AN INDEPENDENT NEWSLETTER FOR COOL SEASON TURF MANAGERS

Turf Grass TRENDS

Premier Issue

Pythium root rot

A growing problem on high maintenance turf

by Dr. Eric B. Nelson

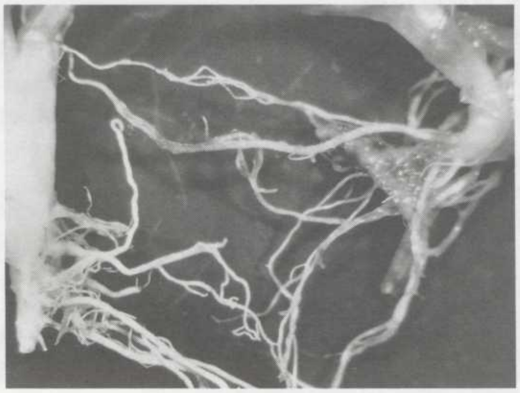
IN RECENT YEARS, Pythium-related root and crown rot damage to highly managed turfgrasses has become increasingly recognized as a major, nationwide problem. The contributing causes are easier to identify than to actually correct, because:

- PYTHIUM-CAUSED DISEASE is difficult to diagnose on the basis of simple field observations.
- OUR PRESENT KNOWLEDGE about specific Pythium species is still quite limited.
- THERE ARE SEASONAL, weather-related conditions and site-specific variables that must be sorted through.

However, even given these difficulties and limitations, there are a number of corrective actions that turf managers can take today, and promising additional remedies are under development. The first step is to get a clearer understanding of the disease.

Disease effects and affected grasses

CHARACTERIZED by both root and crown decay, this disease complex leads to a substantial thinning, and the possible loss of, established turfgrass stands. Although most frequently associated with established highly maintained bentgrass/annual bluegrass putting greens on golf courses, it is also widespread on highly managed home lawns and newly seeded areas as well.



Pythium damaged root and crown. At first, Pythium damage may be evident in the crown, but not in the roots. In severe cases, however, the root systems are greatly reduced in volume and vigor. They may also appear discolored. The crowns of infected plants may also appear water-soaked and discolored.

Although most turfgrass species are susceptible to Pythium root rot damage, they vary in their tolerance to infection. Bluegrasses *(Poa annua* and *P. pratensis)*, ryegrasses, and bentgrasses are species that are particularly susceptible to infection.

Conditions and symptoms vary

EARLY SYMPTOMS OF PYTHIUM ROT may be visible immediately after snow melt, but are more common in the spring (March–May). Symptoms, however, may be evident at any time throughout the growing season, and disease activity may continue into late autumn. Observations of the disease in the Northeast indicate that particular sites are more prone to Pythium root rot damage in early spring and late autumn, while other areas experience the problem primarily in warmer parts of the season—with little or no damage at other

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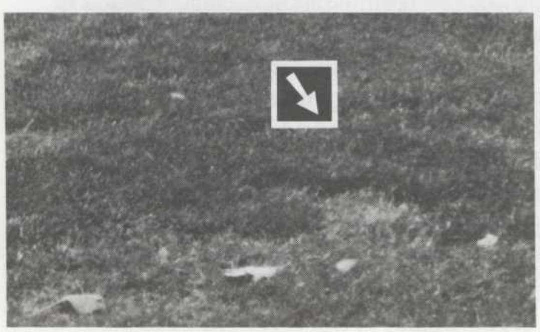


At eye level, damage caused by Pythiums can be obvious and extensive, but the problem has grown because of a host of complexities that affect both the diagnosis of the disease and effective treatment of it.

IN THIS ISSUE

Microscopic photo of Pythium infected root tip. It is difficult to diagnose Pythium root rot on the basis of field observations with the naked eye, but the difficulty doesn't end there. Pythium spores abound on this root tip, and many scientists still base their diagnosis of the disease on the presence of these oospores; however, Pythium growth inside the plant, in the absence of oospore production, can cause extensive root and crown damage—and many Pythium infections go undiagnosed.

times of the year. For instance, poorly drained areas may be subject to damage in the spring and fall, while areas with shade or poor air circulation may be susceptible to warm weather damage. These patterns of damage also may be related to variations in the native complex of pathogenic *Pythium* species associated with different sites, and also to the management practices unique to particular areas. These management practices may limit the activity of certain species and favor the activity of others.

Under the cool wet conditions typical of early spring (March–May) and late autumn (October–November), symptoms may first appear as small diffuse yellow or reddish brown patches of turf approximately two to three inches in diameter. Symptoms often closely resemble the early stages of Pink Snow Mold *(Microdochium nivale)* or Necrotic Ring Spot damage. In the spring, plants may be slow to come out of dormancy, and growth may be less vigorous than in uninfected plants. Under severe conditions, patches of infected turf may coalesce, and large areas may appear yellow and in a general weakened condition. Commonly, infected turf responds poorly to the application of fertilizers. As the season progresses and temperatures rise, large areas of previously infected turf may wilt, turn yellow to brown, and die.

Under warm wet conditions in mid-summer (June–August), initial symptoms appear as small tan to brown or bronze patches of turf—very similar in appearance to Dollar Spot patches. Again, these patches may converge on one another and affect large areas of turf. Extensive stands of plants can rapidly wilt and die. With severe infections, plants may wilt rapidly under heat stress, and thinning may be so extensive that large areas may become devoid of plants. Recovery of severely affected areas may take an entire season.

Diagnostic difficulties

PYTHIUM DAMAGED PLANT ROOTS often remain infected throughout the entire year, making it difficult to eradicate from problem sites. The frequency of root infections increases in the early spring during cool, wet periods. The infection rate reaches maximum levels in early summer. From studies on golf course putting greens, these periods of peak root infection typically coincide with Pythium root rot outbreaks. Following heavy infection periods, roots and crowns may contain abundant oospores of several of the pathogenic Pythium species, providing sufficient inoculum for the infection of newly developing roots in the fall and spring. These spores allow the fungus to survive unfavorable environmental conditions in a dormant state, and are insensitive to many fungicidal treatments.

Unlike Pythium (cottony) Blight, no foliar mycelium is evident during periods favorable for infection. Without observable evidence of the actual fungus itself, one can rarely diagnose Pythium root rot from field symptoms alone. Compounding the problem, Necrotic Ring Spot and Summer Patch can produce visual symptoms that are very similar to those produced by Pythium root rot. Thus, only upon micro-

Ideally, a qualified diagnostician should examine turfgrasses suspected of being affected by Pythium root rot, but, for one reason or another, many turf managers presently do not have ready access to such a resource.

scopic examination of roots and crowns can one effectively determine whether the damage is from Pythium species.

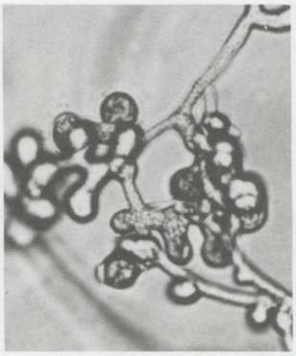
Typically, damage is first evident in the crown—with the roots largely unaffected. However, as the infection progresses on severely infected plants, the root systems may be extensively discolored, and are greatly reduced in volume and vigor. Crown areas may also appear water-soaked and greatly discolored. If root systems are not well developed prior to infection by Pythiums, the level of damage that a root system can sustain, and still function, becomes dramatically reduced. Under conditions of root system restriction, severe plant decline can occur.

