

DISEASES OF TURFGRASSES

Old reliable disease control methods—resistant species, culture and chemistry—are joined by the new kids on the block, bio-rational controls.

by Peter Landschoot, Ph.D., Pennsylvania State University

Diseases continue to be limiting factors in successfully managing quality turf. Despite the best efforts of plant pathologists, turfgrass breeders and vigilant turf managers, large numbers of lawns and golf courses are damaged by diseases each year.

While the pathogens which cause these diseases cannot be eliminated from turf, in many cases it is possible to manage them to tolerable levels. This, however, requires an understanding of the plants as well as the pathogens which parasitize them.

The first step in managing a turfgrass disease is to obtain an accurate diagnosis. While this is a straightforward task with turfgrass pests that are relatively easy to observe (weeds and insects), the pathogens which cause turf diseases are usually only visible under a microscope.

Occasionally, turfgrass pathogens produce large fruiting structures (mushrooms for example), or massive amounts of spores and mycelium which can be seen without a microscope. More often, symptoms (the expression of the plant to the disease) are used as diagnostic features.

Symptoms of turfgrass diseases can take on a variety of sizes, shapes, and colors. On individual plants they may appear as small, circular, tan-colored lesions surrounded by brown or purple halos on leaves; as a yellowing of the entire leaf blade; or as a brown or black rot of the crowns and roots.

Symptoms of leafspot on Kentucky bluegrass. Note the dark brown halos encircling the lesions. Photo courtesy of N. Jackson.

Symptoms can also be observed on populations of plants. They may take the form of circular patches, rings, or irregular areas of blighted turf.

Once an accurate diagnosis has been made, the next step is to devise a control strategy. Traditionally, disease control strategies have been grouped into four categories: cultural control; chemical control; disease-resistant species and varieties; and the newest category, bio-rationals (biological control).

Cultural controls

Cultural control measures should be the first line of defense against turf diseases. They are geared toward modifying the environment of the turfgrass stand. Cultural practices which play a role in the development of turf diseases include mowing, fertilization, liming or acidifying the soil, irrigation, thatch removal, aeration, and any other practice which modifies the turf environment.

Mowing practices have a strong influence on turfgrass diseases. Every time a mower removes leaf tissue, a wound is created through which a pathogen may enter the plant. Also, guttation fluids can accumulate at the cut leaf tip and provide a food source for some pathogens. In some cases, mowers may actually spread the pathogen from one location to another.

Mowing below the height at which the turfgrass species is best adapted can place stress on the grass and make it more susceptible to some diseases (especially during the summer months). To reduce the potential for increased disease injury, mow at the height recommended for the species



IPM: A CONCEPT FOR DISEASE MANAGEMENT

Integrated pest management (IPM) can be defined as using all available tools, including cultural practices, pesticides, resistant species and varieties, and bio-rationals, to manage pests below an economic or aesthetic threshold level.

A well-planned and executed IPM program should result in suppressing the target pest with minimal impact on non-target organisms and the environment.

An IPM program for managing turfgrass diseases begins by accurately identifying the disease. If the signs and symptoms cannot be distinguished by casual observation, a sample should be submitted to a diagnostic lab for positive identification. Some turfgrass managers have purchased microscopes to improve the precision of disease diagnosis while others have used antibody-based diagnostic kits for identifying some foliar diseases (see Shane, *LANDSCAPE MANAGEMENT*, June 1989).

Once the disease has been diagnosed, an economic or aesthetic threshold of disease injury should be established. The threshold level is the point at which further disease injury cannot be tolerated. Once this level has been reached or exceeded, control measures are warranted.

Threshold levels will vary depending on how the turf is used (golf course greens, for example, will be adversely affected by even a small amount of disease damage while considerably more disease injury can be tolerated on low maintenance turf). The site should be monitored on a regular basis to determine when the threshold level is reached.

The coordination of several management practices determines the success of an IPM program. These practices must be compatible with a sound turf management program and be practical as well as cost effective. IPM will undoubtedly become increasingly important in the future as more restrictions are placed on the use of pesticides. By adapting the IPM concept now, the effective management of turf diseases will be an easier task in the future.

—Dr. Landschoot □

you are attempting to manage. Also, maintain a sharp cutting blade to prevent leaf tissue from tearing and shredding, and refrain from mowing when the turf is under heat or drought stress.

Fertilization is an important factor in the development of turfgrass diseases.

