AN INDEPENDENT NEWSLETTER FOR TURF MANAGERS

Turf Grass TRENDS

Volume 3, Issue 4

April 1994

Dreschlera and Pyrenophora: leaf-spotting diseases

by Dr. Eric B. Nelson

The names of the agents of leaf-spotting diseases have changed over the years but the diseases themselves remain among the more serious: leaf-, crown-, and root-rotting diseases affecting cool-season turfgrasses world-wide. Among the most important diseases caused by members of this group are: "leaf spotting" and "melting out" of Kentucky bluegrass caused by *Dreschlera poae*. There are also: "leaf spot," "leaf blight" and "foot rot" of perennial ryegrass caused by *Dreschlera siccans*. Finally, "net blotch" and "leaf blight" of perennial ryegrass and tall fescue are caused by

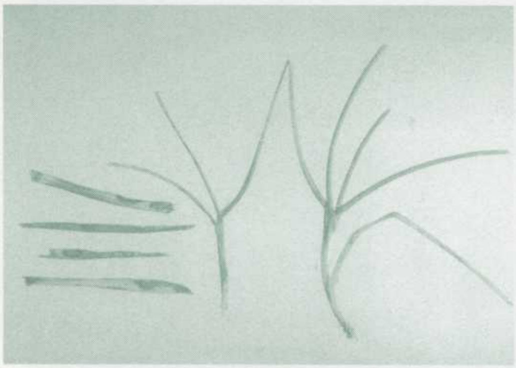


Photo provided by Dr. Eric B. Nelson, Cornell University
Leaf spot on Kentucky bluegrass

Pyrenophora dictyoides, and "red leaf spot" of creeping bentgrass is caused by *Pyrenophora erythrospila*. (See Table 1 on page 2.)

These diseases, caused by the important fungal genera *Dreschlera* and *Pyrenophora*, were previously known as the 'Helminthosporium' diseases of turfgrasses. The *Dreschlera* and *Pyrenophora* species share nearly all of the same identifying characters used by taxonomists to distinguish between fungal species. So many characteristics, in fact, that some species of *Pyrenophora* were formerly misclassified as *Dreschlera* species. The main difference between the two genera is that species of *Pyrenophora* possess reproductive properties not found in *Dreschlera.*

All these pathogens share the common properties of requiring prolonged leaf wetness and cool temperatures for infection. Only *D. erythrospila* and *D. gigantea* require warm temperatures for optimum disease development. Additionally, all of these pathogens can infect leaf, crown, and root tissues, depending on how advanced the disease becomes and on environmental conditions.

Despite expressing themselves as multiple diseases across the spectrum of cool-season turfgrass species, many of the *Dreschlera* and *Pyrenophora* species will only infect specific turfgrass species. Although symptoms are quite similar, regardless of the grass species infected, subtle differences do exist in disease expression

Photo provided by Dr. Eric B. Nelson, Cornell University
Leaf spot on Kentucky bluegrass

that often allow for accurate field diagnoses. However, the only definitive diagnosis of diseases caused by these pathogens is by microscopic observation and comparison of the sizes and shapes of the spores produced on and in leaf, crown, rhizome, and root lesions. Various aspects of each of the most important diseases are detailed below.

IN THIS ISSUE

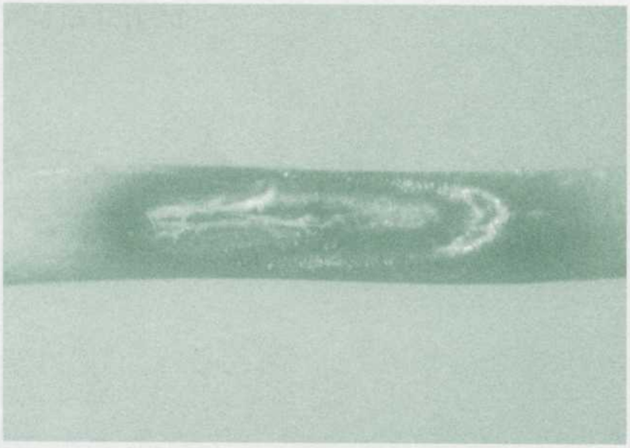


Photo provided by Dr. Eric B. Nelson, Cornell University
Leaf spot on Kentucky bluegrass

Leaf spot and melting-out of Kentucky bluegrass

The symptoms: The most conspicuous leaf-spotting symptoms of this disease can be found in the early spring through early summer and in the autumn through early winter. The margins of the small (about 1 mm diameter) lesions appear purplish-black to reddish-brown with white to tan centers. See photos on page 1.) As the lesions increase in size and number, usually along the longitudinal axis of the leaf, the leaf blades begin to yellow then gradually become extensively blighted. As the disease progresses, the crowns, roots, and finally the rhizomes become infected, resulting in a blackish to reddish-brown appearance on the rotted tissues. (See adjacent photos.)

Once root and crown infections occur, large areas of turf may rapidly die in a patch-like pattern. This phase of the disease is known as the "melting out". Melting out is generally more common when previously infected plants are stressed during warm, dry periods or in extensive periods of leaf wetness following warm, dry periods. It is during this phase of the disease that severe wilting and foliage drop can occur. In highly symptomatic turfgrass areas, particularly on closely-mown turf, symptoms may appear as small discolored patches, where leaf and stem lesions are more

Photo provided by Dr. Eric B. Nelson, Cornell University
Melting-out symtoms on Kentucky bluegrass

Table 1

Diseases caused by *Dreschlera* and *Pyrenophora* in cool-season turfgrasses

Pathogen	Host turfgrass	Seedborne	Disease
Dreschlera species			
D. biseptata	Fescues	No	Leaf spot
D. catenaria	All cool-season grasses	Yes	Leaf blight, Crown rot
D. dematioidea	Bentgrasses	Yes	Leaf spot
D. fugax	Bentgrasses	No	Leaf mold
D. gigantea	Bentgrasses	No	Zonate leaf spot
D. noblea	Ryegrasses	Yes	Leaf spot
D. poae	Bluegrasses	No	Leaf spot, Melting-out
D. siccans	Ryegrasses, Fescues	Yes	Brown blight, Foot rot
D. triseptata	Bentgrasses	No	Leaf spot
Pyrenophora species			
P. dictyoides	Ryegrasses, Fescues	Yes	Net blotch, Leaf blight
P. erythrospila	Bentgrasses	Yes	Red leaf spot, Leaf blight
P. tritici-repens	Bentgrasses	Yes	Leaf spot, Leaf blight

readily apparent.

The pathogen: The causal agent of this wide spread disease is *Dreschlera poae.* This and other species of *Dreschlera* are characterized by the production of abundant dark-brown multi-cellular spores called conidia within leaf lesions and on other diseased tissues. (See photo above.) These conidia are the primary means of plant infection early in the spring, when each of the 4-5 cells of the conidium can germinate and infect susceptible tissues if the surfaces of the leaves remain wet for prolonged periods. Once formed, these conidia are easily spread by wind, rain, irrigation, traffic or grass clippings.

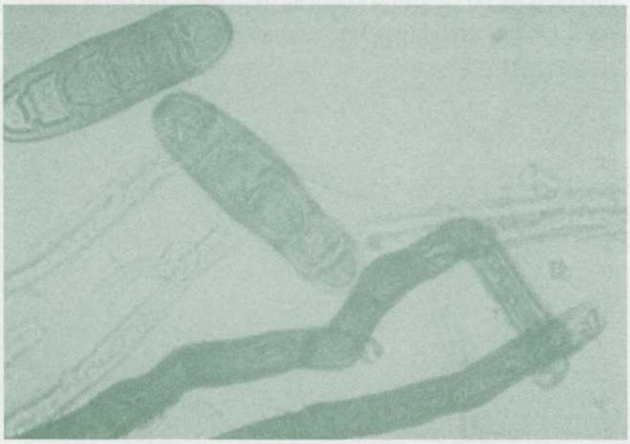


Photo provided by Dr. Eric B. Nelson, Cornell University

Dreschlera conidia

Under optimal wet, cool and humid conditions, the conidia can germinate on a susceptible grass blade within a matter of minutes while successful infection of the plant tissues generally requires at least 10 hours. Germinated conidia give rise to dark-brown mycelium easily observed with a microscopic examination of infected plant tissues.

