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Turf Grass TRENDS

Issue 11

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Classic patch disease damage may be obvious, but what caused it isn't. In this case, the problem could be five different diseases: necrotic ring spot, summer patch, brown patch, pythium, or bipolaris. The long straight lines in the foreground are the results of mole damage.

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

IN THIS ISSUE

Understanding necrotic ring spot

Undetected chronic infections contribute to a variety of problems

by Christopher Sann

ROOT-DAMAGING DISEASES are among the most destructive of all cool season turf problems. They also are the most misunderstood and the most frequently misdiagnosed. "The squeaky wheel gets oiled," and foliar diseases attract everyone's attention. In contrast, root diseases are out of sight and out of mind—until relatively late in the disease process. In some cases, such as pythium root rot, once the damage is visible, it is often too late to correct the problem. In addition, several of the most common root diseases produce symptoms that are difficult to tell apart.

Not surprisingly, many turf managers tend to know more about one foliar disease, such as dollar spot, than about root diseases as a whole—much less about one specific disease like necrotic ring spot (N.R.S.), which is caused by a specific fungus called *Leptosphaeria korrae*. So we have difficulty diagnosing these diseases and developing appropriate control strategies. In the case of necrotic ring spot, this difficulty translates into a myriad of turf management problems.

Delayed symptoms and chronic infections

UNLIKE MOST FOLIAR DISEASES, the above ground signs of root diseases are usually slow to appear. With the exception of heavy infections under high stress, the expression of symptoms may take months or even years. From a management point of view, the problem is that chronic infections can go undetected for years.

Depending on the micro-environment, each turf grass plant has a threshold or minimum root mass necessary to maintain top growth. The gross symptoms of N.R.S. usually do not appear until the loss of root mass is compounded by environmental stress, causing loss of turgor, wilting, and leaf and/or crown death. This threshold may be reached rapidly if a hot dry period follows a prolonged wet period, or it may take months or years of slow root loss.

If the combination of root loss during the active infection period and the micro-climate and cultural stresses on the plants are not sufficient to kill the turf, then a rough balance—or chronic infection—can develop. This chronic infection means that the rate of root loss roughly matches

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"Child" plants from long-term infections

MODERATE, LONG-TERM INFECTIONS sometimes cause infected plants like this ryegrass to alter their normal physical structures. It is not uncommon to find "child plants" at the end of infected rhizomes that are thinner and less robust than plants on uninfected rhizomes—with several thin stolons comprising the crown structure. These thin "child plants" can have five to eight thin stolons growing from the same crown. Eventually, a plant under prolonged heavy disease pressure will develop multiple weak crowns growing from the same node.

If the rhizome or stem has completely died, the distance between nodes can stretch to 3/4–1 inch—with multiple crowns and air roots emanating from each node. This most radical change in the physical structure of the plant is difficult to find as it is often cut off by regular mowing.

Photo by Christopher Sann

the natural rate of root regeneration that all turf grass species exhibit. Root infections, such as necrotic ring spot, can exist in this chronic state for years. An increasing amount of admittedly anecdotal, field information indicates that a chronic level of infection may be the most common "natural" state of this and other root diseases.

This situation is not without precedent; for example, various *Pythium* species can be isolated from the roots of almost any sample at any time of the year. A diagnostic lab in the Midwest reports that it has cultured out pythiums in about 95% of the samples that have been submitted to them. The only time that they have not been able to locate these pathogenic (disease-causing) fungi is if the sample had been recently frozen. Yet many of the sites from which these samples were taken did not exhibit the symptoms associated with *Pythium* infections.

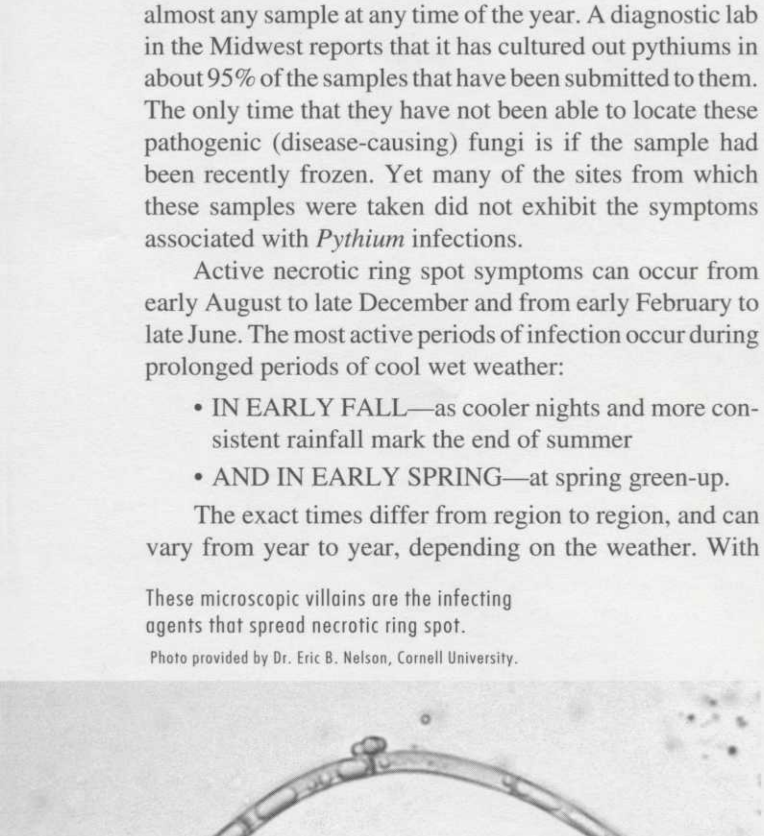
Active necrotic ring spot symptoms can occur from early August to late December and from early February to late June. The most active periods of infection occur during prolonged periods of cool wet weather:

- IN EARLY FALL—as cooler nights and more consistent rainfall mark the end of summer
- AND IN EARLY SPRING—at spring green-up.

The exact times differ from region to region, and can vary from year to year, depending on the weather. With active infection periods that can occur ten months of the year, the symptoms can be seen at virtually any time of the year *(see chart page 9).*

These microscopic villains are the infecting agents that spread necrotic ring spot.

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



Symptoms

THE PRIMARY EFFECT of *L. korrae* is the destruction of the infected plants' root structure. Depending on the severity of the root damage, the level of stress on the turf, and variations in site conditions, turf affected by necrotic ring spot can exhibit a wide range of symptoms. Turf that has a mild, chronic *L. korrae* infection is often less vigorous than uninfected turf, can often show signs of early drought stress, can be removed easily by pulling, and sometimes exhibits chlorosis and does not respond well to fertilization despite good soil chemistry and structure.

In cases of moderate, long-term *L. korrae* infections, the turf can exhibit such symptoms as:

- EXCESSIVE THATCH PRODUCTION with no signs of natural decomposition occurring (particularly two— four year old sodded sites),
- THIN SITES THAT DO NOT IMPROVE, despite intensive management practices, while adjacent areas show little or no signs of stress,
- TURF STANDS THAT SUFFER MASSIVE FOLIAR damage under extreme heat, despite the provision of adequate water supplies,
- AND SITES THAT HAVE CHRONIC FOLIAR diseases that seem to respond poorly to chemical control

Severe infections can result in the now familiar "classic patch disease" symptoms. Where the loss of roots is severe, patches first appear as small, two to four inch, depressed areas of stunted growth compared to the surrounding turf. These symptoms are most prominent at spring green-up or during periods of rapid leaf growth. They may last from a few days to several weeks, depending on soil temperatures:

- IF THE WEATHER IS COOL AND MOIST for prolonged periods, as it is in northern states, the patches can grow to 10—12 inches in diameter and occasionally up to three feet.
- IF THE WEATHER IS WARMER AND DRYER, the patches stop enlarging, and the plants rapidly lose leaf density, wilt and die.

