Volume 9, Number 3

TURFAX™

of the International Sports Turf Institute, Inc.

May–June 2001

The International Newsletter about Current Developments in Turfgrass

IN THIS ISSUE

Thatch and Mat Must Be Minimized

Peter H. Dernoeden

Thatch refers to an organic layer found in turf above the soil surface. This organic layer is composed of living, dead, or partially decomposed stems, roots, and leaves. At one time, a 0.5 inch (13 mm) thatch layer was considered desirable on greens. Today, due in part to lower mowing heights, **a thatch depth of less than 0.3 inch (10 mm) is suggested.**

Mat refers to a layer of mixed topdressing and organic matter (usually old stem tissue and roots) that develops below the thatch layer. On extremely well-managed putting greens there may be more mat then thatch. **Under low mowing (<5/32 inch; 3.8 mm), thatch and mat layers can become extremely dense, making it very difficult to brush-in topdressing.** Mat layers can be just as detrimental as thatch in the summertime and both need to be aggressively managed.

Some thatch is desirable because it provides cushion for equipment, people, and impact of a ball. Dense thatch, however, is detrimental. **Thatch reduces the environmental stress tolerance of turf, predisposes plants to supraoptimal heating in summer, and promotes disease and insect pests.** When a thatch layer becomes thick, the stem-bases of plants develop in the thatch rather than at or below the soil line. Stems developing in thatch are far less insulated from extremes of hot or cold and wet or dry weather conditions. All roots emanate from stems and they also are more vulnerable to environmental extremes when they become largely restricted to the thatch layer. Furthermore, buds that produce the new shoots, tillers, and roots also are jeopardized by virtue of being exposed to environmental extremes in thatch rather than insulated by soil. Hence, the most important plant tissues (i.e., the growing point and/or meristems, and roots) are more vulnerable to desiccation during drought, freezing temperatures in winter, and supraoptimal temperatures in the summer. Wet thatch, in particular, contributes to scald damage during hot, rainy periods or when turf is excessively irrigated during the summer. Green plants in coring holes, surrounded by brown turf in the summer, are a good indicator of a thatch and/or mat problem. This is because the coring hole provides an opening unobstructed by thatch or mat, which allows for better water infiltration and air exchange. The surrounding damaged turf with a thatch or mat layer holds water. The water absorbs and transfers heat from the sun, which builds to lethal levels causing scald during periods of high temperature stress.

Thatch also provides harborage for insect pests and pathogens. **Black cutworms (*Agrostis ipsilon*), chinch bugs (*Blissus* spp.), sod webworms (several species), black turfgrass Ataenius (*A. spretulus*), and other insect pests find thatch a suitable medium in which to survive.** Most pathogens can survive unfavorable periods as spores, sclerotia, fruiting bodies, or as mycelium embedded in dead organic matter. Pathogens often live saprophytically on dead organic matter in thatch and soil during environmental periods that are unfavorable for infection of plant tissues. In particular, **pathogens causing dollar spot (*Sclerotinia homoeocarpa*), leaf spot (*Bipolaris* spp. and *Drechslera* spp.), and anthracnose**

Continued on page 3

FEATURE ARTICLE

Diagnosing and Controlling Billbugs

Daniel A. Potter

Billbugs are among the most misdiagnosed pests of lawns and golf courses. Their damage is often confused with symptoms of drought stress damage from other insects or diseases, especially dollar spot. The **bluegrass billbug** (*Sphenophorus parvulus*) attacks cool-season grasses, especially Kentucky bluegrass and non-endophytic perennial ryegrass, in the northern half of the United States and southern Canada. The hunting billbug (*S. venatus vestitus*) is a pest of warm-season grasses, especially zoysiagrasses and improved hybrid bermudagrasses in the transition zone and southern states. Diagnosis and control of the two species are generally similar.

