AN INDEPENDENT NEWSLETTER FOR COOL SEASON TURF MANAGERS

Turf Grass TRENDS

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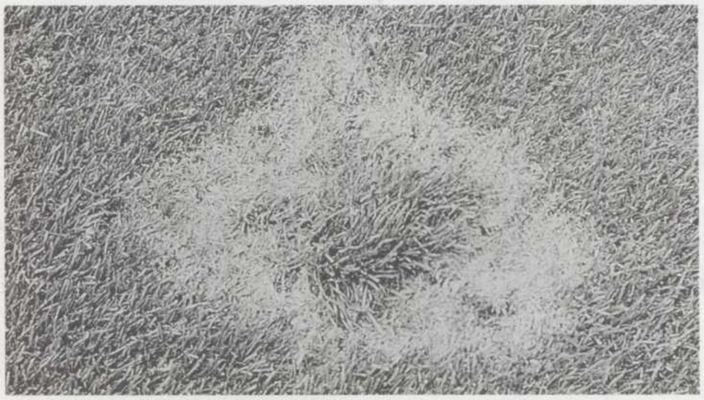

"Frog-Eye" symptom of Summer Patch. Test results seem to indicate that the classic "frog eye" symptom shown here is either an early sign of infection or an indication of very high local concentrations of the fungus.

Summer Patch

The biology and conditions that favor its growth

by Dr. Eric B. Nelson

SUMMER PATCH IS ONE OF A GROUP of major turf management problems commonly referred to as "patch diseases." These diseases are all characterized by circular areas of dead and dying turf that result from root, crown, and rhizome infections by related, but quite distinct fungi. The most common patch diseases affecting cool season turfgrasses are Summer Patch, Necrotic Ring Spot, and Take-all Patch. Summer Patch and Necrotic Ring Spot were formerly grouped under the disorder called "Fusarium blight syndrome." Summer Patch and Necrotic Ringspot are primarily diseases of Kentucky bluegrasses, annual bluegrass, and fine-leafed fescues. Take-all Patch is primarily a disease of bentgrasses.

Complications

CONTROL STRATEGIES FOR SUMMER PATCH are complicated by several factors:

- UNLIKE MOST foliar turgrass diseases, there is a time difference between the infection period and the appearance of symptoms,
- THE CONCURRENT PRESENCE of other diseases with similar symptoms,
- AND EFFECTIVE LONG-TERM treatment may require a combination of actions designed to address underlying factors that contribute to its reappearance.

The infection of a turf stand and the expression of the disease's symptoms usually do not occur simultaneously. Thus, although Summer Patch is typically considered a disease of mid- to late summer, management strategies must be initiated in mid-spring to achieve the most effective control.

The second complicating factor is that the symptoms of Summer Patch are often similar in appearance to those of other root and crown diseases—and also to damage caused by various environmental conditions and insect infestations. It is not uncommon to find symptoms of Necrotic Ring Spot, Pythium Blight and Pythium Root Rot together with the symptoms of Summer Patch.

If a turf stand is subject to attacks by other root infecting fungi, such as Pythium Root Rot or Necrotic Ring Spot, then the damage from subsequent or concurrent attacks of Summer Patch can produce truly disastrous results. The limitations of space do not allow a full discussion here of how to identify and treat these other problems. Nonetheless, a turf manager needs to be informed about them, and to coordinate treating them, if they are present, with his treatment of Summer Patch.

Thirdly, beyond the fungicidal control of acute symptoms, control strategies may have to include both modifications to cultural practices and actions aimed at correcting site specific conditions favoring Summer Patch. These site conditions are useful in helping to determine whether the problems at a particular site are, in fact, due to Summer Patch. Sample control strategies are discussed in-depth in Christopher Sann's article *(see page 6)*.

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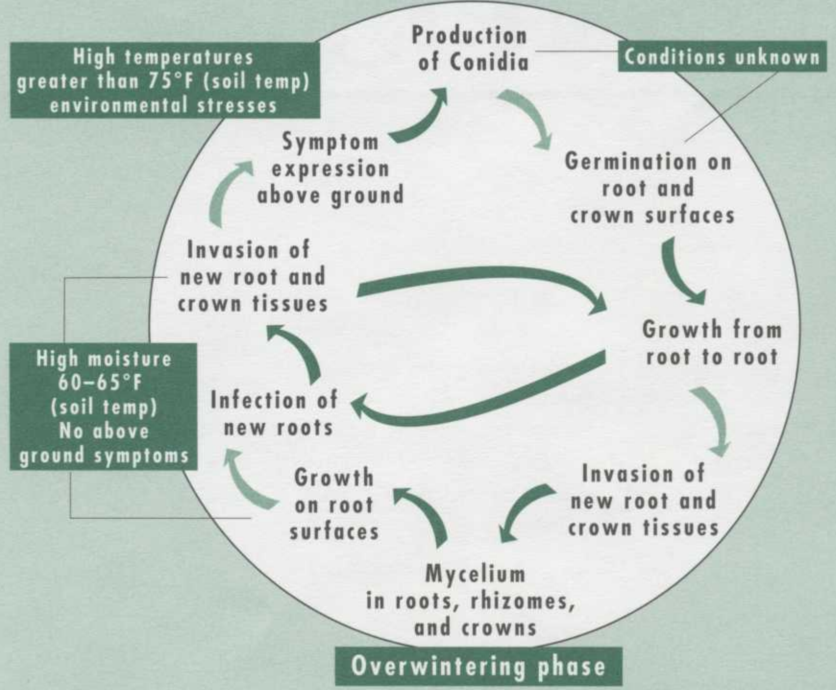
DEPARTMENTS

INTERACTIONS

Summer Patch Disease Cycle



Magenporthe poae, the pathogen causing Summer Patch, survives in a dormant state in infected roots, crowns, and rhizomes. When soil temperatures warm in the spring, the pathogen resumes growth and is able to colonize newly-developing root and rhizome tissues and may easily spread along roots and rhizomes to adjacent plants.

Actual penetration and infection of roots occurs when soil moisture levels are relatively high and soil temperatures stabilize around 60–65°F (15–18°C). Once soil temperatures reach 75°F (24°C) or greater, symptoms become visible above-ground.

Although the fungus is capable of producing two types of spores in the laboratory, the role of these spores in nature is unknown. However, it is likely that the fungus could sporulate on root, rhizome, and crown surfaces, and these spores could then be disseminated to adjacent plants and roots. The conditions that might regulate this stage of the disease cycle are unknown. Once plants are infected, they are likely to remain infected going into dormancy, where the fungus again will survive through the winter months in a dormant state.

Roots and rhizomes thus damaged typically will turn brown and brittle as the disease progresses underground—without causing any apparent above-ground symptoms. The infection can persist in damaged roots and rhizomes—acting as a re-infection source for years.

Biology of *M. poae:* infection and initial growth

SUMMER PATCH IS CAUSED by the root-infecting fungi *Magenporthe poae.* Plants become infected with *M. poae* during mid to late spring—when soil moisture is relatively high and soil temperatures reach 60–65°F (15–18°C). Under these conditions, the fungus colonizes and damages turf root systems, while the plants remain asymptomatic.

The fungus grows as an ectotropic mycelium over the root and rhizome surfaces. This dark brown mycelial growth can be seen with a high-powered hand lens or a low-powered microscope and can be a useful key in identifying Summer Patch *(see photo page 7).*

The Summer Patch fungus can grow over a wide range of soil temperatures. Although *M. poae* may grow more slowly under less than ideal conditions, its habit of growing on the surface of roots, rhizomes, and crowns allows the fungus to spread readily from root to root and plant to plant.