Occasionally, plants at the center of the patch remain unaffected, leaving the classic "frog-eye" symptom. Despite fifty years of association with patch diseases, this symptom is not common across necrotic ring spot's whole range, and ***it should not be considered diagnostic.***

Range and critical environmental factors

THE N.R.S. FUNGUS, *L. KORRAE,* can be found over the entire growing range for all cool-season, as well as some areas for warm-season, turf. It has been identified as the pathogen in spring dead spot, a disease of certain warm-season turf species.

The distribution of necrotic ring spot is greater in cooler wetter regions and less in hotter dryer regions. Two regions illustrate how environmentally dependent this disease can be:

- IN THE NORTHWEST, N.R.S. is a major disease on the cool, wet coastal plain west of the Cascade Mountains. It is much less of a problem on the hot, dry, eastern side of the mountains.
- IN NEW ENGLAND, N.R.S. is common, and produces patches that may reach 18–24 inches in diameter. It is just as prevalent in the Mid-Atlantic states, but the patches rarely exceed four to six inches in diameter.

Throughout its range necrotic ring spot is more of a problem on irrigated turf and sites where soils tend to hold water or are poorly drained—such as areas that are compacted, heavily thatched and root invaded, have impervious layers in their soil profile, or that have a high organic matter content. Compacted soils, soils with poor pore structure, and soils with poor soil chemistry—especially soils low in calcium and humic acid, the major components of soil particle flocculation and aggregation—can reduce or inhibit root reproduction and, thereby, increase the expression of necrotic ring spot symptoms.

With the exception of severe heat or moisture stress, *L. korrae* infected plants that are growing in loose, well-structured, properly drained soils with good soil chemistry can survive high infection levels that would otherwise prove fatal. All other things considered, the determining factor for whether a series of chemical controls should be applied should be the overall health of the soil.

When infected turf is treated at low levels

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Time of the year is a factor. If this photograph of infected bluegrass was taken in the spring, the damage is the result of an acute infection. If taken in the fall, the damage is more likely the result of a chronic infection.

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

Susceptible species

NOT SIMPLY THE OCCASIONAL, "classic" patch disease of bluegrass, necrotic ring spot should be considered a common, chronic root-damaging infection that can adversely affect all of the common cool-season turf grass species, which are listed here in from the most to the least susceptible:

- FINE FESCUES
- ANNUAL BLUEGRASSES
- RYEGRASSES
- KENTUCKY BLUEGRASSES
- BENTGRASSES
- TALL FESCUES

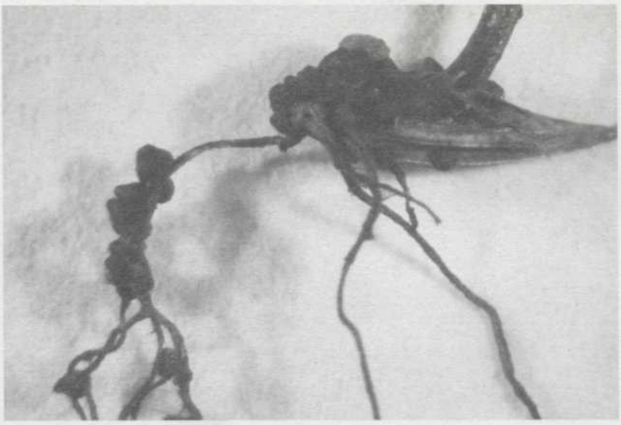
Necrotic ring spot's effects vary by species. Individual varieties, within a species, may also show improved resistance to N.R.S. induced stress damage:

- RESISTANT SPECIES AND VARIETIES will show a markedly higher level of root establishment and regeneration, i.e. bluegrass varieties that are considered to have good sod-forming characteristics are probably better varieties than average or poor sod-forming varieties.
- IN MIXED VARIETY BLUEGRASS STANDS, it is not uncommon to find plants with little or no apparent damage next to plants that are dying.
- UNDER HEAVY DISEASE PRESSURE, tall fescues, which have larger root masses and are more resistant, may exhibit limited loss of root mass and associated leaf loss, but they rarely show major signs of damage.

The genetic ability to grow and replace roots varies from species to species and can prove to be an advantage:

- CREEPING FESCUES have small root masses and are highly vulnerable to N.R.S.,
- IN WET AREAS, ryegrasses may be highly vulnerable to the deforming affects of moderate infections.

Wet, cool, compacted soils and non-pathogenic site conditions can play a substantial role in the foliar expression of root disease symptoms. Under these conditions, some moderately tolerant varieties may prove to be susceptible. ■



These *L. korrae* resting bodies are diagnostic, but don't go looking for them. They are difficult to find in the field—much less to get a good look at, as in this rare photograph. Photo provided by Dr. Eric B. Nelson, Cornell University.

Necrotic ring spot *ontinued from page 3*

with an effective fungicide, such as Rubigan, over a period of time, much higher levels of leaf density result—with better color and increased plant vigor and increased resistance to other opportunistic infections. That increased density and coloration is carried over from season to season and from year to year.

How the disease works

LEPTOSPHAERIA KORRAE IS A FUNGUS that it produces dark mycelial strands, or hyphae, that grow on the surface of roots, rhizomes, and root hairs. At intervals along the surface, the hyphae produce short peg-like structures that penetrate the root cortex. The hyphae also grow on to adjacent roots, spreading the infection through the roots of individual plants and from plant to plant.

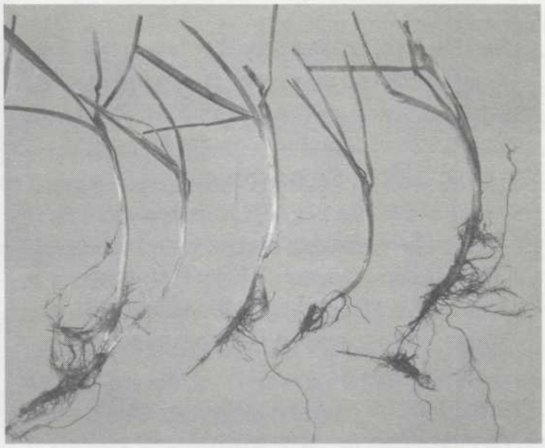
The N.R.S. fungus also produces large dark brown sclerotia, or resting bodies, that clog the vascular system of the roots and impede the upward flow of water and nutrients. Infected roots and rhizomes become necrotic, discolor, and die.

Unfortunately, complete knowledge of N.R.S.'s life cycle has yet to be established; however, light to moderate infections that begin during the cooler periods of its active range are probably less likely to result in dramatic leaf and crown damage. Heavy infections that occur during the periods of maximum active growth, when followed by heat or drought stress, are more likely to produce higher levels of blighted turf.

