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Circle No. 106 on Reader Inquiry Card

Warm-season turfgrass insect management: monitor often for pests

R.L.BRANDENBURG / Turf Entomologist,
N. C. State University

The twolined spittlebug problem has been increasing on warm-season turfgrasses over the past 10 years. This may be due to the increasing population in the South, the increased use of centipedegrass, and extensive plantings of hollies in landscape (a host for spittlebug adults).

Despite this general increase in the abundance of spittlebugs we have seen in recent years, we were not prepared for such high numbers in many areas during 1996. High populations were observed on many species of both cool and warm-season grasses. This phenomenon appeared to be a reflection of a wet, cooler-than-normal summer. Does this mean twolined spittlebugs will be a serious problem in 1998? It's difficult to predict this pest for the summer season. Undoubtedly, higher-than-normal populations of spittlebugs overwintered, but we don't know if this will translate into above-normal populations this summer. Be prepared and scout centipedegrass frequently for this pest.

Twolined spittlebugs, if conditions allow, can damage centipede turf. Turfgrass managers in the south should scout for them.

The southern chinch bug is a pest of St. Augustinegrass particularly in hot, dry weather. Despite rainfall that in some areas was more than twice the normal average, we observed damage from chinch bugs. In fact, we saw some of the heaviest infestations we had observed in the past five years. Was this contrary to our accepted understanding of chinch bug outbreaks? Yes, it certainly was, but it also emphasized the need to continually monitor turfgrass despite what conventional wisdom might tell you. Time spent monitoring the turf helps avoid surprises. The same could be said for bermudagrass mites which also prefer hot, dry weather. Wet weather doesn't mean you can forget about them.

White grubs are generally less of a problem in areas of warm-season turf compared to the cool-season zones, particularly the Northeast. However, wet soil during July and August may contribute to more grubs this spring. The adult beetles of white grubs generally lay their eggs in late June through July. These eggs must be laid in moist soil that remains moist throughout the development of the very small first stage grubs. If the soil is dry the eggs don't hatch or the very small, newly-hatched grubs die.

Many areas last year had enough rainfall to keep the soil moist during this critical period for egg and grub survival. As a result we probably had above average survival of white grubs over a wider area (especially non-irrigated areas) and those above average numbers overwintered to damage turf in the spring. This may well be reflected in the number of moles attracted to turf areas to feed on these grubs. It may also result in more beetles, such as Japanese beetles to feed on certain ornamental plantings next season. **LM**

PRODUCTS FOR CONTROL OF WARM-SEASON INSECT PESTS

Southern chinch bug:
bendiocarb (Turcam, Dycarb); ethoprop (Mocap); cyfluthrin (Tempo, Decathlon); permethrin (Astro); diazinon; chlorpyrifos (Dursban); isofenphos (Oftanol); isazofos (Triumph); fonofos (Crusade, Mainstay); lambda-cyhalothrin (Scimitar, Battle); acephate (Orthene); fluvalinate (Mavrik)
Timing: apply as needed during hot, summer months.
Thorough coverage is critical. Irrigate immediately after application of granules. Avoid over-fertilizing.

Leafhopper/twolined spittlebugs:
acephate (Orthene); bendiocarb (Turcam, Dycarb); chlorpyrifos (Dursban); diazinon; carbaryl (Sevin); isazofos (Triumph); fluvalinate (Mavrik).
Timing: begin monitoring and treat damaging populations in early summer.

Cutworms, armyworms:
azadirachtin (Turplex); lambda-cyhalothrin (Scimitar, Battle); acephate (Orthene); carbaryl (Sevin); diazinon; isofenphos (Oftanol); chlorpyrifos (Dursban); fluvalinate (Mavrik); cyfluthrin (Tempo, Decathlon).
Timing: monitoring/treatment may be necessary in early spring-late fall.