On the basis of laboratory and field observations of Pythium root rot, the above-ground symptoms are clearly not a suitable basis for an accurate diagnosis of this disease. The microscopic observation of oospores in root tips, the root cortex and crowns has been the most accurate method of positively identifying Pythium root rot.

One problem with this technique is that much of the root and crown damage can occur as a result of Pythium growth inside the plant—in the absence of large numbers of oospores. Therefore, diagnoses based strictly on observations of oospore quantities are likely to overlook a number of Pythium root rot occurrences. Ideally, a qualified diagnostician should examine turfgrasses suspected of being affected by Pythium root rot, but, for one reason or another, many turf managers presently do not have ready access to such a resource.

Treatment

WE CAN REDUCE the severity of Pythium root rot damage by adjusting cultural practices to minimize plant stress. Maintaining an extensive and vigorous plant root system, as well as the effective management of water, are key elements in minimizing environmental stresses conducive to Pythium root rot.



Microscopic photo of Pythium sporangia. All species of Pythium produce sporangia that give rise to spores that "swim" in free water. That, in fact, is why Pythiums need prolonged wet periods to induce severe disease development. Sporangia are not long-lived and are sensitive to fungicides. Pythium oospores, on the other hand, can survive adverse environmental conditions in a dormant state. This ability helps to make them impervious to many fungicidal treatments.

Biological control of Pythium root rot also appears promising. Recent studies have shown that the application of topdressings—amended with certain composts and organic fertilizers—will reduce the symptoms of Pythium root rot on golf course putting greens. Unlike fungicide applications, application of composts and organic fertilizers may also reduce populations of Pythium species in soil.

If conditions warrant the application of fungicides, the recommended approach is to carefully choose—and thoroughly water in—a currently-labeled fungicide. Although turfgrasses affected with Pythium root rot respond to drenches with Pythium-selective fungicides, symptoms may frequently recur— particularly as temperature and precipitation change. This recurrence happens because pathogen inoculum levels in the soil are rarely suppressed following fungicide applications.

The currently available Pythium fungicides and application recommendations are listed in the table on page 4. Of the systemic fungicides, Banol® or Aliette® have been most effective in controlling Pythium root rot in the Northeast. Subdue® has been effective in some locations, but has failed in others. The granular formulations of Subdue® have been more effective than the liquid formulation. Koban® and Terrazole® are contact fungicides that also have been effective in some locations for the control of Pythium root rot. They are the only fungicides that have been shown to be effective in reducing soil inoculum of *Pythium*.

For sites with a history of early spring Pythium root rot problems, a fall application (mid-October–mid-November) of an appropriate Pythium fungicide (usually Banol®) is most effective in suppressing disease development early in the following spring. This should be followed-up with another application in the spring. In order for control to be effective at any time during the season, the fungicide must reach the root zone. We therefore recommend that all fungicides be thoroughly watered-in at the time of application. We also advise avoiding continuous application of any one fungicide on the same site, since this practice may enhance the development of fungicide-resistant Pythium populations—a phenomenon that researchers have already observed among some strains of root-rotting Pythium species.

Researchers have observed that applications of high rates of several of the newer non-Pythium specific broad-spectrum systemic fungicides actually increased damage from Pythium root rot. That is why we currently recommend that these types of fungicides be used sparingly on sites with a history of Pythium root rot and during periods favorable for Pythium infection. ■

DIGGING DEEPER

Which Pythium makes a difference

PYTHIUM GRAMINICOLA appears to be the principal culprit involved in Pythium root and crown rot disease in the Northeastern U.S. The evidence includes how frequently this particular species has been isolated from creeping bentgrass and perennial ryegrass and the strength of its ability to produce root and crown rot in these grasses.

Not all species of Pythium produce disease. In healthy, as well as diseased, turfgrass stands, researchers can readily isolate pathogenic, as well as non-pathogenic, species.

Little is currently known about the biology and ecology of the major species of *Pythium* that cause Pythium root rot. The most thorough understanding of any of these species on turfgrasses has come from studies of the soil ecology of *P. aphanidermatum,* the primary cause of cottony blight, and, to a limited extent, *P. graminicola.* However, the extrapolation of this information to other root-rotting *Pythium* species is uncertain. We certainly do not know much of the biology of *P. torulosum* and *P. vanterpoolii.* The limited information available on *P. graminicola* and *P. aristosporum* has come from annual crops such as wheat, corn and barley. Research is just beginning to address the biology, ecology and epidemiology of root-infecting Pythium species in established turfgrasses. ■

Pythium species that are generally more damaging under cooler (45°–60° F) conditions include:

- *Pythium graminicola*
- *P. vanterpoolii*
- *P. torulosum*
- *P. aphanidermatum*
- *P. aristosporum*

Species that can damage turfgrass roots under warm (75°–85° F) conditions include:

- *Pythium aphanidermatum*
- *P. graminicola*
- *P. myriotylum*
- *P. aristosporum*
- *P. periplocum*
- *P. vanterpoolii*
- *P. arrhenomanes*

Fungicides for the Control of Root-Rotting Pythium Diseases of Turfgrasses

Fungicide	Trade Name	Formulation	Application Rates (per 1000 ft²)*	Cost Range (per 1000 ft²)
Chloroneb	Teremec SP®	65W	Not Recommended for Pythium Root Rot	
	Tersan SP®	65W	Not Recommended for Pythium Root Rot	
	Scott's ProTurf Fungicide II®	6.3G	Not Recommended for Pythium Root Rot	
Ethazole	Koban®	30W	7 oz.	$8.24–$11.75
			9 oz.	$10.60 –$13.83
		1.3G	8 lb.	$13.87–$18.80
	Terrazole®	35W	8 oz.	$ not available
Mancozeb	Fore®	80W	Not Recommended for Pythium Root Rot	
	Lesco 4®	80W	Not Recommended for Pythium Root Rot	
	Lesco Mancozeb DG®		Not Recommended for Pythium Root Rot	
	Manzate 200®	37F	Not Recommended for Pythium Root Rot	
		75DF	Not Recommended for Pythium Root Rot	
	Tersan LSR®	80W	Not Recommended for Pythium Root Rot	
Metalaxyl	Subdue®	2E	2 oz.	$2.73–$3.48
		2G	1.5 lb.	$3.08–$3.90
		5G	10 oz.	not commercially available
	Scott's Pythium Control®	1.2G	2.5 lb.	$4.74–$6.34
(+triadimefon)	Scott's Fluid Fungicide II®	16AS	Not Recommended for Pythium Root Rot	
(+mancozeb)	Pace®	7+14S	Not Recommended for Pythium Root Rot	
Fosetyl-Al	Aliette®	80W	4 oz.	$.85–$1.06
			8 oz.	$1.70–$2.12.
Propamocarb	Banol®	6S	2 oz.	$3.57–$4.38
			4 oz.	$7.14–$8.76

* All fungicides must be thoroughly watered-in to get effective Pythium root rot control. Only Aliette® can be applied as a spray and still maintain control of Pythium root rot.

Under formulations: W=wettable powder; G=granular; F=flowable; AS=aqueous solution; S=solution; E=emulsifiable

TERMS TO KNOW

contact fungicides .... Chemical agents that attack various forms of fungi on contact.
systemic fungicides ..... Chemical agents that enter and spread through plants attacking fungi throughout the plants.
crown rot .... Decay of the crown of a plant, where the above ground portion of the plant joins the roots.
dormancy .... A state of reduced or suspended activity.
epidemiology .... The study of the spread of diseases in host populations.
foliar mycelium .... Masses of filaments that represent the active growth stage of a fungus and is usually visible on the surface of leaves of infected plants only during the growth stage.
infection period .... The time span during which a disease agent is active and able to spread the disease.
inoculum .... The structures of a disease-causing agent that spread the disease during infection periods. Also used in "pathogen or soil inoculum" to refer either to the disease-causing agent or its presence in the soil.
oospores .... Microscopic reproductive cells of Pythium fungi, which are able to survive adverse environmental conditions.
pathogen .... A disease-causing agent.
pathogenic .... An adjective used to describe the disease-causing potential of an agent.
root cortex .... The major internal portion of a plant root.
sporangia .... Microscopic reproductive cells of Pythium fungi from which swimming spores are produced.
symptoms .... The observable effects of diseases.