General Description. Billbugs belong to the weevil family, a group of slow-moving beetles having a long beak-like snout with chewing mouthparts at the tip. Adults are hard-bodied, 5/16 to 7/16 inch (8–11 mm) long, and slate gray to charcoal black, although they may appear brownish due to dried mud adhering to the body. The snout, head, and thorax are about as long as the wing covers, and the elbowed antennae are attached near the base of the snout. They usually "play dead" when picked up or disturbed. **Billbug larvae resemble small white grubs, but without legs. Mature ones are about 3/8-inch (9.4-mm) long and cream-colored, with a brown head. The body is hump-backed, somewhat fatter through the tail end, but tapering at the tip.**

Life Cycle and Habits. Bluegrass billbugs overwinter as adults in thatch, soil cavities, bark mulch, leaf litter, or other sheltered locations. Adults become active in April and May, and may be seen crawling over sidewalks or driveways. Females deposit eggs in small cavities chewed in grass stems or stolons. **Young larvae begin feeding within grass stems, which become hollowed out and packed with powdery frass. Older larvae tunnel down to feed on the crown and then move to the soil to feed externally on the crown and roots, leaving an accumulation of fine, whitish sawdust-like frass near the feeding site.** This is the point when visible damage is noticed. Larvae are present from June into August. New adults appear in August and September and may again be observed on pavement as they seek overwintering sites in October. There is one generation per year.

Hunting billbugs hibernate as adults in the transition zone, but farther south the adults may be active nearly year-round. Most eggs are laid in the spring when bermudagrasses and zoysiagrass are well out of winter dormancy. Eggs are inserted into leaf sheaths or grass stems, and the larvae then feed in the same manner as bluegrass billbugs. Larvae may be present from May into October.

Damage and Diagnosis. In cool-season grasses, watch for scattered patches of dead or dying grass, resembling dollar spot disease, beginning in late June and continuing into August. The injury may be as subtle as chronic thinning of the turf. Damage on golf courses tends to occur in sunny, dryer areas around greens and green banks, tee banks, bunkers, and in areas around the clubhouse. In lawns, it may be mistaken for drought stress or sod webworm injury. **Hunting billbugs commonly cause 6 to 12 inch (15 to 30 cm) patches of brown, dying grass** resembling burn from dog urine. When roughed up with your hand, the stolons may break apart, the pieces appearing to have been chewed off at the ends.

The "tug test" is the best way to diagnose billbug injury. Grasp the affected stems and gently pull upward. If the grass breaks off easily at the crown and the stems are hollowed out with bits of sawdust-like frass around their broken ends, then billbugs are responsible. Use a knife to examine the crown and roots for fine sawdust-like material, a white legless larvae with a brown head.

Control. Endophytic perennial ryegrasses are relatively resistant. Recent research by Richmond, Niemczyk, and Shetlar (2000, *J. Economic Entomology,* 93:1662–1668) showed that **overseeding stands to produce as little as 30% endophytic grass discourages bluegrass billbug infestations.** Agronomic practices that enhance turf vigor will help the stand to outgrow billbug damage.

For sites with a history of billbug problems, applying imidacloprid (Merit®) or halofenozide (MACH 2®) from mid-May to early June provides preventive control, with residues generally lasting long enough to also control major grub species (e.g., masked chafers, Japanese beetle grubs) hatching out later in the summer. Both Merit® and MACH 2® have systemic activity that kills larvae inside the stems, as well as in the soil. **Alternatively, applying a labeled pyrethroid, e.g., bifenthrin (Talstar®), cyfluthrin (Tempo®), deltamethrin (DeltaGard®), or lambda-cyhalothrin (Scimitar®) between mid-April and mid-May intercepts the overwintered females before they can lay eggs in the stems.**

Continued on page 3

Diagnosing and Controlling Billbugs

Continued from page 2

Use a liquid application and apply only a light post-treatment watering, 1/8 inch (3.2 mm) or less, to keep the residues in the upper thatch where adult billbugs reside. Deploying the latter strategy after mid-May, however, may result in turf damage because females will already have laid some eggs.

Control becomes more difficult after mid-June, when larvae have moved into the soil to feed on the crown and roots. Insecticides labeled for grubs and billbugs, e.g., halofenzide, imidacloprid, bendiocarb (Turcam®), carbaryl (Seven®), or diazinon (but not for golf courses and sod farms), followed by sufficient watering to move the residues to the root zone, provide some control at that time. Such treatments may be too late to prevent turf damage, however, because the billbug larvae may already have damaged the plant crowns.

Thatch and Mat Must Be Minimized

Continued from page 1

(*Colletotrichum graminicola*) survive in and build-up their populations in the presence of thatch. Wet thatch also provides the moist conditions needed by algae and moss to proliferate. Furthermore, thatchy or puffy stands are predisposed to scalping.