Some pathogens favor lush, succulent leaf growth that may occur as the result of heavy applications of nitrogen fertilizer. Diseases that are favored by excessive applications of nitrogen fertilizer include leaf spot,

vegetation and the soil surface. A moderate amount of thatch can insulate the turf canopy from the soil and provide resiliency on sports turf. Too much thatch can prevent wetting of the soil and result in drought-stressed turf which is more susceptible to some diseases.

Thatch can also provide a habitat for disease organisms and bind pesticides before they reach the target pathogen. A regular thatch reduction program is essential to manage diseases.

Soil physical properties can greatly



White mycelium on turf in the early morning is a sign of the pathogen which causes dollar spot disease (*Sclerotinia homoeocarpa*).

brown patch, pythium blight, stripe smut, and the snow mold diseases.

Certain diseases are more prevalent under low fertility. Nitrogen-deficient turfgrass plants are more susceptible to dollar spot, red thread, pink patch, and the rust diseases.

The soil pH has an important role in managing at least two diseases: microdochium (fusarium) patch and take-all patch. Both diseases are serious problems on golf course turf that tend to be favored by a high pH (7.0 or above). Studies have shown that applying acidifying fertilizers (such as ammonium sulfate and ammonium chloride) or sulfur can lower the pH of the soil and suppress these diseases. This is especially important for take-all patch since it is not readily controlled by fungicides.

While irrigation is essential during the summer to prevent drought damage, it can also contribute to disease problems. Most fungal pathogens require free water to initiate the infection process. Watering at night should be avoided since it leaves a film of water on the plants for an extended period of time. Watering should be performed early in the morning during periods of disease activity.

Thatch is the tightly-bound layer of dead and living stems and roots that develops between the zone of green

affect the health and performance of turfgrasses. Soil compaction leads to poor infiltration and reduced oxygen diffusion into the root zone. Some root and crown diseases such as summer patch and anthracnose are frequently associated with compacted and poorly-drained soils on putting greens.

Aerifying compacted and wet soils allows improved rooting, thus, increased resistance to root diseases.

Chemical control of turfgrass diseases is usually accomplished by using fungicides. Turf fungicides can be divided into two broad categories: (1) contact fungicides and (2) systemic fungicides (Table 2).

Chemical controls

Contact fungicides are generally applied to the leaf and stem surfaces of turfgrasses. They do not move appreciably within the plants. Hence, these materials may be washed or mowed off the plant surfaces. Consequently, they are only effective for short durations (usually 7 to 14 days) and do not protect new foliage. These fungicides are usually used to control foliar diseases and not root/crown diseases. As a group, contact fungicides, with a broad spectrum of control, have been used extensively in the turf industry for a number of years.

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TABLE 1.
DIAGNOSTIC FEATURES ON SOME COMMON TURFGRASS DISEASES.