Growing along the outside surface of the roots, *M. poae* damages turf plants by driving a short peg down into the cortex of the root. Once in the cortex, the fungus expands and blocks the upward flow of nutrients and water. This process can occur at multiple sites along the root—thereby causing the rapid decline of an infected root. Roots and rhizomes thus damaged typically will turn brown and brittle as the disease progresses underground—without causing any apparent above-ground symptoms. The infection can persist in damaged roots and rhizomes—acting as a re-infection source for years.

Initial symptoms

SUMMER PATCH SYMPTOMS first appear later in the season—well after periods of peak root infection. Above-ground damage frequently appears during hot 85–95°F (29–35°C) weather immediately after a prolonged wet period.

Knowing what kinds of locations are more prone to develop Summer Patch will help you make a positive identification of the disease. Site-specific factors may be contributing to outbreaks of Summer Patch in:

- SUNNY AREAS NEAR PAVING OR BUILDINGS
- SOUTH AND EAST FACING AREAS

Any practice that induces undue stress on turf plants, or restricts their root development, will accentuate the disease. For example, excessively low mowing heights will reduce the root mass and thus enhance the potential of Summer Patch damage.

The new sod on the right presents a stark contrast to the turf on the left, which shows extensive Summer Patch damage. The initial small circular patches have combined to form large bare patches. Turf managers need to take long-term actions that not only eliminate gross symptoms, but prevent re-infection.

- AREAS AT THE BOTTOM OF A SLOPE, but generally not on the slope itself
- POORLY DRAINED AREAS and those with compaction problems

The initial symptoms appear as small patches of thinning, dead, or dying turf that look very much like symptoms of Pythium Root Rot. During these initial stages of the disease, patches may range in size from 1–3"(26mm–78mm). As the disease progresses in the first year of symptom expression, the patches may grow up to 12"(312mm) in diameter. At this stage, the patches may appear crescent-shaped or donut-shaped—with healthy turf in the center. Diseased turf within the patch may take on a yellow or reddish-brown to straw-colored tan appearance, depending on the grass species, temperature, and moisture conditions. In general, the dead turf remains erect until knocked down either by traffic or irrigation. Under severe conditions and high levels of disease incidence, patches may coalesce to form large areas devoid of turf.

The role of general conditions and cultural practices

GENERALLY, STRESSES INDUCED BY CHEMICAL, physical, or environmental factors will enhance the expression of symptoms; however, drought stress has been shown to have the opposite effect. In two tests of the effect of drought stress, one plot was watered on a regular basis and the other one only on evidence of drought stress—wilting. Both plots were inoculated with a high concentration of *M. poae,* and both developed Summer Patch symptoms. However, in the first test, the patches in the well-watered plots were as much as

Fungicides for controlling Summer Patch

Common Name	Trade Name	Formulation*	Application Rates (per 1000 ft.^{2})	Cost Range (per 1000 ft.^{2})**
Benomyl	Tersan 1991	50W	5 oz.	$4.74–5.47
			8 oz.	$7.59–8.74
Fenarimol	Rubigan	50W	2 oz.	$ not available
		1AS	4 oz.	$7.13-8.05
Propiconazole	Banner	1.1E	4 oz.	$6.94–8.52
Thiophanate methyl	Fungo	50W	8 oz.	$8.79–9.88
		46F	10 oz.	$9.27–12.35
Triadimefon	Bayleton	25W	4 oz.	$6.96–9.13

* W = wettable powder, AS = aqueous solution, E = emulsifiable concentrate, F = flowable

** *Turf Grass Trends* does not recommend basing purchasing and use decisions solely on price. Prices for specific products vary according to time, availability, volume discounts, special sales, and other factors that *Turf Grass Trends* cannot track. The numbers given should be used only as sample ranges.

A CLOSER LOOK

In the lab *M. poae* demonstrates explosive growth rates

GROWN UNDER LABORATORY CONDITIONS at four different temperature levels, ranging from 68–95°F (20– 35°C), *Magenporthe poae*, the fungus that causes Summer Patch, showed its ability to grow at devastating rates in less than one week. At 68°F (20°C) the colony increased an average of 510% in six days. At 77°F (25°C) it increased 980% in six days. At 86°F (30°C) it increased 977%, and at 95°F (35°C) it increased 1,000% in six days.

The bottomline is that, based on growth rates alone, this fungus can potentially damage roots up to eight times faster at 77–86°F (25–30°C) than at 68°F (20°C).

The study results indicated that growth rates began to accelerate at temperatures below 68°F (20°C) and reached its maximum growth rates at 77–86°F (25–30°C). Also, at 95°F (35°C), the growth stopped after two days and did not increase thereafter.

This study also demonstrated a relationship between Summer Patch growth rates and available water. After four days, maximum growth was achieved between 68–86°F (20–30°C) under high to saturated moisture conditions. Growth increased by about 100% between 68–77°F (20–25°C) and then increased an additional 20% between 77– 86°F (25–30°C).

The bottomline is that, based on growth rates alone, this fungus can potentially damage roots up to eight times faster at 77–86°F (25–30°C) than at 68°F (20°C). At 77°F (25°C) researchers have recorded growth rates of .5" (13mm) in one day. Another study—of soil temperatures at a depth of 2.33" (59mm)—showed that the peak *M. poae* temperature range of 77–95°F (25–35°C) was reached in the last two weeks of July and the first week of August. Combined with the fact that these higher temperatures are ideal for *M. poae,* turf is particularly susceptible because at 77°F (25°C) most turfgrass's natural root growth is severely impaired. ■

11% larger than the drought-stressed plots. In the second test, the patches in the well-watered plots were as much as 58% larger. These results confirm the importance of high soil moisture in the development of Summer Patch. Because of complications with other factors, drought stressing turf is not a recommended way of reducing Summer Patch problems.

Despite fairly high levels of root infection, Summer Patch symptoms will generally not develop if soil temperatures do not exceed 70–75°F (21–24°C). This is primarily due to two facts: turf root growth can be quite restricted at soil temperatures above 75°F (24°C), and soil temperatures above 75°F (24°C) are more ideal for the growth and reproduction of *M. poae.*

Frequently, Summer Patch symptoms are first evident adjacent to sidewalks, driveways, and buildings with south-facing exposures—where soil temperatures may be elevated. As already indicated, high soil temperature, accompanied by high soil moisture, is important in favoring the activity of *M. poae.* In particular, sites with poorly-drained or highly compacted soils are especially prone to damage, as are areas where considerable thatch has accumulated.

A number of management practices can affect the severity of Summer Patch. Any practice that induces undue stress on turf plants, or restricts their root development, will accentuate the disease. For example, excessively low mowing heights will reduce root biomass and thus enhance the potential of Summer Patch damage.

The use of quick-release forms of fertilizers also enhances symptoms of Summer Patch. Studies have demonstrated that turf fertilized with soluble forms of nitrogen—such as urea, ammonium chloride, or sodium nitrate—can be more severely damaged by Summer Patch than turf fertilized with slower release forms—such as sulfur-coated urea. According to studies at the University of Maryland, using sulfur-coated urea fertilizers, instead of cold water soluble fertilizer sources of nitrogen, can reduce Summer Patch damage by an average of 35% during the peak period of July through mid-September.