Its look and its smell

DEPENDING ON ENVIRONMENTAL and cultural stresses, the symptoms of infection by *Leptosphaeria korrae* range from as little as a slight thinning of leaf density to the wholesale collapse of large areas of turf. Generally, the amount of visible damage that appears on the crown and leaves of an infected plant is a function of length of the time of the infection and the micro-climate or environment around the plant. The longer that the roots are actively infected and the greater the net loss of functioning roots, the more negative the impact on the overall health of individual plants. In severe cases, it is not uncommon to find that as much as 80% to 90% of the root structure of a stand of infected turf may be damaged.

On individual plants, the crown and leaves can show a range of symptoms of from the death of a few of the outer most leaves around the crown to the complete collapse of the crown and leaves. Unlike foliar diseases, necrotic ring spot does not exhibit a "diagnostic" foliar lesion as many of the more familiar diseases. What is indicative of an *L. korrae* infection is a light purple to dark magenta ring at the base of the outermost green leaves in the crown where the color is normally white to light green. This color can be seen on the outside of the crown by removing the dead or dying outside leaves.



From left to right, these plants show how necrotic ring spot progresses—from some leaf death, to increased root and leaf death, to rhizome death and the development of multiple nodes (as the plant tries to escape the fungus), and finally to complete plant death.
Photo provided by Dr. Eric B. Nelson, Cornell University.

By itself, this purple color is not specific to this disease alone, but combined with the time of year that the disease is active and the amount of root damage, it is a strong indication of infection by *L. korrae*.

Unlike diseases such as pythium root rot, which kill roots by disrupting the functioning of root hairs and the roots cortical cells and are diagnosed by their wet appearance, *L. korrae* and other dry rot diseases, like take all patch and summer patch, kill by restricting the availability of water and nutrients. Turf killed by dry rotters has a dry feel, and depending on the weather, traffic, and cultural practices, may remain upright for some time. In contrast, turf damaged by pythium is slimy to the touch, but it may also remain upright.

When active infection periods and weather conditions

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Reducing necrotic ring spot damage

by Christopher Sann

SITE USAGE CAN PLAY A CRUCIAL ROLE in the expression of N.R.S. symptoms. If the infected area is subjected to high traffic or prolonged sports use, control of the symptoms may be difficult, if not impossible. In order for such a site to have any chance of recovering from a severe infection, usage should be restricted for a significant period of time—until changes in cultural practices, soil chemistry, and fertility can reduce the symptoms to an acceptable level.

If a recovered site is reintroduced to its previous level of use and the level of damage returns to high levels, then chemical controls (if an option at that site) should be used as a last resort; however, because of the root-damaging character of necrotic ring spot fungus, chemical controls will only reduce the amount of damage. They cannot and do not eliminate the damage.

Cultural practices

No matter what the site usage, changing the cultural practices on an infected site can play a significant role in reducing symptoms:

- RAISING THE MOWING HEIGHT as far as possible can increase the shading of the soil and reduce soil temperatures and evaporative moisture loss.
- WATERING INFECTED TURF more frequently can improve stand survivability by reducing drought stress and increasing the number and variety of naturally occurring predators of the N.R.S. pathogen.
- PERIODICALLY REMOVING accumulated thatch, aerifying existing thatch, or a combination of both techniques can improve moisture penetration.
- PERIODICALLY TESTING THE SOIL and adjusting the chemical balance can provide a better growing environment for the plants.
- INTRODUCINGING less susceptible varieties or species will reduce the number of vulnerable plants.
- USING WETTING AGENTS and root stimulating compounds to increase root mass has begun to be used with success.
- USING ORGANIC OR SLOW RELEASE synthetic fertilizers will reduce the stress on the root system by limiting the amount of rapid foliar growth and its diversion of resources away from the roots.

Chemical controls

If changing site usage and adjusting site cultural practices do not substantially reduce necrotic ring spot symptoms, then properly timed chemical control applications can have the desired effects.

There are two basic approaches to chemical control of N.R.S.:

The **first** is to make a full strength or curative rate application of a listed fungicide at the onset of conditions favorable to the growth of *Leptosphaeria korrae*. This approach requires close monitoring of site conditions and keeping detailed records on the site—to gauge when to make a pre-emptive application. This technique can be especially effective in dryer regions, where severe damage from N.R.S. is only an occasional problem.

The **second** method is to apply lighter rates of listed fungicides on a preventive basis at previously determined times of the year. The exact timing of these applications should vary according to the region. In general, one or two reduced rate applications in the early fall, as night time temperatures approach 60°F, followed by one or two reduced rate applications, in the early spring following complete green-up, are effective if they are used over the years.

In the Middle Atlantic states this has translated into one application in early October and a follow up application in mid April. In more northern regions, like central New York, two applications—one in late August and the other in early October—followed by two applications in the spring—one in mid May and again in mid June—are probably necessary. The more prolonged the cool, wet conditions, the longer the period of active fungal growth; hence the need for a second application in each season.

In the early years of a long-term preventive application program, sites that have a history of heavy N.R.S. activity may require monitoring of site conditions and making curative applications when conditions warrant. As this preventive program progresses, the need for monitoring will be reduced.

Depending on the site conditions, tests have shown that, tank mixing wetting agents and/or rooting compounds with the preventive rates of fungicides can be beneficial.

Some caution about adding these amendments should be observed:

- LIQUID WETTING AGENTS may produce foliar burn at certain concentrations and at certain times of the year. If this is a problem then use a granular form of wetting agent.
- IF THE SITE HAS A HEAVY THATCH LAYER, greater than 3/8 inch, that is root invaded, do not use root stimulating compounds, since they will produce increased root mass in the thatch as well as the soil.
- IF THE USE OF ROOTING COMPOUNDS is contra indicated, because of site conditions, tank mixing very light rates of triadimefon, at about 1/10 oz. per thousand square feet may be helpful. Tests at Virignia Polytechnic Institute (V.P.I.), have indicated that the use of light rates of triadimefon also stimulates root growth. ■

Necrotic ring spot continued from page 4

for both summer patch and necrotic ring spot overlap, you can distinquish them by the smell of the dead and dying grass. Turf affected by summer patch has a strong "dry grass" odor. This same odor has not been observed in N.R.S. damaged turf. Drought stressed turf can be distinguished from turf damaged by summer patch and necrotic ring spot, because it does not exhibit the same site damage patterns, and often will exhibit the black fruiting bodies of non-pathogenic fungi.

Conclusion

AN ACCURATE DIAGNOSIS of necrotic ring spot can require a considerable amount of detective work and may require microscopic confirmation. Accurately diagnosing *Leptosphaeria korrae* can be beneficial in many more ways than just preventing the occasional "traditional" frog eye damage. Turf infected by it is harmed in a variety of ways that may be puzzling to explain or remedy, until you correctly detect the underlying presence of a chronic case of necrotic ring spot. When you have a problem that doesn't respond to conventional management practices, think about checking for necrotic ring spot, a patch disease that frequently doesn't form patches. ■

TERMS TO KNOW

aerifying ..... A mechanical means of removing cores of turf/soil to increase the aeration to the roots.

chlorosis ..... Yellowing of the grass blades.

cortical cells ..... Cells forming the central core of a root.

hyphae or mycelium ..... The filamentous life stafe of a fungus. Many individual filaments (or hypae) make up a mycelium.

