Cool-season turf managers: watch for fairy ring, rust

If droughts return, the North could see a recurrence of the near-invulnerable fairy ring rust and two rarely-seen blights.

by Peter Landschoot, Ph.D.,
Penn State University

■ During periods of unseasonably warm temperatures and drought, diseases such as fairy ring and rust become major headaches.

Fairy ring is caused by one of about 60 different soil-inhabiting fungi, the most common being *Marasmius oreades*. Fairy ring symptoms usually appear as rings or arcs of dark-green, fast-growing grass, sometimes accompanied by mushrooms.

Fairy ring can be a severe disease problem under drought conditions. Below the dark-green rings are massive amounts of fungal mycelium that can repel water. If this occurs when soil water is depleted, the result is desiccation of the turf. The hydrophobic effect can be a serious problem if fairy ring is extensive and irrigation water is not available.

Additionally, *M. oreades* can produce a toxin called hydrogen cyanide that damages turfgrasses.

In most cases, a light application of nitrogen fertilizer or iron will "mask" the dark green color associated with fairy ring.

However, there is no fool-proof means of controlling the fungus that causes the rings to occur. Fungicides are rarely effective in controlling the disease in the field. The problem with obtaining effective control in the field centers on getting enough of the fungicide to contact the large amount of mycelium that permeates the soil. Also, it is difficult to wet the soil with drenches of fungicides because of the hydrophobic condition caused by the fungus.

At present, suppression of the hydrophobic effects of fairy ring is best obtained by persistent irrigation and application of wetting agents.

Anthracnose basal stem and crown rot infests a *Poa annua* putting green.

Manipulation of cultural practices is the best option for managing this disease.

Rust diseases—Rust can be troublesome during drought, or when the turf is not well-fertilized. Although rusts don't kill the plants they attack, they can weaken them.

Rusts are caused by fungi in the genus *Puccinia*, and usually occur in late summer in the northern states. They are most common on ryegrasses and bluegrasses, but can attack nearly all turfgrass species. Rust diseases rarely warrant fungicide applications. The best approach to managing rust diseases:

- supply the plant with nitrogen fertilizer; and
- irrigate.

Fortunately, in most years, rusts occur at a time that coincides with late summer fertilizer applications and frequent rainfall.

Weather conditions in 1991 also gave rise to diseases that, until recently, were considered rare.

Other diseases—Two especially troublesome diseases on golf courses were: (1) anthracnose basal stem and crown rot, and (2) foliar blight of perennial ryegrass (caused by *Pyricularia grisea*).

Anthracnose blight is a serious problem on golf course fairways in the midwestern and northeastern U.S.

Another less common form of anthracnose occurs on the crowns and stem bases of annual bluegrass and bentgrass, and is referred to as anthracnose basal stem and

continued on page 58

Rust disease as it appears on Kentucky bluegrass.

ELSEWHERE

Warm-season disease control, p. 58

Zoysia gains in popularity, p. 64

Seed priming speeds establishment, p. 72

crown rot, (ABSCR) to distinguish it from the foliar blight.

Over the past 10 years, this disease has occurred more frequently on putting greens in several northeastern states. Symptoms of ABSCR on close-cut turf appear as yellow or orange-colored irregular patterns.

Poa annua is more frequently affected than bentgrasses:

1. Individual grass tillers turn yellow or orange at the leaf tips.

2. The entire leaf blade and sheath turn yellow and eventually a tan color.

3. The most distinct symptom of this disease is the black, rotted appearance of the crowns and stem bases.

4. The entire shoot can easily be removed from the plant crown.

5. Tiny, pincushion-like structures called acervuli may sometimes be observed on the stems and sheaths with a hand lens.

In Pennsylvania, we have observed the disease in early spring, mid-summer and late fall. In nearly every instance, the soils have been wet or saturated. The disease also appears to be more severe on compacted soils and under low mowing heights. Cultural practices such as aeration, light, frequent applications of nitrogen fertilizers and high mowing heights may reduce some disease damage.