Reacted forms of urea, such as methyline ureas and urea formaldehydes, should produce similar—or even better—reductions. Research on general, long-term turf quality indicates that water soluble nitrogen sources can dramatically improve the quality of turf in a short time period; however, continued use appears to lead to a decline in quality. Water insoluble nitrogen sources take longer to achieve the same level of overall quality, but their continued use appears to sustain the level of improvement.

Peak conditions

WHILE THE SUMMER PATCH FUNGUS GROWS in soil temperatures ranging from 50–105°F (10–40°C), maximum growth occurs in the 77–86°F (25–30°C) range. These soil temperatures (77–86°F) can occur during the months of May through September on short-cut turf (1.5"[39mm] or less) and during the months of June through August on tall-cut turf (3.0"[78mm] or more). In an average season, maximum soil temperatures generally occur in the last two weeks of July and the first two weeks of August.

Soil moisture levels present a similar picture. The range of moisture levels over which the fungus can grow are just below saturation to near the permanent wilting point. The maximum growth rate occurs at a range from slightly less than field saturated to slightly higher than field saturated.

By themselves these two environmental conditions are

Resistant grass varieties

Kentucky bluegrass

THE FOLLOWING VARIETIES OF KENTUCKY BLUEGRASS ARE RESISTANT TO SUMMER PATCH.

Able 1	**America**	**Baron**	**Challenger**	**Eclipse**	**Estate**	**Midnight**	**Nassau**	**Ram 1**
Adelphi	**Banf**	**Bristol**	**Columbia**	**Enmundi**	**Glade**	**Mystic**	**Princeton**	

Different turf species respond differently

TESTS OF THE NATURAL RESISTANCE of four turfgrass species other than bluegrass to *M. poae,* which was inoculated and incubated at 82°F (28°C), showed the following results:

Turf species	**% TURF DECLINE:** Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Creeping fescue	0	2	20	25	47	74
Creeping bentgrass	0	2	3	25	52	69
Tall fescue	0	2	6	13	26	28
Perennial ryegrass	0	0	0	0	3	20

- FINE FESCUES AND BENTGRASSES showed about the same high susceptibility to *M. poae,* while tall fescue showed moderate susceptibility, and perennial ryegrass showed the least.
- THE AGE OF A STAND OF TURF CAN ALSO AFFECT THE GROWTH RATE of Summer Patch. Tests on seven-year old sod, eight-week old Poa, and 8-week old Merion ultimately showed the same results, but with substantially different time lines.

  On seven-year old sod established on a growing medium two weeks before inoculation, a substantial 40% reduction in turf quality was seen after three weeks, a 50% reduction was reached around four weeks out, and a 98% reduction in quality was reached after six weeks. The same test of eight-week old Merion and Poa produced the same 50% reduction after three weeks, but the 98% reduction level was reached in just four weeks.
- AREAS DAMAGED, OR PRONE TO DAMAGE BY *M. POAE* should be overseeded with resistant bluegrass varieties for light to moderate infections and perennial ryegrass or tall fescue for heavy infections. ■

important, but together they can produce a set of conditions—field saturated and 77–86°F (25–30°C)—that encourages maximum fungal growth. Under this combination of these conditions, this explosive growth can lead to massive turf death in 17 to 29 days from the onset of these conditions.

Conclusion

THE COMPLEXITIES DISCUSSED HERE, which make identifying and effectively controlling Summer Patch so challenging, represent a strong argument for taking a comprehensive, long-term approach. In plain English, it pays to be well-informed and well-organized, when dealing with Summer Patch; otherwise, even massive short-term attempts to alleviate the problem may well end in failure.

To facilitate this approach, this issue of *Turf Grass Trends* includes a Summer Patch sampler *(see page 9)*, which provides an overview and treatment of three different kinds of infected sites, and a Summer Patch Site Survey and Quick Reference Guide *(see pages 10–11)*, which readers can use to evaluate their own problem sites and to develop appropriate action plans. ■

Further readings on Summer Patch

IF YOU WOULD LIKE TO READ MORE about *Magnaporthae poae,* the fungus that causes Summer Patch, we recommend the following articles:

■ **Phytopathology 80**
(A Journal of the American Phytopathology Society)
"Pathology of some ectotropic fungi with Phialophora anamorphs that infect the roots of turfgrass" by Landschoot, P. J. and Jackson, N., 1990, pgs. 520–526.

"Growth of Magnaporthae poae and Gaeumannomyces incrustans as affected by temperature-osmotic potential interactions" by Kackley, K. E., Grybauskas, A. P., and Dernoeden, P. H., 1990, pgs. 646–650.

"Influence of temperature-soil status interactions on the development of Summer Patch in Poa spp." by Kackley, K. E., Grybauskas, A. P., and Dernoeden, P. H., 1990, pgs. 650–655.

"Role of drought stress in the development of Summer Patch in field-inoculated Kentucky bluegrass" by Kackley, K. E., Grybauskas, A. P., and Dernoeden, P. H., 1990, pgs. 655–658.

■ **Agronomy Journal Vol. 83, No. 3**
"Summer Patch and Kentucky bluegrass quality as influenced by cultural practices" by Davis, D. E., and Dernoeden, P. H., 1991, GPs. 670–677.

Infected site. Summer Patch is affected by a variety of site characteristics, including air flow, drainage, grade, soil compaction, and the amount of sun and shade. The sunny-side of paved areas and buildings can also contribute to Summer Patch by raising adjacent soil temperatures.

Adjusting management and cultural practices to improve control of Summer Patch

by Christopher Sann

IF YOU HAVE BEEN A TURFGRASS MANAGER for any period of time, you have had to deal with Summer Patch disease. The damage that it causes is like no other turfgrass disease. It can devastate large areas in what appears to be a short period of time, and, if inadvertently encouraged by neglecting to eliminate one or more of the contributing factors, Summer Patch can keep damaging the same area for years—despite vigorous attempts to control it.

To deal with Summer Patch efficiently, you need to know as much as you can about it. Dr. Nelson's article on page 1 addresses this first level: understanding the biology of Summer Patch. It also addresses the problem of making an accurate diagnosis of Summer Patch—given the usual multiplicity of problems and the complexity of conditions in the field.

The next level is doing something about it. What is the best way to treat this disease? Most importantly, given Summer Patch's ability to re-invade certain sites, what is the best way to stop it from doing more damage in the future? To properly control Summer Patch, turfgrass managers need to take the long view. That may seem like a lot to ask a person when he may be facing the wholesale loss of large areas of turf, but it is the only way to effectively approach this disease.

Hitting it with a series of fungicide applications—when its symptoms are most obvious—will stop the current infections, but won't solve the problem. It can come back again and again. A variety of factors that may be contributing to this kind of chronic infection are site-specific, so this article is followed by a description of three sample sites and action plans tailored to reflect the characteristics of each site. A survey form and quick reference guide is also given, which you can use on your own Summer Patch problem sites.

CULTURAL PRACTICES

SITE-SPECIFIC REMEDIES ARE ESSENTIAL to long-term control, but so are adjustments to a number of common cultural practices, such as mowing height, water and other inputs, and using resistant turfgrass varieties. These adjustments can have significant effects on the severity of Summer Patch symptoms.

Cutting height

CUTTING HEIGHT IS PROBABLY the most significant of the mechanical cultural practices that affect Summer Patch. General studies have shown that the quality of a turfgrass stand improves as the height of cut increases. In a two-year test of two cutting heights (3.0" vs. 1.5" [78mm vs. 39mm]) of the same bluegrass variety, there was an average 18% increase in the quality of the tall-cut turf over the short-cut plots. In dryer years, that improvement in quality was 29%, and the fall recovery period of that same year showed a 31% increase in quality. Test of reserve carbohydrate levels, a measure of turf's ability to recover from short-term problems, showed that tall-cut turf had 78% higher levels than short-cut turf.

