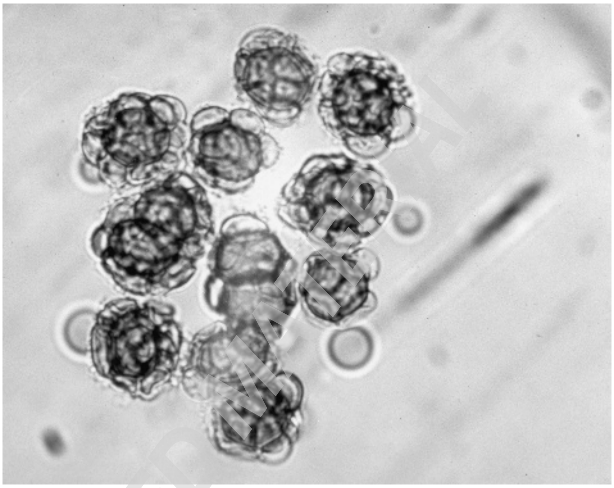
CHAPTER 1

Introduction to Turfgrass Diseases



CAUSES OF TURFGRASS DISEASES

There are five groups of organisms that cause plant diseases—fungi, bacteria, viruses, nematodes, and mycoplasma. Fungi are the most important cause of turfgrass diseases; they are followed in importance by the nematodes and the viruses. There is only one major viral disease of turfgrass, St. Augustine decline, and one major bacterial disease, bacterial wilt.

A disease is an abnormality in structure or function that is caused by an infectious agent and that injures the plant or destroys its aesthetic value. Diseases are sometimes classified in two categories, infectious and noninfectious (or physiological), but I prefer to consider noninfectious diseases as injuries. Injury is damage to a plant that is caused by a noninfectious agent that harms the plant or destroys its aesthetic value. Damage resulting from hail, lightning, nutrient deficiencies, and fertilizer or pesticide burn are examples of noninfectious plant injury.

A pathogen is an agent that causes a disease. Most pathogens are parasites as well. A parasite is an organism that obtains some or all of its nutrients from a living host. (The organism on which a parasite lives is called its host). Some pathogens are obligate parasites; they can obtain their nutrients only from a live host or living tissue. Rusts, powdery mildews, and all viruses are obligate parasites. Organisms that live only on dead organic matter are called saprophytes (slime molds are an example). Organisms that are mostly parasitic but that can, under certain conditions, live as saprophytes are called facultative saprophytes (for example, *Typhula, Rutstroma,* and *Drechslera*). Organisms that live most of the time as saprophytes but that can, on occasion, become parasites are called facultative parasites (for example, *Rhizoctonia* and *Pythium*). Table 1.1 shows the classification of some organisms that are known to cause diseases in turfgrass, and Figures 1.1 and 1.2 illustrate the developmental stages of the facultative saprophyte *Drechslera* spp.

For disease to occur, three conditions are necessary: a susceptible host, a virulent pathogen, and a favorable environment. These three conditions in combination are called the plant disease triangle. If any one of them is missing, disease will not develop.

The disease process usually involves four steps—infection, incubation, symptom development, and inoculum production. Infection is the process by which a disease-producing organism (pathogen) enters the plant. Incubation is the period during which the pathogen inhabits its host without producing visible symptoms. The interaction between the pathogen and its host results in symptom development. Inoculum production is the process whereby the pathogen reproduces propagules for spread and survival. The inoculum can be simply the spore of a fungus, or it can be the entire organism, as it is in the case of a virus or a bacterium.

Table 1.1. A Classification of Organisms That Cause Turfgrass Diseases Based on Life Cycles

Obligate Parasites	Facultative Saprophytes	Facultative Parasites	Saprophytes
Erysiphe graminis	*Bipolaris sorokiniana*	*Colletotrichum graminicola*	Fairy rings*
Parasitic nematodes	*Drechslera poae*	*Gaeumannomyces graminis*	*Mucilago crustacea*
Puccinia spp.	*Gloeocercospora sorghi*	*Leptosphaeria korrae*	*Physarum cinereum*
St. Augustine decline virus	*Laetisaria fuciformis*	*Pythium aphanidermatum*	
	Limonomyces roseipellis	*Rhizoctonia solani*	
	Microdochium nivale	*Xanthomonas campestris*	
	Pyricularia grisea		
	Sclerophthora macrospora		
	Rutstromea floccosum		
	Typhula spp.		
	Ustilago striiformis		

*Mild infection may occur.