| DISEASE | CAUSAL AGENT(S) | SYMPTOMS/SIGNS | SUSCEPTIBLE GRASSES |
|---------------------------|--|---|---|
| Anthrachnose | Colletotrichum graminicola | Yellowing of leaf blades associated with a black crown rot. Pin cushion-like fruiting bodies with small, spiny projections can be seen with a hand lense. | Annual bluegrass, bentgrasses, and fine fescues. |
| Brown patch | Rhizoctonia solani | Large, circular brown patches or thinning of turf. On low-cut turf, patches often surrounded by dark rings. White, cottony mycelium may be present on high-cut turf in early morning. | Bentgrasses, ryegrass, tall fescue, St. Augustinegrass, and zoysiagrass. |
| Dollar spot | Lanzia spp. Moellerodiscus spp. (sclerotinia homeocarpa) | Small, bleached patches of dead grass appear in turf. Lesions on leaves are white, often with brown borders. White, cottony mycelium may be present on dew-covered turf in early morning. | All cool- and warm-season turfgrasses. |
| Fairy ring | Basidiomycete fungi | Dark-green rings become apparent in mature turf. Mushrooms often present around periphery of ring. | All cool and warm season turfgrasses. |
| Gray leaf spot | Pyricularia grisea | Oblong leaf spots that are brown or tan in the center with purple or brown halos. Severely affected plants appear scorched. | St. Augustinegrass |
| Leaf spot/melting out | Drechslera and Bipolaris spp. | Small tan lesions with purple or brown borders on leaf blades. In severe cases, the crowns are rotted and the turf may be significantly thinned. | Primarily Kentucky bluegrass. Other cool- and warm-season grasses may be affected. |
| Necrotic ring spot | Leptosphaeria korrae | Large ring-shaped patches, usually creating depressions in turf. Roots and crowns show brown or black rot. | Primarily Kentucky bluegrass. In some cases, fine fescues and annual bluegrass. |
| Powdery mildew | Erysiphe graminis | White, fluffy mycelium on leaf blades, usually present on turf growing in shaded areas. | Kentucky bluegrass and Bermudagrass. |
| Pythium blight | Pythium aphanidermatum & other Pythium spp. | Irregular patches of blighted turf. White, dense, cottony mycelium growing in turf in morning. | Perennial ryegrass, bentgrasses, tall fescue. |
| Red thread/ Pink patch | Laetisaria fuciformis/ Limonomyces roseipellis | Small red to pink patches of blighted turf. Long, slender threads of red mycelium (red thread), or fluffy, pink mycelium (pink patch) growing out of foliage. | Fine fescues, perennial ryegrass, Kentucky bluegrass. |
| Rust | Puccinia spp. | Yellowing of leaves often apparent. Brown pustules occurring on leaves and stems. | Tall fescue, perennial ryegrass, Kentucky bluegrass, zoysiagrass, and bermudagrass. |
| Slime molds | Myxomycetes | Blue or tan-colored spore-like structures on leaves. | All cool- and warm-season turfgrasses. |
| Snow mold (gray) | Typhula incarnata | Large patches of matted turf appearing at snow melt. Gray mycelium and orange resting structures often present on affected foliage. | All cool-season turfgrasses. |
| Snow mold (pink) | Microdochium nivale | Small patches of matted turf with pink or reddish color on the leaves. | All cool-season turfgrasses. |
| Spring dead spot | Leptosphaeria korrae, Ophiosphaerella herpotricha, or Gaeumannomyces graminis. | Large ring-shaped patches, often creating depressions in turf. Roots, crown and stolons show brown or black rot. | Bermudagrass |
| Stripe smut | Ustilago striiformis | Black streaks of spores along length of leaf blades. Shredding of leaf blades. | Kentucky bluegrass and bentgrass. |
| Summer patch | Magnaporthe poae | Large yellow or tan ring-shaped patches. A root and crown rot is usually apparent. | Bluegrasses and fine fescues. |

TABLE 2. GENERIC & TRADE NAMES OF THE COMMON TURFGRASS FUNGICIDES

| GENERIC NAMES | CONTACT (C) OR SYSTEMIC (S) | COMMON TRADE NAMES ¹ |
|---|-----------------------------------|--|
| Anilazine | C | Dyrene |
| Benomyl | S | Tersan 1991, Lesco Benomyl, Lebanon Benomyl |
| Cadmium chloride Cadmium sebacate + thiram + potassium chromate Cadmium succinate Chloroneb | C C + C C C | Caddy Kromad Cadminate Tersan SP, Teremec SP, Proturf Fungicide II Daconil 2787 |
| Chlorothalonil | C | |
| Ethazol (etridiazole) | C | Koban, Terrazole |
| Fenarimol Fosetyl-Al | S S | Rubigan Aliette |
| Iprodione | S | Chipco 26019, Proturf Fungicide VI |
| Mancozeb | C | Fore, Formec, Dithane F-45, Lesco Mancozeb, Manzate 200 DF |
| Maneb Maneb + zinc sulfate | C C + C | Dithane M-22 Tersan LSR, Dithane M-22 w/Zinc, Lesco 4 F w/Zinc |
| Mercury chloride Metalaxyl Metalaxyl + mancozeb | C S S + C | Calo-Clor, Calo-Gran Subdue, Proturf Pythium Control Pace |
| Pentachloronitrobenzene (quintozene) Phenylmercuric acetate Phenylmercuric acetate + thiram Propamocarb Propiconazole | C C C + C S S | Terraclor, Turfcide, Proturf FF II, Lesco PCNB PMAS Proturf Broad Spectrum Fungicide Banol Banner |
| Thiophanate-ethyl + thiram Thiophanate-methyl | S + C S | Bromosan Fungo 50, Spot-Kleen, Clearys 3336, Topsin M, Proturf Systemic Fungicide Duosan |
| Thiophanate-methyl + mancozeb Thiophanate-methyl + iprodione Thiram | S + C S + S C | Proturf Fluid Fungicide Tersan 75, Spotrete, Thiramad, Lesco Thiram |
| Triadimefon | S | Bayleton, Proturf Fungicide VII, Lebanon Turf Fungicide |
| Triadimefon + metalaxyl Triadimefon + thiram | S + S S + C | Proturf Fluid Fungicide II Proturf Fluid Fungicide III |
| Vinclozolin | S | Vorlan |
| Zineb | C | Zineb |

¹Products may be available only through specialized dealers or only in large quantity. Some products can be purchased and applied only by licensed pesticide applicators. This list is presented for information only. No endorsement is intended for products mentioned, or is criticism meant for products not mentioned.