Cutting height also has a direct effect on soil temperatures, and that can have a strong effect on Summer Patch growth. The average soil temperature measured at one-inch deep was 6% higher in short-cut turf than in tall-cut turf for the months of July, August, and September. This translates into about 3°F difference. Under marginal weather conditions short-cut mowing can raise the soil temperature from a range that is conducive to steady fungal growth into a range that favors an explosive growth rate. The higher soil temperature also shifts the turf itself from an active natural root growth phase to one characterized by restricted root growth.

Water & other inputs

WATERING PRACTICES can play a role in the expression of Summer Patch symptoms. A test of varying amounts and frequencies of watering of both short-cut and tall-cut turf produced opposite, but logical results. The lightly, frequently watered plots were watered 10 times more frequently, but to only 1/10th the depth of the deeply, infrequently watered plots. The 1.5"(39mm) short-cut turf that was lightly, but frequently watered showed an 8% improvement in quality over the same height of turf that was deeply and infrequently watered. A comparison of 3.0"(78mm) tall-cut turf plots yielded a 7% quality edge for the deeply and infrequently watered tall-cut turf. So short-cut turf responds better to light, frequent waterings, while the tall-cut turf, which provides a less welcoming host for Summer Patch, does better with deep,

The potential for a Summer Patch outbreak is highest when a very wet period is immediately followed by a prolonged hot spell. This combination of environmental conditions can be so strong as to overwhelm even the most conscientiously designed preventive program.

infrequent waterings.

In a test of *Magenporthe poae* under laboratory conditions, higher water levels produce maximum *M. poae* growth rates. Maximum growth occurred at 77–86°F (25–30°C) after four days. These maximum growth rates occurred over a range of moisture levels from just less than field capacity to slightly more than field capacity. At these moisture and temperature levels, the colony growth rates averaged about .5" (13mm) per day.

As this test implied, the potential for a Summer Patch outbreak is highest when a very wet period is immediately followed by a prolonged hot spell. This combination of environmental conditions can be so strong as to overwhelm even the most conscientiously designed preventive program.

MANAGEMENT PRACTICES

Fertilizers

IN ADDITION TO THE UNIVERSITY OF MARYLAND studies with nitrogen sources and Summer Patch severity, general studies on nitrogen sources and general turf quality have yielded some pertinent information. Over a two-year period, the use of sulfur-coated urea showed an average 4% improvement over uncoated urea and two other soluble sources. In dry years, this improvement rose to 8%. The nitrogen sources had a definite impact on root biomass. Turf plots fertilized with sulfur-coated urea show a 21% increase in root biomass compared to those fertilized with plain urea. When dealing with one of the root damaging fungi, this can play a significant role. This information was confirmed by the University of Maryland studies, where, from mid-July through mid-September, turf fertilized all season with sulfur-coated urea exhibited 38% less damage from Summer Patch than turf fertilized with uncoated urea.

Fungicides

THE TRADITIONAL METHOD OF SPRAYING a labeled fungicide to solve an immediate problem only provides temporary relief at best. Additional outbreaks can occur later in the same season or the next year. The reason is simple: spraying the labeled fungicide does nothing to correct the underlying causes.

Preventive applications of fungicides can broaden the protection and reduce the potential for heavy damage, but, by themselves, they represent only a partial solution to the problem. Within these limitations, a number of systemic fungicides are effective in controlling Summer Patch *(see the table on page 3)*. They must be applied starting in mid- to late spring—once soil temperatures reach 60°F (15°C). Remember that the turf may appear completely healthy during this period.

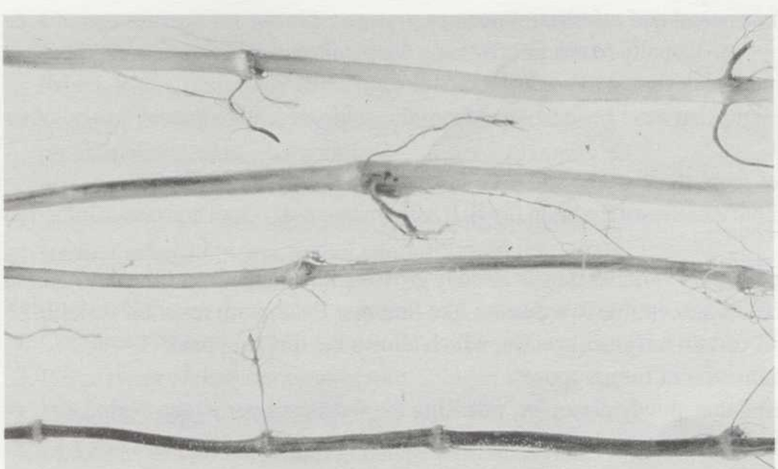
The fungicides should be applied at labeled rates—generally two to three times at monthly intervals prior to the time of maximum soil temperatures. It is essential that the fungicides be applied with enough water to carry them down to the root zone, where they can be absorbed by the plants through their root systems. Without this drenching, control is much less effective and more costly. To achieve the highest levels of control, these applications need to be coordinated with other recommended actions.

Certain contact fungicides, particularly chlorothalonil, which is sold under the trade name Daconil 2787, may enhance disease development and should be avoided in sites with a history of severe Summer Patch problems.

Turfgrass species

DIFFERENT TURFGRASS SPECIES and different varieties within a species can play a significant role in the expression of Summer Patch symptoms. Tests of four turfgrass species other than bluegrass for susceptibility to Summer Patch produced the following results: When test plots were evaluated for Summer Patch damage after six weeks, ryegrass showed 20% damage, tall fescue 28%, creeping bentgrass 69%, and creeping fescue 74% damage *(see table on page 5)*.

Even varieties within a species can show different levels of resistance. When plots were evaluated in the second year after being inoculated



Rotted rhizomes associated with Summer Patch. The fungus that causes Summer Patch spreads on the surface of roots and rhizomes, and can, therefore, spread rapidly through a stand of turf. These rhizomes show the results.

with *M. Poae,* the variety that was supposed to show more resistance did, despite first year results to the contrary. Apparently, varieties that have shown a historical resistance to Summer Patch can be overwhelmed by severe conditions, but, if the severe conditions dissipate, the resistance can re-appear.

Co-factors—the final ingredient

CO-FACTORS CAN OFTEN BE THE DECIDING element in the ultimate expression of Summer Patch symptoms *(see article on page 5 in premier issue of* Turf Grass Trends*).*

Here are a few examples of co-factors and how they can affect *M. poae:*

- IF THE SOIL IN THE TOP TWO INCHES IS COMPACTED, this can lead to higher soil temperatures earlier than non-compacted soils, thereby increasing the time that soil temperatures are in the optimum range for Summer Patch.
- IF A LAYERING PROBLEM EXISTS IN THE ROOT ZONE, causing water to spend a longer time in that zone, then this can greatly enhance the conditions for maximum fungal growth.
- IF THE TURF HAS A CHRONIC NECROTIC RING SPOT history, the root mass volume can be dramatically reduced, making it vulnerable to a *M. poae* infection that would not damage healthier turf.