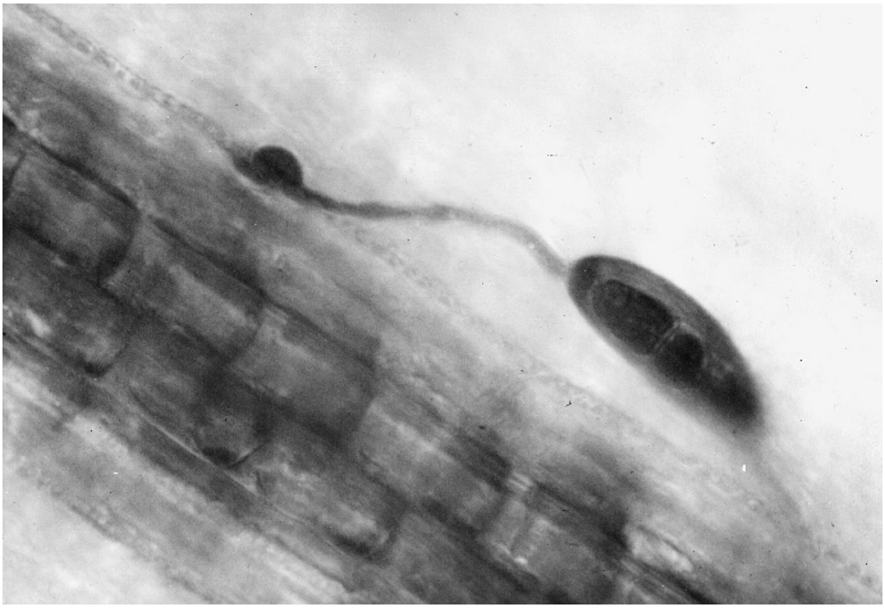


Figure 1.1. A *Drechslera poae* spore on a fescue leaf with germ tube that has produced an appressorium. A penetration peg will be produced by the appressorium, which will infect the leaf.

IMPORTANCE OF TURFGRASS DISEASES

Disease plays a major role in determining the success or failure of a turfgrass stand. It is often the most important single factor limiting the successful growth of a cultivar or species, a fact that you must keep in mind when selecting a turfgrass species or cultivar. For example, spring dead spot (SDS) on bermudagrass limits its widespread use as a fairway grass, especially in the northern regions of the warm-season grassbelt; St. Augustine decline (SAD), a viral disease, has eliminated St. Augustinegrass as a desirable turfgrass in many areas; and necrotic ring spot, summer patch, and stripe smut have made it impractical to plant Kentucky bluegrass cultivars like Merion, Windsor, and Fylking. The best-textured, nicest-colored, and fastest-germinating grass, if susceptible to a major pathogen, will turn into the worst-looking and poorest-colored grass imaginable when it becomes decimated by disease, and you will wish it hadn't germinated at all.

Turfgrass diseases caused by fungi are of great economic importance. It is difficult to get exact figures on dollars spent controlling turfgrass diseases, but the turfgrass industry spent 80 million dollars on