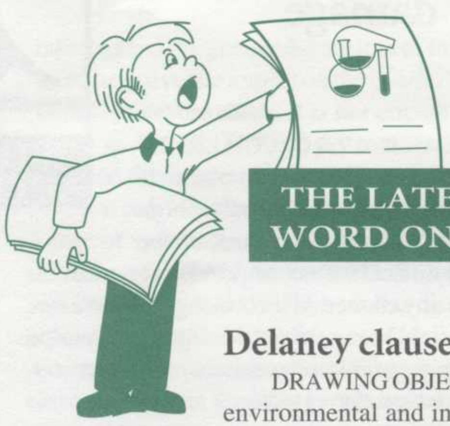
Leptospirea korreae ..... The causal agent of necrotic ring spot.

micro-environment ..... The miniature local environment that a microorganism encounters.

sclerotia ..... Resting structures of some fungal pathogens.

spring dead spot ..... A disease of bermudagrass caused by the necrotic ring spot pathogen, *Leptospirea korreae.*

spp. ..... An abbreviation for the word "species."



THE LATEST WORD ON . . .

Delaney clause

DRAWING OBJECTIONS from both environmental and industry groups, the Clinton administration has proposed doing away with the Delaney Clause and replacing it with a set of new rules worked out by the Environmental Protection Agency, the Food and Drug Administration, and the Department of Agriculture.

The 35-year old Delaney Clause bars adding any carcinogen to processed foods. It does not apply to fresh foods, where residues are allowed. So, tomatoes have had to met one standard, while products made from tomatoes, theoretically at least, have been held to a higher standard. A recent New York Times editorial pointed out, "in practice, the Delaney Clause has only intermittently been invoked against pesticides."

The issue came to a head, largely because a recent court case requires the government to either enforce the Delaney Clause or change the law. In addition, the new proposal reflects the technological changes that have taken place in the 35 years since Delaney became law—namely advances in the detection of trace amounts of chemicals in foods that have made extremely minute quantities measurable.

In effect, the new proposal would lessen the absolute standard set by Delaney to a standard of "negligible risk," which will be applied to both processed and fresh foods. A somewhat tougher standard will be applied to foods generally produced especially for children. The standard is defined as a million to one chance of causing cancer over a lifetime of use. The New York Times points out that this is "a very tough standard—far tougher than could be met by some existing pesticides, which can pose risks as high as one in 10,000 of developing cancer."

Obviously, the proposed change could affect the availability of some products currently in use by turfgrass managers. But at this point, it is difficult to judge the real implications for frontline turfgrass managers. Obviously, as the debate takes shape, consumer and environmental groups as well as food and chemical industry groups will all provide their views on the facts involved and will try to influence constituencies and legislators alike.

The new proposal will face a heated debate in Congress before it can become the law of the land. It also includes strict deadlines for compliance, sets deadlines for a review of pesticides, and authorizes increased government power to remove from the market pesticides that fail the new "negligible risk" standard. It would also ban the export of pesticides that are banned here, and it would encourage farmers and others to dramatically cut pesticide use.

Nitrate ground water contamination

LAWNCARE came out smelling like a rose in a study of sources of nitrate ground water contamination. The study by Dr. M. Petrovic of Cornell University compared the annual nitrate (N) contributions of various land uses over a two year period. The areas studied included forests, lawns, corn fields with and without cover crops, and areas with septic systems.

In the chart below we have assigned a value of one (1.0) to the land uses that contributed the least nitrate—unfertilized forests and lawns. Lawns fertilized with more expensive urea-formaldehyde produced a slightly higher nitrate level, while lawns fertilized with more commonly used urea products produced a significantly higher level of nitrate—but nothing like the levels produced by agricultural uses and septic systems.

While all of the lawn uses tested produced results well below the federal drinking water standard, agricultural use produced contamination levels below the federal standard—but at least fairly close to, while septic system use produced results that exceeded the federal standard by a wide margin.

AVERAGE NITRATE GROUND WATER CONTAMINATION

Land use	Fertilizer	Result
Forest	none	1.0*
Lawn	none	1.0
Lawn	urea-formaldehyde	1.5
Lawn	urea	8.0
Federal drinking water standard		40.0**
Corn	manure	54.5
Corn (cover crop)	urea	58.5
Corn (no cover)	urea	76.5
Septic system	—	340.5

** Lowest contributor = 1.0*

*** 10 ug/L. (ug/L= micro-grams per liter).*

Turf-specific leaching models

AT THE INTERNATIONAL TURFGRASS RESEARCH Conference, Dr. Petrovic also reported on the results of a study of the fate of the herbicide MCPP (Mecoprop) and the fungicide Triamedifon (Bayleton). MCPP is leaf absorbed, and Triamedifon is root-absorbed. Instead of the expected result—of the leaf absorbed material being less prone to leach—Dr. Petrovic found that the Triamedifon was less likely to leach.

One implication of these results is that the predictability of existing forecasting models for chemical leaching in soil has been poor for turfgrass sites, because the models were designed for bare soil agricultural situations. New turf-specific models are needed—particularly since a more thorough testing of turf management products is likely.

The study was conducted on new (4 months after seeding) bentgrass stands on various soil types under different irrigation regimens. The concentration of the two materials in leachette was collected at 15 inches down, and was measured over a 50-60 day period.

In the following table, the results represent the percentage of the total applied material recovered—in short, the amount that leached.

PERCENTAGE OF MATERIAL RECOVERED
(AMOUNT LEACHED)

Material	Irrigation	Sand	Sandy Loam	Silt Loam
MCPP	Medium	35%*	2%	1%
	Heavy	74%*	>1%	1%
Triamedifon	Medium	1%	>1%	>1%
	Heavy	2%	>1%	>1%

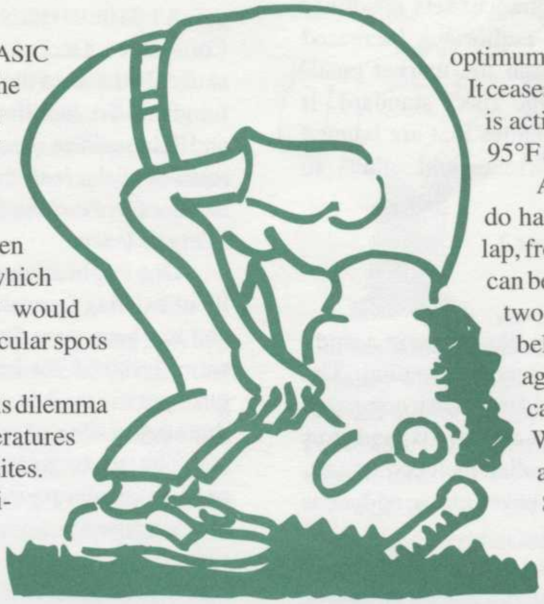
* Analysis incomplete

On sandy soil, the recovery rates spiked from day two—with the highest concentrations recovered under both irrigation regimens at 10 - 20 days after application. After that period, about two-thirds of the high rate was recovered for the duration of the study period. On sandy loam soils, the rate of recovery varied from day to day, but was generally low for both irrigation regimes over the test period. Silt loam soils showed results that closely mirrored that of sandy loam soils.