Stress management for lawns—no joke

A KEY ELEMENT IN THE MANAGEMENT of Summer Patch is the reduction of stress conditions. In general, any practice that will reduce stress and promote a vigorous root system will reduce disease severity. The adjusted practices already discussed all have stress-reduction effects. For example, mowing turf at heights recommended for the particular variety and avoiding excessively low cutting heights, particularly during periods of heat stress, help by creating better conditions for the turf than for the fungus. Using slow-release fertilizers and deep and infrequent irrigations also lessen stress by creating conditions that favor deep, steady root growth. Other practices—such as aerification, syringing to reduce heat stress, improving drainage, and reducing compaction and thatch—also help to alleviate symptoms of Summer Patch.

The use of resistant varieties also aims at reducing stress, by eliminating plants that are susceptible to the disease and replacing them with plants that have a built-in way of fending off the disease. Re-sodding or overseeding affected areas with tolerant varieties of perennial ryegrass, tall fescue, or resistant varieties of Kentucky bluegrass are perhaps the best strategy for controlling the disease. Mixtures of these species and varieties will provide more effective control than using a single species or variety.

Formulating a plan

THE ADVANTAGES of a comprehensive approach are obvious: if the value of a series of individual actions has been demonstrated, then linking them together is most likely to produce the better long-term results. Adjusting your cultural practices will produce results, but combining the recommended practices with changes based on a thorough analysis of contributing site-specific conditions will produce the best results. ■

TERMS TO KNOW

aerification .... The process of mechanically introducing air space in the top layer of soil to loosen it and encourage absorption of water.
asymptomatic .... Not exhibiting symptoms.
biomass .... Living material. Used to refer to the amount of organic material represented by plants.
compaction .... A condition of soils subjects to heavy vehicular or foot traffic, which can contribute to Summer Patch by allowing higher soil moisture levels.
conidia .... Fungal spores important in dispersal and infection processes.
inoculate .... To infect plants with a pathogen—usually to test its effects on the plants under various conditions or to test the effectiveness of materials designed to control the pathogen.
isolates .... Samples of a pathogenic fungus that have been isolated from the environment to ensure that no other microorganisms are present.
percolation .... The process by which water seeps through the soil pore spaces.
Pythium root rot .... A disease caused by pathogenic varieties of Pythium fungi. It is characterized by root and crown infection and decay.
overseeding .... The practice of introducing turfgrass varieties into an already growing turf stand. Over time this method may be used to replace varieties susceptible to a disease like Summer Patch with resistant varieties.
rhizome(s) .... An underground structure of certain turfgrass species, which allows the turf to spread.
sporulate .... A verb that refers to the production of fungal spores.
sulfur-coated urea .... Fertilizer coated with material that slowly dissolves, releasing the fertilizer over a long period.
syringing .... Lightly watering plants. Usually done frequently.
urea .... A material used for fertilizers.

Sample plans for Summer Patch at three different sites

EACH SPECIFIC PROBLEM SITE requires a different course of action that reflects the contributing factors involved. Here are three different kinds of sites and a sample course of action for each site.

Site #1

SPRING at a recent upscale development with four-year old bluegrass sod, which was installed by the developer. A sprinkler system was also installed, and is set to run every other day for 15–20 minutes per location. The homeowners have been fertilizing the lawn two to three times a year for the past three years. Thatch has reached 3/4", and is dry and undecomposed. The sod soil is lose and open. The subsoil is fine textured, dense clay. Roots are 1.5" deep. Summer Patch damage to the front of the lawn is moderate to heavy.

■ RECOMMENDED COURSE OF ACTION

Current year

1. Test soil, and apply soil amendments as recommended.
2. Dethatch the whole front lawn—with heavy emphasis on damaged areas to remove a source of re-infection.
3. Slit seed the whole lawn with top quality ryegrass at 2 lbs./1000 ft.^{2}, in one direction. Slit seed damaged areas a second time with Summer Patch resistant bluegrass at 1 lb./msf. at 45° angle to first slit.
4. Base fertilization on recommendations of soil test, using as much slow release material as possible and at 3.5–4 lbs. of nitrogen/year.
5. Change settings on sprinkler system to once or twice a week for 1.5–2 hours per location, after seed is established. Water preferably in early morning hours.
6. Make at least 2 wetting agent applications per year at recommended rates, spring and mid-summer, to improve water and dissolved oxygen penetration.
7. Make 2 or 3 fungicide applications at recommended rates, starting at least 60 days before late July.

Next year out

1. Continue soil tests.
2. Begin twice annual coring program.
3. Continue to apply wetting agents.
4. Make one or two fungicides annually starting in June.

Site #2

OLDER SITE where large trees were removed from a predominantly fine fescue turf. Extensive damage first year after trees removed. Site will be low maintenance.

■ RECOMMENDED COURSE OF ACTION

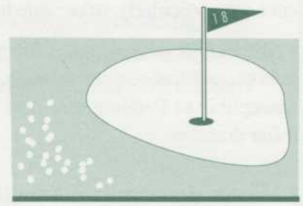
Current year (spring)

1. Test soil, and apply soil amendments as recommended.
2. Slit seed area two ways with a dwarf tall fescue at 2 lbs./1000 ft.^{2} in the spring and again in fall, to change dominate turf to a less susceptible tall fescue variety.
3. Fertilize 2 times per year with very slow release nitrogen source.
4. Make fungicide applications on a curative basis and only if tall fescue is infected. Vulnerable fine fescue varieties will fade out, because of disease pressure.

Next year and out

1. Continue soil testing.
2. Follow soil test recommendations.
3. Fertilize twice a year with slow release nitrogen source.
4. Slit seed area in fall a third and last time with dwarf tall fescue and a compatible bluegrass variety.

Site #3



DRAINAGE AREA at local golf club—in the rough very close to the green of the 18th hole. Damage is chronic and severe. The turf is predominantly bluegrass.

■ RECOMMENDED COURSE OF ACTION

Current year (fall)

1. Dethatch area to remove damaged turf.
2. Slit seed area with ryegrass or tall fescue.

Next year and out

1. Core area of damage and up hill of area heavily three or four times a year.
2. Use wetting agents monthly, at 1/2–3/4 recommended rates from spring through mid-summer, in drainage area and up hill of it to improve water infiltration and reduce time excess water spends in root zone.
3. Make moderate to heavy gypsum applications annually to compensate for calcium leaching out of the root zone.
4. Use root stimulating compounds to develop a stronger root structure.
5. Use fungicides after wet periods, when soil temperatures are in the maximum range. ■

Summer Patch site survey form

THIS SITE SURVEY FORM AND REFERENCE GUIDE are designed to help turf managers to formulate a effective, long-term plan of action. The act of conducting the survey, combined with the results of it, will give you a better feel for your site and a clearer picture of the combinations of adjustments and actions you may need to make to ensure that this site won't continue to be a problem.

Keep in mind that a site survey will only give you data for factors that are observable at the time that you do the survey. Additional factors may have been active earlier, and still other factors may come into play at a later date. So re-survey problem sites at regular intervals.

A Summer Patch Survey Quick Reference Guide

▪ Strong determinant factors

• SUN AND SHADE .... sunny, partial shade, or full shade

Summer Patch is usually a problem in full sun or partially shaded sites. If the area is moderately shady, then the problem is probably not Summer Patch. Look at Pythium Blight, Pythium root rot or Necrotic ring spot as the more likely problem.

• WATER FLOW .... Normal, saturated, etc.

Areas that are subjected to periodic saturation, because of drainage flow through root zone are prime sites for Summer Patch and Pythium Blight.

