1 1</td>
<td>3 1</td>
<td>1</td>
<td>1 3</td>
<td>1 2</td>
<td>3 1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monopoly</td>
<td>4 5</td>
<td>5 5</td>
<td>5 4</td>
<td>2 4</td>
<td>4 3</td>
<td>3 3</td>
<td>4 4</td>
<td>4 4</td>
<td>4 4</td>
<td>4</td>
<td>4 4</td>
<td>4 4</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nugget</td>
<td>5 4</td>
<td>2 4</td>
<td>5 4</td>
<td>5 3</td>
<td>1 5</td>
<td>5 5</td>
<td>2 2</td>
<td>3 2</td>
<td>1 2</td>
<td>5</td>
<td>5 4</td>
<td>4 4</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parade</td>
<td>4 4</td>
<td>1 1</td>
<td>4 4</td>
<td>1 4</td>
<td>4 1</td>
<td>4 4</td>
<td>4 4</td>
<td>4 4</td>
<td>1 4</td>
<td>4</td>
<td>4 4</td>
<td>4 4</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rugby (KL-155)</td>
<td>4 4</td>
<td>1 5</td>
<td>1 5</td>
<td>3 4</td>
<td>4 3</td>
<td>4 4</td>
<td>4 4</td>
<td>4 4</td>
<td>4 1</td>
<td>1</td>
<td>4 4</td>
<td>4 4</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sydsport</td>
<td>5 4</td>
<td>2 5</td>
<td>5 4</td>
<td>4 2</td>
<td>1 2</td>
<td>4 2</td>
<td>2 2</td>
<td>2 5</td>
<td>1 3</td>
<td>4</td>
<td>1 4</td>
<td>4 5</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Touchdown P-142</td>
<td>4 5</td>
<td>5 5</td>
<td>4 5</td>
<td>5 3</td>
<td>4 1</td>
<td>2 3</td>
<td>3 2</td>
<td>1 2</td>
<td>4 4</td>
<td>2</td>
<td>4 4</td>
<td>4 5</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Victa</td>
<td>4 5</td>
<td>1 1</td>
<td>5 4</td>
<td>1 2</td>
<td>3 3</td>
<td>1 2</td>
<td>4 2</td>
<td>4 2</td>
<td>1 4</td>
<td>4</td>
<td>4 4</td>
<td>4 5</td>
<td>4 4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 5 = Very Resistant; 4 = Resistant; 2 = Susceptible; 1 = Very Susceptible; 3 = Average at Puyallup or Variable Reports Elsewhere.
† Rating by S. Brauen in Proc. NW Turf Conf. 1976 (5 = Best; 1 = Unacceptable).
†† Rating of plots at Puyallup.
§ Literature reports of ratings elsewhere.
### Disease Resistance Rating and Location

<table>
<thead>
<tr>
<th>Variety</th>
<th>Chewing</th>
<th>Spreading</th>
<th>Creeping</th>
<th>Hand</th>
<th>Paywall†</th>
<th>Others§</th>
<th>Paywall†</th>
<th>Others§</th>
<th>Others§</th>
<th>Others§</th>
<th>Others§</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta</td>
<td>(4)</td>
<td>(3)</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Glory)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banner</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barfalla</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biljart</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Checker</td>
<td>5</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grelo</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dawson</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Encota</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Famosa</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frida</td>
<td>5</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halifax</td>
<td>5</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highlight</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Jamestown</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Koket</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mariet</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Menuet</td>
<td>5</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Scaldis</td>
<td>4</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Sonate</td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilton</td>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wintergreen</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

* 5 = Very Resistant; 4 = Resistant; 2 = Susceptible; 1 = Very Susceptible; 3 = Average at Puyallup or Variable Reports Elsewhere.
† Rating by S. Brauen in Proc. NW Turf Conf. 1976 (5 = Best; 1 = Unacceptable).
‡‡ Rating of plots at Puyallup.
§§ Literature reports of ratings elsewhere.
**BENTGRASSES** (*Agrostis* spp.)—Disease Resistance† and Overall Quality Rating for Western Washington.

