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Turf Grass TRENDS

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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.

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

–continued on page 2

IN THIS ISSUE

"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

–continued on page 4

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

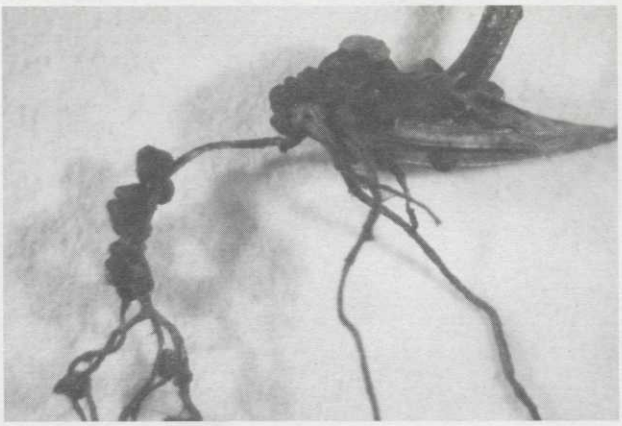
Necrotic ring spot's effects vary by species. Individual varieties, within a species, may also show improved resistance to N.R.S. induced stress damage:

- 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.

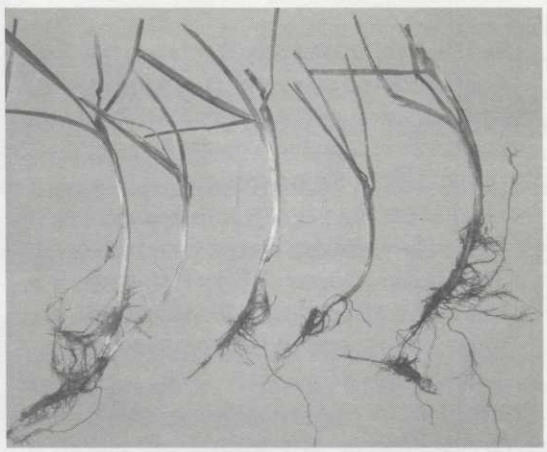
The N.R.S. fungus also produces large dark brown sclerotia, or resting bodies, that clog the vascular system of the roots and impede the upward flow of water and nutrients. Infected roots and rhizomes become necrotic, discolor, and die.

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

–continued on page 6

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.

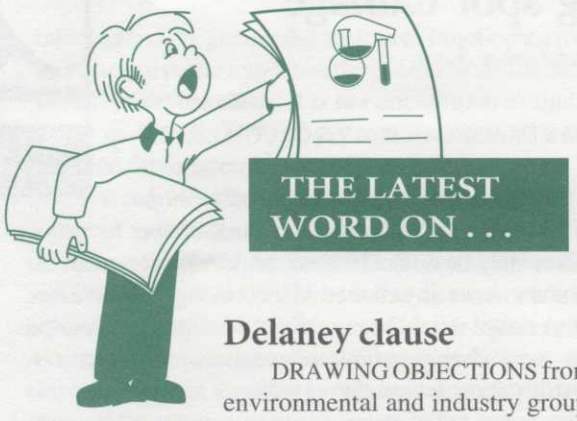
Leptospirea korreae . . . . . The causal agent of necrotic ring spot.

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 Con-