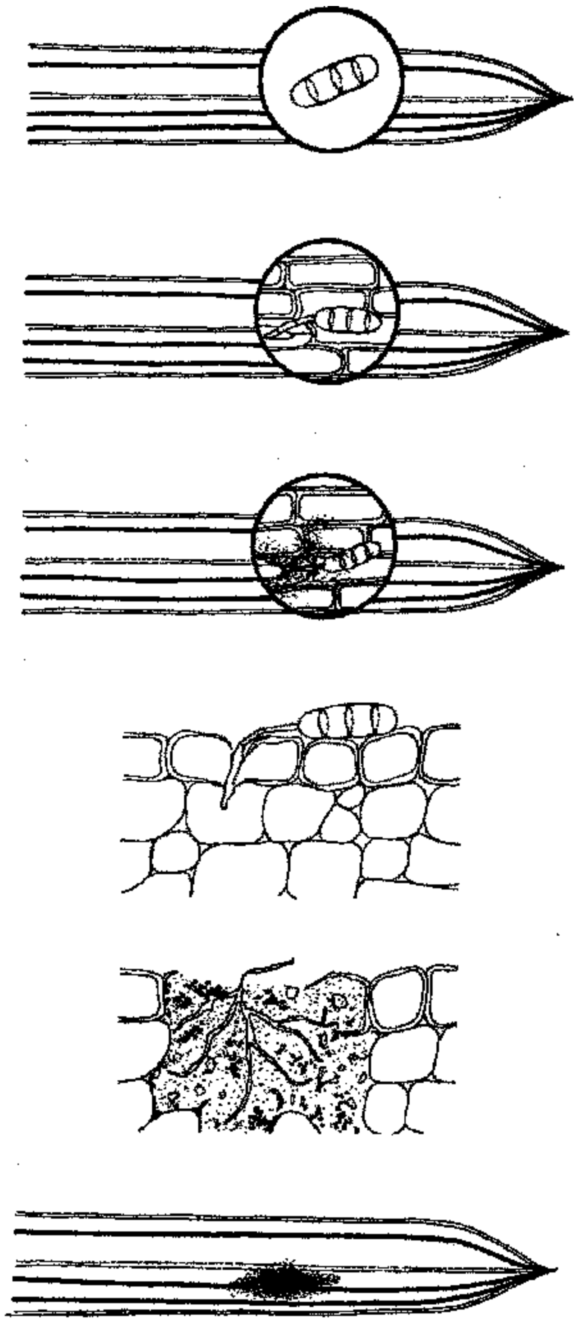


Figure 1.2. Germination of a *Drechslera* spore and subsequent penetration, incubation, and development of symptoms on a turfgrass blade.

fungicides in 1988. More fungicides are used on turfgrass than on any other single crop in the United States.

IDENTIFYING TURFGRASS DISEASES

A little knowledge is said to be a dangerous thing—and it is! It often happens that samples of dead or dying grass are collected and mailed, with little background information, to a diagnostic laboratory. At the laboratory, disease organisms are isolated from the plant material and a diagnosis is made. Under such circumstances a disease may be diagnosed as ‘‘Helminth’’ or as necrotic ring spot, when it is neither. Or what appear to be black *Helminthosporium* lesions are observed on dying turf, and it is assumed that *Helminthosporium* is causing the problem, which may or may not be the case. It would be difficult to find a patch of Kentucky bluegrass in the spring that didn't have *Helminthosporium* lesions, but does that mean this organism is causing the problem? Maybe. Before you jump to conclusions, look at the other symptoms in the area. Ask questions such as: Were there many black lesions? Were they large? Did the grass show a general, all-over thinning? If the answers are yes, then *Helminthosporium* is probably the cause. Were ‘‘frog-eye’’ patterns present? Was there evidence of wilt inside the frog-eyes? Did hillsides and southern exposures get the disease first and most severely? When wilting occurred, did syringing seem to help? If the answer to all of these questions is yes, then it is likely that necrotic ring spot is the problem.

Koch's Postulates

Koch's postulates provide a basis for establishing the cause of a disease:

1. **Association**—The organism suspected of causing the disease must always be present when the disease occurs.
2. **Isolation**—It must be possible to isolate the suspect organism and grow it in a pure culture (except in the case of obligate parasites).
3. **Inoculation**—When a disease-free host is inoculated with the organism, it must exhibit the same symptoms observed when the disease occurs spontaneously.
4. **Reisolation and comparison**—When the organism suspected of causing the disease is reisolated from the inoculated plants, grown in a pure culture, and then compared with the first organism isolated, the two organisms must be identical.