Table 2

Kentucky bluegrass varieties with resistance to *Dreschlera poae.*

Excellent to very good resistance	Good to moderate resistance
Able 1	Adelphi
Bonnieblue	America
Blacksburg	Aspen
Bristol	Banff
Challenger	Baron
Chateau	Estate
Columbia	Fylking
Eclipse	Glade
Emmundi	Merit
Midnight	Mystic
Nassau	Touchdown
Princeton	

Disease development: The pathogen is commonly seed-borne on susceptible Kentucky bluegrass varieties. Nearly all infected seeds give rise to infected plants. The fungus will also grow on dead and decaying leaves and in thatch layers where abundant conidia may be produced. Under moist, cool (50 - 60 F), overcast or foggy conditions, typical of early spring or in shaded areas of a turf site where leaf wetness is a consistent problem, infection levels are often highest leading to most of the leaf destruction that occurs. In large areas of severely-infected plants, the turf may appear yellow to brown by early to mid April.

The disease quickly progresses from the leaf sheaths and leaves to the crowns and rhizomes. Conidial dispersal begins as soon as leaves begin to grow and with the first mowing. Peak conidial release generally coincides with the periods of maximum number of leaf spotting lesions, since each lesion is where the new batch of conidia are produced. Mowing has been shown to be of primary importance in the dispersal of conidia, either by movement on equipment and operators or by dispersal of the clippings over areas of uninfected turf. Strong air movements will dislodge conidia from lesions and blow them to adjacent areas. Rain and irrigation will also spread conidia from an infected area to adjacent healthy turfgrass by splashing of water droplets.

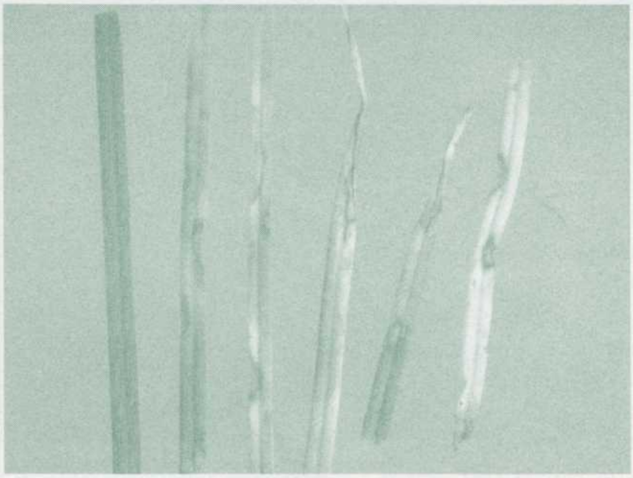


Photo provided by Dr. Eric B. Nelson, Cornell University

Leaf blade chlorosis and lesions on perennial ryegrass

A number of cultural factors may further intensify symptoms. Maintaining infected turf at a short cutting height enhances both the leaf spot and melting-out symptoms of the disease since the shortened leaf blade will show symptoms faster than taller-cut turf. Over-fertilization causing rapid leaf cell elongation will increase both the leaf-spotting and melting-out phases of the disease by making the elongated cells more vulnerable to the infection process. Applications of sterol-inhibiting fungicides, like Bayleton, and growth stimulating hormonal type herbicides, like 2,4-D, will often exacerbate symptoms.

Control:

- Maintain balanced fertility. Avoid over-stimulation of early growth in the spring when maximum spore production and dispersal increase the chances of plant infection. Use dormant fertilization practices and slow release fertilizers or supplemental iron applications in lieu of nitrogen fertilizers.
- Avoiding irrigation late in the day. Morning irrigation allows the turfgrass canopy to dry during the day, thus reducing the time the leaves remain wet which, in turn, will reduce the the successful infection of plant tissues by germinated conidia.
- Modify the surrounding landscape to increase the air movement, lower the humidity, and reduce the amount of shade.
- Maintain optimum mowing heights for the cultivar of choice. Kentucky bluegrass and fine fescue turf used on home lawns should be maintained at a 2-3 inch mowing height.
- Avoid the overuse of sterol-inhibiting fungicides and hormonal herbicides when symptoms are apparent.

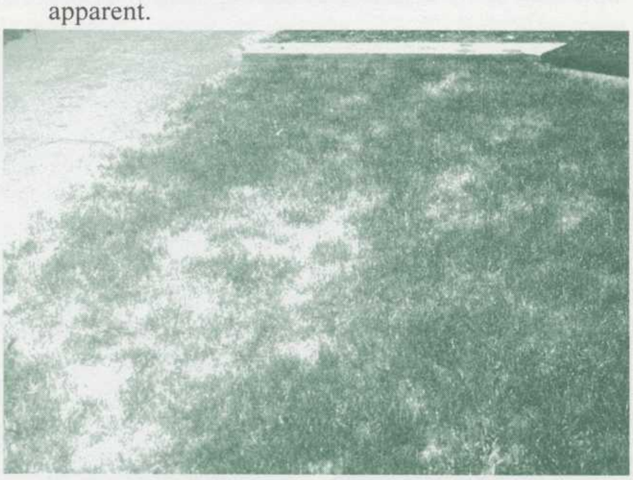


Photo provided by Dr. Eric B. Nelson, Cornell University

Melting-out symptoms on perennial ryegrass

- Maintain thatch layer at one-half inch or less. If mechanical thatch removal is warranted, it should not be done during maximum infection periods.
- Many Kentucky bluegrass cultivars have been bred for resistance to this disease. (See Table 2 on page 3.) These cultivars should be used whenever possible.
- As a last resort, apply contact fungicides such as chlorothalonil, mancozeb, or iprodione to reduce symptoms and sporulation of the fungus.

Brown blight and foot rot of perennial ryegrass

Symptoms: Historically, this disease has been considered of minor importance. However, increases in the incidence of this disease have accompanied the rapid increases in the use of perennial ryegrass on golf courses and on home lawns in the last 15 years. Because this has only become a significant disease lately, little research has been done on this disease in turfgrasses to date.

Symptoms typically appear in the spring and in the autumn months. Leaves of perennial ryegrass may be infected in the seedling stage as they develop from infected seed. On mature plants, leaves may become infected as they emerge from sheaths in the early spring. Leaf spots, with grayish-white centers and a brown border, will develop on leaf blades, often causing a leaf blade chlorosis adjacent to the lesion. (See photo on page 3, right.) Under excessively wet conditions, entire tillers may be killed.

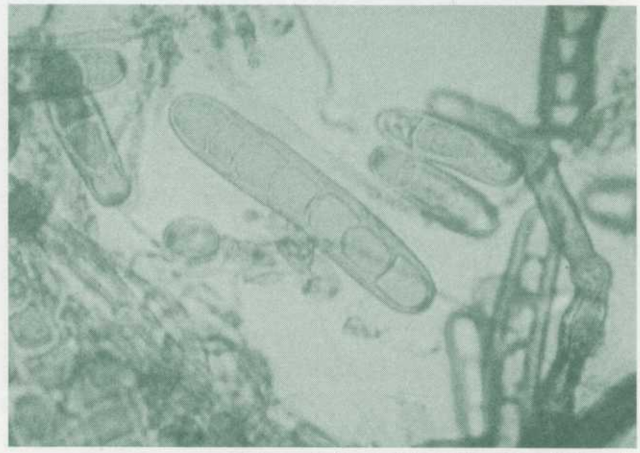


Photo provided by Dr. Eric B. Nelson, Cornell University

Dreshlera siccans conidia

Multiple infections of leaves may occur resulting in massive numbers of small chocolate-brown spots which may become so numerous that the entire blade becomes chlorotic and is killed. As the disease progresses, melting-out-like symptoms become evident. (See photo on left.) In the autumn, lesions may develop as longitudinal brown streaks on the leaf blades up to 0.25 inches in length.