Cool-season disease chart, page 62

Some golf course managers report acceptable control when systemic fungicides are applied on a preventative schedule. The challenge in designing a preventive fungicide program for this disease lies in determining when it will occur.

***Pyricularia* blight**—Last September, from New Jersey to Kentucky, many ryegrass fairways turned yellow and thin. At overseeded golf courses it was found that many of the new seedlings succumbed to rapid blighting and death. Weather conditions in many of these locations were very hot and humid over a period of several days. (It is important to realize that widespread problems such as this may be varied in cause and each situation must be considered on a case by case basis before making general conclusions.)

Pyricularia grisea was the primary culprit. This fungus is not well known above the transition zone, but is the cause of gray leaf spot on St. Augustinegrass and annual ryegrass in southern states.

On mature perennial ryegrass infected with *P.grisea*, early symptoms included:

- small, brown lesions or spots with dark brown borders;
- a zone of chlorotic tissue developed around the spots, eventually enveloping the entire leaf; and/or
- leaves often became tan in color and appeared shriveled.

In most cases, the crowns were not damaged and new leaf material was produced soon after cooler temperatures returned. Infected seedling plants appeared water-soaked and blue-gray in color. Many affected seedling plants collapsed within four or five days after symptoms first appeared.

It is unknown if resident populations of *P. grisea* were responsible for the occurrence of *Pyricularia* blight in southeastern Pennsylvania or if spores were carried from the South by a tropical storm that passed near this area immediately prior to disease outbreak. Plant pathologists will be monitoring this disease in the future to determine if this may be a disease we will have to contend with on a regular basis in the future.

—Dr. Landschoot is associate professor of turfgrass pathology at Penn State Univ.

New diseases greet turfgrass managers in warm-season areas

Two new diseases have been detected in certain southern turf areas, attacking St. Augustinegrass and bermuda.

by Monica L. Elliott, Ph.D.,
University of Florida

■ *Gaeumannomyces*-like fungi are everpresent. They cause root rot diseases on both cool- and warm-season turfgrasses throughout the world. Common diseases on cool-season turf include summer patch and necrotic ring spot on bluegrass species and take-all patch on bentgrass.

Until recently, spring dead spot was the only disease on warm-season turf caused by *Gaeumannomyces*-like fungi. This disease occurs on bermudagrass in locations where the bermudagrass becomes dormant due to cold temperatures. It is known to be caused by three different fungi in the US:

- *Gaeumannomyces graminis* var. *graminis (G.g. graminis)*;
- *Leptosphaeria korrae* and
- *Ophiosopherella herptotricha.*

Exactly which pathogen is causing the

continued on page 61

Take-all patch of St. Augustinegrass: yellow, thinning turf in irregular patches.

Bermudagrass decline has been observed exclusively on putting greens.

problem seems to depend on the geographic location of the bermudagrass.

Two new diseases can now be added to the list. One is take-all patch of St. Augustinegrass (the proposed name), caused by *G.g. graminis*. This same fungus causes bermudagrass decline, a disease observed exclusively on golf course putting greens.

Both diseases primarily occur during the summer and early fall, when the weather is typically hot and humid throughout the Southeast. It is suspected that the root rot observed on zoysiagrass is also caused by *Gaeumannomyces*-like fungi, probably *G.g. graminis*.

Disease symptoms of St. Augustinegrass take-all patch when viewed above ground in sod production fields consist of yellow, thinning turf in irregular patches more than 10 feet in diameter. Roots of plants in these patches are short and rotted, and stolons are easily lifted from the ground. Nodes are often rooted, and black lesions may be observed on the stolons.

Similar symptoms have been observed on residential lawns, except affected areas are circular to irregular in shape and vary in diameter from less than one foot to more than 10 feet. In some cases, the grass will die and "thin out," exposing bare soil; or the grass will appear drought stressed. However, in all cases, the roots are short and rotted, resulting in distinctive black roots.

