Cool-Season Turf Diseases

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A good deal of research in the area of turfgrass diseases has turned to biological management. Biological management of necrotic ring spot, summer patch and typhula blight has been demonstrated.

Another area of interest has been the re-occurance of resistance to fungicides by turfgrass pathogens, this time involving the pythium blight pathogen *Pythium aphanidermatum* and the anthracnose fungus *Colletotrichum graminicola*. These subjects and many more concerning the current status of turfgrass diseases are discussed in this article.

These diseases, the organisms that cause them, and their cultural, biological and chemical management tools are given in Table 1.

Biological management

Necrotic ring spot. It now appears that necrotic ring spot, caused by *Leptosphaeria korrae*, is the primary patch disease found on Kentucky bluegrass in the cooler regions of the cool-season turfgrass area. The symptoms can be observed throughout the growing season even though *L. korrae* appears to be most active during the cooler weather of the spring and fall.

The plants that were infected by *L. korrae* in the cooler weather are in a weakened condition and are very susceptible to summer heat stress or drought stress. Subjecting the necrotic ring spot plants to either of these stresses will lead to the death of the weakened plants and the recurrence of symptoms, even though the pathogen may not be active at this time. The symptoms during cool weather are patches six inches to two feet in diameter with straw-to red-colored blades intermingled in the patch.

Older patches may have green grass in their centers with the straw-to red-colored blades in the outer area of the patches. When the disease symptoms occur during the warm weather the red blades are often scarce and usually only straw-colored or wilted leaves are present.

Nitrogen is important for recovery of the patches caused by necrotic ring spot. Three to five pounds of actual nitrogen per 1,000 sq. ft. per season is necessary to promote recovery and to prevent new patches from developing.

Proper cultural practices are also important in patch recovery and in the prevention of new patches. These include coring to relieve compaction and layers that result when sod of one soil type is laid on top of soil of another type, which is common practice during the establishment of home lawns and commercial lawn properties. This results more in short rooting during the warm weather (when the roots of the turfgrass plant are confined to the upper layer).

Coring and re-incorporating the soil back into the thatch will, over a period of years, alleviate the layering problem. It may also help manage any potential thatch problem, which is important in managing necrotic ring spot.

Thatch has a poor moisture-holding capacity and turfs growing in a thick thatch and susceptible to drought stress. Light, frequent irrigation is also important in managing this disease. The theory that deep, infrequent irrigation is more beneficial to turf development is just that, a theory. Preliminary research data indicates that light, frequent waterings may be more beneficial to the turf. Such waterings on a daily basis, around mid-day, have been shown to help manage necrotic ring spot.

The turf appears to be benefitting culturally from the cooling of the turf and biologically from the build-up of beneficial micro-organisms in the moist thatch that may be antagonistic to *L. korrae*. There are also some new products that help manage the disease biologically.