Table 3

Perennial Ryegrass varieties resistant to *Dreschlera siccans* and *Pyrenophora dictyoides*

Excellent to very good	Good to moderate
Blazer	AllStar
Dasher II	Citation II
Derby	Commander
Manhattan II	Fiesta II
Omega II	Pennant
Ranger	Premier
Repell	Runaway
Riviera	Saturn
SR 4100	SR 4000
Yorktown II	

Occasionally, under a severe infection, crown rot symptoms may be evident. Crowns may develop a purplish-brownish appearance and plants may rapidly wilt and die under heat stress.

The pathogen: The causal agent of brown blight of perennial ryegrass is *Dreschlera siccans*. Unlike *D. poae,* conidia of this species are not the typical dark brown color of the many other *Dreschlera* species, but range from colorless to an olive color when immature, developing a golden-brown color when mature. (See photo on page 4, right.) Like *D. poae*, these conidia are the primary means of plant infection early in the spring, when each of the 5-7 cells of the conidium can germinate and infect susceptible tissues if the surfaces of the leaves remain wet for at least 48 hours.

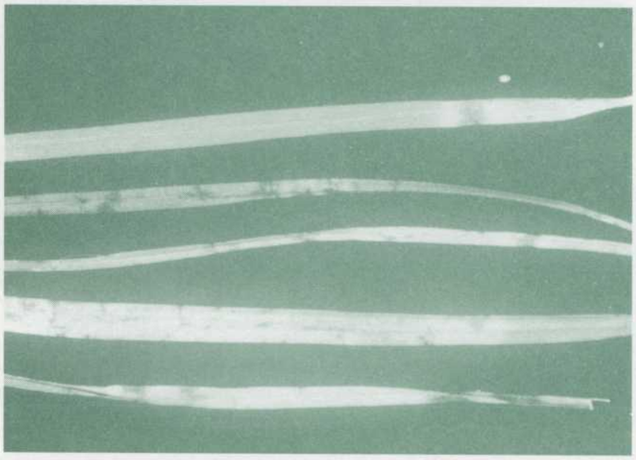


Photo provided by Dr. Eric B. Nelson, Cornell University

Net blotch on perennial ryegrass

Like *D. poae, D. siccans* is proficient at surviving and sporulating in thatch as well as on infected plant tissue. Conidia may be dispersed by wind, rain, irrigation, traffic and grass clippings, just as other *Dreschlera* species do. Furthermore, under optimal wet, humid conditions, conidia can germinate rapidly on a susceptible grass blade. Germinated conidia give rise to a chestnut-brown mycelium easily observed with a microscopic examination of infected plant tissues.

Disease development and control: Although the disease may be transmitted by infected seed, resulting in seed rots and seedling blights, the major means of dissemination in mature turf is by means of splashing water and wind. High relative humidity greatly facilitates the spread of the pathogen in the turfgrass canopy. In some cases, nitrogen application may enhance the severity of symptoms on perennial ryegrass. However, there are conflicting reports on the role of nitrogen fertilization on disease development.

The same control measures for *D. poae* on Kentucky bluegrass are effective for *D. siccans* on perennial ryegrass. Additionally, a number of perennial ryegrass cultivars are resistant to the disease. (See Table 3 on page 4.)

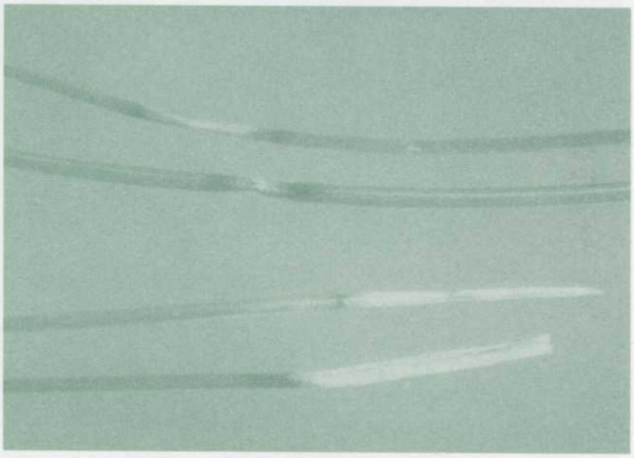


Photo provided by Dr. Eric B. Nelson, Cornell University

Net blotch on fescue leaves

Net blotch of fine fescue, tall fescue and perennial ryegrass

Symptoms: Net blotch is one of the more common diseases of fine fescue, tall fescue, and perennial ryegrass in the United States. On fine fescues, leaf lesions initially appear during cool, wet weather as small reddish-brown spots that quickly girdle the leaf blade. This results in a yellowing of the leaf blade and a tip die-back. Small brown patches may appear in fine fescue turfs, and occasionally, a melting-out can occur when crowns and roots also become infected. On tall fescues and perennial rye grasses, lesions initially appear as small brown spots with yellow margins. (See photos above.)

As these spots coalesce, they take on the appearance of a fine network of brown streaks

Table 4

Fine fescue varieties resistant to *Pyrenophora dictyoides*

Chewings fescues	Hard fescues
Agram	Aurora
Checker	Biljart
Enjoy	Reliant
Jamestown	Scaldis
Longfellow	Spartan
	SR 3000
	Waldina
Creeping red	**Sheep fescue**
None	Bighorn

running both parallel and perpendicular to the leaf axis. This network of streaks eventually coalesces to form brown leaf spots. Blades show a progressive death from the tips.

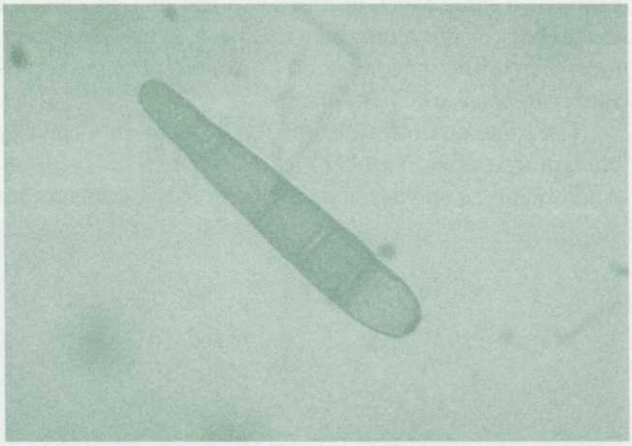


Photo provided by Dr. Eric B. Nelson, Cornell University

Pyrenophora dictyoides conidia

Heavily infected turf may show crown rot symptoms with groups of plants dying in patches, similar to melting-out symptoms prevalent with the other leaf-spotting diseases.

The pathogen: Net blotch of all three grasses is caused by the pathogen, *Pyrenophora dictyoides*, formerly called *Dreschlera dictyoides.* Conidia of *P. dictyoides* are distinctly different from those of *D. poae* and *D. siccans,* both in color and shape. (See photo above.) Conidia may contain from 1-7 cells, each capable of germinating and infecting susceptible tissues independently of one another.

Disease development and control: *P. dictyoides* may initially infect plants from seed-borne inoculum, although the pathogen can be infrequently detected in routine germination tests and rarely does its presence reduce the ability

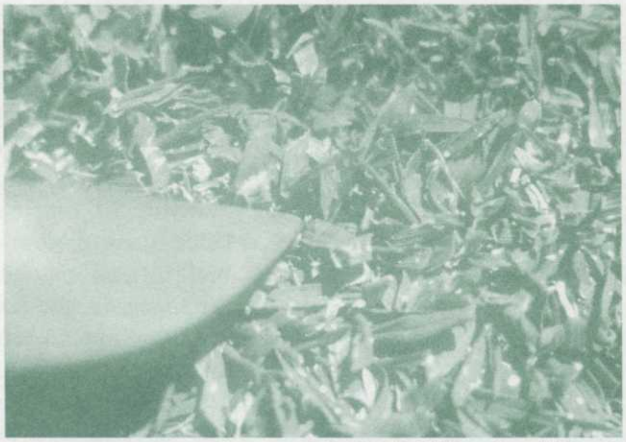


Photo provided by Dr. Eric B. Nelson, Cornell University

Leaf spot on bentgrass

of the seed to germinate. It appears that seed-borne inoculum of *P. dictyoides* serves to establish the pathogen in a particular site.