Stress reduction a key—The disease has been identified in Florida, Alabama and Texas. Since this is a new disease, cultural and chemical control methods have not been determined, but any practice that alleviates stress will be useful.

The symptoms common to take-all patch are similar bermudagrass decline. Usually, symptoms will first develop on the "clean-up pass" of the putting green, but it can spread across the entire green.

Irregular yellow patches develop first, and, if not treated, plants will die and the turf will gradually "thin out" to bare ground. Again, the roots are short and rotted. The disease may appear similar to nematode damage or pythium root rot. Therefore, it is important to have the cause of the symptoms diagnosed by a professional. Preliminary evidence indicates that the best curative or preventive treatment is to maintain a higher height of cut than is normally maintained in the summer months.

Disease symptoms of St. Augustinegrass take-all patch when viewed above ground in sod production fields consist of yellow, thinning turf in irregular patches more than 10 feet in diameter.

Some *Gaeumannomyces*-like fungi cause more than one disease, and some diseases are caused by more than one pathogen. However, the pathogens and the diseases they cause are actually very similar in nature. All of these pathogens are commonly associated with grass roots. Therefore, the potential for disease development is very high. However, the actual disease will depend on the stresses placed on the turf host.

Warm-season disease chart, page 64

Attacks root system—The *Gaeumannomyces*-like fungi live on the outer root surface. The initial root penetration by these fungi may be unnoticeable or, at the most, result in a general discoloration of the root. If conditions are favorable, these fungi penetrate and occupy the vascular tissue of the root, which consists of water-conducting tissue (xylem) and carbohydrate-conducting tissue (phloem). Above-ground symptoms still may not be evident at this time. However, a plant with a damaged root system is more susceptible to stress than a healthy plant, because it has to work harder to obtain nutrients and water from the soil and is not able to store carbohydrates produced by the leaf tissue.

Whether the disease progresses or not depends upon accompanying plant stress. Lower stress will result in a patch that shows no symptoms above ground, despite having an infected root system. A high-stress situation, if not alleviated, will kill the plant.

Under high stress, the root, stolons and rhizomes continue to rot and become dysfunctional, resulting in the characteristic "patches" of dead or damaged turf associated with the diseases caused by *Gaeumannomyces*-like fungi. Because these pathogens move slowly through the root system and not the leaves, these patches often appear yearly in the same location.

The three components required for any disease are:

- a susceptible host;
- a virulent pathogen; and
- a conducive environment.

With patch diseases, once the *Gaeumannomyces*-like fungi and turf host are established on the site, the only thing that changes is the environment, usually the micro-environment surrounding each turf plant or group of plants. Thus, cultural control methods are the best control methods for patch diseases because they are usually aimed at affecting a change in the turf environment. Most evidence indicates that systemic fungicides are effective only as preventive medicine. In other words, the fungicide must be applied before severe symptoms develop.

—Dr. Elliott is assistant professor of turfgrass pathology at the University of Florida's Ft. Lauderdale Research and Education Center.