COOL-SEASON TURF DISEASES
TABLE 1
TURF DISEASE AND CONTROLS

Disease	Causal Agent	Hosts	Biologial and Cultural Control	Chemical Control
Anthracnose	*Colletotrichum graminicola*	Annual bluegrass Fine-leaf fescue Kentucky bluegrass Perennial ryegrass	Adequate nitrogen. Cool grass by syringing	Maneb plus zinc sulfate, chlorothalonil, benomyl, thiophanate-methyl, thiophanate, thiophanate-methyl + mancozeb, triadimefon
Brown patch	*Rhizoctonia solani*	All major turfgrass species	Reduce nitrogen. Remove "dew." Increase air movement	Mancozeb, maneb + zinc sulfate, chlorothalonil, anilazine, vinclozolon, benomyl, thiophanate-methyl, thiophanate, thiram, thiophanate-methyl + maneb, cadmium compounds, thiophanate + thiram, PCNB, iprodione
Dollar spot	*Lanzia spp.* *Moellerodiscus spp.*	Annual bluegrass Bahiagrass, Bermudagrass Centipedegrass, Colonial bentgrass, Fine-leaf fescues Kentucky bluegrass, Perennial ryegrass, St. Augustinegrass Zoysiagrass	Increase nitrogen Remove "dew."	Benomyl, thiophanate, thiophanate-methyl, chlorothalonil, anilazine, fenarimol, cadmium compounds, thiophanate + thiram, thiabendazole benomyl, iprodione, thiophanate-methyl + maneb, vinclozolin, triadimefon
Summer patch	*Phialophora graminicola*	Annual bluegrass Kentucky bluegrass	Light, daily watering during the sumer	Fenarimol, thiophanate-methyl, thiophanate, triadimefon, iprodione, benomyl
Helminthosporium Diseases Brown blight Leaf blotch Melting-out, Net blotch Read leaf spot Stem and crown necrosis Zonate Eye spot Leaf spot	*Dreschlera* *D. siccans* *D. cynodontis* *D. poae* *D. dictyoides* *D. erythrospila* *D. specifera* *D. gigantea* *Bipolaris sorokiniana*	Ryegrass Bermudagrass Kentucky bluegrass Fescue Creeping bentgrass Bermudagrass Bermudagrass Bentgrass Fine-leaf fescue, Kentucky bluegrass	Remove clippings. Raise cutting height Plant resistant cultivars Moderate spring nitrogen. Daily irrigation.	Mancozeb, chlorothalonil, iprodione, anilazine, maneb, + zinc sulfate, PCNB, vinclozolin
Take-all patch	*Gaeumannomyces graminis*	Creeping bentgrass Kentucky bluegrass Velvet bentgrass	Reduce soil pH. Avoid liming, Use acidic fertilizers. Sulfur	Fenarimol
Pythium blight (cottony blight)	*Pythium spp.*	Perennial ryegrass Creeping bentgrass Annual bentgrass	Improve soil drainage. Increase air circulation	Chloroneb, ethazol, metalaxyl, propamocarb
Red thread	*Laetisaria fuciformis*	Creeping bentgrass Colonial bentgrass Bermudagrass Annual bluegrass Perennial ryegrass Fine-leaf fescue	Increase nitrogen	Anilazine, iprodione, triadiefon, vinclozolin, chlorothalonil
Pink patch	*Limonomyces roseipellis*	Perennial ryegrass Creeping bentgrass Fine leaf fescue	Increase nitrogen.	Try red thread fungicides
Snow molds Typhula blight Fusarium patch	*Typhyla spp.* *Fusarium nivale*	Annual bluegrass Colonial bentgrass Creeping bentgrass Fine-leaf fescues Kentucky bluegrass Perennial ryegrass Tall fescue, Velvet bentgrass	Avoid early fall nitrogen fertility that leads to lush growth.	Mercury compounds, PCNB products, chlorothalonil, chloroneb, These products may have to be used in combination for effective snow mold management. Benomyl, iprodione, or mancozeb will control Fusarium patch where it occurs alone.
Necrotic ring spot	*Leptosphaeria korrae*	Kentucky bluegrass	Nitrogen to promote recovery. Light daily irrigation. Lawn Restore Green Magic, Strengthen & Renew.	Iproione, fenarimol, benomyl, thiophanate, thiopanate-methyl
Stripe smut	*Ustilago striiformis*	Kentucky bluegrass Creeping bentgrass	Reduce nitrogen. Prevent summer dormancy	Fenarimol, triadimefon

Lawn Restore, produced by the Ringer Corporation, is a natural organic product that is a complete fertilizer containing all the major nutrients as well as some beneficial microorganisms that produce substances under laboratory conditions that are antagonistic to the pathogen *L. korrae*. It has also been shown to manage necrotic ring spot under field conditions. Lawn Restore has been effective in both promoting the recovery of existing necrotic ring spot patches and preventing the development of new ones.