However, the environmental conditions prevalent at the time determine the ultimate expression and severity of this disease. The fungus can survive in both living and dying leaves on which conidia are formed all season long. As with other *Dreschlera* species, *P. dictyoides* can survive well in infected crowns and in thatch. Conidia produced in these sites are disseminated through the same mechanisms as the other leaf spotting pathogens. Leaf spot symptoms are

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

Red leaf spot on creeping bentgrass

suppressed during warm, dry weather when crown infections predominate. None of the perennial ryegrass or tall fescue cultivars have shown resistance to net blotch. There are, however, a limited number of resistant fine fescue varieties. (See Table 4 on page 5.) Other control measures for net blotch are the same as for *D. poae* on Kentucky bluegrass.

Red leaf spot of creeping bentgrass

Symptoms: Circular or oblong lesions, either brown or reddish-brown develop on *Agrostis* (bentgrass) leaves during wet, humid weather. But unlike the other *Dreschlera* and *Pyrenophora* species, symptoms are more evident in warm weather as opposed to cool weather. Large numbers of leaf lesions may give an overall reddish cast to the turf. Once leaves become girdled, they quickly wither and die, showing symptoms similar to drought stress or other root-rotting diseases. (See photos above.)

The pathogen: Several different fungal pathogens cause red leaf spot symptoms on bentgrasses. The primary pathogen is *Pyrenophora erythrospila.* However, *Dreschlera catenaria* also causes similar symptoms, more typically appearing as sunken reddish-brown patches of turf on golf course putting greens. The two fungi can be easily distinguished by the shapes of their conidia. The conidia of *P. erythrospila* are light grayish-brown and may contain 4-8 cells (See photo on page 11.), whereas conidia of *D. catenaria* are yellowish-brown and up to twice the length of *P. erythrospila* conidia.

Disease development and control: Red leaf spot is a warm, wet weather disease that usually does not appear until well into the summer months. Similar symptoms incited by *D. catenaria* are evident at somewhat cooler temperatures. Although both pathogens are seed-borne, the

Continued on page 11

Cultural controls:

How to minimize leaf spot and melting-out damage

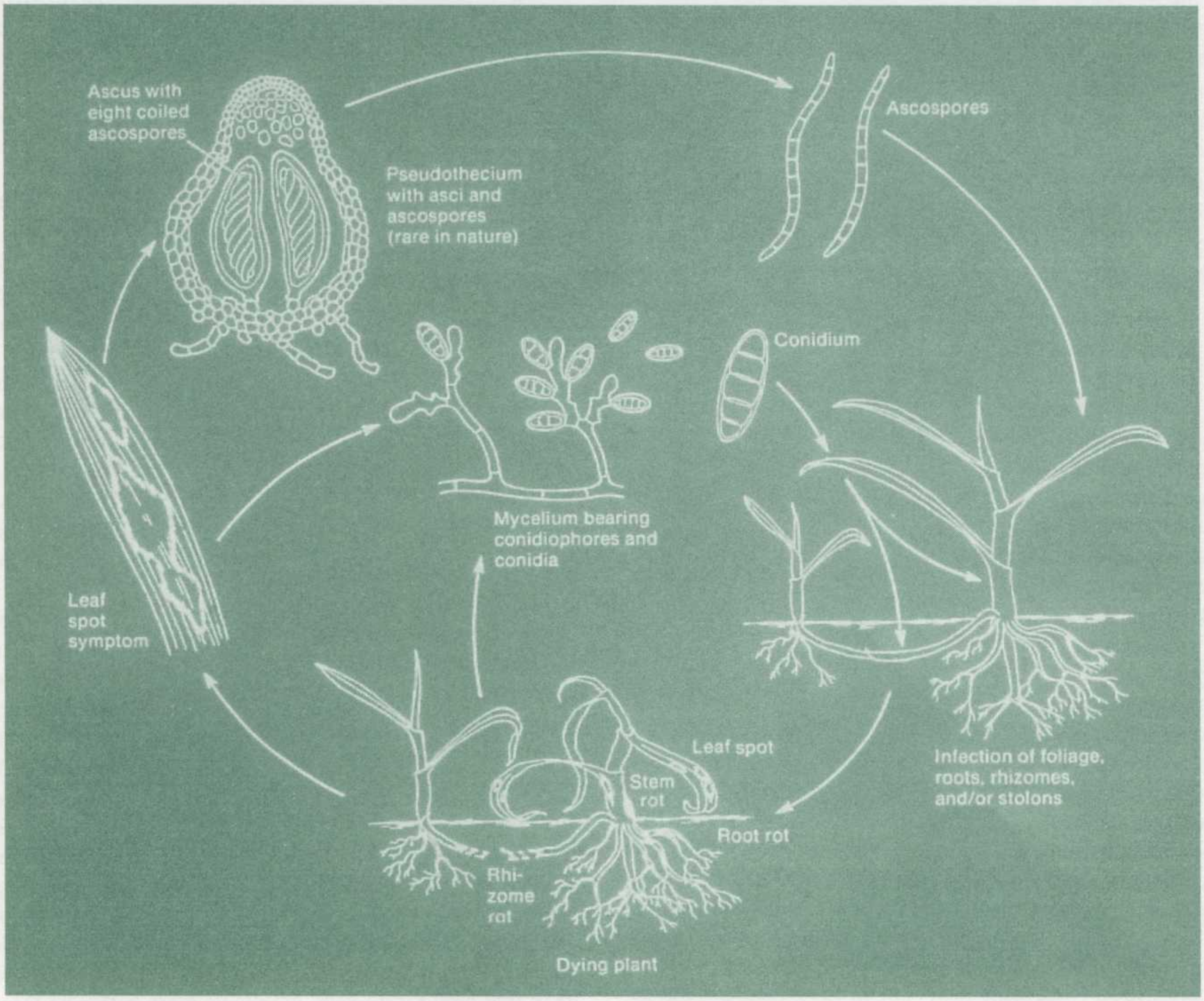
by Dr. Eric B. Nelson

Cultural control practices, for just about any turfgrass disease, are based on a thorough knowledge of the disease cycle of the causative pathogen. A particular practice may be aimed at reducing the spore production by the fungus or it may be targeted at reducing the germination of the fungal spores. Alternatively, a practice may indirectly affect the growth of the fungus inside the plant or affect the response of the plant to the infection by affecting the overall health and vigor of the turfgrass plants. Regardless of how cultural control practices work, an understanding of the disease cycle of the pathogen is critical.

The leaf spot diseases of cool-season turfgrasses, caused by the fungal species *Dreschlera* and *Pyrenophora*, exhibit a characteristic disease cycle. (See figure above.) The pathogens survive either in infected turfgrass plants or in thatch as ascospores, as is the case for *Pyrenophora*-species caused diseases, or, in the case of *Dreschlera* species, as conidia and mycelium. These fungi are also seed-borne where they can survive quite readily and be inadvertently introduced into uninfected sites.

The cycle begins in spring

In the spring, as turfgrass plants emerge from dormancy and winds and rain are frequent, ascospores or conidia can be readily dispersed to adjacent healthy plants.



Dreschlera and *Pyrenophora* disease cycle

As mowing begins, the dispersal of infected leaf blades will also disseminate the pathogen.

Once the spores land on susceptible leaf blade tissue, they can quickly germinate and penetrate the cuticle of the leaf. At this stage it is critical for the fungus that plenty of water be available on the leaf surface, as, without water, conidia and ascospores fail to germinate. Once germinated, an emerging germ tube will penetrate the leaf blade cuticle and inject fungal matter and begin the process of killing cells. After enough cells have been killed, symptoms of the disease, characteristic lesions on the leaf, will appear. As more and more cells die, the lesions become larger. At this point, under conditions that are not completely understood, the fungus produces a new "crop" of conidia or propagation structures. These can then be spread by the action of wind, water, and clippings dispersal to susceptible plants, where, under the right conditions, spores can germinate and begin the cycle all over again. Later in the season, in the case of the *Pyrenophora* pathogen, ascospores will form and survive on infected plant tissues over the winter months.