Understanding fungicides

FUNGICIDES USED for turfgrass disease control can be categorized as contacts and systemics. Many older fungicides are contact fungicides that are typically applied to foliage to prevent pathogenic fungi from infecting leaves. However, these fungicides are also effective in killing pathogens on thatch and leaf clippings in the turfgrass canopy. Contact fungicides act by killing both dormant spores and dormant and active mycelium of pathogenic fungi. However, they must be reapplied frequently, so that newly formed foliar tissue remains protected. In order for contact fungicides to be effective foliar protectants, they must be allowed to dry on the plant surface after application. Therefore, in order to achieve the most effective control of foliar diseases, they should never be watered-in or applied in the rain. If, on the other hand, they are to be used to control pathogen activity in thatch, they can be watered-in. Since contact fungicides are largely water-insoluble, their movement through thatch is limited and they may not be effective root protectants.

Common fungicides used for turfgrass disease control

	Active ingredient	Trade name(s)	Movement in plant
CONTACT FUNGICIDES			
	Anilazine	Dyrene®	
	Chlorothalonil	Daconil 2787®	
	Etridiazole	Koban®, Terrazole®	
	Mancozeb	Fore®	
	Quintozene	Turfcide®, Terraclor®	
	Thiram	Spotrete®, Thiramad®	
SYSTEMIC FUNGICIDES			
CLASS—			
BROAD SPECTRUM	1. Benzimidazoles		
	Benomyl	Tersan 1991®	Upward
	Thiophanate Methyl	Fungo 50®	Upward
	Thiophanate Ethyl	Cleary 3336®	Upward
	2. Dicaboxides		
	Iprodion	Chipco 26019®	Upward
	Vinclozolin	Vorlan®	Upward
	3. Sterol Inhibitors		
	Fenarimol	Rubigan®	Upward (limited downward)
	Propiconazole	Banner®	Upward (limited downward)
	Triadimefon	Bayleton®	Upward
PYTHIUM-SPECIFIC	1. Carbamates		
	Propamocarb	Banol®	Upward
	2. Acylalanines		
	Metalaxyl	Subdue®	Upward
	3. Ethyl Phosphonates		
	Forsetyl Al	Aliette®	Upward and downward

Many of the modern fungicides used for turfgrass disease control are systemic fungicides. This means that they move in the plant vascular system from the original site of application to other distant plant parts. For example, a systemic fungicide applied to turf foliage may move through the plant to protect roots as well as leaves against infection by a pathogen. Most of the currently used systemics are translocated upward in the plant. A few have downward movement as well.

The way systemic fungicides move in the plant influences the manner in which they should be applied in order to get effective control of specific types of diseases. These properties should be taken into consideration in developing any sound disease control strategy that includes systemic fungicides. In general, foliar disease control with systemic fungicides is more prolonged when they are drenched into the root zone. For example, foliar applications of upward-moving systemic fungicides provide excellent short-term control of foliar diseases whereas drenching the fungicide into the root zone provides a much longer period of protection—as well as control against some root and crown diseases. Root disease control with upward-moving systemic fungicides is only possible if they are drenched into the root zone; whereas, downward-moving systemic fungicides can provide control of root diseases when applied as a foliar spray.

Systemic fungicides have the advantage over contact fungicides in that they

1) HAVE LONGER RESIDUAL ACTION,
2) CAN PROTECT ROOT AND CROWN TISSUES,
3) CAN ERADICATE PATHOGENS that have already infected plant tissues, and
4) CAN PROTECT newly-formed plant tissues.

However, there are some disadvantages to using systemics. Most of them do not actually kill pathogenic fungi, but simply suppress pathogen activity. This is usually accomplished through a very specific mode of action. Repeated application of fungicides with the same mode of action provides selection pressure that greatly enhances the opportunity for pathogens to develop resistance. Once resistance to a particular fungicide develops, that fungicide is no longer effective. Therefore, the same fungicide should never be used repeatedly over prolonged periods of time.

The development of fungicide resistance can be minimized by

1) ALTERNATING FUNGICIDES with different modes of action;
2) USING FUNGICIDES WITH DIFFERENT MODES of action in mixtures; or
3) ALTERNATING OR MIXING systemic fungicides with contact fungicides.

In the above table, systemic fungicides in the same class have the same mode of action. Those in different classes (numbered 1, 2, 3) have different modes of action. Therefore, broad-spectrum systemic fungicides should always be mixed or alternated with fungicides in other classes and never with those in the same class. Likewise, Pythium-specific fungicides should always be mixed or alternated between classes. ■

Patch disease co-factors

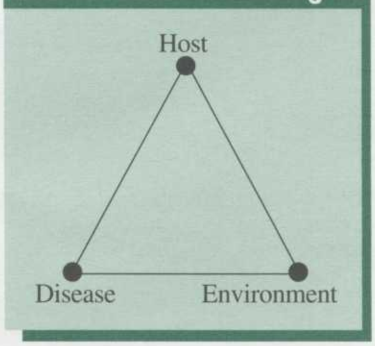
A host of unrecognized, contributing factors

by Christopher Sann

CONSISTENTLY CONTROLLING Patch disease damage in the field is frustrating. Compounding the problem, some turf managers and lawncare operators—all of whom are human beings, after all—may have difficulty admitting that they don't know what is happening. Few bosses or customers want to hear that. The result is that a turf professional may be tempted to simply ignore the damage, or to try a variety of "stab in the dark" corrective measures—some of which can actually intensify the damage. Both methods can ultimately lead to the loss of a job or loss of customers.

Turf managers could relieve much of their frustration, if they would take the time to understand the idea of patch disease co-factors and the role that they play in the appearance of visible patch disease damage.

Classic Disease Triangle



What are co-factors?

PATCH DISEASE CO-FACTORS are any conditions that adversely affect the turfgrass host in a way that contributes to the development of visible patch disease damage. They are the added ingredients that tip the natural balance, which exists between the host and the disease pathogen, from a non-visual state toward the symptomatic or visible state. Frequently, patch disease co-factors are conditions that affect the size and health of the host plant's root system.

One success hasn't lead to another

SUCCESSFUL TURFGRASS MANAGERS are familiar with the three factors that make up the classic disease infection triangle:

- THE HOST
- THE DISEASE CAUSING PATHOGEN
- AND THE ENVIRONMENT in which both host and pathogen live.

Also, many managers have observed that, with common foliar diseases of turfgrass, there is a straight line, linear relationship between the infection and the appearance of symptoms.

An understanding of the three factors of the disease infection triangle and the linear relationship between infection and symptoms has been essential to control most of the foliar diseases. This understanding has lead to an unprecedented ability to control most foliar turfgrass diseases. Unfortunately, as a model for understanding and controlling other types of turf diseases—this linear paradigm, or model, has hindered understanding the biology—and the control—of patch diseases. They don't fit the mold.

An understanding of the three factors of the disease infection triangle and the linear relationship between infection and symptoms has been essential to control most of the foliar diseases.