Diagnostic Features of Prevalent Cool-Season Turfgrass Diseases

Disease	Causal agent(s)	Symptoms/signs	Susceptible grasses
Brown patch	*Rhizoctonia solani*	Large, circular brown patches or thinning of turf. On low-cut turf, patches often surrounded by dark rings. White, cottony mycelium may be present on high-cut turf in early morning.	Bentgrasses, ryegrass, tall fescue.
Dollar spot	*Lanzia spp.*	Small, bleached patches of dead grass appear in turf. Lesions on leaves are white, often with brown borders. White, cottony mycelium may be present on dew-covered turf in early morning.	All cool-season turfgrasses.
Leaf spot/melting out	*Drechslera* and *Bipolaris spp.*	Small tan lesions with purple or brown borders on leaf blades. In severe cases, the crowns are rotted and the turf may be significantly thinned.	Primarily Kentucky bluegrass. Other cool-season grasses may be affected.
Necrotic ring spot	*Leptosphaeria korrae*	Large ring-shaped patches, usually creating depressions in turf. Roots and crowns show brown or black rot.	Primarily Kentucky bluegrass. In some cases, fine fescues and annual bluegrass.
Pythium blight	*Pythium aphanidermatum* and other *Pythium spp.*	Irregular patches of blighted turf. White, dense, cottony mycelium growing in turf in morning.	Perennial ryegrass, bentgrasses, tall fescue.
Red thread/pink patch	*Laetisaria fuciformis/ Limonomyces roseipellis*	Small red to pink patches of blighted turf. Long slender threads of red mycelium (red thread), or fluffy, pink mycelium (pink patch) growing out of foliage.	Fine fescues, perennial ryegrass,Kentucky bluegrass.
Summer patch	*Magnaporthe poae*	Large yellow or tan ring-shaped patches. A root crown rot is usually apparent.	Bluegrass and fine fescues.

Control Strategies for Prevalent Cool-Season Turfgrass Diseases

Disease	Cultural control	Chemical control	Resistant species/varieties
Brown patch	Avoid excess N in summer, increase air circulation, avoid excess watering, improve drainage.	anilazine; benomyl; chlorothalonil; iprodione; mancozeb; maneb thiophanates; thiram; vinclozolin	Kentucky bluegrasses are less-susceptible to brown patch than other cool-season turfgrasses.
Dollar spot	Avoid N deficiency, maintain good soil moisture, remove guttation and dew from leaf surfaces, avoid night watering.	anilazine; benomyl*; chlorothalonil; fenarimol; iprodione; mancozeb; propiconazole; thiophanates; thiram; vinclozolin	Resistant Kentucky bluegrass varieties include Adelphi, America Aspen, Challenger, Eclipse, Escort, Nassau, Somerset, Wabash**
Leaf spot melting out	Avoid excess N applications in early spring; mow 2" high; avoid light, frequent irrigation. Do not use benomyl, thiophanates or triadimefon to control.	anilazine; chlorothalonil; iprodione; maneb; mancozeb; vinclozolin	Resistant Kentucky bluegrasses include: Adelphi; Bristol; Destiny; Eclipse, Enmundi; Glade; Ikone; Liberty; Majestic; Mona; P-104; Rugby and Somerset.
Necrotic ring spot	Manage turf for mazimum root growth; irrigate to maintain good soil moisture; maintain mowing height at 2" or above.	benomyl; fenarimol; propiconazole,	Perennial ryegrasses resistant.
Pythium blight	Improve drainage, increase air circulation, avoid excess N, reduce irrigation.	chloroneb; etridiazole; metalaxyl*; Fosetyl-Al; propamocarb	Kentucky bluegrass is less likely to be damaged by Pythium blight than other turf.
Red thread/ pink patch	Maintain adequate fertility of turf (especially N).	alilazine, benomyl***, chlorothalonil, iprodione, propiconazole,	Resistant perennial ryegrasses include: Allaire, Commander, Delray; Manhattan II; Palmer; Pennant; Prelude; Regal; Regency; SR 4000; SR-4100; and Yorktown.
Summer patch	Avoid low mowing heights, reduce compaction, avoid overwatering in summer; improve drainage.	benomyl; fenarimol; propiconazole; thiophanates; triadimefon	Resistant Kentucky bluegrasses include Adelphi; Enmundi; Sydsport and Touchdown.