It is important to satisfy all of Koch's postulates when identifying the causal organism of a disease. A good example of what can happen when all the steps of Koch's postulates are not followed is the case of *Fusarium* blight. The causal organisms of this disease were determined to be *Fusarium roseum* and *F. tricinctum,* based on isolations from the field and greenhouse inoculations that produced foliar lesions on Kentucky bluegrass. The researchers failed to demonstrate frog-eye symptoms, and therefore never completed steps 3 and 4 of Koch's postulates. This led to many years of confusion in understanding the epidemiology and management of this disease. It wasn't until many years later when researchers began to reexamine the disease that the true causal agents were found, *Magnaporthe poae* and *Leptosphaeria korrae,* and the disease was renamed from *Fusarium* blight to summer patch and necrotic ring spot, respectively. Yes, these fungi did produce frog-eye patterns in both the laboratory and the field when the correct pathogens were used for inoculations.

Taking Samples

When you take samples of diseased grass, follow these instructions:

1. Look for an area that has just begun to show symptoms. Older areas may be contaminated with saprophytic organisms living on the dead tissue.
2. Take a large enough sample. You need at least a 6 in. (15 cm) plug, not just a couple of leaves. Include the root system of the plant in your sample.
3. If the sample is to be mailed, wrap it in paper. Never put it in a plastic bag, because the saprophytic fungi, bacteria, and nematodes will turn the sample to mush before it gets to its destination. The one exception is soil samples for nematode analysis, which should be placed in a plastic bag to keep them from drying out. Samples should be packed tightly and mailed immediately after they are taken and early in the week, so that they don't sit in the post office over the weekend.

Include the following information with your samples:

1. Species and cultivar of turfgrass
2. Age of the grass stand
3. Symptoms (wilt, yellowing, stunting, leaf spots, thinning, etc.)
   a. Initial symptoms
   b. Current symptoms
   c. Pattern of symptoms on the grass stand

4. Prevalence of the disease (a few spots, large areas, all greens, one green, etc.)
5. Severity of the disease (moderate, severe)
6. Location of the disease (high spots, low spots, edges of greens, near house, under tree, etc.)
7. Soil type (clay, sand, loam, heavy soil, etc.)
8. Recent treatments
   a. Fertilizer (date of last application, amount, and type)
   b. Pesticides (not just fungicides) applied in last month
   c. Cultivation (give dates)
      (1) Coring (aerifying)
      (2) Spiking
      (3) Vertical mowing
9. Weather
   a. Just before symptoms developed
   b. At the time symptoms developed
10. Date the problem was first observed

Interpreting Research

It is often difficult for laypersons to interpret the data supplied by researchers. The researcher may tell only half the story or may not relate laboratory findings to what actually happens in the field. For example, Fylking is still reported to be resistant to melting-out, which it is, and which sounds good because melting-out is a major disease. But if the researcher fails to mention that Fylking is susceptible to necrotic ring spot (see Figure 1.3) and summer patch—as a matter of fact, so susceptible that either of these diseases has the potential to completely destroy the Fylking turf in a matter of a few years—you will be surprised and disappointed when your stand of grass becomes decimated, yet I have seen this happen. Sometimes, after expounding a variety's good points for ten minutes, a scientist will end by saying, "Of course, it has some other problems" or "It is, of course, susceptible to summer patch." Unless you know how susceptible it is to summer patch or how serious a disease summer patch is, you will probably plant it, thinking, "Well, it only has one problem, as compared with so many good points." It would be like buying a car that was perfect except for a defective motor. In both cases you waste a lot of money on something that won't work.