TABLE 3.
METHODS OF DISEASE CONTROL

| DISEASE | CULTURAL | CHEMICAL | RESISTANT SPECIES/ VARIETIES |
|---------------------------|---|--|--|
| Anthracnose | Fertilize to maintain vigor, improve drainage, verify, and raise mowing height during periods of heat stress. | benomyl, chlorothalonil, mancozeb propiconazole, triadimefon | Bentgrasses are less susceptible than annual bluegrass on putting greens. |
| Brown patch | Avoid excess N in summer, increase air circulation, avoid excessive watering. | anilazine, benomyl, chlorothalonil iprodione, mancozeb, maneb thiophanates, thiram, vinclozolin | Kentucky bluegrasses are less susceptible to brown patch than other turfgrasses. |
| Dollar spot | Avoid N deficiency, maintain good soil moisture, remove guttation and dew from leaf surfaces, avoid night watering. | anilazine, benomyl*, cadmium* chlorothalonil, fenarimol, iprodione mancozeb, propiconazole thiophanates, thiram, vinclozolin | Resistant Kentucky bluegrass varieties include Adelphi, America, Aspen, Challenger, Eclipse, Escort, Nassau, Somerset, & Wabash.** |
| Fairy ring | Use clean fill during establishment, improve water infiltration, or mask symptoms with N-fertilizer or iron. | None effective, must fumigate with soil sterilant to eradicate the fungus (this will also kill grass). | No resistant species or varieties are available. |
| Grey leaf spot | Avoid excessive N fertilization and overwatering | chlorothalonil thiram | Perennial ryegrass is resistant. |
| Leaf spot/melting out | Avoid excess N applications in early spring, mow $\geq 2''$ in height, avoid light, frequent irrigation. Do not use benomyl, thiophanates, or triadimefon to control this disease. | anilazine, chlorothalonil, iprodione maneb, mancozeb, vinclozolin | Resistant Kentucky bluegrasses include: Adelphi, Bristol, Destiny, Eclipse, Enmundi, Glade, Ikone, Leberly, Majestic, Mona, P-104, Rugby, and Somerset.** |
| Necrotic ring spot | Manage turf for maximum root growth, irrigate to maintain good soil moisture, maintain mowing height at 2" or above. | benomyl, fenarimol, propiconazole | Perennial ryegrasses are resistant. |
| Powdery mildew | Reduce shade and improve air circulation. | benomyl, fenarimol, propiconazole triadimefon | Use grasses adapted to shaded areas such as fine fescues and rough bluegrass. Resistant Kentucky bluegrasses include: A-34, Glade, Touchdown, & Eclipse.** |
| Pythium blight | Improve drainage, increase air circulation, avoid excess N, reduce irrigation. | chloroneb, etridiazole, metalaxyl* phosethyl, Al propamocarb | Kentucky bluegrass is less likely to be damaged by Pythium blight than other turfgrasses. |
| Red thread/ pink patch | Maintain adequate fertility of turf (especially N), remove and destroy clippings. | alliazine, benomyl***, cadmium chlorothalonil, iprodione propiconazole, thiophanates*** triadimefon, vinclozolin | Resistant perennial ryegrasses include: Allaire, Commander, Delray, Manhattan II, Palmer, Pennant, Prelude, Regal, Regency, SR 4000, SR 4100, and Yorktown II.** |
| Rust diseases | Avoid N-deficiency and drought-stress (especially in late summer/early fall) | maneb, mancozeb, fenarimol propiconazole, triadimefon | Some resistant Kentucky bluegrasses include: Kenblue, Parade, Rugby, A-34, and Classic**. |
| Slime molds | Remove spores by spraying water on leaves or brushing turf. | None required. | Not applicable since grasses are not infected. |
| Snow molds: | | | |
| Gray snow mold | Avoid excess N in fall before grass goes dormant, mow until top growth ceases in fall, prevent accumulation of snow in sensitive areas, rake up mats (patches) in spring to speed recovery. | Fungicides should be applied in late fall before snow cover. cadmium chloroneb fenarimol iprodione mercury fungicides PCNB thiophanates thiram triadimefon vinclozolin | Some resistant Kentucky bluegrasses include: Adelphi, Aspen, Enmundi, Plush, and Vantage**. |
| Pink snow mold | (Same as for gray snow mold) | benomyl, fenarimol, iprodione mancozeb, mercury, fungicides PCNB, thiophanates, thiram vinclozolin | Most fine fescues and Kentucky bluegrasses are moderately resistant to this disease. |
| Spring dead spot | Avoid low mowing heights, thatch, compaction, and excessive N fertility. | benomyl, fenarimol, propiconazole | Use grasses other than bermudagrass where this disease is a problem. |
| Stripe smut | Avoid excess N in early spring, avoid drought stress in early summer. | Apply fungicides in early spring or late fall, water-in for good root uptake. Benomyl, fenarimol propiconazole, thiophanates triadimefon | Ryegrasses, tall fescues, and the fine fescues are less susceptible to this disease than Kentucky bluegrass. |
| Summer patch | Avoid low mowing heights, reduce compaction, avoid overwatering in summer, and improve drainage. | benomyl, fenarimol, propiconazole thiophanates, triadimefon | Resistant Kentucky bluegrasses include Adelphi, Enmundi, Sydsport, and Touchdown. |