Today's high standards for quality golf turf require that thatch and mat layers be aggressively minimized. **These organic layers are managed through a combination of aerifications, topdressing, and proper fertility and irrigation practices.** Putting greens should be cored with wide diameter tines and heavily topdressed in the spring and again in late summer prior to the time annual bluegrass (*Poa annua*) seeds germinate. During the golfing season, putting greens with significant thatch or mat layers should be quadratined and lightly topdressed on a 3- to 4-week interval. During wet periods, greens may be spiked frequently to promote water drainage and air exchange with the soil. Water injection aeration is also beneficial in promoting soil aeration and root growth.

During the summer the turf should be irrigated deeply and infrequently. Research conducted at Texas A&M University by Dr. Richard White and coworkers has shown that deep and infrequent irrigation results in less thatch build-up and a reduction in algae and disease problems. Too many golf course superintendents are irrigating nightly for a set period of time. This practice keeps thatch and mat layers saturated, thereby promoting algae, moss, black layer, scald, large divots, scalping, and generally less than optimum playing conditions. It is very important to keep the turf as dry as possible during the summer. **Deep and infrequent irrigation will improve the environmental stress tolerance of turf, help to discourage pests, minimize problems associated with large divots and deep ball marks, and enable creeping bentgrass (*Agrostis stolonifera*) to compete more effectively with annual bluegrass.**

Fertilizer management is also important in minimizing thatch. Most of the annual nitrogen used on cool-season grasses should be applied during the autumn months. **During the summer, light applications of nitrogen (0.1–0.2 lb N/1,000 ft^2; 5–6 kg N ha^{-1}), known as spoon-feeding or foliar feeding, should be applied every 2 to 3 weeks.** Spoon-feeding promotes vigor, particularly in creeping bentgrass, thus enabling the turf to more effectively compete with annual bluegrass and to more rapidly recover from divots, ball marks, and mechanical damage. Spoon-feeding with water soluble N-sources, such as urea and ammonium sulfate, is preferred. Use of the aforementioned N-sources has been shown to provide as much as 30 to 60% suppression of dollar spot and brown patch (*Rhizoctonia solani*). Natural organic fertilizers are good N-sources and they are safe. Natural organic N-sources, however, are not generally superior to low rate applications of water soluble N-sources in promoting summertime vigor. **Research conducted at the University of Maryland does not provide strong evidence that natural organic N-sources are better at promoting thatch degradation, promoting soil microbial activity, or reducing diseases, when compared to synthetic slow-release fertilizers or urea.** Indeed, some composted sewage sludges that contain large wood chips and some dehydrated manures can promote thatch and dollar spot.

FEATURE ARTICLE

Turfgrass Root Basics

James B Beard

Perennial turfgrasses are characterized by an extremely fine, fibrous root system. This leads to considerable frustration on the part of researchers due to the time-consuming, costly procedures required to accurately study and measure turfgrass roots. Nevertheless, the monitoring of rooting depth and functional viability on a regular basis is an important dimension in any turf manager's information assemblage for key decision-making activities. Roots are a hidden, but major component of a turfgrass plant. Roots function in water absorption, nutrient uptake, anchorage, and sod strength. Actually, **the unique, extensive, fibrous root system of turfgrass has a extraordinary ability to take up nutrient elements, and thereby protects the quality of groundwater.**

Turfgrass shoots/leaves have their meristematic region and allied cell division and elongation activities located at the base. Thus, the leaf tip is the oldest portion of the leaf and the leaf base the youngest. As a result the oldest part of the leaf is cut off during mowing. Just the opposite exists for roots, where **the tip of the root most distant from the originating turfgrass crown or stem node region is the youngest part of the root. Thus, in harvesting sod the meristems or growing tips of the roots are cut off.** Consequently, new root initiation must originate from the meristematic tissues in the crowns and the nodes on lateral stems, such as stolons and rhizomes. This basic principal dictates that the shallower the soil depth cut during sod harvesting, the more rapid the rate of sod transplant rooting, assuming there is no water stress.