This study, as have others, indicated that some turf management pesticides are subject to dramatic leaching problems on sandy soils under heavy irrigation practices. Sandy soils are most common in coastal areas and bottom lands. In the future, use in these kinds of areas, of materials with high leaching potential may be subject to label restrictions. –continued on page 15

Turf diagnostic tools —temperature

by Christopher Sann



TEMPERATURE IS A BASIC parameter used in the diagnosis of turf grass problems, but how many turf managers keep records of soil temperatures at the facilities or sites they manage? And given the all too random manner in which turf problems develop, how would anyone know from which particular spots to collect the data?

The easiest way around this dilemma is to keep track of the air temperatures at one or more problem-prone sites. Depending on a number of variables, day-time air temperatures roughly approximate soil temperatures taken in the top inch of soil. Certainly, this is only a rough approximation, but environmental regulations now require that turf managers keep records of "site specific" weather conditions—particularly the air temperature and the wind speed—when making pesticide applications. So let's put those data to good use!

Many turf grass diseases—including killers like summer patch, leaf spot and anthracnose—are caused by fungi that grow and reproduce only within specific temperature ranges (*see page 9*). You can use this information and your new site temperature data to reduce the number of potential causes for problems at particular "recorded" site.

Example

For example, the two leaf spotting pathogens of bluegrasses, *Dreschlera* and *Bipolaris*, induce symptoms that are difficult to distinguish. They have:

- LATE STAGE OVERALL SYMPTOMS that are virtually identical,
- EARLY AND LATE STAGE plant symptoms that are quite similar,
- AND THEY BOTH CAUSE characteristic lesions on bluegrass leaves that have very similar shapes and coloration—particularly in the more advanced stages.

But they differ substantially in the temperature ranges over which they grow and reproduce. *Dreschlera* is active from 43°F to 81°F. with an optimum growth range of 59°F to 65°F. It ceases activity above 81°F *Bipolaris* is active in a range of from 68°F to 95°F and is most active above 80°F.

Although these two pathogens do have a temperature range overlap, from 68 °F to 81°F, temperature can be an aid in distinguishing these two diseases. At temperatures below 70 °F, new leaf spot damage almost certainly will be caused by *Dreschlera* species. While any new damage that appears at temperatures above 82° F probably will be caused by *Bipolaris* species. Microscopic examination may required to confirm identification of which pathogen is causing new damage that appears between 70°F and 82° F. Contact your local, regional, or state turf grass specialist or turf grass pathologist to assist in microscopic examinations.

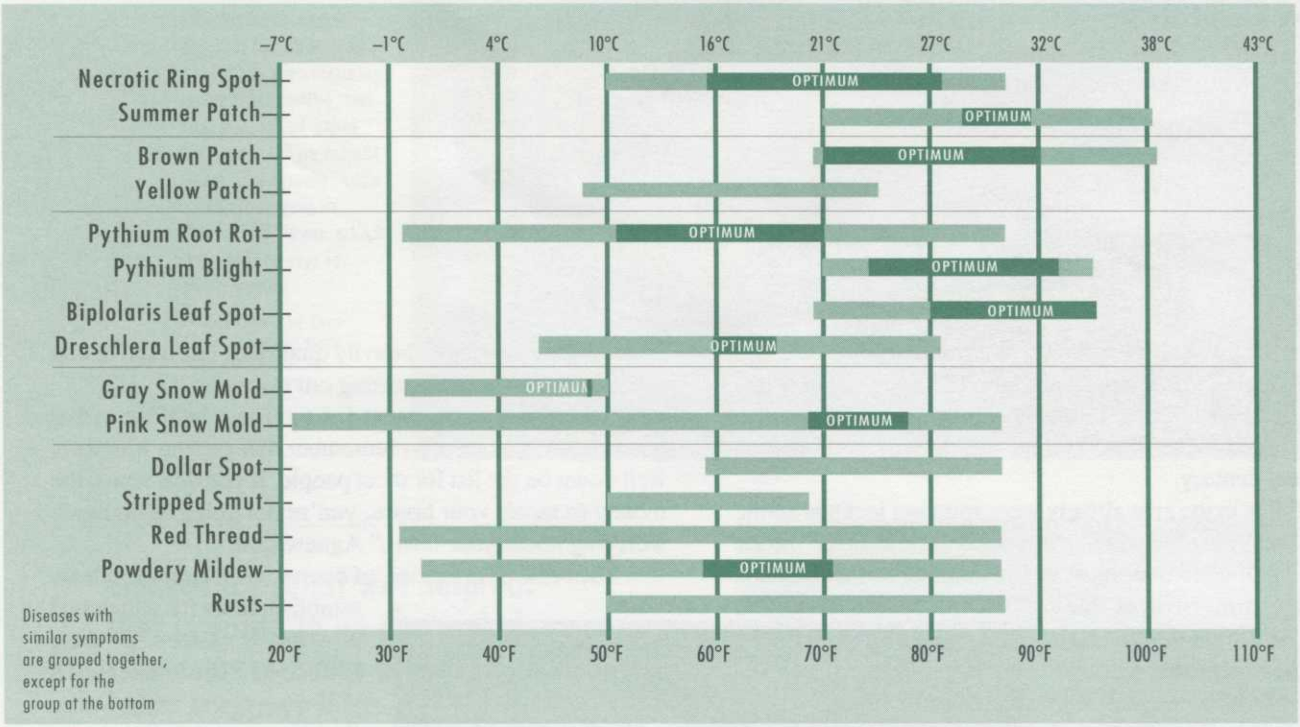
From a chemical control stand point, the use of materials specifically labeled for either *Dreschlera* or *Bipolaris* should be used when the temperatures are appropriate for the activity of the respective pathogens. When the symptoms appear in the overlap of the two temperature ranges, and a suitable microscopic examination cannot be made, then a material that controls both *Dreschlera* and *Bipolaris* should be used.

Temperature ranges also may help you to differentiate between turf damage caused by summer patch and necrotic ring spot. The temperature range for summer patch is slightly higher than the range for necrotic ring spot as is its optimum range.

Temperature may not be a useful diagnostic tool in some situations— such as where a disease (like pythium root rot or pythium blight) may be caused by a number of different strains of the pathogen. In these cases, microscopic examination is required for accurate identification.

Temperature differentiation also may not be useful when a single pathogen or group of closely related pathogens has a wide growth range or substantial overlapping—such as occurs with *Rhizoctonia* species that cause brown patch and yellow patch. ■

Turf grass diseases with pathogens, growth and temperature ranges



DISEASE	PATHOGEN	TEMP. RANGE OF GROWTH		TEMP. OPTIMUM GROWTH	
Necrotic Ring Spot	*Leptosphaeria korrae*	50–86 °F	(10–30°C)	59–82 °F	(15–28°C)
Summer Patch	*Magnaporthae poae*	70–105 °F	(21–41°C)	83–87 °F	(28–31°C)
Brown Patch	*Rhizoctonia* spp.	68–105°F	(20–41°C)	70–90 °F	(21–32°C)
Yellow Patch	*Rhizoctonia cerealis*	47–75 °F	(8–24°C)	Not determined	
Pythium Root Rot	*Pythium* spp.	32–86 °F	(0–30°C)	52–70 °F	(11–21°C)
Pythium Blight	*Pythium* spp.	70–95 °F	(21–35°C)	74–93 °F	(23–2°C)
Bipolaris Leaf Spot	*Bipolaris sorokiniana*	68–95 °F	(20–35°C)	>80 °F	(>27°C)
Dreschlera Leaf Spot	*Dreschlera* spp.	43–81 °F	(6–27°C)	59–65 °F	(15–18°C)
Gray Snow Mold	*Typhula* spp.	32–50 °F	(0–10°C)	48 °F	(8°C)
Pink Snow Mold	*Microdochium nivale*	22–86 °F	(5–30°C)	68–77 °F	(20–25°C)
Dollar Spot	*Sclerotinia homoeocarpa*	59–86 °F	(15–30°C)	Not determined	
Stripped Smut	*Ustilago* spp.	50–68 °F	(10–20°C)	Not determined	
Red Thread	*Laetisaria fuciformis*	32–86 °F	(0–30°C)	Not determined	
Powdery Mildew	*Erysiphe graminis*	34–86 °F	(1–30°C)	59–72 °F	(15–22°C)
Rusts	*Puccinia* spp.	50–86 °F	(10–30°C)	Not determined	