Unlike foliar diseases, all patch disease pathogens attack the root system of the host plant before any foliar symptoms appear. Also, unlike foliar diseases, patch disease pathogens range from slow to very slow in terms of the speed with which they can damage host plants. With foliar diseases, after the initial infection, the appearance of symptoms only takes somewhere from a few hours to a few days. In contrast, the onset of visible symptoms caused by patch diseases can take weeks, months and even years *(see chart page 7)*.

This long delay between the initial infection period and the appearance of symptoms—combined with turfgrass managers historical tendency to look for a more linear relationship—is at the core of much of the misunderstanding, and the incorrect diagnosis of, patch diseases.

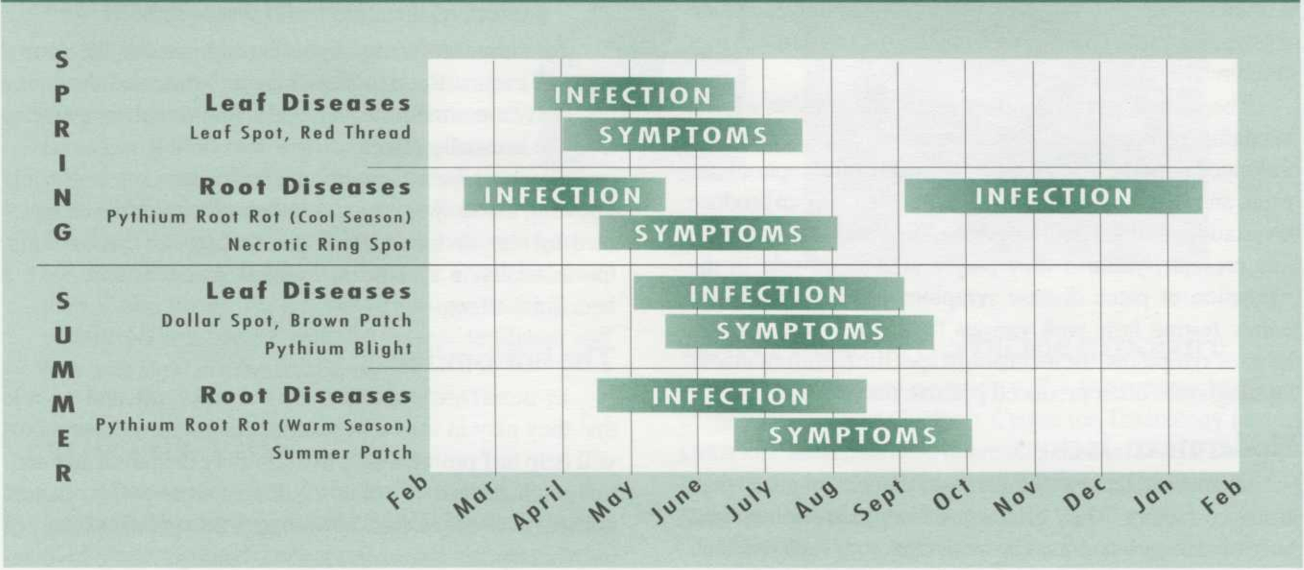
Why are co-factors important?

CO-FACTORS ARE FREQUENTLY THE CATALYST between the initial infection or root damaging period and the onset of symptoms. If the co-factor has a strongly deleterious effect on the health of the host, then the symptoms will appear quickly. If the co-factor's effect on the host is less severe, then the symptoms can take considerably longer to appear. The weakest co-factors often require the addition of a second, or even third, co-factor to bring on visible symptoms. Often, patch disease infection will not produce any obvious symptoms—either because an element of the disease infection triangle has been removed, stopping the infection, or there are no co-factors of sufficient strength to adversely affect the health of the host.

Different groups of co-factors

CO-FACTORS CAN GENERALLY BE DIVIDED into three groups—strong, moderate and weak:

Infection and Symptom Relationships



- STRONG CO-FACTORS are conditions that either actively damage a host's root system or severely restrict its growth. Strong co-factors combine with the patch disease pathogens to produce symptoms within weeks.
- MODERATE CO-FACTORS are those conditions that weaken the host or limit its ability to recover. Moderate co-factors typically produce symptoms in a period of months.
- WEAK CO-FACTORS are conditions that often require one or more additional co-factors to produce visible symptoms. Weak co-factors can take many months or even years to produce symptoms. Without additional co-factors, weak co-factors sometimes produce chronic—rather than an acute—symptoms that persists for years. Chronic symptoms may manifest themselves as a nondescript, poor quality turf— a turf that is slow to react to normal maintenance—or one that is vulnerable to persistent infestations from opportunistic diseases, such as Nigrospora or Red Thread.

Strong co-factors

STRONG CO-FACTORS CAN GENERALLY be divided into two groups—physical/chemical and pathogenic. Of these two groups, the physical/ chemical group is the largest and are probably the least recognized as contributing to the appearance of patch disease symptoms.

Both mechanical and chemical soil compaction reduce root hair growth, by eliminating soil pore spaces—the spaces between the various particles that make up the soil. There are many kinds of mechanical soil compaction:

- THE COMPACTION OF SURFACE SOILS caused by high volume foot and vehicular traffic is well known.
- LESS WELL KNOWN is the compaction of subsoils in newly constructed areas, which is caused by the inappropriate use of large machinery.
- THE MECHANICAL CULTIVATION OF AN AREA, without the incorporation of high humus materials, and it's subsequent destruction of the soil profile, can lead to compaction.
- THE SEALING OF BARE SOIL SURFACE AREAS by rainfall or irrigation frequently can lead to compaction problems.
- THE CONSTRUCTION OF TURF AREAS using materials of dissimilar particle size often leads to the settling of the smaller particles down through the soil profile, causing an area of compaction to develop. This settling of dissimilar soil particles to form a compaction layer—called a pan—is hastened in chronically saturated soils.

Chemical compaction can occur when soil chemistry is neglected. Soil chemistry degrades over time causing calcium, which normally creates a positively charged layer around the soil particles (flocculation), to be stripped away. This allows the remaining positively and negatively charged soil ions to bind together electro-magnetically. This electrochemical compaction can also occur in well managed, but saturated soils.

Various forms of layering make up the other large portion of the physical co-factor group. Layering, when it occurs near the soil surface, often presents an almost impenetrable barrier that limits the size of a plant's root system. Both decomposed and undecomposed thatch at the soil surface is the most common example of layering. There also can be layering between two divergent soil types, called a soil interface, such as that which occurs when sod grown in one soil type is laid on a different soil type. Soil interface problems also can occur when a thin layer of soil is added on top of an existing soil and the new soil is not mechanically mixed with the old. Multiple layering can occur when new soil is spread on top of soil that has a thatch layer or where the existing turf has not been removed.

Both compaction and layering pose an additional problem beyond the physical limitation of a plant's root structure.

– continued on page 8

Compaction and layering frequently act as a hindrance to the normal downward percolation of water. When water is slow to drain through the root zone, the accompanying exclusion of oxygen and the build up of waste toxins can damage root structures.

The second group of strong co-factors consists of root damaging pathogens. In root zones that are saturated for prolonged periods, diseases like Pythium or Phytophora can result, and, when combined with patch diseases, can produce devastating results. There have been some indications that the ever present Pythiums may play a significant role in the expression of patch disease symptoms. In some early research, testing how well various fungicides control patch diseases symptoms, the inclusion of specific pythium-attacking fungicides often produced positive results.