The principle sites through which water and nutrients are taken up from the soil solution into the roots and translocated upward to the shoots are via the root hairs. These are very delicate, whitish, outward extensions of individual epidermal or surface root cells. These root hairs are microscopic and thus cannot be seen by the naked eye. However, the surface area of these roots is 5 to 10 times greater than the primary and secondary root system that is visible to the eye. Therefore, understanding how environmental factors, cultural practices, and chemicals affect root hairs is a major concern in relation to maximizing the ability of turfgrasses to take up vital water and nutrients.

Most turfgrasses are perennials, but **certain perennial species have root systems that behave as an annual.** Included among the annual-type root systems are such cool-season turfgrasses as perennial ryegrass (*Lolium perenne*), bentgrass (*Agrostis* spp.), and rough bluegrass (*Poa trivialis*). **The critical period in the loss of root systems of cool-season turfgrasses is during mid-summer when soil temperatures at a 4-inch (100 mm) depth exceed 80°F (17°C)** (Figure 1). Warm-season turfgrasses may be characterized as having annual root systems on occasions when spring root decline (SRD) occurs. **The critical time in terms of a limited root system for warm-season turfgrasses is in the spring when soil temperatures at a 4-inch (100-mm) depth reach 64°F (18°C)** (Figure 2).

The genetic rooting ability of various turfgrass species and cultivars in terms of depth and mass varies considerably (Table 1). They range from very deep-rooted species, such as the bermudagrasses (*Cynodon* spp.), with a depth of 7 to 8 feet (2.1–2.4 m) under mowed conditions, to the shallow root systems of the zoysiagrasses (*Zoysia* spp.), American buffalograss (*Buchloe dactyloides*), and

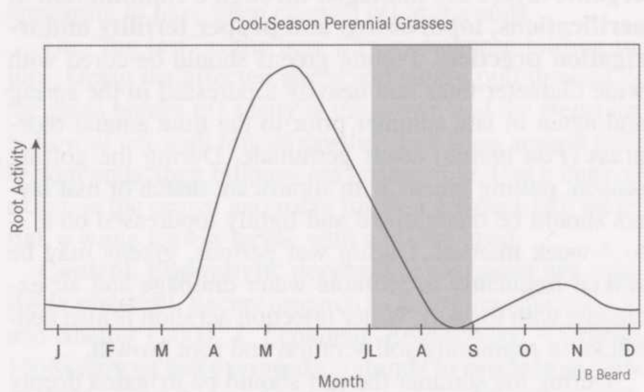

Figure 1

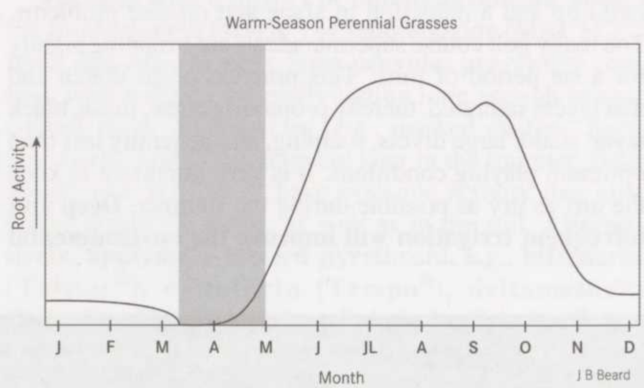

Figure 2

Continued on page 5

Continued from page 4

many cool-season turfgrass species where the root system typically is less than 18 inches (0.3 m).

The wide range of environmental factors that may affect turfgrass root growth are summarized as follows:

- **Soil texture**—sandy to sandy loam root zones typically allow maximum rooting.
- **Soil temperature**—optimum root growth of cool-season turfgrasses occurs at soil temperatures of 50 to 65°F (10–18°C), while optimum root growth of warm-season turfgrasses occurs at soil temperatures of 75 to 85°F (24–29°C).
- **Soil reaction**—a soil pH between 6.0 and 7.5 is preferred, with pHs below 5.5 to be avoided.
- **Soil compaction**—on intensively trafficked, small areas construction with a high-sand root zone will be required to maximize rooting; while on more extensive, low-budget sites, the primary option is turf cultivation, such as coring and slicing, usually are needed based on the intensity of traffic/soil compaction.
- **Soil waterlogging**—saturated soils lead to rapid death of the root system, and particularly the root hairs. Thus, it is important to ensure proper surface and subsurface drainage, plus appropriate irrigation in which the rate of water application does not exceed the rate of soil water infiltration.
- **Soil aeration**—soil oxygen is critical to support the vital cellular life system of turfgrass roots. Thus, proper soil non-capillary pore space is needed to ensure the downward movement of soil oxygen and the outward movement of potentially toxic gases.
- **Soil salinity**—roots can be adversely affected by high salt levels in the soil solution. This problem is minimized by periodic deep irrigation involving amounts of water in excess of the evapotranspiration rate to ensure downward leaching of salts beyond the root depth.
- **Hydrophobic dry patch**—soils will repel water due to an organic coating surrounding the individual sand particles that results from the death of mycelial growth associated with soil fungal basidiomycetes. The best option available to correct these problems is the timely use of an wetting agent that is effective on hydrophobic dry spot. Note there are other types of hydrophobicity.
- **Shade**—turfs growing in the shade usually have a reduced root system due to a lack of sunlight used in photosynthesis that supplies the carbohydrates needed for root growth.