* Resistance has been recorded.

** Based on National Turfgrass Evaluation Program and Penn State data. No endorsement of cultivars is intended for those mentioned, or is criticism meant for cultivars not mentioned. *** Controls red thread and not pink patch.

for a number of years.

Systemic fungicides are a newer group of chemicals which are absorbed and translocated within the plant. Thus, they are not as likely to be removed from the plant by rainfall and mowing. Systemics may protect the plants for a period of two to four weeks and will protect new growth.

Most systemic fungicides will control both foliar and root/crown pathogens. When attempting to control root/crown pathogens, systemic compounds should be watered into the

rootzone for maximum effectiveness.

In general, systemic fungicides tend to have a specific mode of action, thus, they do not have as broad of a spectrum of control as contact fungicides.

Although fungicides are an effective management tool for many turf diseases, they have some drawbacks as well. In some cases, certain fungicides have been shown to promote turf diseases. One notable example involves an increase in leaf spot severity when benomyl or tri-

adimefon is used.

Another potential problem associated with fungicide use is fungicide resistance. Fungi can become tolerant to fungicides when used in succession for long periods. Thus far, resistance has occurred in populations of several common turfgrass pathogens.

To prevent resistance from occurring, fungicides should be periodically alternated or used in mixtures with compounds possessing different modes of action.

Perhaps the primary reason for fungicide failure, however, is using the wrong fungicide because of a misdiagnosed disease.

CALENDAR

COMMON DISEASES OF COOL-SEASON TURF

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | |
|------------|-----|-----|-----------------------|----------------|-----|-----|-----|-----------------------|-----|------------|-----|--|
| | | | Anthraxnose | | | | | | | | | |
| | | | | Brown Patch | | | | | | | | |
| | | | | Dollar Spot | | | | | | | | |
| | | | Leaf Spot Melting Out | | | | | | | | | |
| | | | Necrotic Ring Spot | | | | | Necrotic Ring Spot | | | | |
| | | | | Pythium Blight | | | | | | | | |
| | | | Red Thread/Pink Patch | | | | | Red Thread/Pink Patch | | | | |
| | | | | Rust | | | | | | | | |
| Snow Molds | | | | | | | | | | Snow Molds | | |
| | | | | Stripe Smut | | | | | | | | |
| | | | | Summer Patch | | | | | | | | |

COMMON DISEASES OF WARM-SEASON TURF

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | |
|-----|-----|-----|------------------|-----|-----|-----|-----|----------------|-----|-----|-----|--|
| | | | Brown Patch | | | | | | | | | |
| | | | Dollar Spot | | | | | Dollar Spot | | | | |
| | | | Leaf Spots | | | | | | | | | |
| | | | Pythium Blight | | | | | Pythium Blight | | | | |
| | | | Rust | | | | | | | | | |
| | | | Spring Dead Spot | | | | | | | | | |

Species selection

The third means of managing turfgrass diseases is by using disease-resistant species and varieties. While turfgrass breeders have made tremendous strides in developing grasses with improved disease resistance, no turfgrass is resistant to all diseases.

One way to increase the overall resistance of the turf stand is to plant mixtures of different grass species and/or blends of cultivars of an individual species. If one cultivar or species is damaged by a disease, the others will hopefully fill the voids left by its demise.

Bio-rational control

Using bio-rationals for controlling turfgrass diseases is relatively new. The most active area of research involves using organic fertilizers for disease suppression.

These products are thought to stimulate the development of microorganisms which antagonize turfgrass pathogens. Studies in some areas of the country have shown success with these compounds; however, further testing is required to substantiate their value in the consistent control of turfgrass diseases. **LM**



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