Moderate co-factors

MODERATE CO-FACTORS are a much broader group than strong co-factors. Their effects are often more subtle than those of strong co-factors. The moderate group includes such conditions as

- IMPROPER CULTURAL PRACTICES,
- THE FAILURE TO MONITOR AND CORRECT soil chemistry imbalances,
- THE IMPROPER USE OF FERTILIZERS, including timing and composition,
- THE FAILURE TO MAINTAIN A HIGH ENOUGH LEVEL OF FERTILITY—thereby affecting the host plant's ability to recover from damage,
- IMPROPER WATERING PRACTICES,
- IMPROPER DRAINAGE.

The list goes on and on.

Weak co-factors

WEAK CO-FACTORS REQUIRE either multiple layers of additional weak co-factors or, more often, the outside intervention of an additional force to produce patch diseases symptoms. These outside forces could be drought, high soil temperatures, dramatic change in a turf stand's environment, or insect attacks.

Which co-factors should be controlled?

DECIDING WHICH CO-FACTORS should be controlled and how much of an effect controlling a given co-factor will have on the ultimate production of obvious symptoms is difficult. First, more research still needs to be done on which co-factors have the greatest effect on which pathogens. Even when these relationships have been analyzed, the individual conditions at each infestation site will determine the order in which co-factors should be corrected or controlled.

In general, strong co-factors should receive immediate intervention:

- IF THE PROBLEM IS COMPACTION, then appropriate corrective measures, such as coring or aeration, should be initiated.
- IF THE PROBLEM IS LAYERING, then aeration and wetting agents should be used.
- IF THE PROBLEM IS PATHOGENIC, then cultural practices should be changed accordingly. If that proves ineffective, then fungicides should be used.

Moderate co-factors should be addressed in the normal flow of events. Recognizing their presence and designing corrective measures to be included in the normal maintenance of a site is usually effective.

Weak co-factors require the least intervention. Usually knowing that they exist and that their effects can be exaggerated by outside forces alerts you to keep an eye on them. Occasionally, a change in cultural practices can have a beneficial effect.

The bottomline

UNDERSTANDING WHAT CO-FACTORS ARE and the role that they play in the expression of patch disease symptoms will help turf professionals to accurately diagnosis and control patch diseases. Combining this awareness of co-factors with the ever increasing knowledge of the specific biology of individual patch disease pathogens should put turfgrass managers in a much better position to actually manage the dreaded patch diseases. ■

What do we mean by "patch disease"?

"PATCH DISEASE" is a loose field term that refers to a variety of late summer diseases characterized by large areas of damage. Previously, researchers gave a variety of names to this group, including Fusarium Roseum, Fusarium, Fusarium Blight and Fusarium Blight Syndrome.

Although the term still has not been defined precisely, current thinking includes in this group the pathogens that cause:

- NECROTIC RING SPOT—a problem on all cool season turf varieties except the bent grasses
- SUMMER PATCH—a problem on the bluegrasses, both perennial and annual, and the fine fescues
- TAKEALL PATCH—primarily a problem on bent grasses.

Although patch diseases can be a problem in low maintenance turf, they are predominantly a problem of high maintenance turf.

Because of the variability of the symptoms of these diseases and the fact that more than one pathogen may be present and active, a positive visual diagnosis can be very difficult. Laboratory culturing and microscopic examination are the only certain way to determine which specific pathogens are present, but that still may leave unanswered the question of which pathogen is actually causing the damage. ■

FIELD TIPS

Liming & fertilizing

If you are applying fertilizers and limestone at the same time, you should reconsider the practice. When you apply fertilizer and limestone within two weeks of each other, a substantial part of the nitrogen will be lost to a phenomenon known as "ammonia volatilization." In a rising pH environment, ammonium (a form of ammonia) becomes a gas. It volitalizes, and is lost from the soil into the air. The amount of nitrogen that is lost to volatilization is higher with fast release fertilizers and less with slow release fertilizers.

Why lime turf?

When soil acidifies, the hydrogen ion concentration increases. These hydrogen ions become electrically bound to electro-magnetic exchange sites that are the nutrient holding areas in the soil. As these exchange sites become bound up, there are fewer areas to hold plant nutrients. With fewer sites available, plant nutrients are more vulnerable to leaching and volatilization. Under very low pH conditions 80-90% of the nutrient-holding sites can be bound up, causing severe turf starvation.

A further note–always use a soil test to determine what type and how much lime to use.

Focus on turf roots or leaves?

If there was ever a question as to what part of the turfgrass plant—leaves or roots—turfgrass managers should emphasize, consider these two facts:

- UP TO 90% of the mass by weight of the turfgrass plant is roots and
- UP TO 80% of the root structure of the turfgrass plant is regenerated each year.

Potassium's value confirmed

Recent studies have demonstrated why potassium is important to healthy plant growth:

- HIGH LEVELS OF POTASSIUM increase cell wall thickness and cell turgor or internal pressure, which help to increase wear tolerance,
- POTASSIUM DECREASES THE LOSS OF WATER through transpiration,
- LATE FALL APPLICATIONS of high potassium and low nitrogen fertilizers can improve winter hardiness,
- POTASSIUM INCREASES ROOTING and, therefore, increases drought tolerance.

Lower risks of herbicide exposure

A recent study of exposure to 2,4-D by researchers at the University of Guelph's Centre for Toxicology in Ontario, Canada, showed interesting results. They tested exposures of applicators, mixers and bystanders to 2,4-D and other broadleaf herbicides.

The average applicator exposure per day was approximately 1/90th of the acceptable daily limit set by the World Health Organization (WHO). The highest exposure levels occurred to applicators who used poor handling techniques or poor personal hygiene. Although mixers have a higher potential for exposure than applicators, their exposure was 1/330th of the daily limit.

Homeowners who have their lawns commercially sprayed with 2,4-D showed no exposure. As a part of the study, two groups actively exposed themselves one hour after spraying by alternately walking, sitting, and laying for one hour on treated areas. The group that wore long pants, shoes, and t-shirts did not show any exposure. The group that wore shorts and went barefoot had an exposure that did not exceed 1/60th of the WHO standard. Two groups that waited 24 hours before exposing themselves to test areas showed no signs of exposure.

The researchers concluded that applicators should wear recommended clothing when applying the herbicide and follow training guidelines. Homeowners, children and pets should stay off sprayed lawns for 24 hours.

Consider options when replacing spray tips

While brass spraying tips are the traditional choice, the next time you replace your spraying tips you might consider using tips made of alternative materials. New polymer tips cost about the same as brass tips, but can give up to four time the useful life. Stainless and hardened stainless tips cost approximately twice as much as their brass counterparts, but last five to 15 times longer. The new ceramic tips are three times as expensive as brass, but last an impressive 50 times longer.

Your final choice should be determined by the materials that you spray, but clearly automatically going with brass tips may not be the best choice in the long run.

Volatility seen as factor in applying pesticides

Research at the University of Massachusetts on pesticide volatility yielded the following observations and recommendations:

- WHERE POSSIBLE, USE THE LEAST VOLATILE formulation of a pesticide. In situations where volatility may present a problem, consider using granular formulations.
- WIND SPEED AND TEMPERATURE have a substantial influence on volatilization. Differences of 15 to 20 degrees can increase the rate of volatilization by 300 to 400%.
- IRRIGATION OR RAINFALL AFTER AN APPLICATION reduces the potential for volatilization by moving the pesticide into the crown and root areas.
- APPLY PESTICIDES in the early morning or late afternoon in areas where volatilization is a problem. Temperature and wind tend to be at their maximum in the early afternoon. ■

BACK-AT-THE-OFFICE

YOUR COMPANY NAME

RESTRICTED USE PESTICIDES LOG

APPLICATOR: ______________________________

PRODUCT	ACTIVE INGREDIENT	%	DATE	AMOUNT	LOCATION	TARGETED PEST(S)

Recording use of pesticides

Certified applicators must keep records on their uses of restricted use pesticides. Such records are also useful, since they help you measure the effectiveness of the pesticides you use—and they are essential documentation, if you are unfortunate enough to ever have a customer bring a lawsuit against you.