spp. = species

AS YOU CAN SEE FROM THE ABOVE TABLE AND CHART, temperature ranges can be, in some cases, a definitive diagnostic tool when identifying fungal pathogen damage in turf and in others case at least helpful. But in order to use temperature ranges as a diagnostic tool it is necessary that precise data on air or soil temperatures be kept on a systematic basis.

Midwest flood recovery underway, but will take years

by Jim Parks

AS THE WATER RECEDED and residents of the devastated Mississippi and Missouri basins began to put their lives back together, it was obvious that the Great Flood of 1993 was destined to live in infamy well into the next century.

Folks in the area already were spinning legends about how they were personally impacted by the body blows nature delivered over most of last summer to the nation's midsection. Stories that grandchildren-yet-to-come will hear repeated through their lifetimes were being told.

Turf killed by the flooding is visible beneath a layer of dried silt. Periodic river flooding always has been a mixed blessing, bringing destruction and new nutrients. Now the situation is complicated by materials from hundreds of sewage treatment facilities, farms, manufacturing plants, and storage facilities.

Photo provided by Gary Peterson, Jasper County Extension Service

Scars from swollen rivers fed by incessant rain will remain in memory far longer than they are likely to last in the physical environment. Although few gave immediate priority to repairing the countless hundreds of lawns and other severely damaged turf, there was a belief among the experts that their recovery could occur quickly.

"I would expect that the effects of the floods can be pretty short-term," said Michael Agnew, extension turf grass specialist at Iowa State University.

Repair work, he said, largely is a matter of removing silt, tilling, severely aerating and re-seeding or placing sod. That, he added, "means more business for those companies trying the repair the damage."

A second wave of remedial work is in store as next year promises to bear a bumper crop of crabgrass and broadleaf weeds as a result of the excessive moisture almost continuous rain brought in areas that escaped actual flooding. "They're going to be just rampant. They've taken hold and it won't be easy to control them," he said.

Any prediction of a boon for professional turf providers and retail establishments which serve do-it-yourself homeowners have to be heavily qualified. The hitch in that scenario has to do with sorting out priorities.

"Repair or replacement [of turf] can be done rather quickly, but you have to remember that getting it done is well down on the list for most people. If you don't have the money to repair your house, you're not going to do much worrying about your lawn," Agnew said.

The scale of priorities, of course, is different for those establishments for which turf is a major element in their livelihood. The university's golf course was under water five times and an aerial photograph of a flooded John O'Donnell Stadium in Davenport, Ia.—home of the Quad City River Bandits, a minor league baseball team—was published in just about every newspaper in the country.

Even where such facilities are located on higher ground and thus escaped the surging rivers, they were adversely affected by the effects of the flooding. "Those who rely on municipal water were hurt. Des Moines water was out for 19 days and, during that period, we had a 10-day dry period during which time they couldn't water," Agnew said.

Then, too, there are lingering economic effects to be factored in. "With the losses we've had, it's going to take some time for the economy to turn around. Emergency relief will help but that is going to be channeled where there is the greatest need. I don't expect a lot of emergency relief funds to end up helping the turf industry," he said.

Not to be overlooked is the fact that a summer of water is apt to be followed by a winter of snow in that part of the country. "We start with ground that is saturated. If you add two to three feet of snow on top of that, you have real potential for major spring floods when all of that melts at

The repair of some flooded facilities may "only" involve cleaning up and replanting, but the grounds of other facilities will be rebuilt more extensively, such as this ballfield in Davenport, Iowa, which was underwater for three weeks.

Photo provided by Gary Peterson, Jasper County Extension Service

" Emergency relief will help but that is going to be channeled where there is the greatest need. I don't expect a lot of emergency relief funds to end up helping the turf industry."

MICHAEL AGNEW, Extension Turf Specialist
IOWA STATE UNIVERSITY

one time," Agnew said.

Others in the area pointed out that if the fear of new flooding materializes, many of the levees that were broken last summer will not have been replaced to hold back the water. Considerably lower flows in the rivers have the potential of repeating this year's damage as soon as warm weather returns.

Rich Hoormann, agronomy specialist with the University of Missouri extension service, predicted that it will be late next summer before grass crops ruined or severely damaged this year will be replaced. "Optimistically, we could have some back by May or June [1994], but it's doubtful," he said.

"I don't think turf is the primary concern right now. A lot of things are far more important," said Tom Voigt, extension turf and grass specialist with the University of Illinois. "You'll get some calls about re-establishment [of lawns] this fall, but I think most people will put off thinking about it until next spring."

He and others said there has been no effort so far to assess the extent of turf damage either in terms of acreage or money lost. Also undetermined is the long-range effect of the floods on soil.

"We don't really know what the river[s] deposited. I

Flooding shows another benefit of buffalo grass

IRONICALLY, the variety being developed on an experimental and pilot-project basis as a counter to extensive drought proved itself capable of weathering the opposite extreme.

Ed Keeven, who had a stand of about 20 acres at his Emerald View Turf Farm in O'Fallon, Mo., said the grass hunkered down and survived under water for five weeks.

"What makes it drought-resistant is its ability to shut its tops down and almost hibernate. It turns out it does the same thing under water," he said.

"It came back right away — and looked even better."

The bluish green, fine-leafed grass is the only variety of native American grass used as home grass. It is a descendent of the legendary prairie grass whose interwoven web of roots provided a formidable challenge for pioneer sodbusters when the Great Plains were opened for farming more than a century ago.

While impressed by the present variety, Keeven said research now under way points to even better strains in the near future. "What we have now is great; what's upcoming is going to be even better," he said.

Keeven planted buffalo grass in August, 1992, in a joint venture with golfer Ben Crenshaw and Texas grower David Doguet. "We put in 20 acres. I now wish it had been 200," he said. ■

Both the trees and the turf were killed on either side of this road in Davenport. Plants growing on the higher areas in the foreground and the background, which weren't covered by the flood waters, survived.

Photo provided by Gary Peterson, Jasper County Extension Service

Midwest Flood continued from page 11

could imagine that it might be a case of a mixed blessing to some extent, he said.

He explained that not all the silt spread over the area is a negative. Subdivisions which generally had lawns in a few inches of topsoil over a clay base could find an improvement in terms of possibly richer soil to a greater depth. Although reluctant to speculate on what actually has happened, he said the situation, in some places, could be analogous to the legendary creation of rich farmland in the Mississippi Delta as a result of the depositing of river borne silt.

If there appears to be some justification for predicting a coming bonanza for the commercial turf industry, it is tempered by the fact that those based in the affected area shared the fates of other businesses and farms there.