*** Resistance has been recorded.**
**** Based on National Turfgrass Evaluation Program and Penn State data. No endorsement of cultivars is intended for those mentioned, nor is criticism meant for cultivars not mentioned.**
***** Controls red thread and not pink patch.**

Source: Dr. Landschoot

Diagnostic Features of Prevalent Warm-Season Turfgrass Diseases

Disease	Causal agent(s)	Symptoms/signs	Susceptible grasses
Bermudagrass decline	*Gaeumannomyces spp.* or similar fungi as yet undetermined.	Begins as small, irregular, yellow patches which expand and thin-out as grass dies. Roots are short, thin and rotted, usually observed first at edges of putting greens.	bermudagrass*
Brown patch (Rhizoctonia blight); Rhizoctonia leaf and sheath spot	*Rhizoctonia solani, R. zeae, R. oryzae*	Begins as small, circular light green patches that turn yellow and then brown or straw-colored. Patches expand to several feet in diameter. Turf at outer margin of patch may be dark and wilted (smoke ring). Whole leaf facsimiles pull up easily due to basal rot of leaf sheath. Aerial blight common with centipedegrass and St. Augustinegrass. In warm months, may also observe light-brown foliar lesions.	Bahiagrass, bermudagrass, centipedegrass*, St. Augustinegrass* zoysiagrass*
Gray leaf spot	*Pyricularia grisea*	Lesions begin as small, brown spots that expand into oval areas with tan centers and dark and purple or brown margins. Yellow halo may be present. During warm, humid weather, lesions covered with gray velvet mat of mycelium. Leaves wither, resulting in scorched appearance.	St. Augustinegrass*. Yellow-green cultivars are less susceptible than blue-green/bitter-blue cultivars. St. Augustinegrass treated with the herbicide atrazine is more susceptible.
Helminthosporium leaf spot/melting-out	Bipolaris, Drechslera and *Exserohilum spp.* (previously *Helminthosporium* fungi); and *Curvularia spp.*	Leaf spot symptoms vary with specific pathogen and host from small, solid brown to purple lesions to expanded lesions with bleached centers that girdle the leaf blade. Severely infected leaves turn reddish-brown to straw color. 'Melting-out' occurs under severe infection as turf areas thin and die. Lesions on stems are dark purple to black. Crown and root rots will also occur.	bermudagrass*, St. Augustinegrass, zoysiagrass
Pythium root rot	*Pythium spp.*	General turf browning and thinning. Roots appear thin with few root hairs and have a general discoloration. Turf does not respond to N applications.	All warm-season turfgrasses are susceptible.

*** Most susceptible species**

Control Strategies for Prevalent Warm-Season Turfgrass Diseases

Disease	Cultural control	Chemical control	Resistant species/varieties
Bermudagrass decline	Aerate and topdress greens monthly during late spring, summer and early fall. Apply NH_4-N rather than NO_3-N. Balance N with K and apply micronutrients. Raise mowing height during outbreaks.	benomyl; fenarimol; propiconazole; thiophanate methyl, triadimefon	No resistant cultivars available.
Brown patch	Avoid excess N, especially readily available forms of N. Avoid excess irrigation.	anilazine; benomyl; chlorothalonil; iprodione; maneb; mancozeb; PCNB; thiophanate methyl; thiram. Do **not** use benomyl or thiophanate methyl if causal agent is *R. oryzae or R. zeae.* Use fenarimol, propiconazole and triadimefon as preventive, not curative compounds.	No resistant species are available.
Gray leaf spot	Avoid excess N. Irrigate deeply and only when necessary.	chlorothalonil; propiconazole; thiophanate methyl + mancozeb	Yellow-green cultivars of St. Augustinegrass are less susceptible. St. Augustinegrass treated with the herbicide atrazine is more susceptible.
Helminthosporium leaf spot/melting-out	Avoid excess N. Balance fertility components. Irrigate deeply and less frequently. Avoid thatch accumulation. Raise mowing height during disease outbreaks.	anilazine; chlorothalonil; iprodione; maneb; mancozeb; propiconazole; vinclozolin	No resistant species are available.
Pythium root rot	Improve drainage, aerate and reduce irrigation.	chloroneb; ethazol; metalaxyl; fosetyl-Al; propamocarb. Except for fosetyl-Al, these fungicides should be watered into the rootzone.	
Spring dead spot	Avoid low mowing heights, thatch, compaction and excess N.	benomyl; fenarimol; propiconazole; thiophanate methyl	No resistant species of bermudagrass are available.