▪ Moderate determinant factors

• GRADE .... Heavily sloped, level, concave, etc.

Heavily sloped sites are less likely to have Summer Patch than flat or concave grades. Frequently areas at the bottom of slopes have a problem with Summer Patch.

• ORIENTATION .... Facing north, south, east, or west

South and west facing sites are more likely to have a problem than east facing sites. North facing sites usually have little problems with Summer Patch.

• SPECIES .... Bluegrasses, bentgrasses, and fine fescues are particularly vulnerable to Summer Patch.

• AIR FLOW .... Sites with good air flow will dry out faster than sites with poor air circulation. Sites with poor air flow are also very susceptible to Pythium diseases, Necrotic ring spot and a myriad of foliar diseases.

▪ Weak determinant factors

Cultural practices

• CUTTING HEIGHT .... Frequency & height of cut

Raise the cutting height to 3" or more. If this is not possible, increase the time between cuttings.

• WATERING .... Frequency & depth

On tall-cut turf, water only deeply and infrequently. If you must water often, increase the depth of watering and modify the schedule after rainfall. Use wetting agents to eliminate saturated conditions.

• FERTILIZER .... Urea, sulfur-coated or methylene ureas

Avoid using quick realease fertilizers. Use release N sources, such as methylene ureas, urea formaldehyde, IBDU or organics. In hot weather use more potassium and iron and reduce nitrogen applications.

• CULTIVATION .... Coring, verticutting, etc.

Coring and verticutting areas can be beneficial depending on the site.

• AMENDMENTS .... Top dressing, etc.

Avoid making top dressing applications with high humus materials or any materials that can develop a soil interface problem.

• SOIL CHEMISTRY .... Monitor the soil chemistry regularly and maintain high Potassium and Calcium levels.

Co-factors

• COMPACTION .... Physical & chemical

Check for compaction, both physical and chemical. High traffic should be reduced or eliminated. Core or verticut where possible, use wetting agents. Chemical compaction is a sign of wet soils, high magnesium/low calcium levels or particle shifting. Check soil chemistry and use wetting agents.

• THATCH .... Depth, condition, speed of accumulation

Dethatch where possible, aerobasize to foster decomposition, make regular light limestone applications to keep thatch pH at 6.5. Renovate the area and remove the thatch, were possible.

• LAYERING .... Soil interface, organic matter, etc.

Core, deep core or use wetting agents.

• PERCOLATION

Use wetting agents to help flush water out of the root zone.

• OTHER DISEASES

Control or prevent other root damaging fungi and control foliar diseases as they occur. Avoid prolonged use of broad spectrum systemic fungicides.

• OTHER

Keep turf in the best condition possible to promote recovery after an outbreak.

Site history as a guide for future actions

ONCE YOU HAVE INTERPRETED THE SITE SURVEY DATA, check the history of the site to see if this Summer Patch damage is new to the area, a growing recent problem, or a chronic ongoing problem. The site history will give an indication whether this damage is a problem than can be dealt with easily, be solved with changes in practices and applications, or will require major change of direction to be successful:

- IF THIS CURRENT OUTBREAK is the first occurrence of Summer Patch at this site, then a curative fungicide application and a fertilization to help the site recover may be all that you need.
- IF THIS HAS BEEN A PROBLEM THAT HAS OCCURRED before and is increasing, then curative and rehabilitive measures should be augmented with cultural changes, such as mowing, watering, fertilizer changes, wetting agents, variety changes.
- IF, ON THE OTHER HAND, THIS SITE HAS HAD A CHRONIC Summer Patch problem, then preventive fungicide applications starting two or three months prior to the normal onset of symptoms should be started. Alternating effective fungicides should be standard. Keep in mind that despite your best efforts intense short-term weather and rainfall patterns can overwhelm even the best plans. So be prepared to quickly make curative applications when needed.

Finally, change the species of the predominate turfgrass to the ryegrasses, tall fescues or known resistant bluegrass varieties or make whatever changes that time and money will allow to make this problem Summer Patch site a thing of the past. ■

Turf Grass TRENDS

SUMMER PATCH SURVEY

____

COMPANY NAME

NAME OF SITE ____________________________ APPROXIMATE AREA: _______ ft. x _______ ft.

SURVEYED BY ____________________________ DATE OF SURVEY ______ / ______ / ______

Type of information	Factors FAVORING Summer Patch	Factors AGAINST Summer Patch
▪ Strong determinant factors:		
• SUN AND SHADE	□ Full sun	□ Heavy shade
• WATER FLOW THROUGH AREA	□ Periodic saturation	□ Dry
▪ Moderate determinant factors:		
• GRADE	□ Flat □ concave	□ Heavily sloped
• SITE ORIENTATION	□ South □ west	□ North
• PREDOMINATE TURF SP. AND VAR.	□ Bluegrass □ bentgrass □ f. fescue	□ T. fescue □ ryegrass
• AIR FLOW	□ Poor	□ Good
• OTHER IMPORTANT CONDITIONS	□ Hot,wet weather	□ Cool, dry weather
▪ Weak determinant factors:		
Cultural practices		
• MOWING	□ Less than 3"(78mm) high	□ 3"(78mm) or higher
• WATERING	□ Frequent and shallow	□ Infrequent and deep
• FERTILIZER	□ Urea based	□ Slow release N
• CULTIVATION PRACTICES	□ None	□ Coring, verticutting
• AMENDMENTS	□ High humus dressing	□ Low humus dressing
• SOIL CHEMISTRY	□ Low potassium & calcium	□ High potassium & calcium
Co-factors		
• COMPACTION	□ High traffic	□ Low traffic
• THATCH	□ Greater than 1/2"(13mm)	□ Less than 1/2"(13mm)
• LAYERING	□ One or more	□ Uniform
• PERCOLATION OF WATER	□ Slow	□ Normal
• OTHER FUNGAL INFECTIONS	□ Prolonged use of broad spectrum systemic fung.	□ Occasional use of broad spectrum systemic fung.
• OTHER CO-FACTORS THAT MAY AFFECT THE HEALTH OF THE TURF	□ __________	□ __________

Site history: □ Chronic □ Occurred before and increasing □ First occurrence

Conclusions: ____

____

Planned actions:

• CURRENT YEAR ____________________________________

____

• NEXT YEAR OUT ____________________________________

____

LETTERS TO THE EDITOR

Should costs be included?

Turf Grass Trends is super! I thoroughly enjoyed your premier issue. It fills a niche not addressed by current publications.

What's particularly amazing is the almost complete absence of errors or mistakes. However, I did stumble across one. In his excellent article on Pythium diseases, Dr. Nelson does a great job of explaining Pythium root rot. Unfortunately, there is an error on Page 4 regarding the relative cost of Pythium control products. Aliette fungicide is considerably more expensive than indicated. Using a $12 per lb. retail price, Aliette's actual cost per thousand is $3.00 and $6.00 at 4 + 8 oz. rate, respectively.

You may want to clarify this with Dr. Nelson and Rhone-Poulenc (the manufacturer of Aliette); I'm confident they are interested in an accurate portrayal. In the future, you may want to discourage cost comparisons since it is almost impossible to make accurate comparisons based on suggested list prices, special promotions, local availability, etc.

Again, congratulations on a successful first issue and good luck!

— L. DOUGLAS HOUSEWORTH, PH.D.
Man. Tech. Support, Turf & Ornamental Dept.
CIBA-GEIGY, Greensboro, North Carolina

We appreciate the encouragement and the correction. You are right about the costs of applying Aliette.