Another group of products produced by the Agro-Chem Co. (Green Magic, Strengthen and Renew and Nutra Aid), when used in a systematic program, also have been shown to manage necrotic ring spot under field conditions. They appear to improve the environment and allow an increase in the natural population of beneficial organisms in the soil and thatch.

The key word is "management." These products are not a one-shot cure, but used systematically on a regular basis, they will manage the disease and provide a healthy turf.

Typhula blight. Typhula blight is caused by two species, *Typhula incarnata* and *T. ishikariensis. T. incarnata* is the primary species in the eastern U.S. and in southern and mid-regions of the Midwest and western United States. *T. ishikariensis* is most prevalent in the more northern snow mold regions, especially where prolonged periods of permanent snow (two or more months) exist in the midwestern and western U.S.

The two typhula species are easily distinguished from each other when observed soon after the snow melts. *T. incarnata* produces graying spots in the turf with scattered, fairly large brown sclerotia evident, where as *T. ishikariensis* spots have a reddish cast to them and contain numerous small, dark black sclerotia.

Typhula blight only occurs under snow cover. It does not occur in the cool, wet weather of fall and spring, except under leaf piles. Typhula blight has been, and still is, managed primarily by fungicides (Table 1).

Lee Burpee at the University of Guelph has isolates of a saprophytic typhula species, *Typhula phacorrhiza* that will biologically manage typhula blight caused by *T. ishikariensis*. This biological management of typhula blight was shown to be effective under field conditions in Ontario. Research is currently being conducted to find a way to make this biological management tool commercially available.

New fungicide resistance

Pythium blight. Metalaxyl resistance to pythium blight caused by *Pythium aphanidermatum* was reported back in 1983 by Dr. P.L. Sanders at Pennsylvania State University on a single golf course in Pennsylvania. This past season, she found resistance to matalaxyl in several additional locations in other states. We also found metalaxyl resistant strains of *P. aphanidermatum* at two locations in Kentucky on perennial ryegrass fairways.

We concurred with Dr. Sanders' previous findings that these new strains are far more aggressive than the older, wild type strains. They also appear to be pathogenic over a wider range of temperatures, occuring when temperatures were only in the high 70s.

The metalaxyl-resistant strain of *P. aphanidermatum* was not cross-resistant to chloroneb, ethazole, probamocarp or fosetyl A1. These fungicides can be used where these resistant metalaxyl strains occur. How widespread or how persistent these strains will become only time will tell, but a good rule of thumb is that if these strains are going to occur, they will begin to show up the second or third year, especially if multiple applications of metalaxyl are made during the first two seasons.

The fact that the perennial ryegrasses are super susceptible to pythium blight combined with the development of the highly aggressive metalaxyl resistant strains of *P. aphanidermatum*, raises serious questions about the use of the perennial ryegrasses in areas of the country where there is a high incidence of pythium blight.

Anthracnose. Resistance to the benzimidazole fungicides (benomyl, thiophanate, thiophanate-methyl) by *Colletotrichum graminicola*, the cause of anthracnose, took much longer to develop than with other fungi like *Erysiphi graminis* (powdery mildew) or *Sclerotinia homeoecarpa* (dollar spot).

Resistance to the benzimidazoles by *E. graminis* and *S. homeoecarpa* usually occured in the first three years and often in the second year. On the golf courses from which the benzimidazole-resistant strain of *C. graminicola* was isolated, the superintendent had used benzimidazole fungicide for 14 years. Resistant dollar spot had been observed on the course for over 12 years.

The question is, why did resistance to the dollar spot organism show up so quickly, whereas resistance to anthracnose took so long? I think the answer lies in the type of pathogen these two fungi are.

Sclerotinia homoeocarpa germinates and may grow for a short period of time and then infects the plant.

If fungicides like the benzimidazoles eliminate sensitive strains from the population, *S. homoeocarpa* is not capable of growing saprophytically after the fungicide has disappeared from the environment in order to re-establish itself throughout the turf area. This allows resistant strains, which are in low numbers in the population, to infect the turn and begin to build up their numbers quickly in the absence of competition from the benzimidazole-sensitive wild type strains. Under such conditions, the benzimidazole-resistant strains can build up rapidly in the turf.