<table>
<thead>
<tr>
<th>Species</th>
<th>Corticium juceforme (Laetisaria)</th>
<th>Fusarium nivale</th>
<th>Rhizoctonia solani</th>
<th>Sclerotinia homoeocarpa</th>
<th>Ophiobolus graminis† (Gaumannomyces)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety</td>
<td>Location</td>
<td>Location</td>
<td>Location</td>
<td>Location</td>
<td>Location</td>
</tr>
<tr>
<td>Bardot</td>
<td>+</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Emerald</td>
<td>+</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Kingstown</td>
<td>+</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Nimisila</td>
<td>+</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Northland</td>
<td>+</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Novobent</td>
<td>+</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Penncross</td>
<td>+</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Tracenta</td>
<td>+</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Waukanda</td>
<td>+</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

* Most promising varieties in plots at Puyallup.
† 5 = Very Resistant; 4 = Resistant; 2 = Susceptible; 1 = Very Susceptible; 3 = Average at Puyallup or Variable Reports Elsewhere.
†† Based on natural infections in Puyallup plots.

**RYEGRASS** (*Lolium*)—Disease Resistance and Overall Quality Rating for Western Washington.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Overall Quality†</th>
<th>Corticium (Laetisaria)</th>
<th>Puccinia</th>
<th>Fusarium nivale</th>
<th>Rhizoctonia solani</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Puyallup‡</td>
<td>Other§</td>
<td>Puyallup‡</td>
<td>Other§</td>
</tr>
<tr>
<td>Birdie</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Citation</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Derby</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ensporta</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Game</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Pennfine</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Manhattan</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Yorktown</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

* 5 = Very Resistant; 4 = Resistant; 2 = Susceptible; 1 = Very Susceptible; 3 = Average for tests at Puyallup or Variable Reports Elsewhere.
† Ratings by S. Brauen in NW Turf Conf. Proc. 1976 (5 = Best; 1 = Unacceptable).
‡‡ Rating in plots at Puyallup.
§ Literature reports of ratings elsewhere.
Prevalence of Major Turfgrass Diseases in an Average Year.

<table>
<thead>
<tr>
<th>Western Washington</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Thread and Pink Patch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairy Ring (Marasmius)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fusarium Patch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drechslera (Helminthosporium) Leaf Spot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take-all Patch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puccinia Rusts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entyloma Smuts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damping Off—Seedlings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powdery Mildew</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eastern Washington</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Thread and Pink Patch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairy Ring (Marasmius)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fusarium Patch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drechslera (Helminthosporium) Leaf Spot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take-all Patch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puccinia Rusts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smuts ( Stripe)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typhula Snow Mold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damping Off—Seedlings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powdery Mildew</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Issued by Washington State University Cooperative Extension, J.O. Young, Director, and the U.S. Department of Agriculture in furtherance of the Acts of May 8 and June 30, 1914. Cooperative Extension programs and policies comply with federal and state laws and regulations on nondiscrimination regarding race, color, national origin, religion, sex, age and handicap. Trade names have been used to simplify the presentation of information. No endorsement is intended. Revised April 1985. $2.00.
Key to Selected Turfgrass Diseases

Close-Cut Turf (golf greens—bentgrasses and Poa annua)
Small (1-3"), definite brown spots, in cool, moist weather ....................... FUSARIUM PATCH
Gray to brown spots with small brown sclerotia, usually under snow .......... TYPHULA SNOW MOLD
Larger (2-8") scorched areas with pink fungus threads, in winter ...... RED THREAD AND PINK PATCH
Dead brown, later gray and ring-like spots which continue enlarging, in summer ...... TAKE-ALL PATCH