Source: Dr. Elliott

Zoysia: a grass for the future — and not just on golf courses

New seeded zoysias will fit in because of lower prices and even lower management requirements.

■ Does zoysiagrass have a future in the green industry—not only on golf courses, but also on athletic fields and home lawns?

Dr. Milt Engelke of Texas A&M University says it does.

"The future is real bright," says Engelke. "This grass is greatly under-used. It, along with buffalograss, will be politically and environmentally 'correct' in the next few years."

Engelke: sees zoysia popularity spreading

Engelke, whose research has led to a "DALZ" series of experimental cultivars, thinks that consumer education will determine how widely the zoysias are actually accepted.

"Right now, one of the biggest problems is cost; it's extremely expensive," Engelke says. But he further notes that zoysia's initial costs are eventually offset by low maintenance costs, including much less water.

"The new zoysias," he adds, "will be far more cost-effective as production time is reduced. We'll see more zoysia in home lawns and athletic fields as the cost comes down. Education will be the bottom line. And it'll take a decade for us to properly educate the consumer."

Zoysiagrass is native to Asia, but is well adapted to warm humid and transition areas of the U.S. It begins to go dormant at about 55° F. Engelke believes that, given time, its popularity may also spread to the southern and western U.S.

Adjectives most often used to describe zoysia are uniform, dense and low-growing. Because of its density, zoysia has superior resistance to weeds. Its stems and leaves are tough and stiff, resulting in excellent playability on golf course fairways.

Success on the course—Golf course superintendents near Kansas City and in Tennessee rave about zoysia's performance on fairways.

Members of Lawrence, Kansas's Alvamar Golf & Country Club, where Dick Stuntz is superintendent, find the zoysia to their liking. And Stuntz appreciates the fact that "if you keep nitrogen applications down and control traffic, you can turn the water off."

He cuts his fairways at 1/2 inch, three times a week, and applies pesticides only when necessary.

"The vast majority of our areas have tolerated the low height of cut very well," he observes. "I'm headed for 3/8ths of an inch—not for playability, but for thatch control."

Here is the program his zoysia is on:

- **Fertilization:** 1 to 2 lbs. N per 1000 sq. ft. per season; 3 to 4 lbs. K_2O per 1000 sq. ft. per season
- **Poa control:** Roundup at 24 oz. per acre
- **Weed control:** pendimethalin at 1 1/2 lbs. per acre, twice per season (April 1-15 and May/June)
- **Post-emergence crabgrass control:** Daconate at 1 to 2 oz. per 1000 sq. ft.
- **White clover control:** Banvel 4S at 32 oz. per acre
- **White grub control:** trichlorfon at the third instar stage (when damage is detected) with pre- and post-irrigation

In order to avoid winterkill, Stuntz's program includes:

1. Eliminate cart traffic, if possible.
2. Around Sept. 15, raise height of cut to 3/4 or 7/8 inch.
3. Use adequate K_2O.
4. Make sure drainage is adequate.

David Stone at The Honors Course, Ooltewah, Tenn., finds the biggest problem is keeping bermudagrass out of his zoysia fairways. He uses a variety of bermudagrass herbicides to get good results, when applied four times per year (June 1, July 1, Aug. 1, Sept. 1).

Stone: bermuda encroachment a problem

"You can never totally eliminate the bermuda in our area, but you can totally control it," he claims.

Besides the work being done at Texas A&M University, Jack Murray in Florida is also conducting research on seeded zoysias, which would make the grass more practical for a wider range of uses.

Says Engelke: "The biggest problem with zoysiagrass is management. Most people over-manage it. But I see zoysia becoming much more dominant in the next decade, and seeded zoysias will fit in because of even lower management requirements."