Mole crickets:
chlorpyrifos (Dursban bait); propoxur (Baygon bait); carbaryl (Sevin bait); bendiocarb (Turcam, Dycarb); chlorpyrifos (Dursban); isofenphos (Oftanol); fonofos (Crusade, Mainstay); acephate (Orthene); ethoprop (Mocap); fluvalinate (Mavrik, Battle); entomogenous nematodes (Vector MC, others); imidacloprid (Merit).
Timing: soap flushes to monitor egg hatch. Treat nymphs in early summer.

White grub:
bendiobarb (Turcam, Dycarb); diazinon; isofenphos (Oftanol); isazofos (Triumph); fonofos (Crusade); ethoprop (Mocap); imidacloprid (Merit); entomogenous nematodes (Cruiser) trichlorfon (Proxol, Dylox).
Timing: treat small grubs in late summer and fall for best control.

Ground pearls:
No known effective chemical controls. Follow proper turf management practices and irrigation.

Not all trade names are mentioned, and the ones listed are used as examples. No endorsement of product is intended nor does omission of any product imply criticism.

Disease control in cool-season turf

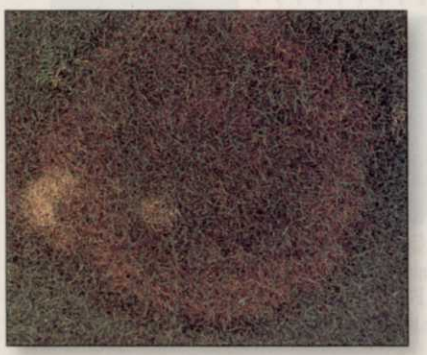
by GAIL L. SCHUMANN, Ph.D./University of Massachusetts

Different years result in different disease problems.

1996 was relatively cool and wet in most northern areas, and the diseases reflected that. The season began with a period of recovery from the severe snow mold in many areas.

Deep, lasting snows

In the fall of 1995, long lasting snow fell on turfgrass that had not yet gone dormant in many sections of the Northeast. This created perfect conditions for snow mold fungi. These fungi prefer moist conditions and refrigerator temperatures. Two different diseases are commonly found: *Typhula* blight (also known as gray snow mold) and *Fusarium* patch (also known as pink snow mold), but both diseases are more severe when snow covers green grass in moist soil for many weeks, especially where late-season, excess nitrogen applications have prolonged the growth of the grass.



Raise height of cut to battle brown patch.

Snow molds are different

Fusarium patch, in particular, is more severe at high soil pH. Fall lime applications can exacerbate this disease. *Fusarium* patch is also different from *Typhula* blight in that it is more likely to result in crown infection and the death of turfgrass plants. It can also become active with the first cool, wet weather of fall and last throughout cool, rainy springs even in the absence of snow. In the absence of snow, the primary symptom of *Fusarium* patch is small, greasy patches similar to those caused by *Pythium* blight in the heat of summer. The fungus can easily be streaked by mowers causing added injury and confusing symptoms.

Tip blight not severe

A stress disease most commonly observed in hot weather appeared in early summer at our research field plots in 1996. *Leptosphaerulina* blight is usually a minor tip blight which is mowed away once drier weather conditions prevail. The prolonged wet weather in early summer 1996 seemed to favor it, leaving some bentgrass areas with a reddish look similar to anthracnose.

Snow mold can last in rainy spring.

Anthracnose at low heights

Anthracnose was by far the most common complaint in the Northeast in the summer of 1996. This stress disease is common when excessive moisture combines with factors which slow the growth of the turfgrass. Although it is more common on annual bluegrass, it can also be found on bentgrass especially at low mowing heights and in compacted, nutrient-deficient soils. Superintendents who skipped spring core aeration reported increased problems with the disease, so they should consider spring coring.

Anthracnose is probably one of the most misdiagnosed turfgrass diseases. A certain diagnosis requires observation of the tiny hair-like structures (setae) produced in the fruiting bodies of the causal fungus. In recent years, the crown rot form of anthracnose has become more common. This is probably related to the fact that stresses continue to increase in modern golf turf with longer playing seasons, greater number of rounds, lower mowing heights and increased compaction. Even when a fungicide stops the growth of the fungus, recovery will be slow, if it occurs at all.