Table 1. The comparative mid-summer rooting depths of 20 turfgrasses, when grown in their respective climatic regions of adaptation and preferred cultural regime.**

Relative Ranking	Turfgrass
superior	*bermudagrasses
excellent	St. Augustinegrass seashore paspalum carpetgrasses
good	bahiagrass crested wheatgrass zoysiagrasses
moderate	tall fescue centipedegrass American buffalograss
fair	creeping bentgrass hard fescue perennial ryegrass colonial bentgrass Chewings fescue red fescues
poor	Kentucky bluegrass
very-poor	rough bluegrass creeping bluegrass annual bluegrass

* Significant variability occurs among cultivars within the species.

** Based on the most widely used cultivars of each species.

There are a number of **cultural factors that strongly influence turfgrass rooting,** which fortunately are under the turfgrass manager's control. They include the following:

- **Mowing height**—the higher the cutting height, the greater the leaf area for photosynthetic activity to produce carbohydrates in support of increased root growth.
- **Nitrogen nutritional level**—moderate nitrogen nutritional levels allow a balanced supply of carbohydrates to support both shoot and root growth of cool-season turfgrasses. Excessive nitrogen levels force shoot growth, with the shoots having priority for the available carbohydrates, thereby resulting in death of the root system.
- **Potassium and iron levels**—high potassium levels throughout the year are important in ensuring deep rooting, which in turn contributes to drought resistance. Iron provides some of the same benefits.
- **Irrigation**—in most situations irrigation water should be applied on an infrequent deep basis to the full depth of the root system. One exception is where the root depth is very shallow, as caused by very close mowing and/or heat stress. Surface soil water saturation via light daily watering encourages shallow rooting.

Continued on page 7

FEATURE ARTICLE

A Global View of Landscape Use

James B Beard

The opportunity to conduct extensive research on the water use rate and drought resistance of turfgrasses and more recently to lecture in 20 to 25 countries per year has given me a global perspective on landscape water use and its important role in various civilizations around the world. **It is very significant that for 11 centuries humans have chosen to devote time and resources including water for the establishment and maintenance of turfgrasses in landscapes to improve their quality-of-life.** While this desire for the enhancement of their living environment may exist worldwide, it has not been attainable in those regions where the peoples must spend all their living hours in generating food, fiber, and housing to survive. Countries who have developed an industrialized employment base in addition to an agrarian base are able to generate sufficient financial resources, such that individuals can afford to improve their living environment through landscape plants including turfgrasses. **In traveling around the world, one reaches the obvious conclusion that those countries with extensive urban landscapes, including lawns, trees and shrubs, also have associated with them a dominant population that is far more productive and where individuals live together in more harmonious interactions,** as compared to countries that are seriously deficient in the use of landscapes to improve the human quality-of-life. Two examples of very productive countries where the people interact relatively harmoniously that utilize and encourage turfgrass and landscape plants are Singapore and The Netherlands. It should be noted that both countries are burdened with some of the higher populations of people per square mile of anywhere on earth. These are two key examples of the importance and benefits of turfgrasses of landscaping.

Australian Experience with Managing Landscape Water Use Through Plant Species Selection

In the United States, activists have been promoting the conversion of turfgrass areas to trees and shrubs as a means of water conservation. As a result, there are a number of municipalities, counties, and townships where laws have been passed dictating the reduction in turfed lawns, and the planting of trees. In contrast, the opposite is being proposed in Western Australia.