—Jerry Roche

—The American Zoysiagrass Association is a new organization working on raising the consciousness level of the turfgrass industry toward the zoysias. For more information, contact Frank Whitbeck at Windrock Grass Farms, Little Rock, Ark.: (800) 225-0303.

Advantages	Disadvantages
✓ Heat/cold tolerant	x Slow recovery
✓ Slow upright growth	x Weak color
✓ High quality surface	x Susceptible to winterkill
✓ Disease resistant	x Thatch accumulation
✓ Drought tolerant	x Production drawbacks (establishment, regrowth, repair)
✓ Low water use	x Growth cycle
✓ Low nutrition requirements	x Compacts easly
✓ Tolerant to salt water	x Damaged by nematodes
✓ Wear tolerant	

Sources: Dr. Milt Engelke, Dick Stuntz

◀ **Laboratory research at Jacklin Seed Co. has found that seed priming has these advantages over pre-soaking or pre-germination: (1) it can be dried back and stored for up to two months; and (2) it can be planted via conventional spreaders.** *Photo courtesy Dr. Doug Brede*

Priming and pre-soaking for faster turf germination

Laboratory research has found that seed priming has several advantages over pre-soaking or pre-germination.

■ Dr. Doug Brede of the Jacklin Seed Co., says pre-soaking and/or priming turfgrass seed can speed germination when you want grass to establish in faster-than-normal times.

"After six weeks under optimal growing conditions, it is nearly impossible to tell a primed bluegrass field from an unprimed one," says Brede. "The benefits of priming come when temperatures are adverse, or when bluegrass is mixed with a fast-germinating species such as ryegrass that normally tends to overwhelm the slow-germinating bluegrass."

An obvious use for pre-soaking/priming is on athletic fields, where only a short period is allocated between games for re-seeding.

The difference between priming and pre-soaking? In seed *priming*, root and shoot don't break the seed coat and can be planted by traditional methods; if you *pre-soak* the seeds, however, you must plant them wet, which normally means that hydroseeding (rather than spreading) techniques must be used.

Pre-soaking—"Pre-soaking is easy with perennial ryegrass and tall fescue," Brede claims.

First step in pre-soaking is to put the seeds in a 55-gallon drum filled with water. Then, aerate them with an aquarium pump and airstone. Wait 48 hours and plant while still wet.

This process, however, produces what Brede terms "mixed results." It is far better, he claims, to pre-soak annual ryegrass and tall fescue with a hormone solution.

Germination speed of primed grasses, fastest to slowest:

1- *annual ryegrass*
2- *perennial ryegrass*
3- *fine fescue*
4- *tall fescue and bermudagrass*
5-*Kentucky bluegrass*
6- *zoysiagrass*

Source: Dr. Brede

In this case, add 6 oz. of gibberellic acid per 10 gal. of water. Seeds will germinate about three days sooner than if the gibberellic acid was not added.

"Pre-soaking is cheap and easy, but aeration is a must for both pre-germination and pre-soaking," says Brede.

Priming—As a rule of thumb, priming—at best—cuts the field germination period in half.

"Primed seed will germinate faster under cooler (60° F) conditions," Brede observes.

Though results with primed seed are usually better than with pre-soaked seed, priming does present some difficulties. Light is needed to increase the germination index of some species like bluegrass, which also needs free oxygen during priming. Some species—like bluegrass, again—also excrete toxins that inhibit the priming process.

Optimal priming times are five days for Kentucky bluegrass, two to three days for perennial ryegrass. "Stop priming when you first notice root emergence," Brede warns.

Primed seeds have a shelf life that slowly wears off until, after three months, all effects are usually lost.

"After six months, germination of primed seeds is actually poorer," Brede notes. (Pre-germinated seeds, on the other hand, must be planted right away.)

—Jerry Roche

A 10-year-old seed lot of Fylking Kentucky bluegrass springs back to life (right) after seed priming. Untreated grass from the same lot (left) has still not begun to emerge at one week after sowing. *Photo courtesy Virginia Kanikeberg*