Red thread may persist

The fungus that causes red thread prefers cool conditions, but can remain active throughout the year at moderate temperatures in prolonged wet weather. In past years, applications of nitrogen fertilizer seemed to reduce the disease

to acceptable levels, but some turf managers now find that fungicides are necessary in severe cases.

Gray leaf spot in warm temps

The hot, stressful weather in the summer of 1995 led to the destruction of perennial ryegrass fairways in the mid-Atlantic states. *Pyricularia grisea* causes gray leaf spot of both ryegrass and tall fescue in hot weather and appears to be a new threat to these turfgrasses.

Gray leaf spot was reported in Kentucky in late August of 1996, but the relatively cool season probably prevented major epidemics. Turfgrass managers should learn more about this potentially damaging disease if 1997 brings hotter weather.

Rust in high, moist turf

The last weeks of August in the Northeast brought a surprising dry spell of weather which slowed turf growth. Even though there was little rainfall, some days were foggy and moist for many hours. This resulted in severe rust outbreaks, especially in lawns and other turf areas that are not mowed frequently.

Rust is easily diagnosed by the presence of pustules of

FOLIAR DISEASES- CULTURAL AND CHEMICAL MANAGEMENT

These diseases all begin with infection of the leaf blades. Minimize the time water remains on leaf blades through dew removal, proper irrigation timing, and pruning of landscape plants for air movement.

Diseases generally worse under LOW nitrogen conditions

Disease	Cultural control	Fungicidal control
Anthracnose	Reduce compaction, raise mowing height.	azoxystrobin, chlorothalonil, cyproconazole, fenarimol, propiconazole, thiophanate-methyl, triadimefon
Dollar spot	Reduce compaction, raise mowing height.	mancozeb, maneb, myclobutanil, PCNB, proiconazole, thiophanate-methyl, thiram, triadimefon, vinclozolin
Red thread	Reduce compaction, irrigate.	azoxystrobin, chlorothalonil, cyproconazole, fenarimol, flutolanil, iprodione, mancozeb, myclobutanil, propiconazole, thiophanate-methyl, triadimefon, vinclozolin
Rust	Reduce compaction, irrigate.	chlorothalonil, cyproconazole, mancozeb, maneb, myclobutanil, propiconazole, triadimefon

Dieases generally worse under HIGH nitrogen conditions

Disease	Cultural control	Fungicidal control
Brown patch	Raise mowing height.	azoxystrobin, captan, chlorothalonil, cyproconazole, fenarimol, flutolanil, iprodione, mancozeb, maneb, myclobutanil, PCNB, propiconazole, thiophanate--methyl, thiram, tyriadimefon, vinclozolin
Snow molds: Fusarium patch (pink) Typhula blight (gray)	Allow turf to go dormant, remove snow where practical, avoid lime apps where fusarium is a problem.	for fusarium only: mancozeb, thiophanate-methyl typhula blight only: chloroneb; flutolanil; both snow molds: azoxystrobin, chlorothalonil, cyproconazole, fenarimol, iprodione, PCNB, propiconazole, triadimefon, thiram, vinclozolin
Bipolaris and *Drechslera*	Mow at height recommended for turf species.	azoxystrobin, captan, chlorothalonil, iprodione, mancozeb, maneb, myclobutanil, PCNB, propiconazole
Leaf spots	Avoid surface drainage; do not mow or irrigate when disease is active.	axoxystrobin, chloroneb, etradiazole, fosetyl-AL, mefenoxam, metalaxyl, propamocarb
Yellow patch (cool-season brown patch)	Improve drainage.	azoxystrobin, flutolanil, propiconazole

powdery orange spores. These begin to show up 10 to 14 days after spores have infected the leaf blades. This explains why rust is uncommon on frequently mowed turf. The leaf blades are mowed away before the rust has a chance to develop. Rust may weaken plants, but rarely kills them. In northern areas, the spores will not survive winter, so the turf should begin spring with a fresh start.