The records can be as simple as a piece of paper with a column for each category of information—or a computerized database with sophisticated sorting and reporting options.

Here are a few points to consider when setting up your pesticide use log:

- THE COLUMNS SHOULD BE WIDE ENOUGH for the information you will be entering, but narrow enough that the form fits on a convenient standard size of paper.
- FOR ONE-PERSON OPERATIONS, the applicator will always be the same person; however, for larger concerns, the records should reflect which certified applicator made each application.
- THE FIRST FIVE COLUMNS RECORD the pesticide you applied, when you applied it, and how much you applied. Listing the chemical isn't specific enough. Instead record the product name, the active ingredient, and the percent of that ingredient in the product.
- DEPENDING ON HOW DIVERSIFIED YOUR BUSINESS IS, you may want to specify location by the customer's name, the crop or type of plants, and/or the particular site.
- BASICALLY, THE LAST COLUMN RECORDS WHY you applied the selected pesticide to that particular location. ■

The big unstated issue

by Christopher Sann

UNSTATED BUT, NEVERTHELESS, quite clear in "What do we mean by 'patch disease'?" *(see page 8 boxed article)*—and virtually every article in this publication—is a fundamental issue that needs airing. Who determines which questions are researched and which ones are left unanswered? In other words, the issue is whose perspective is more decisive in today's turfgrass industry:

- PRODUCT END USERS, including both professional turfgrass managers and their customers and people who care for their own lawns.
- "PURE" ACADEMIC RESEARCHERS, whose primary goal is to expand the boundaries of biological knowledge.
- PRODUCT MANUFACTURERS and the researchers whom they directly employ or at least fund
- THE LEGISLATORS AND REGULATORS who promulgate and enforce everything from health and safety related rules to the rules governing advertising and claims about product efficacy and labeling.
- AND, FINALLY, THE GENERAL PUBLIC, many of whom may not even have a lawn, but who, nonetheless, do have a say in the regulatory process. The general public—even the inactive portion of it—also plays a variety of significant roles in the turfgrass market.

First of all, I am not trying to begin another acrimonious them versus us debate. Quite the contrary. The future of the turf grass industry depends on how well the give and take between all of these different perspectives is managed.

Currently, the perspective of the manufacturer-sponsored researcher virtually dominates today's turfgrass industry. There are several reasons why this is so. The relatively young age of this industry—combined with the fact that the industry has little or no formal educational structure—has left the manufacturer/researcher as the dominant sources of "hard" information. This, in turn, has lead to a system where most of the information that is available is generated at the behest of the manufacturing sector and is predominantly product oriented.

The industry's regulators have had a modifying effect, but not enough of one to change the basic dynamics of the system or its dominance by product manufacturers.

Only a very small portion of available research moneys actually go to "pure" research. Unfortunately, this leaves a situation where a relatively few individuals, companies, and organizations exercise quite a bit of control over the generation of information. The profit motive is an effective force only when it is coupled with a recognition of market needs . Advertising muddies the situation, because its persuasive power can create, distort, and even destroy the perception of real needs. For that reason information that is primarily motivated by the goal of selling products has never been a leader—rather it has been, and will always be, a follower.

Frankly, despite these limitations, the profit motive of generating information and effective products has helped this industry mature out of its infancy. This maturation is an ongoing process that probably would not have occurred without the input and dominant perspective of the manufacturer/researcher.

However, most of the easily garnered information has

– continued on page 13

REGULATORY WATCH

Feds crackdown on "haphazardous" waste reporting

THE E.P.A. AND SEVERAL STATES have begun identifying, citing, and fining hazardous waste generators, who have failed to comply with RCRA regulatory reporting requirements. Fines have totaled more than $20 million to date, and in some cases the agency has brought criminal, as well as civil, prosecutions against offending companies.

New regulations cover storm water run-off

THE E.P.A. IS IN THE PROCESS of implementing new regulations on storm water discharge from commercial sites. The regulations are designed to control the "non-point" discharge of pollution into storm water systems. Under these regulations, some fertilizer and pesticide manufacturers now come under the revised Clean Water Act. Two groups in the turf industry may come under the regulations:

- FIRMS ENGAGED PRIMARILY IN MIXING fertilizer materials
- FIRMS THAT PRIMARILY FORMULATE and prepare pesticides.

For additional information, interested companies should contact their nearest E.P.A. office or call the E.P.A. Storm Water Hotline at 1-703-821-4616.

Well water survey continues

THE E.P.A. RELEASED the second phase of its National Survey of Pesticides in Drinking Water Wells. The results support the conclusions that were reached in phase one of the study: pesticides and nitrogen residues found in drinking water do not pose a serious health hazard.

The residues found in phase one were lower than established limits and the number of pesticides found was relatively low. With the exception of atrazine, a warm-season turf herbicide, no residues of turf-applied pesticides were found. Atrazine is extensively used in agriculture. ■

The state of turfgrass research

by Dr. Eric B. Nelson

THE STATE OF TURFGRASS RESEARCH has seen a spectacular evolution as demands to meet the needs of an ever-changing industry have become more acute. In just the past five to ten years, dramatic changes in government regulations, public opinions, and philosophies about turfgrass management have propelled this evolution to warp speeds.

In the past, turfgrass research efforts were limited largely to larger manufacturers of turf-related products, who had the resources to support research efforts ultimately aimed at promoting their own particular products. Independently generated biology-based research was an area of exploration left mainly to the curiosities of a handful of university faculty, who saw turfgrass biology merely as an interesting sideline to their primary research program. As a result, a solid body of information on the biology and ecology of turfgrass ecosystems has not developed.

A principle factor limiting the generation of biology-based information on turfgrasses has been, and continues to be, that few scientists across the country have positions in universities that allow them to devote their full-time efforts to turfgrass research. Turfgrass agronomists are perhaps the only exception to this situation. They generally have full-time responsibilities for turfgrass research extension and in teaching. When one looks at the turfgrass sub-disciplines, such as entomology, pathology, and weed science, there are probably only four or five people nationwide, in each sub-discipline, with positions that allow them to devote their full-time efforts to turfgrass research. As a result, the generation of biology-based information for the turfgrass industry has come slowly and only in bits and pieces.

One only has to look at research efforts with other commodities to realize the state that turfgrass is in. For example, at some universities, there may be as many as 10–15 faculty across a campus devoted to both basic and applied aspects of wheat or corn research. There is substantial incentive to develop research programs in these areas, because they are food crops that occupy considerable acreage nationwide. Research funding for commodities such as these can be considerable. Compare those figures with the 0–6 faculty at any given university, who maintain only part-time responsibilities for turfgrass research. It is not surprising, therefore, that the information needed for turfgrass managers to make sound biological decisions is lacking.

Over the past 10 to 15 years, turfgrass associations in many states have become more organized and have developed granting programs or foundations to support turfgrass research in their respective states. In these situations, the resources that, in fact, are held in the hands of the beneficiaries of that research, (i.e., the lawn care operator, the golf course superintendent, the landscaper, etc.) can now go to work to generate biologically specific information for the betterment of the industry as a whole—instead of for the betterment of specific products or product uses.

One only has to look at research efforts with other commodities to realize the state that turfgrass is in. For example, at some universities, there may be as many as 10–15 faculty across a campus devoted to both basic and applied aspects of wheat or corn research.