All three Emerald View Turf Farms operated by his family were virtually wiped out, said Ed Keeven. "We have one farm [at Columbia, Ill.] on the Mississippi, one [at Jefferson City, Mo.] on the Missouri and one [at O'Fallon, Mo.] where the Mississippi and Missouri come together, so we literally got it from all sides," he said.

Except for about 200 acres planted in buffalo grass (see accompanying story), virtually all of the combined 1,200 acres the family plants were ruined. "We have to start from scratch," said Keeven, estimating that, barring a recurrence, it will be at least two and a half years before things are back to normal.

"My father [now retired from the business] was in a flood in '73. He told me we're going to feel this one for another four years," Keeven said.

"It took everything we've got. It'll be two years before we have any production," said Linda Schroeder, who assists her husband in operating Roger Schroeder Sod Farm.

The family, she said, is weighing a decision whether to replant grass or convert to soybean production. "Either way it's a gamble. We can't make a much [profit] per acre with soybeans but we can come back much quicker," she explained. "It's like robbing Peter to pay Paul when Peter doesn't have much either," she added.

The floods — which she called the worst in the three generations the family has been farming — did extensive damage to this year's sod crop but it wasn't a complete loss. The farm in St. Louis County, Mo., was covered with water for a relatively short time but the one in St. Charles County, Mo., was under several days.

There is something of a bright note in the disaster, she added, because it brought out a cooperative spirit among growers. Barely had the water began to recede than competing companies were offering to supply each other to help meet demand from major customers.

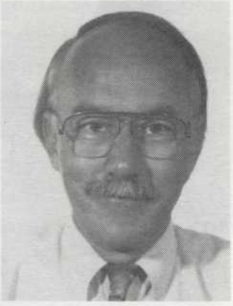
"Instead of competition, we now have more of a helpful market," Schroeder said. "No matter how competitive we are [in normal times], when somebody is hurting, all that stuff is forgotten."

Lance Frye, president of Seven Cities Sod Development, the largest sod producer in Iowa, reported his business through August was off about 65% from last year. Unlike farmers whose land was flooded, he was hurt by falloff in demand, rather than on the supply side. In August the firm had about 500 harvestable acres, compared to about 200 that is normal at that time of year.

"I would expect there will be a lot of demand out there and we could go like gangbusters again, but we'll just have to wait and see," he said. Countering the notion of high demand for sod is the fact that total devastation is apt to result in many potential customers re-seeding "or just walking away from their [destroyed[property altogether."

Either way, lack of business this year is going to keep prices stable next year, Frye said. "With plenty of acres backed up, it will be hard to raise prices even if demand is up." ■

Dear reader:



Turf Grass Trends is back — to stay

Turf Grass Trends has always had the editorial resources to publish issues densely packed with information needed by everyone in the industry, from manufacturers to lawn care operators. Christopher Sann, the founding publisher, proved that. But for a few months, the business side of the publication had the hiccoughs.

Chris' idea to launch *Turf Grass Trends,* a newsletter for professionals and the first one in the field, on a shoe string was a daring idea. He took that idea to the editing and graphics design team of Russ and Connee McKinney. The three of them, ably aided by Dr. Eric Nelson of Cornell University, were pioneers and sometimes pioneers stumble in uncharted wildernesses.

I have about twenty years of experience at newspapers, magazines and newsletters. Some of that was at the helm of publications. I can help chart the way for the business side of *Turf Grass Trends.*

On the editorial side, we'll give you, every month without fail, the quality that we've always given you. Beginning with this issue we're adding more: 16 pages instead of 12 pages. Over the course of the next few months we'll be adding more practical news and features. And we'll be getting to know each of you personally as we call on you to ask what you want from us. As time goes on, look for us to bring you more, useful information in new ways, perhaps accessible by telephone, fax or computer.

The changes we are making to *Turf Grass Trends* are important because in the 1990s and beyond there will be sea changes in how things will be done in the turf grass industry. Upcoming issues will help everyone deal with the new technologies already beating on our doors and those to come. These sea changes will force us to do business in ways that we are not able to imagine now.

With our core team of Chris, Eric, Russ and Connee and experts on and off the field, we'll give you what you need to chart your course. And for you, loyal readers who have stuck with us through thick and thin, we're adding three extra issues — free of charge — to your subscription.

Bon voyage,

Juergen Haber
Publisher

Errata: The chart of the life cycle of Japanese beetle *(Turf Grass Trends* #3, page 10) was based on a design by L. Hugh Newman, *Man and Insects* (London, 1965).

COMING ATTRACTIONS

DECEMBER ISSUE

Environmental regulations

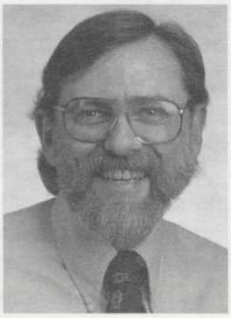
For our second main topic we chose the subject at the top of our initial subscribers' list of concerns: environmental regulations. Obviously, an impossibly big subject. This issue will be, therefore, only a opening salvo. In it we provide:

- AN OVERVIEW OF THE KEY ISSUES involved in the seemingly haphazard growth of environmental regulations,
- AN ANAYLSIS of the turfgrass specific figures on violations and penalties,
- UPDATES on several key controversies involved,
- THE PERSONAL "REGULATORY INSPECTION" experience of an individual lawncare operator,
- A DIRECTORY to help our readers act on the advice to get better informed about, and more involved in, the legislative and regulatory processes by which new laws and regulations are developed,
- AND A SHORT DICTIONARY of environmental laws and terms,

In the coming months, we will return to this subject time and time again.

Alligators all around

by Russ McKinney



TODAY'S TURF managers face a daunting combination of challenges:

- INCREASING environmental regulations are changing the way every segment of the green industry does business,
- OUR ECONOMY is undergoing fundamental structural changes that are difficult to grasp—much less to manage,
- AND THE RELIEF PROMISED by the explosion of new knowledge and new tools is complicated by obstacles to accessing these new resources and putting them to use in the field.

It's easy to feel swamped.

In this context good information obviously isn't a luxury. It can make the difference between successfully managing to change with the times or becoming alligator bait.

–continued on page 14

Alligators continued from page 13

. . . good information obviously isn't a luxury. It can make the difference between successfully managing to change with the times or becoming alligator bait.

In its first six issues, *Turf Grass Trends* set a new standard for providing good, timely, usable information. We delivered a product that didn't leave anyone asking "where's the beef?" We got rave reviews. Then the lights went out. Now they are back on—to stay. In fact, we now have the financial and organizational resources to make *Turf Grass Trends* even better than it was. We will continue to provide in-depth coverage of a key turf management subject in each issue. We also will provide more news, more special features, and more information in every issue—a full 16 pages worth.

Why publish an newsletter, instead of another trade magazine? Because no one else is providing the kind of in-depth, turf management information that *Turf Grass Trends* provides. That is not to say that existing trade magazines aren't doing their job. In fact, they provide a variety of valuable services to people in the field. To cite two related examples, *Landscape Management* 's Ron Hall pointed out that, despite all of the concerns over pesticide exposure, he himself developed skin cancer from overexposure to the Sun. Isn't that always the case? When we aim all of our binoculars to the north, the alligators come at us from the south. We may manage all the complex issues just fine, but some simple factor we all tend to take for granted turns out to be the critical one.