Western Australia is the second driest State in the world's driest continent. A major drinking water source for the city of Perth is from groundwater in the Gnangara Mound, which is a shallow sand aquifer over an impermeable clay. There are four fields of shallow wells, with two additional well fields planned. Many decades ago a pine plantation was planted on the Gnangara Mound groundwater recharge and well field area for the city of Perth. These trees have grown to a substantial height. **As a result, the water table and amount of water available for pumping has progressively decreased due to the high evapotranspiration rates associated with the increasing canopy area of the trees.** Thus, a plan has been developed by the Waters and Rivers Commission for staged harvesting of the pine trees and to plant these areas to a vegetative cover of primarily perennial grasses that will function as a park, as well as functioning in reducing the evapotranspiration rate and increasing the amount of groundwater available for pumping to provide vital drinking water for the city of Perth. This is an excellent "real-world" example that turfgrasses are a relatively low water user compared to trees, and are in fact a water conservation vegetation. Research in the United States provides clear data confirming the experience of the city of Perth.

- **No valid basis exists for water conservation legislation that requires the extensive use of trees in place of turfs.** The proper strategy is to select low water use turfgrasses and trees for moderate to low irrigated landscapes and to select drought resistant turfgrasses and trees for nonirrigated areas.
- **Numerous "low water use plant lists" have created much confusion. Frequently, uninformed authors have incorrectly assumed those plants surviving in arid regions also have low evapotranspiration rates.** Actually, the physiological mechanisms controlling evapotranspiration and drought resistance are distinctly different and in no way are they directly correlated among plant species.

China Discovers the Benefits of Turfgrasses

During the communist Red purges that occurred throughout China many decades ago, one of the dictates to eliminate capitalist's symbols from the country was to remove green lawns and even cut down ornamental trees. Subsequently, many of China's outdoor public open spaces

Continued on page 7

Disease Alert

A root rot fungus is causing extensive damage on St. Augustinegrass (*Stenotaphrum secundatum*) according to Dr. Phil Colbaugh of the Texas Agricultural Experiment Station in Dallas. The damage to St. Augustinegrass lawns extends from Texas eastward along the Gulf Coast. Recent diagnoses also have been made in Arizona and California. The disease is caused by ***Gaeumannomyces graminis* var. *graminis*, with the initial symptoms being a yellowish chlorosis of the leaves and a root system that is basically dead. The lawns typically thin and eventually the turf may die in large irregular patches.** Dr. Colbaugh is finding that good control can be obtained for this root rot problem by a combination spray of thiophanate-ethyl (Cleary's 3336®) plus mancozeb (FORE®) at a 4 ounce (113 g) rate. The use of TeeJet 8004 nozzles to increase the spray volume to 2 to 4 gallons (7.6–15.1 L) of spray has proven beneficial.

A Global View of Landscape Use

Continued from page 6

have been maintained as well-swept dirt ground. The soil had become severely compacted and many areas were groomed each morning by a large number of broom-wielding workers.

More than 15 years ago I was contacted by Chinese government officials concerned with the development of a revegetation plan for urban open spaces, such as the city of Beijing. The elimination of green vegetative covers that stabilize the soil had resulted in a major increase in atmospheric pollution within the city in the form of flying dust and even dust storms that reduced visibility. **More importantly, the increases in a number of serious human diseases were occurring at a much greater rate than in any other major non-Chinese city in the world. Their interpretation was that the lack of green vegetative cover and its associated living biological ecosystem of antagonists to the disease-causing bacterial and viral organisms had resulted in a major increase in disease causing organisms which were readily disseminated by the windblown dust particles.** Similar problems were occurring in many other large cities in China. Unfortunately, I never was given the opportunity to review the actual documents on which these conclusions were drawn.

In an attempt to eliminate these serious urban pollution and human health problems, the Chinese governments in these major urban centers have embarked on a major program to revegetate the open spaces by planting turfgrasses in parks, on sports-recreation areas, along roadsides, and around major government facilities. Even the famous Tiananmen Square now has distinct turfed lawn areas.

- **This series of historical events ranging between the extremes of bare dirt versus the use of turfgrass emphasizes the important values of turfgrasses not only from an aesthetic standpoint, but also from the beneficial effects in reducing air pollution, protecting human health, and enhancing the quality-of-life in densely populated urban areas.**
- This experience also emphasizes the impact that the presence of turfgrasses have on the environment and on the human population.