During the past decade, there have been considerable advances in turfgrass biology in the folowing areas:

- TURFGRASS NUTRITION
- PATHOGEN BIOLOGY AND ECOLOGY
- INSECT BEHAVIOR AND CONTROL
- SOIL SCIENCE
- WEED MANAGEMENT
- AND INTEGRATED PEST MANAGEMENT.

Advances in all of these areas have dramatically changed the ways in which turfgrasses are managed. These advances have occurred as a result of key groups within the turfgrass industry being more outspoken about the importance of turfgrasses to our environment and our society and about the need to understand biological processes in turfgrass ecosystems for most effective, sustainable, economical, and environmentally sound turfgrass management. Those advances would not have been possible without the resources provided by various turfgrass associations, and both federal and state funding agencies, as well as the commitment from turfgrass scientists across the United States, who, for the most part, are young, enthusiastic, and full of new and innovative ideas and management approaches for the turfgrass industry.

Research results have been traditionally delivered to the beneficiaries of this information through various channels—such as field days, workshops, conferences, newsletters, fact sheets, bulletins, etc. However, we need to expend much more effort on getting the proper information to the proper audiences. We have designed *Turf Grass Trends* to facilitate this transfer of information—so that the latest and most significant biologically-based information can be relayed to the end-user—but obviously one newsletter is not going to solve the whole problem. In effect, closing this biological information gap parallels the effort by manufacturers to shorten the gap between their research and development and the marketing of new products. In both cases, the idea is to not waste time and opportunity. ■

Unstated issue *continued from page 11*

been collected. The work that remains to be done in these established areas of knowledge is mostly fine tuning. What remains to be learned about the biology of the turfgrass ecosystem will come at a much dearer price and the profit motive does not do this kind of work particularly well at all—because it tends to stop at "good enough." As Dr. Nelson implies in his editorial, what is good enough for a sales manager may not be good enough for the biology-oriented "pure" researcher. It is also not good enough for end users, struggling with all the complexities out in the field.

The turfgrass industry needs to gradually shift the emphasis away from product-oriented information towards the real world needs of turfgrass managers and other end users. Their need for biologically specific, rather than product specific, information should become the driving force of the industry. My goal in starting this newsletter is to contribute—however humbly—to this trend. Everyone would benefit from it:

- RESEARCHERS WOULD RECEIVE THE SUPPORT they need in order to spend more time and effort to independently answer biology-based information needs.
- MANUFACTURERS WOULD BE ABLE to take that information and, where appropriate, develop new products or techniques that put the information to work.
- REGULATORS WOULD BE ABLE TO USE the information to develop better, more appropriate rules and regulations.
- AND THE PUBLIC COULD CONCENTRATE on weightier matters that cry out for its attention—confident that the management of the huge amount of land devoted to turf is being handled effectively, efficiently, and in an environmentally sound fashion. Hysteria and misinformation would have much less impact than they unfortunately do have at the present moment.

There are a series of internally and externally generated "philosophical" questions, with which the turfgrass industry is now wrestling, such as are we devoting enough, or too much, of our limited resources to the management of these non-crop plants.

For the most part, these questions have been left unanswered due to a lack biologically specific information. If—or let's be optimistic and say when—this information begins to flow, in a more consistent manner, many but not all of these questions will resolve themselves. Some questions will still remain for which there are no clear-cut answers. Then we, as members of an evolving society, as well as an evolving industry, will be better equipped to face the vagaries of nature and the uncertain opportunities of the future. ■

ASK THE EXPERT

HAVE A QUESTION on any aspect of turf management? Send it to: Ask the Expert, Turf Grass Trends, 2070 Naamans Rd., Suite 110, Wilmington DE 19810-2644 or fax it to (302) 475-8450. If we can't answer your question, we will put it to the best available expert on the subject.

ON THE HORIZON

Killer proteins identified

ENGLISH RESEARCHERS have recently shown that a new group of naturally occuring toxic plant proteins can be effective in controlling sucking insects. The toxic, plant-produced proteins may have potential as pesticides, or they might be introduced into bio-engineered plants.

Dry encapsulation benefits workers and plants

MONSANTO HAS INTRODUCED a third micro-encapsulated product, a dry herbicide in a microscopic polymer shell, for the agricultural market. By varying the size of these water-applied shells, this technology offers improved worker safety, possible reduced application stress effects, increased resistance to leaching, and time-release characteristics not found in existing traditional liquid-applied formulations. In the future, this technology may lead to advances in liquid and granularly applied pesticides for the turf industry.

Biological controls are tricky

BIOLOGICAL PEST CONTROL, using biological predators to control pest infestations, has been the subject of increasing interest, particularly in agriculture, but there are serious limiting factors to their use on turf becoming widespread:

- THE TIMING OF CURATIVE APPLICATIONS can be difficult, particularly if the bio-control agents need to be grown to order. By the time the controls are applied, major damage could be done, or the pest may no longer be present or vulnerable.
- PREVENTIVE APPLICATIONS WORK BETTER, but, given the limited life spans of some bio-control agents, timing may be a problem.
- QUALITY CONTROL IS A MAJOR PROBLEM. Both production methods and transportation conditions can have dramatic effects on the efficacy of the control.

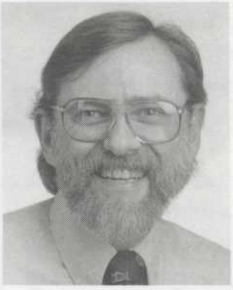
Interest in biological controls will continue, as will research on overcoming the problems associated with them, but turf managers should not expect dramatic advances in the immediate future.

Are drift control agents coming to turf?

DRIFT CONTROL AGENTS are materials designed to help applicators control the drifting of pesticides to non-target locations. Added to sprays, small amounts of these chemicals have been shown to reduce drift deposits on off-target locations by 50% to 80%. They were also shown to increase the amount of pesticide reaching the targeted area by 33%. Their proper use may allow for reduced application rates. Drift control agents are not yet available to the turf industry, but 15 such agents are in use for agricultural applications. ■

A worthy challenge

by Russ McKinney



AT FIRST GLANCE, caring for lawns is not a complex business. After all, for thousands of kids, mowing their neighbors' lawns is a more common first venture than the proverbial lemonade stand. All they need is Dad's lawnmower, a can of gas, and a little initiative.

From such humble beginnings, lawncare has grown into a multibillion dollar industry. It employs tens of thousands of professional turf managers and independent lawncare business operators. The entry level requirements for the frontline sector of the field are still relatively low. Many people enter the field without the benefit of a long period of specialized pre-employment training. Once in the field, the on-going educational requirements for certification are minimal.

But there is a lot to learn. Lawn care-givers must choose from:

- A WIDE SELECTION OF MACHINERY
- DIFFERENT VARIETIES OF GRASS
- VARIOUS METHODS OF PLANTING GRASS
- DIFFERENT WAYS OF HANDLING various kinds of soil conditions
- AND A HOST OF FERTILIZERS AND DISEASE and pest treatments designed to deal with a formidable array of turf diseases and plant pests.

In addition, turf managers must understand

- A DAUNTING AMOUNT OF TECHNICAL INFORMATION provided by manufacturers and academic researchers, and they must meet or comply with
- A GROWING LIST OF ENVIRONMENTAL REGULATIONS and standards.

For lawncare operators to succeed as businesses, they also must meet

- THE DEMANDS AND CONCERNS OF THEIR CUSTOMERS
- THE CHALLENGES OF THE COMPETITION for those customers
- AND A WHOLE OTHER WORLD of organizational and recordkeeping requirements related to "simply" being in business, paying taxes, and having employees.