Successful cultural management of these diseases requires not only an understanding of the disease cycle, but an understanding of the factors that contribute to each of the cycles steps. Once these factors are known then managers can manage their turf sites to minimize these factors.

Leaf spot ratings of Kentucky bluegrass cultivars from the 1990 National Turf Evaluation Program

Variety	Mean Rank	Percent Increase in Resistance
Blacksburg	8.3	830
Cobalt	7.7	770
Touchdown	5.3	530
Merit	4.3	430
Baron	4.0	400
Kenblue	1.7	170
S.D. Certified	1.0	0

S.D. Certified and Kenblue, both common varieties, show very little resistance to leaf spotting diseases. Touchdown, Merit, and Baron, a group of older hybrids, show substantially improved resistance when compared to the common varieties. The newest hybrid varieties, Blacksburg and Cobalt, show improvements in leaf spot resistance that exceeds the older hybrids almost by a factor of one.

Water controls spore germination and plant infection

Clearly, water availability is the most important factor controlling spore production, germination, and successful infection of susceptible plant varieties by species of *Dreschlera* and *Pyrenophora*. Many of these fungal species require leaf wetness periods of from 24 to 72 hours before spores residing on the leaf surface will germinate. So cultural control practices that reduce the period of leaf wetness can have a significant effect on disease expression. Such practices as selectively removing trees or shrubs to increase air flow and reduce turf canopy humidity levels will be beneficial. This selective removal can be used to increase light penetration and duration at shaded locations. Sites with high light levels consistently have fewer problems with leaf spotting pathogens. The use of wetting agents, applied to leaf surfaces to help water movement through resistant soil profiles, has shown some success. Reports from Kansas have indicated that wetting agents can play a significant role in reducing *Pythium* blight occurrences. At selected sites, during times of optimal conditions for disease infection, fans or blowers have been used to dry leaf surfaces.

Not only how much water is available, but the way in which water is applied to an infected site can play a role in the ultimate expression of disease symptoms. Irrigation can also be an important way in which *Dreschlera* and *Pyrenophora* spores are disseminated. That is because the splashing action of water droplets dislodges spores from the body of the fungus. Suspending irrigation during periods of maximum spore development or limiting irrigation to no more than that required to keep the plants from suffering from moisture stress can help. Applying wetting agents to the leaf surfaces through the irrigation system may reduce the surface tension of the droplets so that dispersal of spores is reduced. Wetting agents will reduce the runoff from saturated soils and therefore prevent spores from moving to uninfected areas. Cultural practice that will reduce leaf wetness and water splash will reduce spore germination and dispersal and thus reduce the disease severity as will strategies to reduce winds across a disease-prone turfgrass site.

Plainly, any water management strategy that has the potential to reduce leaf wetness to less than the time required by the infecting pathogen to enter plant tissues should be considered or tried. The efficacy of the various water management cultural practices at reducing disease incidence will be subject to site specifics, including the availability of susceptible turf species, as well as how diligently these practices are followed and the consistency with which they are applied.

Reduced air flow, proper mowing helps

Other cultural practices that may show some success include reducing air flow over affected sites. Altering the landscape on the windward side of a chronically infected site can reduce the amount of spore dispersion. This can be accomplished by planting a vegetation wind screen, or a fence, or changing the topography of the site to reduce air flow. However, these kinds of changes should be carefully considered so as not to increase leaf wetness at the site.

Water and wind affect the germination and the dissemination of spores, but mowing practices even more influence the severity of leaf spot diseases. Dispersing the pathogen's spores by failing to collect infected clippings plays a very large role in the spreading of this disease from one area to another.

Not only mowing clipping dispersal but equipment and human traffic will spread spores. So, managing clipping disposal and prudent traffic restrictions in small infected areas can dramatically reduce disease expression over large areas.

Improper mowing may greatly stress plants by making them more susceptible to infection. Close mowing of Kentucky bluegrass and fine fescues, in particular, greatly increases leaf spot and net blotch severity on susceptible cultivars. Maintaining mowing heights at two inches or higher and supplying adequate fertilizer during periods of optimum fungal growth will greatly reduce the severity of these symptoms. Closely mowed turf often exhibits the telltale signs of leaf spot infections because the characteristic lesions exist on a leaf tissue surface that may be as little as 10% of the available tissue of higher-cut plants.

Role of fertilization practices are not clear

There is some controversy about the relationship of fertilization practices and the severity of *Dreschlera* and *Pyrenophora* leaf spot diseases. A New Jersey study found that Kentucky bluegrass maintained under a high fertilization program suffered less leaf spot damage from *Dreschlera poae* in the spring than that maintained on a moderate to low fertilization program. On the other hand, increased fertilization from the wrong nutrient can result in increased root damage and higher incidences of the melting-out symptoms on infected turf. Other studies, however, have shown that high nitrogen fertilization will enhance the severity of *D. poae* leaf spot symptoms.

In yet other studies, nitrogen applications were not shown to influence leaf spot on perennial ryegrass caused by *Pyrenophora dictyoides*, but did greatly enhance leaf spot caused by *Dreschlera siccans*. Still, results of other studies contradict those results. Nitrogen fertilization is the nutrient component that has produced the controversy. Potassium and phosphorus applications have not had any significant effect on leaf spot severity.

Leaf sugar contents may hold the key

For other leaf spotting pathogens of turfgrasses, such *Cochliobolus sativus*, a clear relationship between the above fertilization factors and disease severity has been established. The discrepancies between some of these studies may lie in the differences in leaf sugar contents. Generally, the lower the leaf sugar content, the greater the severity of melting-out. Studies have shown that mowing Kentucky bluegrass turf at one inch and maintaining it in shade results in a lower leaf sugar content and higher disease incidence than turf maintained at two inches in full sun.

Improved varieties may help

Whatever the cause may be, further work is necessary to clarify this relationship between the *Dreschlera* and *Pyrenophora* diseases and their plant hosts. As a rule, infections of nearly all of the leaf-spotting diseases on turfgrasses can be effectively managed using appropriate cultural control practices coupled with the use of improved disease-tolerant cool-season turf cultivars. An examination of the table on page 8, first published in the Sept./Oct. 1992 *Turf Grass Trends* will illustrate this point.

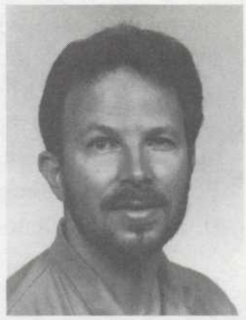
The successful introduction, in whole or in part, of any of the latest generations of hybrid Kentucky bluegrass cultivars into sites where cultural practices alone have not been able to control disease symptoms, should go a long way to eliminating the *Dreschlera* and *Pyrenophora* diseases as major disease pests at that site. Additionally, the introduction of resistant perennial ryegrass species into 100% Kentucky bluegrass stands can help by reducing the actual leaf count of vulnerable plant cultivars, thereby reducing the potential for disease spread.

Cultural control practices should always be the first line of defense in combating the *Dreschlera* and *Pyrenophora* diseases. The proper employment of cultural control practices, in the overall management of a site, along with the implementation of best possible management strategies, can be designed to minimize the stresses on prized turfgrass stands. This will go a long way toward eliminating leaf spot diseases without having to resort to costly fungicide applications. ■

Why do the names of fungi change?

A taxonomic history of Dreschlera and Pyrenophora

by Dr. Eric B. Nelson



Before we begin to talk about fungal classification, It is important to explain how fungi are classified. Traditionally, they have been classified by their reproductive structures. These structures include spore size, shape, germination mode, and pigmentation as well as the size, shape and function of the structures that bear those spores. Reproductive structures in fungi include both sexual reproductive structures and asexual reproductive structures. The definitive classification of all fungi has been, and still is, based on the morphology, or shape and form, of the sexual reproductive structures. Occasionally, taxonomists (people who classify biological things) may also use the color, pigmentation, and growth rates of the fungal colony.