Fungicide news

Some new fungicides and new formulations of fungicides are available for the coming season. When new formulations are produced, it is important to read the revised labels carefully for new application recommendations and new rates. For example, **Daconil Weather Stik** is formulated at a 6F rate, which has a higher concentration of the active ingredient, chlorothalonil, than Daconil 2787 which is a 4F.

There are now five DMI (sterol-inhibitor) fungicides available- cyproconazole (**Sentinel**), fenarimol (**Rubigan**), myclobutanil (**Eagle**), propiconazole (**Banner**), and triadimefon (**Bayleton**). It is important to know the chemical group or family of all fungicides you use. Repeated use of fungicides from the same chemical group can result in fungicide resistance. **Banner Maxx** and **Subdue Maxx** have been reformulated from emulsifiable concentrates, which are oil-based, to microemulsion concentrates. Banner Maxx has some new diseases added to its label including take-all patch. Subdue Maxx has a new active ingredient, mefenoxam, which is an isomer of the previous ingredient metalaxyl. **Chipco Aliette Signature** (fosetyl-Al) has also been reformulated to allow more compatible tank-mixing with other fungicides.

Azoxystrobin (**Heritage**) is a newly registered fungicide with a different chemistry from existing fungicides. University research reports have shown excellent control of many important turfgrass diseases including anthracnose, brown patch, red thread, snow molds, and summer patch. Heritage also has activity against Pythium blight which is unusual in a broad-spectrum fungicide. Turf managers should be aware that this fungicide, like many current products, has potential for resistance with repeated use and does not control dollar spot. At this time, it is registered only for golf courses, not lawn care.

Dollar spot in Kentucky bluegrass. Note mycelium in turf.

Aeration, drainage a good defense

It is always difficult to predict potential disease problems for the coming season. Many midwestern states have had record snowfall, while the Northwest has received record-breaking storms of rain and snow. In many parts of the

ROOT DISEASES

Cultural practices which enhance root growth will reduce the effects of these diseases including aeration, improved drainage, and higher mowing heights. Fungicides are most effective when used preventively.

	Notes	Fungicides
Necrotic ring spot	Try brief mid-day irrigation in hot weather, use resistant cultivars.	Preventive: azoxystrobin, cyproconazole, fenarimol, myclobutanil, propiconazole Curative: thiophanate-methyl
Pythium root rot	Improve drainage, raise mowing height.	Fungicides that are effective for Pythium blight may be helpful, but check labels for legal uses.
Summer patch	Maintain 5.8-6.0 soil pH in root zone, raise mowing height in hot weather.	Preventive: azoxystrobin, cyproconazole, fenarimol, myclobutanil, propiconazole, triadimefon Curative: thiophanate-methyl
Take-all patch	Maintain 5.8-6.0 soil pH in root zone, most common in newly planted bentgrass.	Preventive: azoxystrobin, fenarimol, propiconazole, triadimefon

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Northeast, it has been a mild, almost non-existent winter. The groundhogs in those areas seem to be right in their predictions for an early spring. If the weather warms up quickly, we may see early problems with summer diseases and more time for potential heat stress. Some of our most difficult diseases to control are stress-related. Concentrate on spring aeration programs and improving drainage where it is needed. Try to give the turf optimal growing conditions to help it withstand any potential weather-related stresses that may come later on. **LM**

The author is an associate professor of turfgrass pathology at the University of Massachussetts. Charts and photographs courtesy Dr. Schumann.