The same thing happens with data on disease. Researchers have published results and given talks stating that Kentucky bluegrass is more susceptible to rust, "Helminth," and red thread at high nitrogen levels than at low levels. This is true, too—in the greenhouse or laboratory,

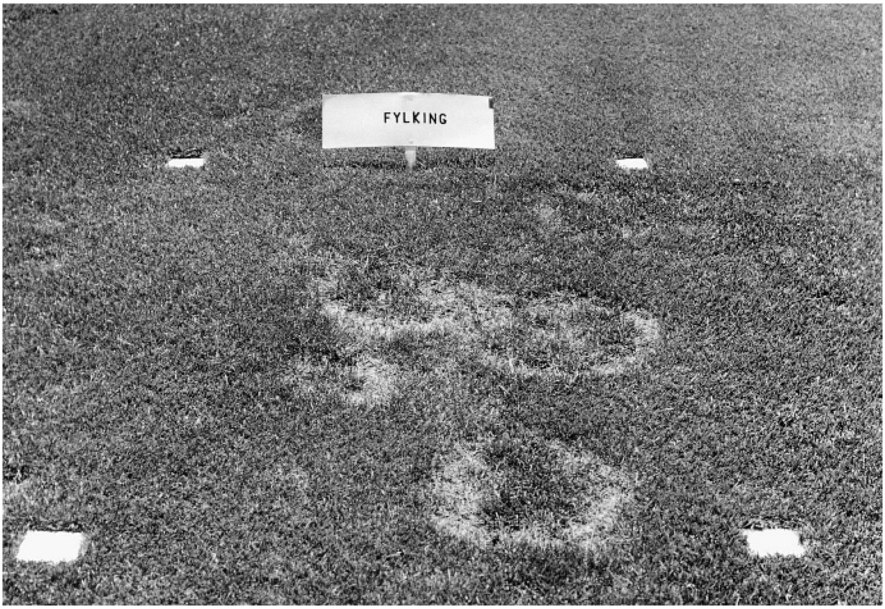


Figure 1.3. Necrotic ring spot in Fylking Kentucky bluegrass.

where grass is grown in pots, fertilized, and artificially inoculated, and where readings are taken before the grass is mowed or clipped. But in the field, nitrogen can help control Helminth, rust, and red thread on Kentucky bluegrass. The difference is that in the field the grass is mowed at least once a week. Because rust, Helminth, and red thread take 10 to 14 days to develop after the grass is infected, and all are foliar pathogens, weekly mowing will ensure that the infection is mowed off before the disease develops. Such laboratory data do increase our understanding of the disease, but they belong in scientific journals and at scientific meetings, not in journals read by laypeople and not at turfgrass conferences and other grower meetings. Why explain laboratory results to a person whose livelihood is growing grass in the field, if what happens in the laboratory has no correlation with what happens in the field? Be wary of laboratory data that are not accompanied by good field data.

This brings up another point. Each year new ideas come forth; some with good data to back them up, others with no supporting data, or one year's experimental results, or merely some random observations. Before you rush headlong into trying a new product or cultural practice that may cost you your job, ask to see the data. If you have trouble understanding the data, ask your local turf expert for an evaluation. If a cultural practice or chemical control can possibly result in the loss of turf, try it on a small area first to see how it works under your conditions, regardless of the advice you have been given. Try thinking for yourself!

DISEASE MANAGEMENT

The word *management* is used in this book in preference to the word *control.* Control implies the eradication of a disease problem. In reality, however, the problem will occur season after season or recur many times during a single growing season. Therefore, diseases actually are managed rather than controlled, and an approach that stresses management should prove more realistic and useful to the turfgrass manager than one that assumes complete control is possible.

Too often turfgrass pathologists have dealt with single diseases as though they occur in a vacuum. Too often chemical and cultural recommendations or cultivar selections are based on consideration of only one disease. A single species or cultivar may be attacked by many diseases throughout the growing season, and therefore the total picture must be evaluated. Recommendations in regard to cultivars, cultural practices, and chemical agents must reflect a knowledge of all the diseases that can occur in a given species or cultivar throughout the season.

Plant pathologists may also talk about diseases as though they occur on just any green vegetation. Diseases attack specific grass species or, in some cases, specific cultivars. Turfgrass diseases should be thought of in relation to the specific cultivars or species they afflict.

Strategies for dealing with turfgrass diseases include planting cultivars that are resistant to the major diseases, and employing appropriate cultural practices and fungicide programs. Chapters 11 and 12 discuss such strategies.