Turfgrass Root Basics

Continued from page 5

- **Thatch**—cultural practices should be adjusted to avoid an excessive thatch accumulation of dead organic matter. An excessive thatch causes the roots to remain in the thatch layer rather than growing into the underlying soil root zone; thus, resulting in increased proneness to disease, insect, drought, heat, and cold stresses.
- **Preemergence herbicides**—a number of preemergence herbicides exhibit varying degrees of toxicity to turfgrass roots, even though there are no direct visible effects to the aboveground shoots. Thus, such preemergence herbicides should only be used as needed to correct a serious developing weed problem.
- **Insects, nematodes, and diseases**—wherever there is a developing pest problem that may cause extensive loss of the root system and allied turf, it is important to implement the appropriate pesticide application that is targeted specifically for the individual problem.

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Research Summary

Cultivar Evaluations

As the introduction and promotion of new turfgrass cultivars continues, you have the opportunity to choose from among many species and cultivars. Your choice(s) will be determined by a number of factors that must be prioritized as dictated by site-specific conditions. They include (a) climate—temperature and rainfall distribution, (b) sun vs. shade, (c) soil—drainage, fertility, pH, salinity, and compaction proneness, (d) disease and insect severity by species, (e) type of use—ornamental vs. sport, (f) intensity of use, and (g) cultural requirements—mowing height, nitrogen requirement, ET rate, etc.

Development of a new turfgrass cultivar should include peer-reviewed, published research to characterize it relative to the above criteria. Unfortunately, too many new cultivars are being rushed to the market without adequate performance, adaptation, and cultural assessments! The developer who releases a new cultivar prematurely is generating information concerning its performance characteristics at the expense of the end-user, who may be the loser.

The performance assessments of a prospective new cultivar require a minimum of four years (after full turf establishment) in each individual location. The evaluations must be conducted in replicated plots (3 reps minimal) along with other cultivars of the same species that are currently in widespread, successful use. Five years usually are needed for the turfgrass ecosystem to evolve into a semi-stable state. Only then can one make a reliable, overall assessment of a cultivar's resistance or tolerance to environmental, soil, disease, and insect stresses. **Over the past 44 years of cultivar evaluations I have observed many entries that looked outstanding for 2 to 3 years, but subsequently failed miserably in year 4 or 5!** Do you want to take a chance on an inadequately assessed cultivar to essentially pay the assessment costs of a developer, and possibly experience a failure within 5 years?

Ask Dr. Beard

Q. *As a Mid-Atlantic golf course superintendent I have always been taught to raise the cutting heights to promote root growth and increase carbohydrates during the summer stress. Now I am told that an increase in mowing height in the summer during periods of stress is a bad thing to do. This will cause the plant even more stress. I now mow my greens during the spring and fall at 11/64 and in the summer at 10/64 to 9/64.*

A. During the summer period when soil temperatures exceed 80°F (17°C) there is a distinct loss of creeping bentgrass (*Agrostis stolonifera*) root depth and density, followed by slowing of vertical leaf growth and eventually a thinning of the shoot density, if soil temperatures continue to rise. **Generally under these conditions, raising the cutting height even 1/64 inch (0.25 mm) will prove beneficial in enhancing the potential for turf survival under these summer stress conditions, especially if there is relatively intense traffic at the same time.** Then be sure to lower the cutting height back down after the summer stress period is over.

There is one exception to the above guidelines, specifically it relates to the newer super-high density creeping bentgrass cultivars that tolerate very-close mowing heights and have better resistance to heat stress. Included are Penn G-2 and Penn G-6. These cultivars have the ability to sustain very acceptable shoot density and rooting under high levels of heat stress when compared to many other cultivars. In this case raising the cutting height above 1/8 inch (3.2 mm) may actually increase the stem biomass accumulation and require an increase in cultural control practices. However, even the most heat resistant creeping bentgrass cultivars have an upper limit at which significant symptoms of root and shoot loss will start to occur.

It also is important during the stress period to be sure adequate potassium nutritional levels are available and to maintain moderate to low nitrogen nutrition of a sufficient level to avoid actual nitrogen stress in cool-season grasses.

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