Straightforward classification doesn't work

There are problems with this system of classification. First, there are fungi that don't seem to produce any sexual reproductive structures. These fungi have been placed in a separate group and the classification within that group is based primarily on the morphology of the asexual reproductive structures. A further problem occurs because some of the fungi within this classification group don't produce any discernible asexual reproductive structures either. These fungi that do not produce sexual reproductive structures or asexual reproductive structures are then lumped into yet another classification grab bag of fungal genera.

To top off an already complicated classification scheme, the fungi, initially classified according to their **asexual** spores, may, at a later time or under conditions different from those of the original classification study, produce **sexual** reproductive structures. In fact, many fungi that have been reclassified, have been so, because our knowledge of that reclassified fungus has advanced to the point where we now understand how to induce sexual reproduction in these species. Also, in cases where the sexual structures had never been observed in nature, persistent searching eventually reveals the presence of these structures. In nearly all cases of newly discovered sexual reproduction in fungi, these sexually produced reproductive structures are very similar, if not identical, to fungi classified in yet another genus.

What to do, what to do!

Since normal classification procedures dictate that the fungi be reclassified into the group of sexual reproducing fungi that they most closely resemble, there should be little or no problems in this renaming. But what do we do about the old name?

Often fungal taxonomists argue about where certain fungi should be classified or reclassified. Then opposing camps develop. Usually one camp of taxonomists will refuse to accept the classification proposed by members of an opponent's camp. The majority of members of the scientific community will usually side with one or the other of the proposed taxonomic classifications. Despite this general acceptance, some taxonomists refuse to concur with the proposed classification. The result: two names for the same fungus appear in scientifically published papers.

The arguments between the opposing camps of taxonomists may go on for years. The arguments usually stop when a young fungal taxonomist proves, through the application of a new, more sophisticated molecular taxonomic tool, that, either both camps were wrong and a new genus should be established, or, that one of the previous taxonomists was right and the fungi should be reclassified there.

Practically, though, some classification names have been used for so long that those who are not taxonomists don't really care to know the "proper" classification and remain content using the old, outdated name. This is the situation that turfgrass leaf-spotting fungi in the former genus *Helminthosporium* have found themselves.

Dreschler works on leaf-spotting pathogens

In the early 1920's Charles Dreschler described many of the pathogens that attack cereals and grasses in the United States. Many of the leaf spotting pathogens of turfgrasses were placed in the genus *Helminthosporium*, a genus that had been established in 1809 and was well known to plant pathologists. The genus *Helminthosporium* contained species of fungi that were commonly associated with leaf spots, leaf blights, foot rots, and other syndromes on both wild and cultivated plants within the *Poaceae* (the family containing cool-season turfgrasses). The pathogens that we know today as *Dreschlera* and *Pyrenophora* were originally placed in the genus *Helminthosporium* because they shared many of the same characteristics of spore morphology as others grouped in that genus. However, Dreschler failed to notice that there were some clear differences between his grass pathogens and the original *Helminthosporium* fungus used to describe the new genus in 1809. As subsequent pathologists began to examine the morphology of these grass pathogens, it became clear that they did not belong in the genus *Helminthosporium.* In 1930, the genus *Dreschlera* was created to accommodate those grass-infecting fungi that clearly didn't belong in the *Helminthosporium* genus, but had to be placed somewhere. Thus, *Helminthosporium vagans, H. siccans, H. dictyoides,* and *H. erythrospilum* became *Dreschlera poae, D. siccans, D. dictyoides,* and *D. erythrospila*, respectively.

Distinctions were made

The genus *Pyrenophora* was also well known at that time. It contained fungi that were placed there based on the morphology of their sexual reproductive structures. When the genus *Dreschlera* was created, it was known that there were associations between it and the genus *Pyrenophora,* but there were enough dissimilarities to keep it as a distinct genus. Furthermore, not all of the *Dreschlera* species so classified produced sexual structures and, because of taxonomic custom, could thus not be properly classified as *Pyrenophora.* It wasn't until much later that the *Dreschlera* species such as *D. dactyoides, D. erythrospilum,* and *D. tritici-repentis,* among others, were reclassified as species of genus *Pyrenophora,* once the sexual reproductive structures were found or induced and compared with those of other species of *Pyrenophora.*

Classification arguments continue

To this day, taxonomists still argue about the classification of these as well as other fungi that are important pathogens of turfgrasses. In fact, the genus *Dreschlera* and the genus *Pyrenophora,* have not been accepted universally as the proper genus for the former grass-infecting, leaf-spotting *Helminthosporium* species. Nonetheless, the majority of plant pathologists accept this genus as an appropriate one for these fungi.

Are there effects on warm-season turf?

The reclassification of the *Helminthosporium* group of fungi may be important from a practical point of view. It turns out that all of the species of *Dreschlera* cause diseases only on cool-season grasses, unlike other genera split out of the original *Helminthosporium* grouping that can also cause diseases on warm-season grasses. This has definite repercussions from the turfgrass manager's point of view.

Warm-season turf managers will better understand this group of diseases so they can avoid using the management criteria commonly linked to the *Dreschlera* genus when devising their own control strategies. Additionally, because newer fungicides are designed to control a limited number of fungal pathogens, understanding which pathogen is causing a problem becomes very important.

Hopefully, the taxonomic placement of species of *Dreschlera* and *Pyrenophora* is stable for the future and turfgrass managers can spend their time doing what they do best: managing turf. However, we should not be surprised to find these fungi have undergone yet another name change by the next issue of *Turf Grass Trends.* ■

***Leaf spotting diseases** continued*

role of seed infections in disease development is unknown. Under severe disease conditions, roots and crowns are also infected, similar to disease caused by other related pathogens. Increased nitrogen fertilization will generally enhance the severity of red leaf spot. Most creeping bentgrass varieties are susceptible to red leaf spot. 'Toronto' creeping bentgrass is especially susceptible to *D. catenaria.* Other control measures are the same as for the other *Dreschlera* and *Pyrenophora* diseases.

Glazed looks

Although heavy doses of scientific names often lead to glazed looks in eyes of readers of articles like this, it is important that turfgrass managers have a good working knowledge of the various species that have been and still are causing a considerable amount of damage of turfgrass sites.

Often untreated infections by members of these fungal species leave the turf plants weakened and vulnerable to opportunistic summer diseases, ranging from "red thread" and "dollar spot" to "summer patch" and "brown patch".

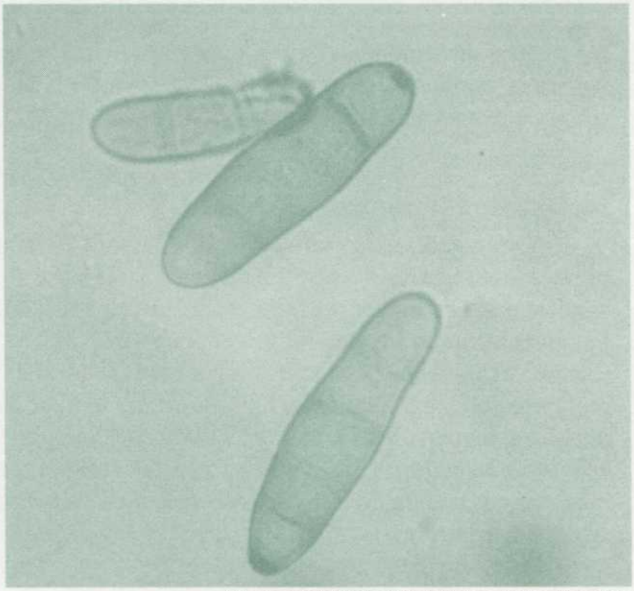


Photo provided by Dr. Eric B. Nelson, Cornell University

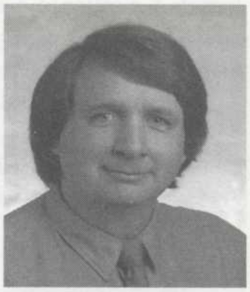
Conidia of *Pyrenophora erythrospila*

Understanding the biology and optimum growth periods of these fungi can lead to actions that preclude the appearance of the disease symptoms. The actions, particularly cultural practices, that reduce symptoms of the leaf spotting diseases often have beneficial carryover effects that produce substantially fewer summer diseases on the treated areas.