The difficulties presented by this list of variables is compounded by the fact that all of them are more or less constantly changing.

How will *Turf Grass Trends* help?

Our aim is to provide a single independent source of reliable, usable information on the full range of topics involved in this field. We will cover specific topics in detail, but, as our name suggests, we will help our readers keep an eye on the general direction of changes. We also will seek to distinguish between verified facts and "mere" opinions—including our own. In short, *Turf Grass Trends* will help frontline lawncare decision-makers to educate themselves, so they can make their own, more informed decisions.

While many publications contain more advertising than actual editorial content, from cover to cover, *Turf Grass Trends* will be nothing but news, information, commentaries, and discussions. We will not be distracted by the need to sell advertising, and we will not be compromised by the ever present temptations of the publication and advertiser relationship.

We also aim to help our readers develop their own independent judgment about the enormous amount of information which is, in fact, put out by businesses with an obvious interest in promoting particular products and approaches. We will devote space to the perspectives of businesses involved in the lawncare industry, but the views expressed will be clearly labeled.

This does not mean that we will seek controversy for its own sake. It means that we will not hesitate to cover a subject, or to express our view on a subject, because it might be controversial. Like all industries, turf management deals with a variety of unsettled questions. Opposing opinions are to be expected.

While our primary audience will be lawncare operators and turf managers, we believe that *Turf Grass Trends* will help manufacturers and suppliers, academic researchers, and government regulators as well. In these fast-paced times, everyone has difficulty keeping up with new developments. *Turf Grass Trends* will provide a common forum for these different segments of the industry.

Who will produce *Turf Grass Trends?*

To provide the required depth and breadth of coverage, *Turf Grass Trends* will be produced by a team whose qualifications cover the whole range of technicalities and topics:

- CHRISTOPHER SANN is a successful lawncare operator with 18 years of experience where it counts—out in the field. In 1990 he began sharing his expertise as a columnist for Lawn Care Industry magazine.
- DR. ERIC B. NELSON is Assistant Professor of Plant Pathology at Cornell University. He is one of the most respected academic researchers working on expanding the scientific understanding that underpins progress in the field.
- RUSS MCKINNEY is an an award-winning business writer and illustrator, who has published hundreds of articles and illustrations. He understands the business and regulatory environment that lawncare shares with other fields, and he knows how to translate complex information into plain language.
- OTHER PROFESSIONALS—turf managers and lawncare business operators, academic researchers, and representatives of businesses and government agencies involved in the field—will contribute in various ways:

by serving as contacts for quoting in articles and by serving as guest experts and commentators.

- OUR READERS also will have several ways of contributing: suggesting topics, submitting their own comments and questions to experts on specific subjects, providing tips on practices that have worked for them, and participating in the discussion of issues and writing letters to the editor.

In today's world, becoming better informed is essential to doing a better job—and to staying in business. *Turf Grass Trends* will improve the flow of information that is as vital to greener, healthier lawns as using the right kinds of grass, the right fertilizer, and the right disease and pest controls. By improving the flow of information, *Turf Grass Trends* will help promote a greener, healthier lawncare industry. ■

LETTERS TO THE EDITOR

Readers who wish to comment on any aspect of the articles, news items, or commentaries published in *Turf Grass Trends,* or on any issues or concerns raised by them, should do so by writing to:

TURF GRASS TRENDS
2070 Naaman's Rd., Suite 110
Wilmington, DE 19810-2644

Please include a return address. Where appropriate, and as space allows, we will respond to the letters we publish. We reserve the right to edit all letters. All published letters become the property of *Turf Grass Trends*.

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- ☐ TURF-RELATED INDUSTRY (MANUFACTURING, DISTRIBUTION, ETC.)
- ☐ GOVERNMENT AGENCY
- ☐ COLLEGE OR UNIVERSITY
- ☐ FACILITY MANAGEMENT OR MAINTENANCE

NEWS CONTACT:

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____

____

WHAT CURRENT TREND IN THE TURF MANAGEMENT INDUSTRY ARE YOU MOST CONCERNED ABOUT?

____

____

OTHER SUBJECTS OF SPECIAL INTEREST TO ME ARE:

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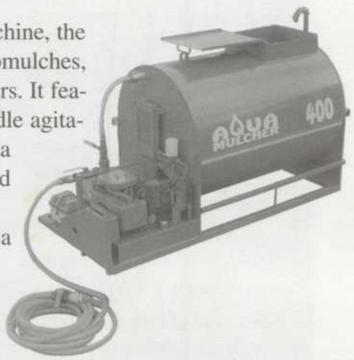
THANK YOU.

JUST OUT

Aqua Mulcher



A compact 400 gallon machine, the Aquamulcher hydroseeds, hydromulches, tacks straw, overseeds and waters. It features all steel construction, paddle agitation, a hydrostatic agitator drive, a centrifugal pump and a clutched pump drive.

Aqua Mulcher comes with a 100 ft. extension hose, nozzle control valve and nozzles, and quick disconnect hose fittings. Its working weight is 4,730 lbs. Its fiber mulch capacity is 150 lbs. of wood mulch or 200 lbs. of paper mulch. With one tank load, the Aqua Mulcher can hydromulch 4,500 sq. ft. in approximately 30 minutes.

For more details, call or write to:

Tailgate Mulcher, TGMI, Inc.
11074 Ashburn Ave., Cincinnati, OH 45240
800-241-8464

Aquatrols offers new formula & new package

Aquatrols has reworked its AquaGro•S soil wetting agent to provide a more concentrated product that costs less to use. Packed in an easy-to-open 40 lb. bag that replaces the 52.5 lb. corrugated box, in which AquaGro used to come, AquaGro 20•S costs 10% less per bag and 15% less to apply per 1,000 sq. ft., according to Aquatrols.

For more details, call or write to:

Aquatrols,
Cherry Hill Industrial Sites, Bldg. 26
Cherry Hill, NJ 08003
800-257-7707, FAX 609-751-385

Deer don't like Milorganite

Many cities are seeking new and creative ways of handling their waste, and Milwaukee continues to lead the way. Since 1926, the city has produced Milorganite fertilizer, a co-product of its waste water treatment. What better way to celebrate its 65th year than to document another benefit.

A Cornell deer study is now yielding evidence that the fertilizer has a co-benefit: applied around the base of hostas and yews, it repells deer . The recommended application rate is 5 lbs. per 100 sq. ft.

"The deer are definitely staying away from the Milorganite applications at this time," says Les Hulcoop, the Cooperative Extension Agent for Dutchess County, New York. Mr. Hulcoop is coordinating the study, which will continue for another year. It will assess whether the milorganite applications remain effective through the winter. Many deer repellants lose their effectiveness in winter. It will also see if bags of Milorganite hung from plants has the same repellant effect.

For more details, call or write to:

Milorganite Division
1101 N. Market St. Milwaukee, WI 53202
414-225-333

Griffin introduces organic fertilizer for golf courses

Nature Safe is a new natural organic fertilizer designed especially for golf courses. It is available in two granulations: regular for use on fairways and lawns and fine for use on tees and greens. Nature Safe 8-3-5 eliminates leaching and the release of gaseous amonia with a non-burning, 85% slow release formulation. It contains no manures, sewage sludge, or synthetic chemicals. The company also offers signs with a club superentendent's name to let golfers know that the club uses natural organic fertilizers.

For more details, call or write to:

Nature Safe, Griffin Industries
4221 Alexandria Pike
Cold Spring, KY 41076
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Turf Grass TRENDS

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