FUNGICIDE ACTIVE INGREDIENTS AND EXAMPLE TRADE

Active ingredient	Trade names
azoxystrobin	Heritage (50WG)
captan	Captan WP, Captec
chloroneb	Proturf Fungicide V (6.25 G), Teremec SP (65WP), Terraneb SP
chlorothalonil	Chlorothalonil, Daconil 2787 (4F), Daconil Ultrex (82.5WDG), Daconil Weather Stik (6F), Daconil (5G), Echo (500F, 75WDG), Manicure (4F, DG), Thalonil (90DG)
cyproconazole	Sentinel (40WG)
etradiazole	Koban (30WP, 1.3G), Terrazole (35WP)
fenarimol	Rubigan (1AS)
fenarimol + chlorothalonil	Twosome (4F)
flutolanil	ProStar (50WP)
flutolanil + triadimefon	ProStar Plus (50WP)
fosetyl-al	Chipco Aliette Signature (80WDG), Prodigy (80WDG)
iprodione	Chipco 26019 (50WG, 2F), Proturf Fungicide X (1.3G)
mancozeb	Dithane T/O (75WP), Dithane (WF, 4F), Fore T/O (80WP, 4F), Protect T/O (80WP, WSB)
maneb	Maneb Plus Zinc (4F), Maneb (75DF)
mefenoxam	Subdue Maxx (2MEC)
metalaxyl	Proturf Pythium Control (1.2G)
metalaxyl + mancozeb	Pace
myclobutanil	Eagle (40WSP)
PCNB	Defend (4F, 10G, 75WP), Engage, Lesco PCNB (10G), Penstar (75WP, 10G), Penstar FLO, Revere (75DG), Terraclor (75WP), Turfcide (400F,10G)
propamocarb	Banol (6L)
propiconazole	Banner Maxx (1.24MEC), Banner (41.8GL)
thiophanate-methyl	Cleary's 3336 (50W, WSP, 4.5F), Fungo Flo, Fungo (50WSB), Proturf Systemic Fungicide (2.3G), Systec 1998 (4.5F)
thiophanate-methyl + chlorothalonil	Consyst (66WDG)
thiophanate-methyl + chloroneb	Proturf Fungicide IX
thiophanate-methyl + iprodione	Proturf Fluid Fungicide
thiophanate-methyl + mancozeb	Duosan (80WP, 80WSP)
thiram	Lesco Thiram (75WDG), Spotrete (75WDG, 4F)
thiram + triadimefon	Proturf Fluid Fungicide III
triadimefon	Bayleton (25DF, 1G), Accost (1G)
triadimefon + metalaxyl	Proturf Fluid Fungicide II
vinclozolin	Curalan (50DF, 4F), Touche (4F), Vorlan (50DF, 4F)

Note: trade names of products commonly available in the Northeast are included for convenience. No endorsement is implied, nor is discrimination intended against similar materials. Use of certain fungicides is restricted in certain states or areas. Each product has specific use rates and intervals. Read and follow label specifications.

SOURCE: DR. SCHUMANN

Warm-season DISEASE CONTROL

Fungal diseases in turf pose significant problems and have economic importance. Before beginning your warm-season disease control program, review the following list of the various symptoms.

By JANELL STEVENS JOHNK, PH.D.

Dollar spot: most severe in hybrid bermudagrass, above, and zoysia.

Diseases play a major role in determining the success or failure of turfgrass. Early recognition and proper identification are essential for successful disease management.

Proper variety selection, fertilization, site maintenance, and cultural practices reduce disease pressure and increase the effectiveness of pesticide applications. Pesticides alone cannot control most diseases. No amount of pesticide controls plant disease if good cultural practices aren't in place.

Too often, a single disease is dealt with, while a single plant species or cultivar may be attacked by many diseases throughout its growing season. Before accepting recommendations of cultivars, cultural practices, and pesticides, consider the impact these recommendations could have on other diseases occurring throughout the season.

Symptoms, factors, strategies

Fungal diseases are the most significant turfgrass diseases and have economic importance due to the threat they pose to large areas of turfgrass.

The following list of turfgrass diseases outlines symptoms, environmental factors favoring disease and management strategies for the most common southern turfgrass diseases.