Success in managing these important diseases leads to a healthy, dense turf that is better able to withstand heat and drought stress, weed infestation and attacks by insects and other diseases. Failure to manage these diseases leaves the turfgrass manager in a hole that is often impossible to get out of. ■

Politics, turfgrass management, and the future

By Christopher Sann



Now that I have had the chance to put some time and distance between me and the column I wrote last month about the controversy surrounding 2,4-D and cancer, I can say that I am just as discouraged as I was when I finished it. No, make that more discouraged! I am discouraged, not about the safety of 2,4-D, but about the politics that surround it and several other issues like it. The immediate anger that I felt has dissipated. The anger that I felt toward a group of people who would knowingly continue to perpetuate what was a lie wrapped in scientific jargon has been superseded by the jarring reality that this is how the game is going to be played in the future. As far as I am concerned, the discredited National Cancer Institute reports on 2,4-D and cancer rank right up there next to the Alar scare as perhaps the biggest environmental fraud ever perpetrated on an American public that is frantically looking for sources it can trust to answer its questions about the environment.

Idealists in environment displaced

Unfortunately, some of the various environmental organizations that have been the American public's trusted advocates are no longer operated by the idealists that led the movements at the time of the publication of Rachel Carson's famous book, "Silent Spring". Today some of the highly-visible segments of the movement seem to be populated by two distinctive personality types: hysterics and professionals. This is not to say that the whole movement is populated by these types, but their presence signals a disturbing turn for the environmental movement. It's a turn that turfgrass managers should pay close attention to.

My position is clear: no friend of industry

Before I continue with this monologue, let me say which camp I reside in. First, I am no friend of the chemical manufacturers. I never was and never will be. To be sure, as a turfgrass manager, I have used the products of the chemical industry for the last 20 years. But I used them as the tools that were available to me. As a thinking citizen, I am still indignant about Hooker Chemical, a company my father described in the early 1950's as the "whores of the industry", and its Love Canal. I've also had long conversations with a chemical plant manager who said that the chemical industry knew that the U.S. Army's formula for the defoliant, Agent Orange, would be contaminated with dioxins that would pose a problem to people, and that the companies produced it anyway. I also have a personal battle with the chemical industry. My father, a chemical engineer, died from a combination of smoking and airborne exposure to a carcinogen that he was unknowingly involved in manufacturing.

In my opinion, over the years the chemical manufacturers have had their share of executives and CEO's who I would classify as being one species above pond scum. That having been said, I think these same "creatures and other lizards" have found their way into the big business of environmental watchdogs. A concerted effort by some members of this group to capture an increased part of the environmental donation and environmental research pie has seen the rise in the number of individuals for whom money is the only goal in life. Maybe the following will sound all too familiar to those of us who have been concerned for our environment since "Silent Spring" was first published.

Recently, when the executives of some major environmental groups were asked if they were concerned that their direct mail solicitation campaigns were adding to the problem of dwindling waste disposal space or that their use of bleached paper was adding to the pollution of water sheds, not one executive of this group deemed this question important enough to respond to. The small environmental organization that pushed the Alar story benefited from its media exposure to the tune of approximately 40,000 new memberships. The National Cancer Institute received a $10 million grant to study the effects of 2,4-D on humans from the Environmental Protection Agency even though all the previous National Cancer Institute studies that purported to show a link between 2,4-D and cancer had been universally criticized as unfounded.

What are the implications for turf?

The cynics among *Turf Grass Trends* subscribers will accuse me of being naive. And, they will say, what does all this have to do with turf and the future? First, to the charge that I am naive, I plead guilty. But, being guilty of expecting better from organizations with high-minded purposes does not discredit the observation that some in the chemical industry in the past have shown up where we least expected them now. Second, the next 10 years will be the most tumultuous in the history of the turfgrass management industry. The effects of the Clinton administration's effort at significantly reducing general pesticide use and its attempt to have 75% of agricultural acreage under integrated pest management by the year 2000 will spill over into turfgrass management industry with unforeseen consequences.

Continued on page 15

Annual bluegrass: its biology and control

By Dr. Joseph C. Neal

Annual bluegrass, *Poa annua*, is one of the most persistent and difficult to control weeds of high maintenance cool and warm season.

It is well adapted to close, frequent mowing, high fertility management practices, frequent irrigation, and compacted soils. is one of the first and primary weeds to infest damaged or thinned turf areas. It resists efforts to control its spread so successfully that many turfgrass managers have given up and now manage it as a desireable species. Even though it is a member of the bluegrass family it is considered a weed in intensively managed turfgrass stands because it is highly subject to moisture and heat stress as well as to almost all of the diseases of turf. It produces prolific quantities of seed heads in the spring, and its growth habit makes it highly visible when mixed with other turfgrass species.

The biology of *Poa annua*

Before one can understand how to control annual bluegrass, one must be able to identify it and understand its life cycle. *Poa annua* has been classified into two distinct biotypes: the annual biotype (*Poa annua ssp. annua*) and the perennial biotype (*Poa annua ssp. reptans*). The primary differences between the two biotypes are root system, growth habit, and life cycle. (See Table above.)

Additionally, even within a biotype, there is a substantial amount of variation. These variations compound the difficulty of controlling annual bluegrass.

Control of annual bluegrass

Annual bluegrass is genetically very closely related to the desirable bluegrass species and it thrives under the same conditions that promote optimum growth of desirable turfgrass species. Therefore, cultural controls of annual bluegrass have met only with moderate success.

There are five general kinds of cultural practices that have been effective in limiting annual bluegrass infestations. They are:

- the prevention or reduction of soil compaction,
- limiting supplementary moisture applications,
- limiting supplementary nitrogen fertilization,
- removing clippings,
- raising cutting height to stimulate competition.

Reducing compaction can be accomplished by regular hollow tine core aeration. This practice actually stimulates bentgrasses, bluegrasses, and ryegrasses to be more competitive by stimulating root production in the desirable species. At the same time, hollow tine core aeration makes annual bluegrass less competitive. Preventing soil compaction, by controlling site and equipment usage, is the best way to limit annual bluegrass infestations by limiting compaction before it develops.

Limiting supplementary irrigation can help stress the annual biotype of *Poa annua* to the dieback stage because of its weak, shallow root system. In areas with poor subsoil drainage, the use of soil wetting agents may facilitate water movement away from the shallow root system, making the site less supportive. Better soil drainage improves the soil structure allowing the desirable varieties to be more competitive.

Reducing nitrogen input to below four pounds of nitrogen per thousand square feet per year will limit its ability to compete with desired species. In some seasons, such as in early spring and in late fall, substituting supplemental iron applications for nitrogen can also limit competitiveness.

Removing clippings by catching them before they are returned to the turf helps to reduce the number of seeds that can germinate. This can be particularly effective when used against the annual biotype, but if continued long enough, over a period of years, can also be effective against the perennial biotype. Clipping removal also helps lower total

Comparative morphology of *Poa annua* biotypes

Annual biotype	**Perennial biotype**
Shallow root system	Strong fibrous root system
Erect growth	Prostrate growth
Seedhead in May & June	Produces seedheads several times
One season life cycle	Several season life cycle
Seed requires dormant period	Seed can germinate anytime

nitrogen input, by removing the leaf tissue that would release nitrogen while it decomposes.

Raising cutting height also reduces annual infestations by increasing the desirable variety's competitiveness. This then reduces the stress imposed on closely-cut turf and increases plant-produced nutrients from increased leaf tissue surfaces.

Chemical controls fall into three categories

When changes in cultural practices fail to limit the spread of *Poa annua* infestations, then chemical controls are often warranted. Chemical products for annual bluegrass control fall into one of three categories: pre-emergent herbicides, post-emergent herbicides, and growth regulators.

Most pre-emergent herbicides, used to control the germination of annual grassy weeds, such as crabgrass and goosegrass, will prevent the establishment of newly germinated annual bluegrass seeds if the herbicides are applied with that purpose in mind.