Bill Knoop, an Extension turfgrass specialist at Texas A&M University who is a regular contributor to *Southern Turf Management,* made a similar point. He asserts that the public's concerns about pesticides are mostly focused on professionals, who are trained and certified in pesticide use, while largely ignoring the problem of homeowners and the retail stores where they buy their pest control products:

"There is a strong chance the store will not have anyone on staff who knows much about landscape pests at all, yet these clerks make far more pest control recommendations than any Extension service."

The green industry clearly needs voices like Hall and Knoop and others, and it needs to make the insights they provide more available to the general public. We believe the industry also needs a newsletter that takes an approach to the subject of turf that is lean and mean, no frills and distractions, just solid information. That's why*Turf Grass Trends* focuses on untangling the complexities of the regulatory environment, the marketplace, and the new technical information becoming available about virtually every aspect of turf management. The winds of change are blowing. There is a lot of ground to cover.

In advertising-driven magazines, after the intial spreads, the editorial is frequently run in what graphics designer's call a "gutter"—in between the columns of displays ads. Our idea is that the editorial needs to have the whole road to itself. We plan to cover a lot of territory in every issue of *Turf Grass Trends.*

In this issue, Christopher Sann provides an innovative field perspective on necrotic ring spot, the confusion-causing differences between leaf and root diseases, and how temperature, the time of year, and your own nose can help you to tell one root disease from another. Of course even this formiable array of tools isn't enough. Sann also sounds a theme that will be explored more fully in future issues: both the microscope and the microchip are playing increasing roles in turfgrass management.

Plus veteran business reporter Jim Parks provides a turf-focused look at the prospects for long-term recovery from the devastating floods that hit the Midwest in 1993. Talk about being surrounded by alligators! The Midwest floods prove once again that nature is the ultimate variable. The sheer amount of devastation is hard to grasp, and the responses of turf professionals in the flooded area are object lessons in how the human spirit is as vital as our technical understanding.

Of course river water isn't the only form devastation can take. Ask the DuPont Co. Turns out that a DuPont fungicide named Benlate attracts alligators: literally hundreds of lawsuits that have cost the company millions of dollars. Even though DuPont won one of the major court battles involved, the situation, which has received considerable national media attention,is every manufacturer's nightmare come true.

Adding insult to injury, the company is also downsizing, and earlier this fall announced another round of extensive cuts in personnel. The future of the turf industry is obviously not tied to the fortunes of any one company, but the availability of good products and equipment is a critical issue. So are judgements about the effectiveness of the products turf managers use and the risks and liabilities involved in their use.

Clearly, *Turf Grass Trends* won't make the floods abate. It won't eliminate product liability disasters. It won't decide how major environmental controversies are settled. And it won't reduce the complexities of turf management to a few easy to follow rules.

But you, our readers, are the people on the frontline who have to deal with everything from the vagaries and complexities of nature to the uncertainties of the market and the hurly burly processes by which environmental concerns become laws and regulations. You deserve the best available help, and that is what we aim to provide. ■

Diagnosing leaf and root diseases

by Christopher Sann

ANY DISCUSSION of the diagnostic differences between foliage and root damaging diseases of turfgrass must begin with a simple truism: Forget any of the skills that you, the turfgrass manager, have developed for diagnosing foliar diseases of turf from any distance further than three inches." When it comes to diagnosing root diseases, at best, these skills will be useless and, at worst, they will give you incorrect diagnoses more times than not.

When dealing with most foliar diseases, there are often a group of highly "diagnostic visual symptoms." They range from species specific leaf lesions to whole site patterns of disease activity. A skilled diagnostician can literally diagnose some foliar diseases while driving by at forty miles per hour. Unfortunately, that kind of visual detecting will not work with root diseases. In fact, it often leads to mis-diagnosis, inappropriate applications of control chemicals, and the extra expense of additional control materials and the cost of labor and machinery to reapply.

The days of "seat of the pants" field diagnosis are numbered. If the cost and aggravation of mis-diagnosing turf grass diseases doesn't make us want to change our approach, then the regulators will. One way or the other, we are entering a new age where we have to qualify, quantify and justify why we make every pesticide application. We might as well get used to the idea.

"Diagnostic" symptoms

The problem with trying to transfer the visual skills of pattern recognition and lesion identification —the tell tale signs of foliar turfgrass diseases—to the diagnosis of root diseases is that there are few, if any, truly diagnostic, unique visual symptoms that consistently occur in root disease symptomology.

To be sure, the symptoms of root damaging diseases are often very different from most of the more familiar, "diagnostic" symptoms of foliar diseases, but these different symptoms are so common within this group—and for that matter in the advanced stages of many of the foliar diseases—that they could be caused by any of a dozen pathogens. Historically, with the use of the broad spectrum heavy metal-based fungicides, the fine distinctions between the various pathogens was a moot point. But in today's highly charged regulatory atmosphere, with the increasingly narrow focus of newer fungicides, this distinction has become crucial.

How to look for root disease symptoms

Vision is still the best tool for making correct diagnoses in the field, but, in the case of root diseases, your vision should be augmented with a 8 - 10 X hand lens, a soil probe, a sample cutter (like a sturdy pen knife or a putting green hole cutter), and a major revision of attitude.

We need to reverse the historic approach of starting at the top of the turfgrass plant and working down to the crown and maybe the roots. Root damaging diseases kill roots. Often the infected plant has sustained massive root loss before any symptoms can be seen on the foliage. Additionally, the more opportunistic foliar diseases will colonize turf that is under attack from root pathogens, and simply identifying the"diagnostic symptoms" of these foliar infections will give you a false impression about what is happening and in what order.

This common mistake can be avoided if you start at the bottom and work your way up. Start by taking a sample from the margins of the damaged area, pry it apart, and examine the roots with your hand lens. If the roots looks healthy (i.e., white with abundant root hairs), then examine the crown. If the crown also appears healthy, then finally examine the foliage.

If, after using this bottom up approach, you cannot find enough visual clues to come to a conclusion, then either further examine the sample under a good microscope, using a good reference book like "The Compendium of Turfgrass Diseases," or send a sample to a good diagnostic lab. Most major state universities either have diagnostic labs or can recommend one. ■

Latest Word *continued from page 7*

Worker exposure study

K.A. HURTO AND R.A. YEARY of Trugreen/Chemlawn measured how pesticide exposure to workers varied by equipment and formulations and how much of the applied pesticide was recoverable over time. Compared to worker exposure from using granular application drop spreaders

- FINE DROPLET SIZED LIQUID application equipment exposed workers to 15 times more pesticide.
- LARGE DROPLET SIZED LIQUID application equipment—10 times more.
- LIQUID BACKPACK SPRAYERS—four times more
- GRANULAR ROTARY SPREADERS—two times more.

The thigh and lower legs received 99% of the exposure during liquid applications, while areas above the waist only received 1% of the exposure.

The residues that could be recovered from turf following a liquid application were 25% of the total amount applied, one hour after the application. This amount decreased, after two hours, to 7%; after 1 day to 6 %; after 7 days to 2%; and after 14 days to <1%. When treated area was irrigated two hours after the application, the amount of pesticide was reduced by an average of 45% for each testing day.

When a liquid application was compared to a granular formulation of the same material, the recoverable residues of the liquid were 20 times that of the granular formulation. ■

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