Despite all the variables involved in the real world prices that end users pay for products, we believe that a comparison of the costs is essential. Afterall, costs are a major factor—especially since a lawncare operator may not be able to charge enough for a application to warrant using a more expensive material—regardless of its potential benefits. These price indicators are simply that—indicators of the approximate price range.

However, given the variables you noted, in the future, we will include a disclaimer (see chart page 3).

Drift agent is available

Let me congratulate you on what appears to be an informative and useful product.

In your On the Horizon column, you spoke of drift control agents. Please note that Rockland Corp. has been selling Rockland Target Drift Retardant for the last two years. This is a highly concentrated drift and mist retardant that can be added directly to spray mixes.

— ROBERT K. WITTPENN
Rockland Corporation
West Caldwell, NJ

The diagnostic art

by Christopher Sann

DESPITE ALL THE SCIENTIFIC technicalities involved in diagnosing turf problems, like virtually every other specialized form of problem-solving, it ultimately is an art. Sure, it requires skills that are gained by trial and error, which is the basis of science. It also requires a healthy dose of curiosity, which motivates our willingness to go through trials and errors in the hope of gaining new knowledge. However, being good at diagnosing turf problems also requires certain personality traits or habits of thought that have more to do with art than science or technology.

These traits may boil down simply to being a person who likes growing things, and taking care of them. What's the reward? When things go right, we see beauty. That is what a healthy, well-maintained stand of turf is—a thing of beauty. Many people in the field probably don't recognize the artist in themselves, but this artistic aspect of turf management is what drives our desire to do better, to achieve a higher level of quality—to manage to make the green spaces we care for more beautiful.

Developing a diagnostic sense should involve a system of financial as well as psychological rewards, but the essence of craftsmanship is that it helps us to feel good about ourselves and what we do—even if the financial rewards aren't always what they should be. When an area responds to what you have done to it, seeing how beautiful it looks provides an on-the-spot reward that is every bit as essential as the technical know-how involved.

Honest evaluation requires both the courage of convictions—the ability to make decisions—and the humility required to recognize when those convictions and decisions didn't work.

The actual process of diagnosis starts with a keen sense of observation and a willingness to search and research for relevant information. Formulating action plans—deciding what the problem is and what you are going to do to correct it—combines these first two activities. As anyone who has tried knows, applying book knowledge amid the complexities of the field isn't a simple process.

Carrying out your plans is relatively straight-forward, but it too has to be done with care. "Measure twice, cut once" is an expression that carpenters use to make this same point.

The next step is evaluating the results of those actions. Let's face it—learning from your mistakes is not as easy as it sounds. Evaluation takes patience. You have to develop a sense for how long to wait and see—how long to give the action you took before you do something else.

Honest evaluation requires both the courage of convictions—the ability to make decisions—and the humility required to recognize when those convictions and decisions didn't work. Even scientists, who work by conducting experiments and drawing conclusions from the results, frequently have difficulty admitting their errors. The process can take generations. The diagnostic art is not something that can be handed down wholesale from one individual to another—especially given today's rate of change. Today's latest discovery may become tomorrow's discarded fallacy. That's why keeping up—continuing education—is important in virtually every field of endeavor.

Classroom learning can help. Books or magazines—or newsletters like this one—can help. But diagnosing complex diseases in the field—where the full array of environmental and site-specific factors and co-factors are at play—takes something more than second-hand knowledge, however accurate or insightful it may be. After all, the field is where many a theory has been disproved, many a product has failed to produce the sought-after result, and many decisions have to be made right now—no matter how little or how much we think we know about turf management.

So diagnosing turf problems takes a personal awareness of what is going on around you. Doing it well takes digging, probing, smelling, feeling, reading, and getting your hands and your knees dirty. You have to be willing to ask questions and—somehow—know when to accept the conventional wisdom and when to reject it in favor of your own gut feeling.

As with all skills, some people are better at it than others. Diagnosing problems is a skill that grows through personal experience. It can be aided by the growing body of knowledge about turf and its ecology, but nothing can replace it. ■

Turf Grass TRENDS

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LETTERS TO THE EDITOR

Please write to address above and include a return address. 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*.

REGULATORY WATCH

Federal legislation tops summer regulatory agenda

TWO IMPORTANT, RELATED PIECES of legislation are working their way through the Congressional committee process this summer: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Pesticide Safety Improvement Act (HR3742).

FIFRA, which includes rules governing certification and training, is up for re-authorization. The key features of the Pesticide Safety Improvement Act include:

- REQUIRING MORE TRAINING for commercial pesticide applicators
- INCREASING FINES FOR VIOLATIONS
- PRE-EMPTING OF LOCAL PESTICIDE USE regulations with state and federal rules.

The law would also require training of state enforcement personnel.

Both bills have the support of the Professional Lawn Care Association of America (PLCAA). In testimony before the sub-committee on Department Operations Research and Foreign Agriculture (DORFA), PLCAA supported increased training requirements; customer right-to-know, notification of application, and customer service agreement rules; and national regulation of the lawn care industry. It opposed increased fines, which would be raised from $5,000 to $25,000 by the currently proposed version of HR3742.

Right to know regulations are currently administered under the Emergency Planning and Community Right to Know Act, which primarily focuses on the storage of toxic chemicals, and PLCAA testified that FIFRA is a more suitable place for these regulations. Right-to-know and related rules are particularly important to the lawn care industry, because of its visibility—to both customers and neighboring non-customers.

For additional information, or to add your voice to lobbying efforts, regarding these bills, contact your U.S. Representative's office. ■

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

Turf events in New York

THE FOLLOWING UPCOMING EVENTS of interest to turf managers in New York and surrounding areas are scheduled:

■ **Cornell Turfgrass Field Day, July 1**
Pine Island, NY, NY State Turf Assn., (800) 873-TURF

Research updates on water management, annual grass weed control in new seedings, turf renovation, and other topics—plus 125 varieties of Kentucky bluegrass shown in high maintenance demonstration trial. The fee is $20 if you register by June 24, or $25 on-site.

■ **Turfgrass Management Seminar, July 30**
Saratoga Sod Farm, NY State Turf Assn., Stillwater, NY, (800) 873-TURF

Talks on installation and maintenance of sod on athletic fields, the non-target effect of fungicides, and new technology for applying insecticides and other materials below the soil surface. Dr. Eric Nelson, *Turf Grass Trends* Associate Editor, will discuss late July turfgrass diseases and the latest—use of aerial photography as a diagnostic tool for golf course greens. The fee is $25 for members of sponsoring organizations and $32 for non-members.

■ **Turfgrass Field Diagnostic Course for Golf Course Managers, Aug. 4–6** Cornell University, Ithaca, NY, J. Gruttadaurio (607) 255-1792

■ **Grassland Field Day & Equip. Show, Aug. 12**
Grassland Equip. Corp., Latham, NY, (518) 785-5841

Texas bluegrass has possibilities

CROSSES BETWEEN TEXAS BLUEGRASS (*Poa aracnifere*) and Kentucky bluegrasses from the bluegrass program at Rutgers University have successfully withstood 100 degree temperatures. The tests may lead to some interesting new introductions.