Colletotrichum graminicola, on the other hand, spends much of its life living as a saphrophyte in the thatch and mat on dead organic matter when it is not a pathogen. So, when fungicides like the benzimidazoles eliminate sensitive strains from the population, the survivors can grow saprophytically and build up the population again.

With this type of competition, it would take benzimidazole-resistant strains many years to build up large enough numbers to become the dominant strain in the population. The message is that those of you who have been using the benzimidazoles for many years should be on the lookout for the emergence of benzimidazole-resistant strains of *Colletotrichum graminicola*. Don't be lulled into thinking that if resistance hasn't occurred by now, it won't occur.

Managing stripe smut

This disease, caused by *Ustilago striiformis*, is one of the most devasting diseases of turf. The patch diseases have certainly received all the notoriety in home lawn turf problems but more turf has been lost to stripe smut.

The reason strip smut doesn't receive all the notoriety is that, in most instances, it is a slower-acting disease that weakens infected plants which are then crowded out by weeds or die under stress randomly as individual plants rather than as large areas dying all at once. the remaining stripe smut infected plants are too week to fill in the voids and this allow weeds to enter in the turf. If the weeds are broad-leaf or annual grasses, like crabgrass, then selective herbicides can be used to remove them.

However, unlike healthy Kentucky bluegrass, the weakened stripe smut-infected plants cannot fill in the voids where the weeds were selectively removed and eventually the perennial weedy grasses like tall fescue and quackgrass fill in these voids. A total renovation of the existing turf is the only solution to a lawn infested with perennial weedy grasses since there are no selective herbicides.

What makes stripe smut such a devastating disease is that it is a systemic perennial disease. This means that once a plant is infected it will remain so for life. Any daughter plants arising from an infected mother plant via rhizomes or stolons will also be infected. So, unlike most other diseases, infection does not have to take place every year. All that's needed is environmental stress for this stripe smut weakened plant to die.

The foliar symptoms are most evident during the cool weather of spring and fall when the fungus grows throughout the veins of the plant, eventually producing spores which rupture the epidermis, causing the leaves to have a frail, torn appearance.

Though the symptoms are most evident in the cool weather of the spring and fall, most of the turf infected with stripe smut dies in the summer when the turf is allowed to go under drought stress. This may be due to the plant's inability to conserve moisture because of its torn epidermis or its general weakened condition.

When healthy Kentucky bluegrass is allowed to go under drought stress, it will go dormant and green up again with the occurrence of late summer or early fall rains. Kentucky bluegrass turf infected with stripe smut, however, will die if allowed to undergo drought stress.

The fact that the disease is systemic suggests that there is little resistance in the plant. Resistance is expressed as keeping the infection localized, that is, small spots on the leaves, as in the case of the rust diseases. Leaf rust and stem rust are considered minor diseases of turf because they tend to produce localized lesions whereas stripe rust is a major disease because it is systemic in the plant, indicating little resistance.

Until recently, a stripe smut-infected turf was subject to a slow but inevitable death, eventually being taken over by perennial weeds, which meant the turf had to be killed by a herbicide like Roundup and completely renovated. However, the development of triadimefon and fenarimol has changed all that. These two fungicides, used on a regular basis, will manage stripe smut.

The first application should occur in the spring just before the turf breaks dormancy, followed by a second application just prior to the summer heat stress period and a third application when the cool nighttime temperatures of the late summer or early fall return.

Other patch diseases

Summer patch. It has become increasingly evident over the past few years that summer patch, caused by *Phialophora graminicola*, is a primary disease of annual bluegrass during warm weather. It can also be found on Kentucky bluegrass and fine-leaf fescues, especially in the warmer areas of the cool-season grass region.