The pre-emergent herbicides are divided into two groups: those with short-soil residuals and those with long-soil residuals. The long-residual pre-emergent herbicides, like pendimethalin, dithiopyr and prodiamine, can be applied in the late spring in time to control germinating crabgrass and still have enough of a residual to kill the germinating annual biotype in the fall. Shorter residual herbicides, like benefin and bensulide, offer some protection against germination if a second application is made in the mid to late summer.

Annual bluegrass

Post-emergent herbicides work by either selectively controlling germinating seedlings and mature plants or by total vegetation control. The two selective controls, calcium arsinate and ethofumesate, work by controlling immature and mature plants or by controlling immature and reducing the growth rate of mature plants.

Glyphosate works by killing all vegetative growth and requires that new seed be introduced into the area. This can be a difficult task if there is a substantial reserve of ungerminated seeds waiting to compete with the desirable varieties. Generally, it is better to avoid having to use broad-spectrum herbicides in all but the worst *Poa annua* infestations and to try to stimulate the desirable turfgrass species.

The third class of chemicals for annual bluegrass control are the plant growth regulators. They work by reducing seed head formation, thinning the stand, and reducing growth and competitiveness so that the area is allowed to convert to the desirable varieties. The timing of these applications varies by product and depends on the mechanism of action.

There are two other chemicals that have some effects on annual bluegrass populations, but they are not considered to be herbicides. The first is the fungicide fenarimol, whose trade name is Rubigan. Total applications of eight fluid ounces per 1000 square feet of this fungicide per year divided among several applications will dramatically thin annual bluegrass stands. Second, the liquid form of the wetting agent AquaGro has been reported to reduce or eliminate seed-head formation if applied after spring green-up but before the new seed head emerges from the leaf sheath.

Poa annua control takes a coordinated effort

Despite the fact that there are numerous chemical and cultural control strategies, none of the current management strategies are completely successful on their own. The most effective *Poa annua* control is best achieved through the coordinated use of as many of these methods as possible.

If the area has a light infestation and should not require over-seeding, such as a home lawn or commercial property, then the repeated use of pre-emergent herbicides to cover the germination period, combined with the best beneficial practices to stimulate desirable turf conversion, is a valid approach.

In areas where the perennial biotype predominates or where the site usage dictates annual overseeding, then plant growth regulators combined with hollow tine aeration and site improvements have shown that these practices can reduce or eliminate *Poa annua* in sites with less than a 50% population. In areas heavily infestated with the annual biotype or resistant perennial biotype populations, the best approach is a total area kill in the late fall with a non-selective herbicide like glyphosate, followed by sodding of the area and follow-up applications of long residual pre-emergent herbicides in the following years.

The key to good *Poa annua* control is identifying which biotype is present and then designing the maintenance program to take site usage and historic tendencies into consideration. ■

News Brief

University of Florida study

Dithiopyr granules superior to liquid

In studies at the University of Florida, granular formulations of dithiopyr provided better control of crabgrass and much better control of goosegrass than liquid formulations of the same herbicide and at application rates that were 33% to 50% less than the liquid formulations. The table below compares the percentage control for crabgrass and goosegrass of the two formulations with oxadiazon and a control for comparison.

Dithiopyr granules versus liquid for crabgrass, goosegrass control

Herbicide	Formulation	Rate	% Control Crabgrass*	% Control Goose grass**
Dithiopyr	1EC	.6	80.5	70
		.8	94.5	71
		1.1	97	84.7
		.3 + .3	100	80
		.4 + .4	95	84.5
Dithiopyr	0.25G	.3	82	37.5
		.6	100	85.5
		.8	100	96.5
		.3 + .3	95	85
		.3 + .1	91	85.5
Oxadiazon	2.0G	4.5	91	88.4
Untreated	—	—	0	0

* average crabgrass control
** average goosegrass control

TGT's view: .25 G Dithiopyr showed commercial quality control of crabgrass (>80%) at rates that were as little 50% that of Dithiopyr 1EC formulation. This increase in efficacy held for goosegrass as well. The 1EC formulation did not provide commercial quality control of goosegrass in the first year at any rate of application, but all rates did the second year. Granular formulations of Dithiopyr are the preferred method of application where cost is not the primary factor and first year control of both crabgrass and goosegrass are needed. —CS

Coming attractions

May Issue

Cinch bugs and sod webworms
by Christopher Sann

Insect-disease comparisons and contrasts
by Dr. Eric B. Nelson

Turf Grass Resources

Back issues of *Turf Grass Trends*: $10.00 each plus $1.50 postage (while they last).

Sturdy vinyl-covered three-ring binders to hold your subscription of *Turf Grass Trends* are $5.00 each plus $2.50 shipping and handling.

***Politics** continued from page 12*

Agriculture may have been our ally

The agriculture industry, who we in the turfgrass industry have always considered as allies, is going to be squeezed hard by the new regulations. There will be a lot of yelling and screaming before it is all over. Don't be surprised if the agriculture industry starts pointing fingers at turf management in an effort to deflect some of the heat. Don't be surprised if there are some not so subtle hints that food is more important than grass. Finally, don't be surprised if some in the environmental "business" try to make points with their contributors or try to improve their media exposures by taking pot shots at agriculture's weak cousins, turf and horticulture.

Buckle up!

We must be on full alert. We must be vigilant and prepared. We must be prepared to respond quickly and forcefully to these kinds of provocations and prepared to defend ourselves and our profession. Buckle your seat belts, it's going to be a bumpy ride. ■

Free Issue Certificate
Turf Grass Trends

[ ] **Yes!** I want to see how *Turf Grass Trends* can really help me become even better at what I do ... and advance my career!

Send me the next issue as soon as it is off the press. I will then take 21 days to decide whether I wish to continue my subscription or return the invoice I will receive marked "cancel" and owe nothing. I understand I may also cancel my subscription at any time for a full refund on all unmailed issues. One year (12 issues) $120.

[ ] Contact me about money-saving rates on multiple subscriptions. My phone (_____) ______________________ .

[ ] My check for $120 for a one-year subscription (12 monthly issues) is enclosed. Send check and this certificate in an envelope to the address below. Same complete money-back guarantee applies.

Attach your business card here.

Turf Grass Trends
1775 T Street NW, Washington, DC 20009
Tel: (202) 328-0888 Fax: (202) 483-5797

4/94

Free Issue Certificate
For a Friend or Business Associate
Turf Grass Trends

[ ] **Yes!** I want to see how *Turf Grass Trends* can really help me become even better at what I do ... and advance my career!

Send me the next issue as soon as it is off the press. I will then take 21 days to decide whether I wish to continue my subscription or return the invoice I will receive marked "cancel" and owe nothing. I understand I may also cancel my subscription at any time for a full refund on all unmailed issues. One year (12 issues) $120.

[ ] Contact me about money-saving rates on multiple subscriptions. My phone (_____) ______________________ .

[ ] My check for $120 for a one-year subscription (12 monthly issues) is enclosed. Send check and this certificate in an envelope to the address below. Same complete money-back guarantee applies.

Attach your business card here.

Turf Grass Trends
1775 T Street NW, Washington, DC 20009
Tel: (202) 328-0888 Fax: (202) 483-5797

4/94

Turf Grass TRENDS

Turf Grass Trends is published monthly.
1775 T St. NW, Washington, DC 20009
Tel: (202) 328-0888
Fax: (202) 483-5797
CompuServe: 76517,2451
Internet: 76517.2451@COMPUSERVE.COM

Juergen Haber .... *Editor & Publisher*
Christopher Sann .... *Field Editor*
Dr. Eric B. Nelson .... *Science Advisor*

Subscriptions are $120 per year.
Turf Grass Trends accepts no advertisements.
Not responsible for unsolicited manuscripts.

Turf Grass Trends
1775 T St. NW
Washington, DC 20009
ADDRESS CORRECTION REQUESTED

BULK RATE
US POSTAGE
P A I D
WASHINGTON, DC
PERMIT NO. 8796