Brown Patch

(Rhizoctonia solani)

In cool-season grasses, brown patch primarily causes a blight, or dieback, of the leaf tip. In warm-season grasses, brown patch fungus attacks the base of the leaf sheath. On closely-mowed turf, patches are roughly circular. And under high humidity, a "smoke ring" of water-soaked dark leaves and fungal mycelium may be present around the outer margin of the diseased area. On higher-mowed turf, smoke rings usually aren't present and patches often have irregular rather than circular shapes.

Brown patch is a common summer disease of cool-season turf, yet it occurs during transition periods in warm-season turfgrasses. Extensive damage can occur during cool, wet periods prior to winter dormancy or breaking spring dormancy. Brown patch infection takes place long before symptoms are evident. Carefully time preventive fungicides.

Management strategies

1) Use minimal nitrogen applications since nitrogen increases susceptibility.

2) Improve soil drainage.

3) Deep, infrequent irrigation.

4) Drag, pole, or mow early in the morning to speed leaf drying and reduce disease activity.

Dollar Spot

(Sclerotinia homoeocarpa)

Dollar spot is most severe on bermudagrass and zoysiagrass. It appears as small, circular, straw-colored spots about the size of a silver dollar. On grasses maintained at higher mowing heights, patches are larger and irregularly shaped. Grass blades die from the tip back and have straw-colored spots shaped like hourglasses with distinctive reddish-brown to purplish margins.

Dollar spot occurs when it is warm and humid. Nitrogen-deficient turf has more severe damage, especially if the turf is drought stressed before high humidities or rains occur. Several fungicides control dollar spot, but don't rely only on sterol inhibitors which can lead to resistance.

Management strategies

1) Avoid drought stress by irrigating deeply during early morning hours so foliage dries quickly.

2) Maintain balanced fertility.

Gray leaf spot

(Pyricularia grisea)

Leaf spots first appear on St.

Augustinegrass as tiny brown spots with purplish margins. As spots enlarge, they become diamond shaped. Lesions may completely consume leaves and girdle stolons resulting in a scorched appearance. Gray leaf spot occurs during hot humid weather. It is more severe in newly-established turf and in shady locations with poor air circulation.

Management strategies:

1) Irrigate early in the morning to allow foliage to dry quickly.

2) Avoid excessive nitrogen applications during hot, humid weather.

Rust

(Puccinia spp.)

Rust infects zoysiagrass and overseeded ryegrass. From a distance, affected turf has a yellowish to reddish-brown appearance. Red, black, orange, or yellow pustules are found on diseased leaves. Rust damages poorly-nourished turf or turf grown under low mowing heights. Prolonged periods of overcast weather or shaded environments favor disease. Generally, rust-affected turf needs no treatment and can be effectively maintained with good cultural practices.

Management strategies

1) Maintain balanced fertility.

2) Deep, infrequent irrigation.

3) Increase mowing height and frequency.

Helminthosporium complex; Leaf spot / melting out

(Bipolaris sorokiniana, Exerohilum rostrata)

Bipolaris sorokiniana causes leaf spots and crown and root rots of bermudagrass and zoysiagrass. In spring and fall, distinctive purplish-brown spots with tan centers appear on older leaves. During warm, wet weather the spots increase in size to encompass the entire width of the blade, causing a dieback from the tip. Disease progresses to crown and root rots during the summer. "Melting out," spots with purplish margins can be seen on the stolons.

Exerohilum rostrata causes a leaf spot on St. Augustinegrass and bermudagrass. However, these diseases are rarely severe and can be managed culturally.

Management strategies

1) Use resistant varieties.

2) Mow frequently at proper heights to reduce leaf spot phase.

3) Avoid high nitrogen fertilization.

4) These fungi produce many spores when thatch is frequently wet; irrigate deeply, infrequently.

Pythium-cottony blight, grease spot, crown and root rot

(Pythium spp.)

While more of a problem on cool-season grasses, *Pythium* spp. also may cause root rots in warm season grasses. Root-infecting *Pythium* spp. generally are more severe in shaded areas, low spots or near surface water where air circulation is poor. Root rots occur during or following long cool periods when soils are excessively wet.