On annual bluegrass, the initial symptoms are a yellowing of the turf in patches, usually six inches to one foot in diameter, followed by a thinning of the turf, with the remaining turf turning bronze in color. If warm weather persists, all the turf in the patches may die.

Most of the creeping bentgrass cultivars are resistant and creeping bentgrass frequently can be seen recolonizing the centers of these patches. Preliminary data indicate that soil temperature and soil moisture may be important in the development of this disease.

Both excessive and limiting soil moisture during periods of hot weather may result in severe outbreaks of summer patch. Lighter and more frequent irrigations should help reduce the severity of summer patch.

Take-all patch. Take-all patch caused by *Gaeumannomyces graminis var. avenae* was formerly known as ophiobolus patch caused by *O. graminis*. This disease was originally thought to be confined to the Pacific Northwest. It has now been reported throughout the United States and Canada wherever creeping bentgrass is grown.

Effective chemicals

Fungicides for the management of the patch diseases and how to use them are discussed below:

Benomyl, thiophanate and *thiophanate-methyl*. These fungicides will manage all three diseases. They are all basically the same chemistry as far as mode of action is concerned. They are also systemically translocated upward and outward from where they enter the plant. For fungicides to be effective against these root pathogens, they need to be drenched into the soil where they can be taken up by the roots. If they are allowed to dry on the foliage, they will not manage the patch diseases.

For best results the area to be treated should be irrigated just prior to treatment.

Fenarimol. This fungicide will also manage all three patch diseases and does not need to be drenched in to be effective. For management of summer patch on annual bluegrass, treatments should be applied early in the season before the temperatures go into the 80 degrees Fahrenheit range on a permanent basis.

Iprodione. This fungicide is effective against necrotic ring spot and does not need to be drenched in to be effective.

Triadimefon. This fungicide is effective against summer patch and does not need to be drenched in to be effective. There are some reports in the literature that suggest this product is only effective against summer patch when applied as a preventive treatment.

Landscape Management

GRAMS/GALLON TABLE

Gallons / PPM	5	10	15	20	25	50	75	100	150	200	300	400
5	0.1	0.2	0.3	0.4	0.5	1.0	1.4	1.9	2.8	3.8	5.7	7.6
10	0.2	0.4	0.6	0.8	1.0	1.9	2.8	3.8	5.7	7.6	11.0	15.0
15	0.3	0.6	0.9	1.1	1.4	2.8	4.3	5.7	8.5	11.0	17.0	23.0
20	0.4	0.8	1.1	1.5	1.9	3.8	5.7	7.6	11.0	15.0	23.0	30.0
25	0.5	0.9	1.4	1.9	2.4	4.7	7.1	9.5	14.0	19.0	28.0	38.0
50	0.9	1.9	2.8	3.8	4.7	9.5	14.0	19.0	28.0	38.0	57.0	76.0
75	1.4	2.8	4.3	5.7	7.1	14.0	21.0	28.0	43.0	57.0	85.0	114.0
100	1.9	3.8	5.7	7.6	9.5	19.0	28.0	38.0	57.0	76.0	114.0	151.0
125	2.4	4.7	7.1	9.5	12.0	24.0	36.0	47.0	71.0	95.0	142.0	189.0
150	2.8	5.7	8.5	11.0	14.0	28.0	43.0	57.0	85.0	114.0	170.0	227.0
175	3.3	6.6	9.9	13.0	17.0	33.0	50.0	66.0	99.0	133.0	199.0	265.0
200	3.8	7.6	11.0	15.0	19.0	38.0	57.0	76.0	114.0	151.0	227.0	303.0
250	4.7	9.5	14.0	19.0	24.0	47.0	71.0	95.0	142.0	189.0	284.0	379.0
300	5.7	11.0	17.0	23.0	28.0	57.0	85.0	114.0	170.0	227.0	341.0	454.0
400	7.6	15.0	23.0	30.0	38.0	76.0	114.0	151.0	227.0	303.0	454.0	606.0