High-Cut Turf (lawns, etc.—bluegrasses, ryegrasses, fescues, and bentgrasses)
Plants Killed in Distinct Patches
Ring-like areas, grass stimulated on outside, mushrooms sometimes present ...... FAIRY RING PATCH
Ring or circular areas, no stimulation, mostly on bent in summer ................ TAKE-ALL PATCH
Ring or circular areas, no stimulation, on bluegrass in early summer or fall ...... NECROTIC RINGSPOT
Leaves Attacked but Crown Usually Alive
Indefinite brown patches ...................................................... FUSARIUM PATCH
Indefinite scorched areas with cream to red fungus threads ............. RED THREAD AND PINK PATCH
Definite gray patches with brown sclerotia, under snow .................... TYPHULA SNOW MOLD
Leaf Spots
Tan spots with reddish-brown borders, usually on bluegrasses ................. DRECHSLERA (HELMINTHOSPORIUM) LEAF SPOT
Black blisters or stripes, usually on bluegrasses ...................................... SMUT
Yellow, orange, red, or brown powdery spots on bluegrasses and ryegrasses .......... RUST
Powdery gray circular spots, usually on bluegrasses ..................................... MILDEW
1. **Corticium.** Patches of scorched leaf tips during humid weather (above photo). Cream to bright red fine fungal threads grow from leaf tips (left). Most common on fescues and rye-grasses.

2. **Entyloma Blist Smut.** Advanced stage on bluegrass. Black blisters at earlier stage of infection would be seen in island of green tissue surrounded by yellow halo. Primarily on bluegrasses.

3. **Fusarium Patch.** Indefinite patches and areas of dead grass (left). Ideal environment results in circular spots and patch of rapidly expanding patches. Most common on bentgrass for pink snow mold.

4. **Fusarium Patch.** Indefinite patches and areas of dead grass (left). Ideal environment results in circular spots and patch of rapidly expanding patches. Most common on bentgrass for pink snow mold.
ass interspersed with thin green areas (right). Note green-black margins and Poa annua. Also responsible

5 Take-all (Ophiobolus) Patch. Roughly circular doughnut-like dead spots. Circles expand annually and centers are invaded by other grasses and weeds. Only a problem on bentgrass.

6 Puccinia Rust. Turf generally becomes thin and yellow-orange to reddish-brown (below left). Oval to elongated rust pustules (right) vary from yellow-orange, reddish-brown, brown, to black, depending on species and stage of development. Common on bluegrasses.

7 Typhula Snow Mold. Grayish-white spots from several inches to 2 feet in diameter develop under snow (upper). Often reddish-brown or tan hard sclerotia present (bottom). On all types of turfgrass.

8 Drechslera (Helminthosporium) Leaf Spot and Blights. Leaf spots common symptoms. Can also affect roots and crowns, resulting in “melting-out” phase, which attacks bluegrasses and Poa annua.
**COLLETOTRICHIUM ANTHRACNOSE.** *Poa annua* showing anthracnose symptoms during winter. Summer phase on most turfgrass species irregular, thinned, blighted areas.

**USTILAGO STRIPE SMUT.** Black dusty spores and shredding drying leaves are advanced symptoms. Initially yellow-green streaks appear on leaves. Bluegrasses most commonly affected.

**PYTHIUM BLIGHT.** During hot, wet weather spots merge to form irregular tan patches or streaks. Mowers help spread disease. Attacks all turfgrasses.

**SCLEROTINIA DOLLAR SPOT.** On bentgrass putting greens appears as round yellow to brown, later gray and somewhat sunken spots about size of silver dollar. Can merge to form larger irregular areas. Girdling lesions on leaves. Not reported from the Northwest.

**POWDERY MILDEW.** White to light gray-brown powdery growth on upper surface of leaves and leaf sheaths. Later leaves turn yellow, then tan or light brown, and gradually die. Primarily on bluegrasses.

**FUSARIUM BLIGHT.** Dull tan or yellow lesions rapidly enlarged up and down leaves. Patches of affected grass first appear as 2- to 6-inch spots and expand to circular or arch-shaped streaks up to 2 or 3 feet.
15 Slime Molds. Yellowish to white translucent slimy growth covers turf but does not infect plants (above left). Convert to reproductive stage by forming gray to purplish-brown rounded spore masses (above right).

16 Septoria Leaf Spot. Very small black fruiting bodies on dead leaves help identify. Scorched overall appearance results from yellow and whitish-gray leaf tips. Bluegrass most common host.

17 Dog Injury. Rather circular brown spots later bordered by vigorous green growth.

18 Chemical Damage.

19 Mowing Injury. Frayed straw colored leaf tips from dull mower.

20 Thatch. Large irregular areas of dead turf occur in spite of attempts to water and fertilize. Thick layer of undecomposed organic matter between soil surface and green grass blades. Common problem on bent, bluegrass, and fescue lawns.