Management strategies:

1) Irrigate early in the day to avoid moist foliage at night.

2) Improve drainage and increase air circulation.

3) Fungicides generally are not used in lawn care for *Pythium* blight control. However, they are considered necessary in golf course management. To avoid the build-up of fungicide resistant fungi, rotate fungicides and apply in tank-mix combinations whenever feasible.

Spring dead spot

(Leptosphaeria spp., Gaeumannomyces graminis var. graminis, Ophiosphaerella herpotricha)

Spring dead spot occurs on bermudagrass grown in transition zones. Hybrid bermudas are more susceptible than other types. The longer the period of winter dormancy and the colder the temperature, the more damage spring dead spot can cause. Circular patches of bleached, dead grass appear as the turf breaks dormancy in the spring. Patches may range from a few inches to several feet in diameter. Turf is sunken in affected areas. Patches may reappear and expand over the years.

Management strategies

1) Avoid excess nitrogen applications, especially in the fall just prior to dormancy.

2) Manage thatch and promote vigorous root growth.

3) Few fungicides are labeled for this disease and may be of limited use in certain states.

Take-all Root Rot (Patch)

(Gaeumannomyces spp.)

Most warm-season grasses are susceptible to take-all root rot, sometimes called bermudagrass decline which is generally active during the rainy season. However, symptoms often don't appear until the affected turf experiences stress; high temperatures, dry weather.

Patches are irregularly shaped and plants in affected areas have short, rotted root systems. Plants are easily pulled or lifted from the ground. Nodes and stolons become infected and show a brownish discoloration and rotting.

Management strategies

1) Improve drainage.

2) Prevent thatch build-up.

3) Avoid overwatering.

4) Maintain balanced fertility.

5) Preventive fungicide applications may slow disease development.

Fairy rings

(caused by various soil-inhabiting fungi)

Fairy rings are caused by many fungi that grow in thatch and soil. They may appear as circles or arcs of dark green, fast-growing grass. Nutrients are released as fungi consume dead organic matter. Fairy rings also may appear as circles or arcs of dead grass. The massive build-up of fungal mycelium forms a hydrophobic barrier preventing water infiltration. This causes the turf to suffer from drought stress. Fairy rings may persist and increase in size over many years.

Fairy rings are difficult to control due to the impermeability of infected soil. The fungi grow deeply in the soil, making chemical control generally ineffective. Symptom sup-

Briefs from academia

University of Rhode Island: Bridget Ruemmele, K. Field and S. Legare have tested golf shoes with metal or plastic spikes, textured soles and alternative spikes in replicated plots on silt loam and modified sand bentgrass greens. Volunteers walked each of four designated patterns up to 48 repetitions each per plot per day. Significant differences among golf shoe treatments for many evaluation criteria were observed.

Michigan State University: Studies on nitrogen injections into turf using the Toro HydroJect water injection aerifier on fairways and putting greens have been conducted by Drs. Karcher and Rieke since 1994. Nitrogen was applied on seven dates during the growing season at 24-day intervals. Plots injected with urea had consistently higher clipping yields, nitrogen content in leaf tissue and color ratings than when urea was surface applied. In 1995, ammonium nitrate was used as the N source, with very similar results. Therefore, suggest Karcher and Rieke, it is likely that factors other than ammonia volatilization increase nitrogen efficiency when applications are made via injection.

University of Florida: Drs. Al Dudeck, Jerry Sartain, J.L. Cisar and L.E. Trenholm have studied bermudagrass responses to nitrogen and potassium during establishment. "FloraDwarf" and "Tifdwarf" varieties were evaluated. Nitrogen consistently increased growth. However response to potassium differed by cultivar and season. Greater K response occurred in the fall study, reports the research team. □

SOURCE: AGRONOMY ABSTRACTS, 1996 ANNUAL MEETING OF THE AMERICAN SOC. OF AGRONOMY.