Buffalograss has limitations

RESEARCHERS LOOKING FOR A BETTER, low input turf have found several disappointing limitations to buffalograss. It cannot be used in shady areas, and it may be difficult to grow in areas where it does not occur naturally. Interested turf managers should contact their local extension agent to see if they are aware of any local test results, or simply plant a small test patch, and see for yourself how well it does in your area. ■

Biotechnology

The future of the turfgrass industry

by Dr. Eric B. Nelson

WHEN MOST PEOPLE hear the word "biotechnology", they immediately think of ivory-tower scientists tinkering in their laboratories, creating various types of genetically-altered mutant plants or animals capable of mass destruction and world conquest. This vision of biotechnology is perhaps the furthest from reality. Over the past decade, opponents of these new biotechnologies have attempted to convince the public of their dangers, resorting to all kinds of scare tactics, and, in some cases, citing unusual examples of how some of these technologies could end human life as we know it. On the other hand, defenders of these biotechnologies (generally scientists like myself) have tried to convince the unenlightened and the ill-informed of the power by which various biotechnologies can benefit mankind by protecting our national agricultural enterprises and facilitating the clean-up of our polluted planet.

So what is biotechnology anyway? In the broadest sense, biotechnology is any form of applied biology, ranging from plant breeding and the use of microorganisms for the biological control of plant pests and diseases to biological waste treatment and the production of human medicines and industrial biochemicals. You probably are already familiar with several products of biotechnology. For example, the *Bacillus thuringensus* or "BT" biological insecticides for use on turfgrasses and other agriculturally-important crops, are products of biotechnology. They are preparations of microorganisms that produce an insecticidal chemical. Likewise, the use of endophyte-infected ryegrasses and fescues resistant to a number of insect pests and diseases, are products of biotechnology. Additionally, the treatment of municipal solid wastes and waste water also relies on specific microorganisms to degrade pollutants and organic matter and aid in the purification of municipal water supplies. The latter is probably one of the older biotechnologies known.

Whereas the above-mentioned biotechnologies have provided novel and, in some cases, uniquely effective ways of dealing with agricultural and industrial problems, the biotechnologies with the greatest potential to change the way in which we approach plant production and plant protection are those based on developments in molecular biology—particularly in the filed of plant and microbial genetics. Many of these advances have arisen from a discovery—nearly 20 years ago—that DNA (deoxyribonucleic acid), the basic genetic material within every living cell, could be transferred artificially to create new "hybrid" plants, animals, and microorganisms. DNA can be transferred from microorganisms to plants, from plants to microorganisms, microorganisms to

. . . with this technology, it is possible to introduce genes from a bacterium that encode the production of an insecticide into a plant.

animals, and so forth.

For the first time, tools are available to "engineer" living organisms with traits desirable for particular tasks or adaptations. For example, with this technology, it is possible to introduce genes from a bacterium that encode the production of an insecticide into a plant. These "trangenic" plants constitute the new wave of resistant varieties that will appear on the market in the next decade. Efforts are currently underway to develop turfgrass varieties resistant to a number of pests using recombinant DNA technologies.

Biological control of insects, diseases, weeds, and frost injury are all biotechnologies that are dependent on recombinant DNA techniques to engineer microorganisms for use as plant bio-protectants. One of the better-known biological control agents for the control of crown gall disease of stone fruits and roses is based on a genetically-engineered bacterium. Other preparations of microorganisms used for the biological control of plant pests are likely to be genetically altered in some way in the future.

What does all of this mean to you, as a turfgrass manager. First of all, it means that, in the 21st century, you will have to be more scientifically literate than in the past: our society will be based largely on advanced technologies, such as biotechnology. Second, it means that you should start developing an informed opinion about the pros and cons of the environmental risks of such technologies. There are many aspects of recombinant microorganisms and transgenic plants that we do not understand. However, if we compare transgenic plants with those bred by conventional means, it is readily apparent that we know even less about those bred by conventional means. No technology is without risk; however, you need to be informed about biotechnology and its inherent risk relative to other products or practices currently in use.

Finally, it is important to be aware of major developments in biotechnology, because it is likely that many of the products and practices used in the future will be based on developments in biotechnology. Many of the turfgrass varieties available for your use will be products of biotechnology, a number of fertilizers, fungicides, insecticides, and herbicides will be products of biotechnology. Many of the ways in which you dispose of pesticide and non-pesticide wastes will likely be based on various biotechnologies. The use of products and processes developed from biotechnologies is certainly the direction in which science, industry, and agriculture are moving. As the turfgrass industry evolves, many of these developments will gradually be adopted. We at *Turf Grass Trends* will try to keep you abreast of the latest developments in science and technology that affect the way in which you approach turfgrass management. The challenge for all of us will be to keep pace with this rapidly changing area. ■

FIELD TIPS

Benefits of reducing thatch in bluegrass turf

Several years ago, in a test of fungicides for control of dollar spot on a disease prone turf, one of the treatments tested was not a chemical: it was a springtime dethatching with a verticutter. One verticutting—without chemical control in the spring—reduced the incidence of Dollar Spot symptoms by 50% over the untreated control. Apparently, the verticutting disrupted the normal disease growth process and reduced the expression of symptoms.

Cutting height impacts soil temperature

Cutting height has a significant effect on soil temperatures at a depth of 1". Raising the cutting height from 1.5" to 3.0" consistently lowers the soil temperature by 5% The tests were conducted in Silver Spring, Maryland.

Short-cut turf has three months—July, August, and September—where soil temperature conditions are at the maximum for *M. poae*—the fungus that causes Summer Patch. Tall-cut turf has only two months—July and August—where the soil temperature is ideal for *M. poae.*

MONTH	CUTTING HEIGHT	AVERAGE SOIL TEMP.	
July	1.5"	86°F	(30°C)
	3"	83.3°F	(28.5°C)
August	1.5"	84.2°F	(29.0°C)
	3"	81.5°F	(27.5°C)
September	1.5"	76.75°F	(24.75°C)
	3"	74.3°F	(23.5°C)

COMING ATTRACTIONS

The next issue of *Turf Grass Trends* will feature in-depth articles on

- **Grubs** by Michael Villani
- **Foliar summer diseases** by Dr. Nelson
- **Biological & chemical control of broadleaf weeds** by Dr. Nelson
- **PLUS** our regular updates on the latest research findings, new products, regulatory actions, and timely tips on improving your turf management practices.

Subsequent issues will include articles on

• WETTING AGENTS AND WATERING • SEEDS, SEEDING AND SOD
• SOIL TESTING, DORMANT FERTILIZERS AND SOIL AMENDMENTS
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- ☐ COLLEGE OR UNIVERSITY
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____

____

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____

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OTHER SUBJECTS OF SPECIAL INTEREST TO ME ARE:

____

____

THANK YOU.

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AN INDEPENDENT NEWSLETTER FOR COOL SEASON TURF MANAGERS

Turf Grass
TRENDS

TURF INFORMATION GROUP, INC.

July 14, 1992

Dear Professional Grounds Manager:

You need good information to make good decisions. Until now, the problem for turf managers has been where to get it. Now there's an alternative to having to do a lot of digging to find the turf management information you need.

Turf Grass Trends is a new monthly newsletter for cool season turf managers. It gives you a comprehensive source of up-to-date, timely, technically sound turf management information, but it's **written in plain language**—and **there are no distracting ads**. *Turf Grass Trends* is an easy way to:

- KEEP YOUR CULTURAL AND MANAGEMENT PRACTICES IN TUNE with the state of the art
- UPGRADE TRAINING OF YOUR PERSONNEL
- KEEP A WEATHER EYE ON EXPECTED MAJOR CHANGES in environmental regulations and certification
- AND STAY ON TOP OF OTHER TRENDS that affect your business.

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